Active Learning in a Multi-Instructor Ph.D. Course

Brian R. MacKenzie, Prof.
DTU Aqua

DTU Undervisningsbiennale
Good Teaching Practice in Engineering Education

Nov. 17, 2016

About the Course

Short, intensive course (5 full teaching days, and evenings)

Highly international – mix of nationalities among students and instructors

Academic backgrounds – mostly biologists, but working on quite different taxa, and approaches
-fish, plankton, genetics, conservation, management

About me and my teaching background:
-some modest classroom teaching experience – 1 graduate course (5 ETCS)/yr. with ca. 10-12 students; supervised 6 PhD students and 7 post docs; 8 M. Sc. students

-have arranged 1 other Multi-Instructor Ph.D. summer course (10 days; 5 ETCS)

-took DTU's Universitets Pædogogisk Kursus for Erfarne Undervisere (2015-16)

BONUS
BIO-C3/INSPIRE/COCOA/BAMBI
2016 Summer School

Modelling Biodiversity for Sustainable Use of Baltic Living Resources

August 22– 26, 2016
Søminestationen
Holbæk, Denmark

BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

BAMBI

BONUS - INSPIRE

BIO-C3

cocoa
Nutrient cocktails in the coastal zone of the Baltic Sea

Who Were the Instructors and Students?

Instructors – 10 professors and senior research scientists from different Baltic countries

-most were from universities and had some teaching experience

-stayed 2-5 days during course

Students – 23 students, from different countries (20 foreigners, 3 from DK)

-most were Ph. D. students, 3-4 postdocs, 1 M. Sc. scientist

Organiser - BRM

Application of DTU UP Principles and Guidelines

-promote deep learning

-alignment of learning objectives with teaching activities (lectures, exercises)

-group work – topic-specific exercises in small groups

-larger integrative synthesis topic in groups (5-6 members/group)

-written report and oral presentation

-student peer review

What Did the Course Cover?

-used the Baltic Sea as a case study system to learn how biodiversity affects the functioning of ecosystems and foodwebs, and how they provide goods and services to society.

What did the students learn?

-new biodiversity understanding

-quantitative tools that can help students address biodiversity-management questions.

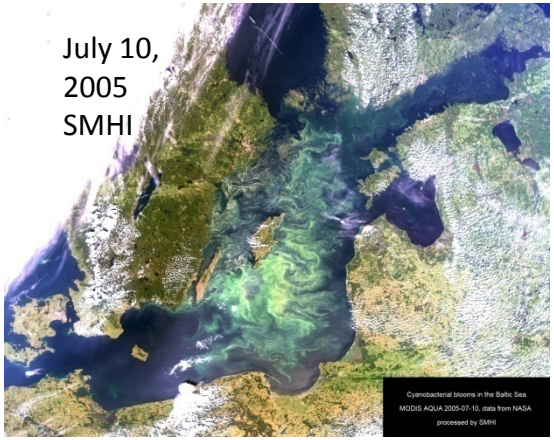
Management of the Baltic Sea

Example management decisions affecting Baltic Sea biodiversity:

-fishing limits

-eutrophication and nutrient loading mitigation

-seal control?



-invasive species prevention and mitigation; shipping, ballast water treatment, etc.

-aquaculture permissions and siting decisions

-MPA setup?- protect which part of biodiversity, roles of connectivity, etc.

What Did the Course Cover?
-> Core Elements

1. Biodiversity dynamics in time and space (patterns of variation)

2. Drivers of biodiversity dynamics ("why does biodiversity vary?")

3. Descriptors of biodiversity – taxonomic and functional perspectives (e. g., traits)

4. Consequences of variations in biodiversity – effects on populations, species, food webs, "ecosystem goods and services",…

5. Tools for quantifying biodiversity dynamics

Course Learning Objectives

What you should learn:

1. Learn ways to model variations in biodiversity due to both natural and anthropogenic drivers.

2. Demonstrate how variations in biodiversity affect species interactions in foodwebs and the provision of ecosystem services and products.

3. Quantify how natural and human-induced perturbations affect taxonomic and functional descriptors of biodiversity for major taxonomic groups in the Baltic Sea (e. g., fish, benthos, plankton).

4. Learn the key Baltic and European biodiversity policy and governance frameworks, and how supporting data can be collected and applied.

5. Learn sources of data for analysing variations in biodiversity in the Baltic Sea.

6. Develop quantitative analytical, modelling and programming skills (e. g., R, excel, Matlab).

Course Design

Intended to promote ”deep” learning and active participation
-will learn concepts, approaches and techniques
-via combination of lectures, discussions and exercises
-individually and groupwork

Feedback from instructors and from fellow students
-via discussions
-also via student peer review of your own student work

Feedback from students at end of course via course evaluation questionaire (completed anonymously on last afternoon via CampusNet).

