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Increasing the attendance rate

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Introduction

The problem I decided to base my project on is the following, quoting myself as of September 2009:

"I have taught the same course "Topology" within the Department of Mathematical Sciences during blocks 1 of academic years 2008/2009 and 2009/2010. Last year (2008) there was a quick decay of the attendance rate, part of which I attribute to following a textbook too closely. This year (2009) I plan to increase the attendance rate mainly by not following the textbook so closely, in particular, by adding interesting/motivating contents from other sources/books and adding more digressions/discussions about the contents from my point of view."

This document is a compilation of what I planned, how it was carried out and some reflections and conclusions about the overall process. The main aim was to investigate the reason for the decay of the attendance rate during the course 2008/2009. The first strategy has been to collect as much information as possible about the courses. For the course 2008/2009, already being taught, the information is limited, but for the course 2009/2010 I kept a lecture per lecture diary, with information about number of students attending, material taught, questions addressed to the students, my personal impressions, etc. I also added some questions concerning the project to the student evaluations. This and other basic information about the courses is presented in the section **Data Collection**.

Once this information is available the next step is to extract conclusions from them. This is done in the section **Analysis**, and this is the most theo-

retical part of this report. Then the **Final Discussion** takes place, with a elaborated answer to the problem definition above.

Data Collection

In this section I present some information related to both courses. This information is divided into the following categories: basic information, attendance rate, regular student evaluations, special student evaluation for 2009/2010, contents and planning and TLAs (teaching and learning activities).

Each subsection contains the data itself and a set of conclusions from the data. At this stage, these conclusions are meant to be objective. Further discussions will be made afterwards in the section **Analysis**, and the conclusions here will be used as the basis for the discussions there.

Basic Information

The course "Topology" is 7.5 points/credits and is aimed at third year students in the university program leading to a "B.Sc. in mathematics". The following figure describes some basic information on the courses as taught by myself in 2008/2009 and 2009/2010, as well as information related to the evaluations. Average mark show percentage over the attainable maximum.

	Course 2008/2009	Course 2009/2010
Block	1	1
Number of weeks	7	9
Registered students	30	23
Erasmus students	1	6
Evaluation system	Weekly homework + Final exam	Weekly homework + Midterm test + Final Exam
Students handing in homework	26	10
Students taking final exam	26	10
Average homework mark	75 (out of 100)	79 (out of 100)
Average midterm test mark	-	74
Average final exam mark	48	73
Average final mark	65	74

Fig. 3.1. Basic information about the course

The main points to stress from the table are:

- Difference in the number of Erasmus students: $1/30 \approx 3\%$ for 2008 and $6/23 \approx 26\%$ for 2009.
- Differences in ratio of students handing in homework and taking final exam: $26/30 \approx 87\%$ for 2008 and $10/23 \approx 43\%$ for 2009.
- Similar homework marks but different final exam marks and final marks. Higher marks for 2009.

Attendance rate

The next piece of information is the attendance rate during the block, which is the main motivation for this project. During year 2008/2009 I noticed how the attendance rate was decaying along the course, but I did not write down the precise numbers. For year 2009/2010 I have exact information taken on every lecture. The following graph represents these attendance rates (for 2008/2009 the numbers are approximate):

