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How to effectively Teach a short Course

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Setting the scene

Problem

How do I effectively teach a short course? In a short course I will probably have a more mixed audience – how do I cope with that? These two questions will be discussed here based on my experiences from teaching the same short course three times a year over the last five years. I will mainly touch upon how amendments to the short course can be justified from a didactical perspective, but also describe some didactical techniques that are also useful for longer courses. Through my experience and by participating in Adjunktpædagogikum I have realized how the use of well selected didactical techniques can improve the learning outcome significantly and here I reflect on the impact of a modified teaching style.

"In a short course don't be a stranger – make the audience feel good, be congenial and tell a few jokes"

Course description

Chemometrics is a multidisciplinary course applying mainly mathematical and statistical terms but also chemistry and biology is often needed to interpret the derived findings (course description in Appendix A). In chemometrics multivariate patterns are extracted and the methods work on data where we have measured several parameters (i.e. variables) for several samples

(i.e. objects). This could for example be to find out which sensory parameters are characteristic for apple varieties when compared to pears and vice versa. As one parameter rarely provides the whole answer (doubtful that e.g. sweetness can separate all apples from pears) the multivariate techniques are very popular within food but also pharmaceutical areas. Thus, the participants that attend the short course are mostly working with or studying food or pharmaceuticals and often the audience is quite mixed (students, engineers, laboratory technicians, managers, medical researchers as well as academic colleagues).

Short courses versus semester courses – pros and cons

A short course has a severe challenge related to the restricted time available and to compare directly with a semester course is not fair. Things that cannot be compared are everything related to the time e.g. time for reflection, time to do extra exercises, time to read up on selected topics. These will not be discussed here as short courses will always be inferior with respect to learning outcomes that develop over time. Very often the intention, the audience, the expected outcome and learning style are different in a short and a semester course but these differences can be handled and exploited.

First a few remarks to what I believe are the most important advantages and disadvantages of a short course. The advantages of short courses are plenty: 1) they are more time efficient, 2) more intense, 3) attractive for a broader and mixed audience, 4) participants are often more motivated, 5) can be profitable and 6) more fun for the teacher (and the participants). Disadvantages are: 1) too little time, 2) the deepness of the understanding will be challenged, 3) the teaching style must be adapted to fit the shorter time available, 4) the teacher must have certain skills as these cannot be acquired over time, 5) the long days can be tough for the teacher and the participants and 6) everything must be very organized (Bentley et al. 2008, Kleinbaum 1995).

In my short course I try to teach practically the same material as my colleague do in the semester chemometrics course. The challenge is what the participants need (and would like) to learn (i.e. expectations). This is often very different between the courses and the teaching style must be adapted to this. Besides the time and different backgrounds (students vs. professionals) the main differences are: 1) willingness to learn, 2) motivation, 3) awareness of what to learn ("I need a technique that can do this", "but what are the pitfalls then…" and "when do I use what" etc.). These

must be evaluated before each course which often implies that despite a very similar course material the courses must be taught in different ways.

What is required to effectively teach a short course?

Back in 1995 Birch put forward ten suggestions for effectively teaching short courses to a heterogeneous group. These are still very relevant and comprise many useful didactical elements. In the following I will discuss some of these suggestions combined with my own experiences and ideas to develop a teaching style that fits my short course. The following sections will be split into three parts; a why, a how and an outcome part where I describe the suggestions from a didactical point of view.

"Short courses are short, and there is no time for practices that do not contribute toward impact" (Moon 2004)

Structure of a short course

Why: For a short course to run smoothly – i.e. to have impact, to create a good learning atmosphere and to make sure the learning outcomes are achieved – an efficient course structure is essential!

How: My short course is split into three parts; lectures, exercises and breaks. It is the intention that lectures and exercises should take up the same amount of time. In the lectures I present new topics, provide examples and discuss elements with the participants (how this is done will be further described in the following). In the exercises the participants will use acquired skills, discuss the new topics and get familiar with how to do things on their own. The exercises are also meant as a break from the teacher's voice to sit down and 'quietly' think about (maybe reflect) what has been presented so far in the course. The exercises are always done in groups of minimum two participants which I have found to give a very good forum for discussion. The lectures and exercises contain a mix of very simple examples and more complex real-world cases that include many of the expected data types the participants deal with on a daily basis.