Student Performance Assessment

1. Execution of topic-specific and synthesis exercises

2. Participation in discussions during lectures and during exercises.

-assessed on pass/fail basis

-assessors – BRM and 2 other guest instructors

Course was approved by DTU Ph.d. school, which means passing students received 2 ETCS for their participation.

Synthesis Exercise

Prepare a synthesis, integrative report on the following topic:

How can/could management decisions for the Baltic Sea affect its biodiversity, and how could or should Baltic biodiversity affect its management decisions?

Biodiversity ← →Management decisions/policy

Report Topic and Guidelines

Student synthesis exercise done as groupwork (4-6 persons/group)

Prepare written report on topic and a 10 minute oral ppt presentation.

Report guidelines:
-maximum 1000 words, including all text, except references.
-can include 3 figures or tables, if desired.

Report Evaluations

The reports were evaluated by the instructors and contributed to overall grade (pass/fail) for the course.

In addition, reports were evaluated by classmates.

All groups allowed to read each other's reports after they have been submitted.

In addition, each group was assigned one of the other groups' reports to evaluate,
i. e., conduct a peer-review.
Each group made a 5-10 minute presentation of their evaluation of the other group's report.

→Learning benefits:
-will allow you to see how the other groups tackled the question, what they prioritized, how they formulated their arguements, etc.
-will help you learn how to critically read a scientific report or paper.

Workplan for Preparing Reports

Workplan

Monday evening – introduce topic and concepts for exercise. Allow students ca. half hour on 1st day to work in groups to start networking and addressing the issues, brainstorming, and scoping. Discussion and interaction with onsite instructors.

Wednesday evening – brief discussion re. progress and status (e. g., incorporation and relevance of material presented so far in course).

Thursday evening – students working in groups

Friday morning – students working in groups

Friday noon – hand in report and ppt file presentation.

Friday afternoon – oral presentation by groups.
-evaluation of oral and written reports by course instructors.

Groupwork for Discussions, Collaboration, Task Allocation, Synthesis, Networking

Did the Course Work?

-check with course evaluation

Evaluation: Modelling Biodiversity for Sustainable Use of Baltic Sea Living Resources

To answer simply check the dot beside each statement that most accurately reflects your view.

5means that you definitely agree
4means that you agree, but with reservations
3means that you are neutral
2means that you tend to disagree
1means that you definitely disagree

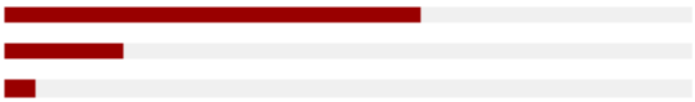
1

1.1 This course was intellectually stimulating

1	0	
	0	
	1	4.3%
	7	30.4%
5	15	65.2%

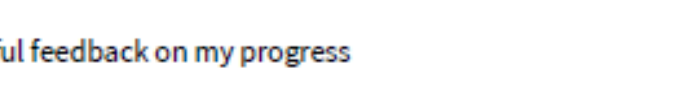
1.2 The aims and learning objectives of this course were NOT made clear

1	14	60.9%
	4	17.4%
	1	4.3%
	4	17.4%
5	0	



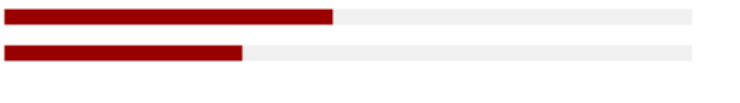
1.3 The teacher normally gave me helpful feedback on my progress