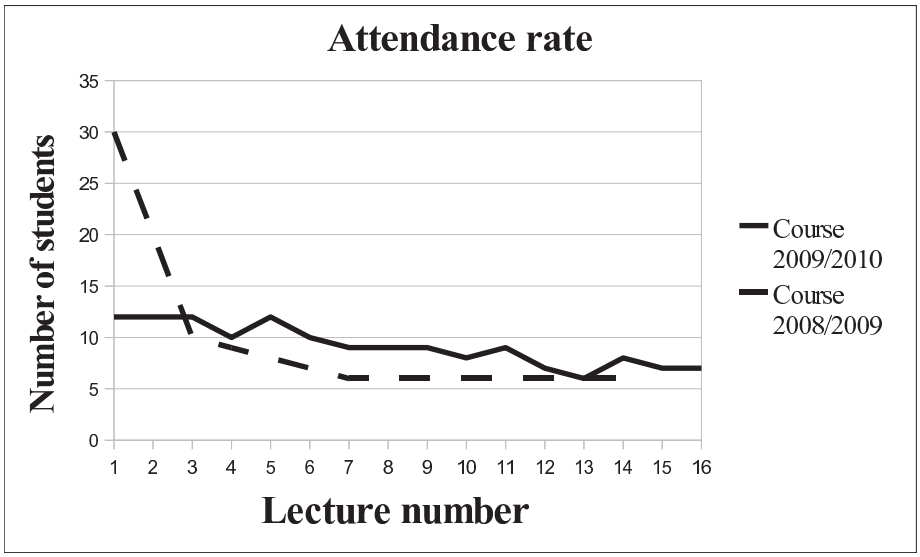

Fig. 3.2. Attendance rates

Highlights of this graph:

- Number students stabilizes for both courses at about $6-8$ students.

- Number of students that came to class on the first few lectures are quite different. This number roughly coincides with the number of students handing in homework and taking the final exam for both courses (see Figure 3.1).
- Ratios between stable audience and first lecture audiences are very different: $6/30 \approx 20\%$ for 2008/2009 and $8/12 = 66\%$ for 2009/2010.

Regular Student Evaluations

In this section I sum up and comment on the student evaluations for both courses. The questions asked to the students for the two evaluations were the following (the standard Department of Mathematical Sciences questions):

- Question 1: I experienced a good correspondence between the teaching and the course objectives.
- Question 2: I think that the practical execution of the course was successful (facilities, equipment, information dissemination etc.)
- Question 3: I experience a good coherence between the various course elements (lectures, practical work, etc.)
- Question 4: I experience the course as relevant to my personal educational objectives.
- Question 5: In cases where I needed feedback on my work (presentations, assignments, papers, reports) I was able to adequately get such feedback from the teachers.
- Question 6: For me, the teaching material is adequate for this course.
- Question 7: Compared to my background knowledge I experience that the academic level of the course is...
- Question 8: I experience the work load of the course as...
- Question 9: In this course, for me the required work load (including classes) per week was...

The vertical axis shows number of students with the given answer. The meaning of the abbreviations is as follows:

- For Questions 1-6: **SA**=Strongly Agree, **A**=Agree, **N**=Neutral, **D**=Disagree, **SD**=Strongly Disagree, **DN**=Don't know.
- For Questions 7 and 8: **TL**=Far too low, **L**=Low, **A**=Adequate, **H**=High, **TH**=Far too High, **DN**=Don't know.
- For Question 9: Number of hours per week.