I also try to get to know the state of the audience (tired, motivated, stressed etc.). This allows me to be flexible with the breaks and to be able to do so only few fixed breaks are inserted in the course program. This is on purpose as I make sure several smaller breaks are placed whenever needed depending of the state of the participants (and myself). At the same time

having some fixed breaks ensures that the participants know when to have time to talk to colleagues, check their E-mail, call the company etc. and can plan the day according to this. I also use these breaks to have time to discuss a specific question put forward by a participant during a lecture and where the answer is too complex and/or irrelevant for everyone.

Outcome: Through discussing (lectures, breaks and exercises), reflecting (breaks and exercises) and testing (exercises) I believe the participants can teach themselves further based on what has been covered in the lecture. The simple examples get everyone on board but only through the real-world cases the participants will see the real advantage of chemometrics.

"Simplicity favors understanding – reality ensures understanding and applicability".

Be prepared, be organized and know your stuff

Why: Having short time makes no time for brushing up on certain topics so knowing as much as possible in advance is essential in a short course.

How: Being an experienced teacher helps me to get around the questions I get during the course and allows me to reflect on the questions almost before I answer. For a semester course the teacher can be less prepared for the very last sessions but in a short course the teacher must have prepared and deliver several lectures on the same day. How to deliver this can be a challenge as participants will get tired of listening to the same voice and teaching style for many hours. To get around this I mix up the lectures with practical and theoretical examples, include the participants and I am aware of not using the same voice level all the time. Preparing yourself for questions is a difficult job and I have realized that only through mastering the technicalities and having a large experience can make you be really prepared for a short course. This makes the teacher skills an important part of a short course; more important than in semester courses where the teacher can develop skills and experience over time.

"Being prepared and organized is mandatory and cannot be debated for a short course"

Outcome: The interactive nature of a lecture can be highly improved when the teacher is skilled and prepared and this will allow for a better discussion of also subjective (individual) concerns put forward by the participants. The main challenge with interactive lectures is that they can be more time consuming so how to fit them into a short course needs some consideration.

In a short course the material used becomes even more important

Why: With little time available what is presented must be carefully thought through and presented using material that supports the teaching strategy.

How: In the short course I prepare my slides (I will only comment on my slides in this project) so they are catchy, fun, provocative and will leave some space for an individual interpretation of a topic (examples of this can be seen Appendix B-E). The latter could be a prepared figure illustrating a certain topic (e.g. a key element) – a topic that can be explained in several ways. By not providing the answer in text I set the scene for a dialogue for what the figure illustrates. This motivates the participants and allows them to write down their own understanding of the figure established through a dialogue guided by not only the teacher but by everyone. The challenge is here to make sure all participants takes part in the dialogue and understand the figure as (several) tests are difficult to carry out in a short course due to the limited time

Outcome: Preparing slides so they are not complete force the participants to (re)think, discuss and reflect on elements derived and explained. From a didactical point of view this provides a higher impact (i.e. improved learning outcome); an impact that is impossible to get from a teacher monologue or a slide filled with (teacher decided) text! However, the teacher must be aware that incomplete slides cannot be less emphasized (or ignored) but always need full attention (and time).

Let the participants derive key elements of the course

Key concepts in the course can be explained in a monologue (by the teacher) but are far better introduced as a part of examples and cases where the participants derive the teaching goals (i.e. see, understand and discuss the ideas behind the key concepts). Cases ensure that the participants learn key elements in a short time and that they are able to build on top of the concepts very fast (which is needed in a short course).

Example I

To understand the difference between causality and indirect correlations and from this let the participants derive another key element (a latent factor – i.e. something not measured but is within data – the sun and time in Appendix B and C, respectively).

Why: Correlation is a key element in my chemometrics course. It is of utmost importance to understand the concept and know the difference between causality and indirect correlations. If the participants are not aware of the difference they might end up with wrong interpretations from otherwise sound data/models and would miss several aspects later in the course. I would like the participants themselves to come up with the reason(s) for indirect correlations. This reason (called a latent factor) is another key element that is being used throughout the course.