1	0	
	2	8.7%
	2	8.7%
	11	47.8%
5	8	34.8%



1.4 It seems to me that the syllabus in this course tried to cover too many topics

1	3	13.0%
	5	21.7%
	8	34.8%
	6	26.1%
5	1	4.3%



1.5 The teacher showed no real interest in what the students had to say in this course

1	22	95.7%
	1	4.3%
	0	
	0	
5	0	

1.6 I have usually had a clear idea of where I was going and what was expected of me in this course

1	0	
	1	4.3%
	2	8.7%
	12	52.2%
5	8	34.8%

1.7 I have found the course motivating

1	0	
	0	
	1	4.3%
	9	39.1%
5	13	56.5%

1.8 It was often hard to discover, what was expected of me in this course

1	9	39.1%
	12	52.2%
	0	
	2	8.7%
5	0	

1.9 This course helped me sharpen my analytical skills

1	1	4.3%
	1	4.3%
	3	13.0%
	13	56.5%
5	5	21.7%

1.10 This course made me feel more confident about tackling new and unfamiliar problems

1	1	4.3%
	0	
	4	17.4%
	12	52.2%
5	6	26.1%

1.11 This course has stimulated my enthusiasm for further learning

1	0		
	0		
	1	4.3%	
	6	26.1%	
5	16	69.6%	

1.12 In this course it was always easy to know the standard of work expected from me

1	1	4.3%	
	3	13.0%	
	7	30.4%	
	5	21.7%	
5	7	30.4%	

1.13 The course helped me to develop the ability to plan my own work

1	1	4.3%	
	4	17.4%	
	8	34.8%	
	7	30.4%	
5	3	13.0%	

1.14 Where it was used, Information Technology has helped me to learn

1	0		
	0		
	5	21.7%	
	9	39.1%	
5	9	39.1%	

1.15 I was generally given enough time to understand the things I had to learn in this course

1	2	8.7%	
	6	26.1%	
	6	26.1%	
	5	21.7%	
5	4	17.4%	

1.16 The teacher made a real effort to understand any problems and difficulties I had in this course

1	0		
	1	4.3%	
	3	13.0%	
	7	30.4%	
5	12	52.2%	

1.18 This course developed my problem-solving skills

1.19 The teacher has put a lot of time into commenting (orally and/or in writing) on my work

1.20 In this course it was made clear right from the start what was expected from me

1.21 The teacher worked hard to make the subject of this course interesting

1.22 The volume of work necessary to complete this course means that it cannot all be thoroughly comprehended

→ overall very positive

What Worked (and didn't)

Course topic and structure

-students thought course was intell. stimulating and motivating

-good integration of individual lecture topics into overall topic (i.e. "sum was more than the individual parts")

Broad mix of instructors and students – diverse backgrounds blended well.

Mix of lectures and exercises – good balance (ca. 50-50)

Student activity and enthusiasm level – very good, high, motivated

Excellent networking and collaborative potential – student-student; student-instructor; instructor-instructor

Full teaching program – high activity level during week (ca. 9 hrs/day).

What Could Have Worked Better

A couple exercises by some lecturers were less ”hands-on” than intended
-lecturers commented through 100s of lines of R code without giving students chance to actually do some analysis or editing for own needs.

Student ETCS credit was too low for their effort.
-they worked hard and deserved more than 2 ETCS:
-5 days x 9 hrs. Lecture/discussion time + report prep. + ca. 15 papers to read before course
→ would request more credit in future

Perhaps use a bit less intensive schedule
– maybe 1 less lecture/exercise to allow more time to work on exercises
- or more downtime for contemplation, discussion
(e. g., 1 afternoon free; longer breaks).

Some Challenges

Designing the content to match an overall course objective and goal.

Ensuring that each instructor's topic contributed to the overall objective.

Getting the right instructors (constraints: busy people, vacation , fieldwork, etc.)

-ones who have teaching experience, enthusiastic, can contribute to an overall teaching objective

Encouraging and ensuring that the instructors design course-specific exercises… which actually worked and could teach the students something

-exercises should teach students about biodiversity, not technical details of R or Matlab scripts, data formats, etc.

Finding time to do the final student assessments on last day of course, yet still enabling student learning to continue.

Solutions to Challenges

Planning and thinking

-about the overall topic, how different people can contribute, who to help teachwhat are the complementaries and synergies from different people, etc.?

-the topic must be broad enough so that it addresses several concepts, approaches, methods, perspectives which can be presented by different instuctors

Communication

-email , phone calls or meetings with instructors to ensure clarity of course topic, teaching elements and learning objectives, requirements for exercises

→ Start planning and communicating early!

Conclusions

-active learning in a multi-instructor Ph. D. course is possible

-can use many of the same teaching and student learning approaches and concepts for less advanced university students

-could likely be even more successful because students are (perhaps) more motivated than many bachelor or Master's students

→Try it!

For Discussion

Could you see this type of course being applied for Master's or advanced level Bachelor's students?

-what changes needed? – duration, intensity, exercises, ambition level, location

How would you modify the approach to promote research-based learning?
i. e. research done by students

How to prepare a multi-instructor course if many instructors from private industry?

Peer-review experience – how to do this with larger number of students

Course Output → Research Output?

A well-designed course could lead to some research output.

e. g., short-term experimental studies, with many replicates

-development of perspective overviews on a current research topic

-meta-analyses of datasets on different but related topics (e. g., species, areas, etc.)