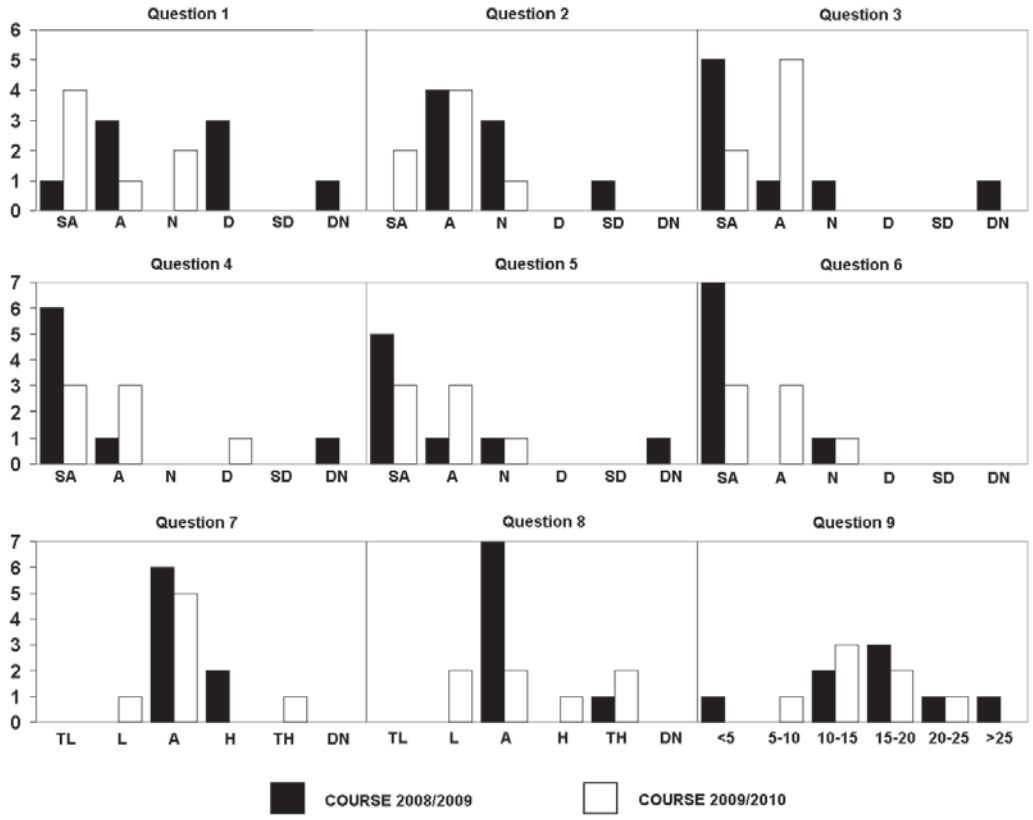

Fig. 3.3. Student answers

From this sequence of graphs we can emphasize the following:

- Working loads were similar for both courses (Question 9).
- Working load was experienced as slightly higher for course 2009/2010 (Question 8).
- In both courses students seem to be happy with the contents, methods and level (Questions 1-7).

The regular student evaluations (for both 2008/2009 and 2009/2010) also include some open questions where the students can write down what they think (answers from the students not included for space reasons).

Student Evaluations for 2009/2010

As part of this project I added the following questions to be asked to the students of the course 2009/2010 as part of the student evaluations:

- How does receiving a lecture on some section of Munkres' book affect reading that section afterwards? It is easier, harder, no difference?
- Does the addition of material not from Munkres' book in the lectures affect your motivation and interest to study topology? How much? Why?
- How much did you like the following topics not in Munkres' book (a) historical introduction, (b) ordinals, (c) closure and interior operators, (d) nets? And compared to the rest of the material covered, did you like them more, less, same?
- Does the addition of material not from Munkres' book in the lectures make any difference in you motivation to attend the lectures? How much? Why?
- In general, what do you think are the advantages and disadvantages of sticking to a textbook during a course? Please explain.

From the student answers (not included for space reasons) we can draw the following conclusions:

- Lecturing on a topic makes it easier to understand and to read the corresponding part of the book (well, anything else would not be a good indicator of my lecturing).
- Students do not have preferences as to where the topics are coming from (textbook or other sources), regarding motivation and interest.
- Students strongly like having notes available on the topic explained in the lecture.
- Students do not have preferences as to where the topics are coming from (textbook or other sources), regarding attendance, but if there are no notes available then students will come to the corresponding lecture.

Contents and planning

In both courses the recommended textbook was:

Munkres, James R., Topology (second edition), Prentice-Hall, 2000.

The next figure is a lecture per lecture description of what was taught. Numbers correspond to sections in the book. Non boldfaced numbers correspond to sections in the book which are basic to the course. **Boldfaced** numbers correspond to a section in the book with an optional character within the course, i.e. I could choose to teach that or another topic. Text correspond to topics not from the book (e.g. "**Historical introduction**"), are also **boldfaced** because they have the same optional character as explained before.

An item appearing twice indicate the section/topic was started in one lecture and finished in the next.