How: One way to get around this is by explaining the concept very well and posing a few questions. An example of a slide used for this can be seen in Appendix B. However, this rarely gives the participants enough time to think about this concept before giving the answer. Thus, the learning outcome is my idea and understanding of the concepts and not something derived and thought through by the participants (no common agreement). A better way of doing this (which I have found ideal for short courses with limited time between lectures) is to present the concept with a case with three small examples that they have to discuss in groups (see Appendix C). They will discuss the nature of the correlation (what causes this, can we trust this or is it a coincidence etc.) and will be forced to think of the reason behind indirect correlations. Afterwards we discuss this in plenum to come to a common agreement of what is behind the key concepts (the overall understanding will be aligned but individual views will still exist).

Outcome: The three examples and the discussion will ensure that the participants develop their own understanding of correlation and the concept of a latent factor. With this rather simple case I prepare them to work more independently, increase their confidence before introducing the new methods and they will be able interpret correlations and latent factors in other situations as well (see example II).

Example II

To be able to use data correctly and to be critical to the data origin (linked to what the participants learn in example I).

Why: Without being critical to the data origin and the interpretation of found correlations the participants can be lead to making false conclusions. I would like the participants to see the point in being critical to data and to what is reported from the data – two other key elements in chemometrics.

How: In example I we get to a common agreement about correlations – this is not the intention with example II. This is more a discussion of as-

pects related to data in general. I put forward two topics; be critical and use data correctly. From this I would like to take the discussion in many other directions as well; directions guided by the participants. One way to get around this issue is by presenting a humoristic case with the development in sperm cells for men (see Appendix D). I could focus on explaining why it is important to consider data before making interpretations and that being critical will ensure that data are being used correctly. However, this often turns out to be a monologue! If I on the other hand start presenting this as a case dealing with statements that are contradictory and why this is a problem; a problem we need to discuss and solve together. To make this work I have selected some relevant newspaper and internet articles, which show that milk can affect the development of cancer in both a positive direction and a negative direction (Appendix E). From this we discuss the data validity based on the already learned concepts of correlations and latent factors.

Outcome: In a short course conflicting statements are perfect didactical tools to quickly motivate the participants to start a good discussion. From this the participants obtain skills, knowledge and competences useful for discussing the validity of data on their own or with other participants and come up with arguments for what could be the reason behind conflicting statements. As the discussion is open we might also touch upon other aspects taught later in the course, which I believe is further strengthening the learning outcome.

Be flexible and have the courage and will to make changes

Why: To be able to change the way you teach according to the participants special needs/interests is crucial in a short course. The changes could be repeating key elements, using more examples from real-life, using my experience to bring more clarity of a certain topic, skipping a section if not interesting for the audience, using experiences from the audience etc.

How: To have the possibility to be flexible is to me related to being prepared, organized, and experienced but also be able to sense the atmosphere in the audience. Besides this the teacher must also have will and courage to change certain things in an otherwise very tight course agenda. To get around this, I always have some lectures that can be shortened, lengthened or even skipped. E.g. I often end a workshop with a test of the acquired skills (only for fun) and this can be made into a very simple or a more comprehensive test depending on the progress in the course and the skills of the participants. An important aspect concerning flexibility is that it must be

handled in a professional way. This means that the course must still seem very organized despite the detours. I try to solve this by explaining the detours taken (why we do it) but without debating if we should do it.

"If changes are needed during a short course don't ask for acceptance from the audience – explain why you change, then do it and trust your instinct"

Outcome: Being flexible only works if you keep in mind the overall learning goals of the course. The outcome will be increased learning, more relaxed participants and a better learning atmosphere. This leads to participants being more active and willing to get into a dialogue.

Outro and final remarks

A short course is a fast and efficient way to teach new concepts but it often requires special skills from both the participants (e.g. motivation and dedication) and the teacher (e.g. skilled and prepared) to make the course run smoothly to provide superior impact and learning outcome. In this project I have touched upon some of the teaching strategies that I have found useful for short courses from a didactical perspective. There are several other elements of a short course that can be taken into consideration (how to make it profitable, will it also work for master students, should the course material be presented before or during the course etc.) and the interested reader is referred to the given references for more information.