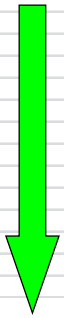
Could include a small research project as part of the learning activity

-promote research-based learning

Schedule

Preliminary teaching schedule for Modelling biodiversity for sustainable use of Baltic Sea living resources

Time	Date Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
09:00		Welcome+ intro. - Brian	Letizia	Ben	Stefan - biodiv. Effects on fish growth	Synthesis report - groupwork
09:30		Riina - Plankton	Letizia	Ben	Stefan - biodiv. Effects on fish growth	Synthesis report - groupwork
10:00		Riina - Plankton	Letizia	Ben	Stefan - biodiv. Effects on fish growth	Synthesis report - groupwork
10:30		Riina - Plankton	Break	Break	Break	Break (10:30-45)
11:00		Break	Letizia - exercise	Ben - exercise	Stefan - exercise	Synthesis report - groupwork
11:30		Henn - zoopl-fish interaction	Letizia - exercise	Ben - exercise	Stefan - exercise	Synthesis report - groupwork
12:00		Henn - zoopl-fish interaction	Letizia - exercise	Ben - exercise	Stefan - exercise	Lunch+networking
12:30		Lunch+networking	Lunch+networking	Lunch+networking	Lunch+networking	Lunch+networking
13:00	Arrival	Lunch+networking	Lunch+networking	Lunch+networking	Lunch+networking	Students do peer review of 1 report; instructors evaluates all repo
13:30		Henn - invasive species	Ute	Martin	Thorsten/Susa	Students do peer review of 1 report; instructors evaluates all repo
14:00		Henn - invasive species	Ute	Martin	Thorsten/Susa	Students do peer review of 1 report; instructors evaluates all repo
14:30		Student presentations	Ute	Martin	Thorsten/Susa	Students present own reports (4 x 10 minutes each)
15:00		Student presentations	Ute	Martin	Thorsten/Susa - exercise	Break
15:30		Break	Break	Break	Break	Instructors give feedback re. Reports and reviews.
16:00		Riina - ZP exercise	Ute - exercise	Martin - exercise	Thorsten/Susa - exercise	Students present their review of another group's report (4 x 5-10 m
16:30		Riina - ZP exercise	Ute - exercise	Martin - exercise	Thorsten/Susa - exercise	General discussion of topic - conclusions, commonalities, gaps,
17:00		Riina - ZP exercise	Ute - exercise	Martin - exercise	Thorsten/Susa - exercise	**Course evaluation**
17:30		Riina - ZP exercise	Ute - exercise	Martin - exercise	Thorsten/Susa - exercise	BBQ beach party
18:00		Supper	Supper	Supper	Supper	
18:30		Supper	Supper	Supper	Supper	
19:00		Supper	Supper	- groupwork discussion - update on progress,	Supper	
19:30		Brian - intro to group synthesis	Student presentations	Henrik Gislason -global fish biodiversity patterr	Synthesis report - groupwork	
20:00		Group brainstorming for synthe	Student presentations	Henrik Gislason -global fish biodiversity patterr	Synthesis report - groupwork	
20:30						
21:00						



Synthesis Report

Possible sub-topics that could be covered in their reports ***(the list is endless and should only be considered a source of inspiration)***:

What is known about the links between food web structure, biodiversity variations and ecosystem functioning for the Baltic Sea or elsewhere? How can the gaps in knowledge be addressed? How long would it take to address them to get the knowledge required for decisionmaking?

How would one address issues of resilience and vulnerability to perturbations? Eg. New invasive species, climate change, fishing…

Which modelling and analytical tools are applicable for addressing different biodiversity-ecosystem service-management needs?

Synthesis Report

Which type of management actions would you recommend to be implemented to have the biggest impact for least cost on conservation of biodiversity and maintenance of ecosystem services? Do we have enough knowledge to make such a decision and if not, what new knowledge is needed?

Which components of biodiversity (e. g., particular populations, species, habitats, entire sub-regions of the Baltic Sea) or which ecosystem services would you prioritize to conserve? State and justify the criteria you use to make such decisions.

Identify major gaps in knowledge. What are the key links and needs for improving Biodiversity-Ecosystem Functioning (BEF) knowledge so it can be used in sustainable ecosystem or resource management for the Baltic Sea?

Synthesis Report

What modelling and data needs are there? Why do we need them? What gaps would they fill? How would the data be collected (e.g., remote sensing, single-site ecosystem monitoring platforms, citizen science, new surveys, …)?

Should the strong spatial gradients of life in the Baltic Sea be accommodated in biodiversity management planning? How to do that?