	Course 2008/2009	Course 2009/2010
Lecture 1	**Introduction**, 7	**Historical introduction**, 7
Lecture 2	9, 10, 11, 12, 13	**Cardinals and ordinals**, 9, 10, 11
Lecture 3	13, 14, 15	12, 13, 17, **Closure and interior operators**
Lecture 4	15, 16, 17	**Closure and interior operators**, 17, 14, 15
Lecture 5	17, 18	16, 18
Lecture 6	19, 20, 21, 22	**Stereographic projection**, 19, 20, 21
Lecture 7	22, 23, 24	22
Lecture 8	25, 26	26, 27
Lecture 9	26, 37	23, 24, 25, **Nets**
Lecture 10	37, 27, 30, 31	**Nets**, 29
Lecture 11	32	**Tychonoff via nets**, 30, 31,32
Lecture 12	**33**, **34**	30, 31, 32
Lecture 13	27, 28	**33**, **34**
Lecture 14	29, **35**	**Compactifications as an ordered set**, **38**
Lecture 15	-	**One-point compactification as the minimum**, 29
Lecture 16	-	**39**, **41**, **36**

Fig. 3.4. Lecture description

Besides the topics not from the book included in the 2009 column, I did some digressions during that course, either in particular topics, showing some ramifications of the topic in subsequent courses, or more abstract ones about the philosophy underlying the subject Topology.

When planning I had in mind on both occasions that I wanted to teach at least sections $9-29$ (the non boldfaced ones in the table), as they form the core of this subject. It is worth noticing that for the year 2008 I taught the optional (boldfaced) sections (apart from the Introduction) at the very end. The main reason for this is that, as I was teaching this course for the first time, I did not know how long it would take for me to teach the core of the subject. Hence I started teaching the basics and left the optional topics

for the end, in case we had time to study them. Another reason is the logical dependence among the different sections and topics.

On the other hand, in year 2009, from the very beginning I started introducing optional topics. Of course now I had the information relevant to the timing from the previous year, which was really helpful: I knew in advance how many hours/lectures I would spend explaining this or that topic. Moreover, I had 9 weeks instead of 7 weeks, although I finally taught during 8 weeks, since the last week consisted of the final exam on Friday, and the rest of the days were left for the students to review/study the subject.

The planning load for 2008 was concentrated on preparing notes for the course, as I was teaching it for the first time. During 2009 the planning load with respect to the core part of the subject was much lighter, as I had the notes from the previous year. On the other hand, because of the optional topics, specially for those not in the book, I did some time consuming activities like consulting different sources, writing down new notes for the lectures, etc.

So, to sum up, there are the following points concerning contents and planning:

- Optional character topics were taught at the end during 2008/2009.
- Optional character topics were spread along the course for 2009/2010.
- Planning load was focused on core topics during 2008/2009.
- Planning load was focused on optional character topics during 2009/2010.

Teaching and learning activities

The teaching method for both courses was lecturing on blackboard (no other media used), and tutorials to solve problems. This is probably obsolete according to Biggs and Tang (2007, p. 104), and it should be revised. Although the main aim of this project was not this one, I took note in every lecture for the course 2009/2010 of how many questions I addressed to the students, together with some qualitative information, see below. My hope was that the quantitative information on the number of questions per lecture would give me some feedback on my progression during the whole course, and would let me learn something about my teaching.

Also, I introduced, for the first time for me, questions, allowing them to discuss with their neighbors. Related to this, in the session supervised by Niels Grønbæk (department supervisor) and Robert Evans (pedagogical supervisor) I was advised to do a teaching activity lasting between 3 and

5 minutes. I did so, and it was a success: I designed the lecture such that I proved, on the blackboard, a certain statement. Then I asked them to prove a variation of the statement, using tools and examples they had already seen during the course. I will not write too much about this here, as it is not the main focus of this report.