A

Appendix A

Basic Chemometrics – course description

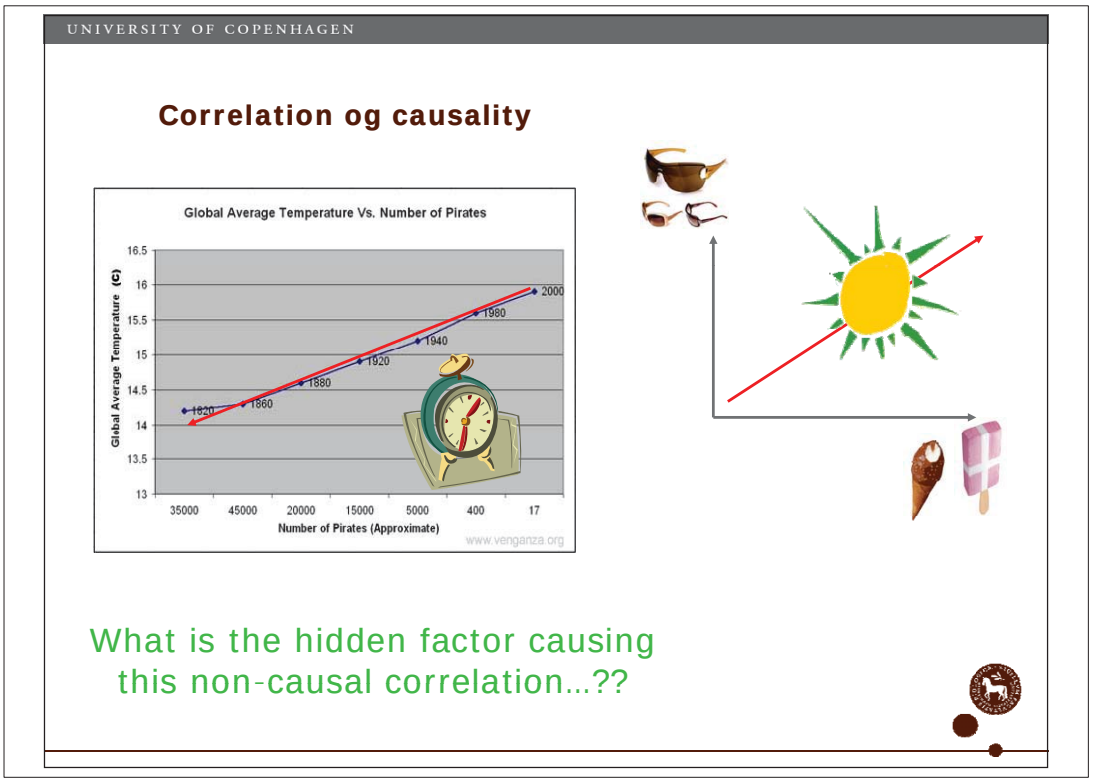
Background:

Chemometrics can be used to solve problems involving large amounts of data. This is relevant within fields such as development/research, process-monitoring and control and laboratory analysis.

Audience: The course is intended for people handling problems where chemometrics can be applied or people who have general interest in learning more about chemometrics and its applications. Some mathematical and statistical expressions will be used in the course and a variety of data (e.g. sensory and spectroscopic data) will be used as examples. Teaching material in English will be handed out at the course and consists of slides. Please note that the exercises will be performed in groups of two. Lectures will be in Danish or English (if foreigners are present).

Teacher: Thomas Skov

B


UNIVERSITY OF COPENHAGEN
Correlation og causality
Global Average Temperature Vs. Number of Pirates
Global Average Temperature (C)
16.5
16
15.5
15
14.5
14
13.5
13
1620
1860
1880
1920
1940
1980
2000
35000
45000
20000
15000
5000
400
17
Number of Pirates (Approximate)
www.venganza.org
What is the hidden factor causing this non-causal correlation...??

C

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Case 1 – Correlation / causality

For the three examples discuss what type of correlation you think is being visualized.

Use the definitions of causality and indirect correlation listed below.

Try to come up with suggestions why you see a correlation.

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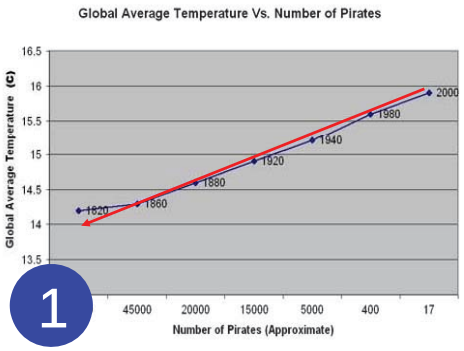
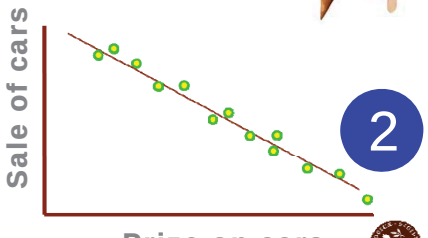
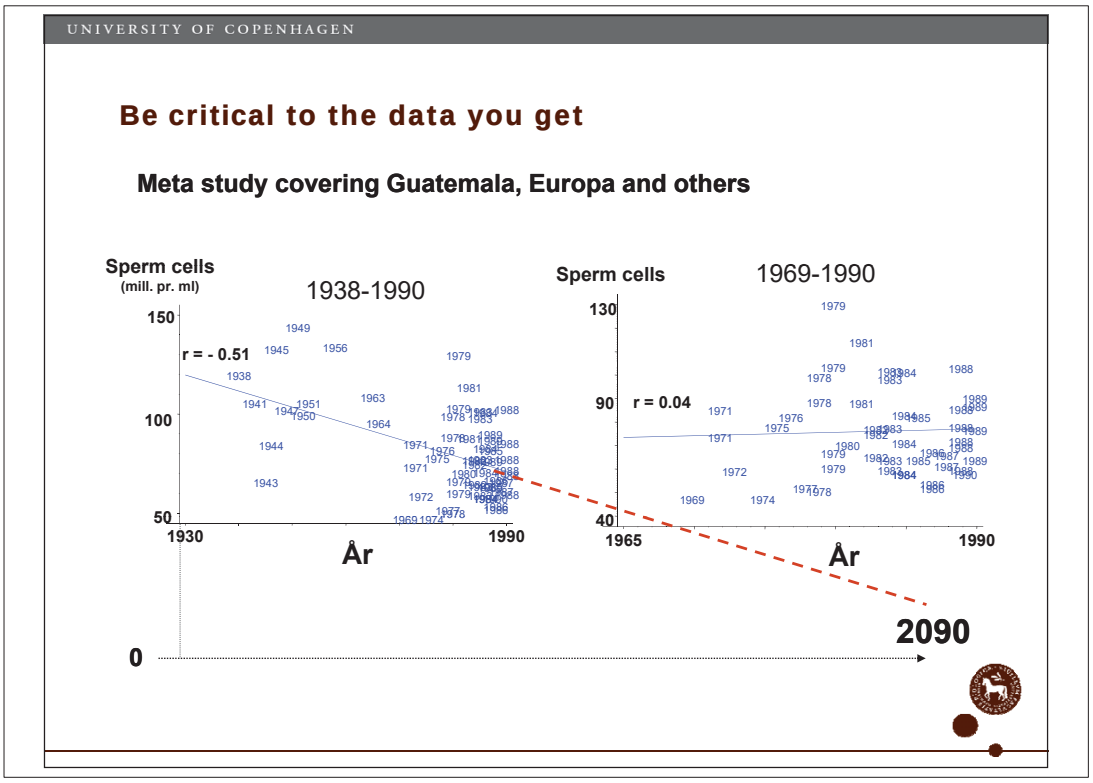
Case 1
Correlation / causality





Causal correlation: If A changes then we know B changes!
Indirect correlation: If A changes we cant say if B changes!

D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Be critical to the data you get
Meta study covering Guatemala, Europa and others
Sperm cells
(mill. pr. ml)
1938-1990
r = - 0.51
150
100
50
1930
1990
År
Sperm cells
1969-1990
r = 0.04
130
90
40
1965
1990
År
2090
0

E

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