Most of the questions were *convergent* questions (Biggs and Tang; 2007, p.121), i.e., with a clear correct answer in mind. Although I addressed the students a few *divergent* questions, I would say that the largest number of divergent questions were addressed the other way around, from the students to me. I think this is positive.

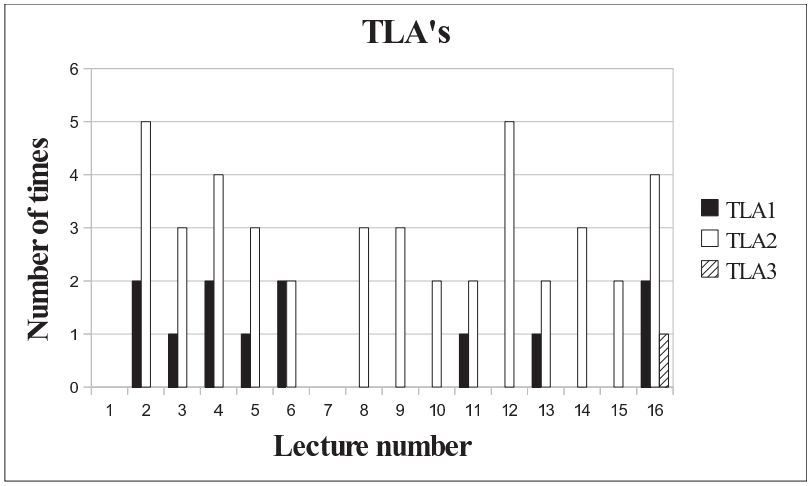

Fig. 3.5. Course TLAs

The legend means the following:

- TLA1: Question and giving them one minute to discuss it with their neighbors.
- TLA2: General standard question to the class.
- TLA3: Activity lasting 3-5 minutes (commented above, only done once).

Most of the questions were answered by the same two brilliant students. This is something to be solved, i.e. how to make the rest of the class participate. These two students were clearly, and because they actually told me, *learning partners* (Biggs and Tang; 2007, p.126), so a plausible solution would be to require all the students to form partnerships with another

student. This implies deciding how to form these teams: same level students or different level students, breaking already established partnerships or preserving them etc. Some of these points and their advantages and disadvantages were actually discussed during the IUP course.

From the figure we infer:

- There is a clear decay of TLA1s along the course, specially half-way.
- Number of TLA2s stays stable along the course.

Analysis

Now that we have gone through all the information in the section **Data Collection**, we address the main

Question: Explain the decay of attendance rate during the course 2008/2009.

According to the problem definition (see the introduction), we start from the following:

Hypothesis: Students do not attend if lecturer closely follows a textbook.

In this section we will discuss this hypothesis based on theoretical grounds, and contrasting them with the actual data from the previous section.

The next obvious question is: why students will not come to the lectures? The obvious answer is that they do no get anything in the lecture that they cannot get on their own by reading and studying the book.

According to the section **Regular Student Evaluations**, the students (2008/2009 and 2009/2010) that filled in the evaluations are happy with the contents and methods of the lectures. But of course these students are the ones attending, not the ones not coming to lectures. Unluckily, the comments of the student evaluations (2008/2009) are not related to the point under discussion. Student comments (2009/2010) concerning lectures are very positive. Student comments (2009/2010) in the section **Student Evaluations for 2009/2010** state that reading the book is easier after attending the corresponding lecture. Again these comments are likely coming from students attending lectures.

We must not forget that there are some students not attending lectures that do not hand in homework and do not take the final exam. Hence, apparently, we can split student population into:

- A: Students attending the lectures. They give the lectures the right value, i.e. lectures help the understanding of the contents and the reading of the book.
- B: Students not attending lectures and following the course. They think reading the book on their own is enough.
- C: Students not attending lectures and not following the course.

According to "Students handing in homework" and "Students taking final exam" the population of students A plus B is 26 out of 30 for 2008/2009 and 10 out of 23 for 2009/2010. The "stable" audience are 6 students for 2008/2009 and 8 students for 2009/2010. This corresponds to population A. Hence, (stable) population B is 20=26-6 for 2008/2009 and 10-8=2 for 2009/2010. We are left with a population of students C of 4 out of 30 for 2008/2009 and 13 out of 23 for 2009/2010. So the first conclusion we may draw is the following:

Conclusion 1: Not following a textbook decreases population B and increases population C.

One of the intended results for the strategy of not closely following the textbook during 2009/2010 was to decrease population B. So this was partially achieved. The side-effect of increasing population C was not foreseen. In any case, the information that we will not closely follow the textbook was never written on the web-page, but told on the first-day lecture. So I do not know why there were just 12 students on the first lecture for 2009/2010 (compared to the massive attendance for 2008/2009). Maybe because I wrote the evaluation method on the web-page and they already did not like it?

It is very debatable if the intended result of decreasing population B is desirable. A priori, the only concern for me should be increasing the number of students reaching the intended learning outcomes. In some ways, I was assuming that attending the lectures would actually help the student to reach the intended learning outcomes.

Now we discuss this point under the light of the final marks. Notice first that final marks were higher for 2009/2010 than for 2008/2009. For 2009/2010 almost everyone who took the exam was attending (10 took the exam, stable attendance rate 8), but for 2008/2009 many who took the exam were actually not attending (26 took the exam, 6 is the stable attendance rate). So a possible consequence is that students not attending get a poorer understanding of the subject. Nevertheless, I have computed the average fi-

nal mark for those 2008/2009 students who were attending and it is 66%, which is really close to the average final mark of 65%. The only conclusion we may draw from all this is the following:

Conclusion 2: Students B can reach the intended learning outcomes.
This is assuming that the evaluations (homeworks, exams, etc) are actually aligned to the intended learning outcomes, but I will not discuss this point here (Biggs and Tang; 2007, Chapters 9,10). Another plausible explanation for students B not attending is that the approach to learning being carried out in the lectures, is a surface approach on the part of the teacher, i.e. me (Biggs and Tang; 2007, p.22), and hence they feel that it is not worth attending. This is different from the point of view above, in which students B are assumed not to be attending because they think reading the book on their own is enough.

Nevertheless, there are, at first sight, a few arguments against this new explanation: first, some of the students attended just the introductory lecture. This does not seem to be enough to decide that the teacher will use a surface approach in the rest of the lectures. Second, students attending give good feedback about the teaching (see **Regular Student Evaluations**, **Student Evaluations for 2009/2010**).

It could also be the case that the surface approach to learning is taking place on the side of the students not attending. Some common factors that might motivate this are the following (Biggs and Tang; 2007, p.23):

- Intention to achieve a minimal pass. I have computed the average final mark for students (2008/2009) not attending regularly and, not surprisingly, it is 65%, close to both the average final mark and to the students attending average final mark.
- Non-academic priorities exceeding academic ones. It does not seem plausible this is the case for the $30 - 8 = 22$ students not attending regularly. Moreover, if I understood it properly, Danish students monthly receive money from the Danish Government, so problems with simultaneity between work and studies should be minimal.
- Insufficient time, too high workload. As far as I know, the load of two courses per block is reasonable for almost every student in the Department of Mathematical Sciences, so it is not reasonable to think this is not the case for the roughly 20 students not attending.

My conclusion is the following:

Conclusion 3: Teacher and students (A and B) show a deep approach to learning.

These three conclusions raised in this section will be used in the next section for the final discussion. The last point I want to discuss in this section is related to my own experience teaching both courses. We have argued that the quality of lecturing was, in general, good, and that it was not directly related to the low attendance rate for the courses 2008/2009 and 2009/2010.

In any case there is an abyss in the way I felt about teaching during 2008/2009 and 2009/2010. Part of it, without doubt, is due to the fact that teaching the same subject for the second year in a row makes one feel more comfortable. But it is specially the freedom in the design of the course during 2009/2010 that made me feel much better during this second year. I chose the topics I found most interesting for me, respecting the core of the subject and taking into account some preferences conveyed to me by the students themselves. This motivates me to prepare good lectures and, in consequence, I guess lectures gain in quality. The workload due to the optional topics was totally worth the effort. The opposite, teaching something that the teacher himself finds boring or is not really looking forward to teach, probably creates a discouraging atmosphere in the classroom for the students. So, I draw the following conclusion, that I will keep for my future as a university teacher:

Conclusion: Teacher freedom on course design is key to quality teaching.

Of course quality teaching is also affected by teaching learning activities and the ups and downs during the course (see section **Teaching and Learning Activities**). But this is material for another pedagogical project.

Final discussion

Going over the questions in the student evaluations for 2009/2010 again, one finds some students discussing if attending the lectures should or should not be part of a course, and another student writes *"I think it is good, that there were some things taught in the lecture that weren't in the book, because now you have to attend the lecture and can't just stay at home and read the book"*. It seems that for quite a number of students not attending

the lectures is a very reasonable option. They consider it and many of them actually do not attend.

This is quite shocking for me because of my background. I have taught, before coming to Denmark, in Spain and UK. There, the standard habit for students is going to lectures and taking notes, even if there is a textbook or a few sources for notes. If a student misses a lecture then he/she asks his/her classmates for the notes of that day. In Denmark, on the contrary, it is hard to see a student taking notes. The emphasis is on the textbook or notes available in advance. In some cases, like the one we are discussing, some (many) students decide not even to attend.

I understand the advantages of reading the notes in advance and going to the lecture just to re-learn what you read. It might be the case that the taking-notes method is obsolete, mainly because it is considered a passive learning method (Biggs and Tang; 2007, p. 8). I have never thought that taking notes was, in general, a passive way of learning. But, under the right circumstances for the student, it is clear that it can be really passive and do not contribute at all to the intended learning outcomes. This is, once more, the academic versus non-academic approach regarding students (Susan and Robert in Biggs and Tang (2007)). Of course, the teacher also plays a role here.

Moreover, lecturing as the single TLA (teaching learning activity) has its own limitations (Biggs and Tang; 2007, p.108). Although in cases like the one under discussion, with just a few students, i.e. not a large class, many of these drawbacks do not apply or are minimized because of the more interactive style of a lecture with few students. As discussed earlier on several occasions, students are, in general, content with the lecture. This does not mean that other methods should not be tried out, maybe the techniques for large classes in Biggs and Tang (2007, p.114).

I do not know how often there are low attendance rates in courses taught at the Department of Mathematical Sciences, but I believe it is not the norm. From the Conclusions 1, 2 and 3 I am led to my final conclusion:

Final Conclusion: The level of this course is not appropriate for the level of the students.

By this I mean that the course is, for many of them, too easy. This has some support in the students' answers to the evaluations for 2008/2009 and 2009/2010 (some students found the course easy). The graph of question 7 in regular student evaluations shows that attending students find the course

has the right level. So, what I mean here is that some students do not attend, as they feel the course is easy enough to be learnt by reading the book on their own. Notice that in any case this final conclusion leaves open why there was such an increase in population C during 2009/2010.

The "Topology" course is an optional course aimed at third year level students, when the standard in many Mathematics Departments is that such a course has a compulsory character and has to be taken at second year level. One reason for this is that going through this course brings the students, apart from the contents itself, a step further in regards to their mathematics formalizing skills and a step further in the level of mathematical abstraction.

Students already on third year level usually have these skills and mathematical maturity. Hence, it is not that surprising that they can follow the course on their own by just reading the textbook, and that they can even get good marks. So the final word would be that the location of this course within the mathematic curriculum should be changed. In fact, a reorganization of the mathematics curriculum is taking place, although for other reasons, so in coming years this course will definitely change in contents and/or level.

All contributions to this volume can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/2009-2-1/

The bibliography can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/
kapitler/2009_vol2_nr1_bibliography.pdf/