The learning approaches promoted by the physics department towards the first-year students at Lund University.

Albert Eisenschmidt

Thesis submitted for the degree of Bachelor of Science
Project duration: 2 months, 15hp

Supervised by Lassana Ouattara

Department of Physics, Lund University
Division of undergraduate teaching

January 2017

Abstract

In the field of educational psychology are two type of learning approaches commonly mentioned; deep learning and surface learning. These two learning approaches contains methods used by the students, for instance, memorizing (surface learning) and hypothesize (deep learning). Several previously performed studies showed a connection between a high academic level, good grades and a high usage of the methods associated with the deep learning. Deep learning is, therefore, the preferred learning approach for students.

Knowledge about all student's choice of learning is important since it can help to improve the education in many aspects. However, the physics department at Lund university lacked this knowledge about their first-year students. The present thesis is, therefore, an attempt to reveal the physics student's level of learning approaches and how the course (FYSA01) affects the students learning approaches.

The result was attained by distributing a survey, well-used in the field, called the revised two-factor study process questionnaire (R-SPQ-2F). It was distributed in the physic course over three semesters; Fall 2017, Fall 2014 and Spring 2014. An increasing usage of the students deep learning and a decreasing usage of surface learning could be noticed for two semesters, Fall 2017 and Spring 2014. The third semester, fall 2014, didn't show any change in the student's usage of deep learning. It showed, however, a larger decrease in surface learning than the other two semesters.

In summary, these results show that the teaching of the first-year students at the physic department influences the students learning approaches. The changes in the students learning approach is most likely an impact of the supplemental instruction meetings (SI-meetings). The students meet during this session and discuss physics problems in groups together with a more experienced student leading the SI-session. Another possible explanation for the improvement could be the peer-learning used during the lectures, where students discuss problems during the lecture.

Additional studies will be needed to develop a full picture of the actual influence the students received by the Physics department. This study only followed the students during their first semester. Future studies could observe the changes of the students learning approaches during a longer period. Another possible area for future research would be to investigate and compare the students learning approaches when the department is implementing new methods.

Table of Contents

List of acronyms

R-SPQ-2F The revised two-factor process questionnaire

SI Supplemental Instructions

Charts:

Tables:

1 Introduction

Various kinds of studies have been conducted over the years to obtain essential information about student-learning approaches. This has resulted in a mainly used picture, containing two types of learning approaches, surface learning and deep learning. The surface-oriented approach is characterized by focusing on repetition and memorization of material in order to reproduce it. The deep-oriented approach is characterized by the student's motivation and intent to gain an understanding of the subject, to learn the context of the topic (Hedin, Svensson 2010).

The aim of this thesis is to examine which of these learning approaches are promoted by the physics department in the FYSA01 course at Lunds University. FYSA01 is a general physics course and contains inter alia: mechanics, electricity, waves and atom physics. The thesis will also take into consideration if there are any correlations between a student's learning approach and his/her grades. The result will lead to a better understanding of how the FYSA01 course is constructed and how to improve it.

The result will be attained by looking at the changes between two surveys, one handed out before the start of the course and one after. The questions in these surveys will not only relate to both types of learning but also to the student's motivation since this is an important part of learning according to some studies. Similar correlations are discussed by Floyd, Harrington and Santiago (2009). Their study showed a correlation between the perceived course value, motivation and the two types of learning. Another study by Everaert, Opdecam and Maussen (2016) confirms a correlation between a good grade, time spent on studying and deep-oriented learning.

1.1 Deep and surface oriented learning:

It is essential for a university level student to know how to attain knowledge in the best feasible way. It is not only for the students and teachers best interest but also for the universities when developing a more successful educational system. First of all, how does society define the knowledge and how should a student attain this knowledge? Viewing a section of the Swedish law called Högskolelagen [chapter 1 §8] might provide some insight:

Högskolelagen (chapter 1 §8)

The law states that the education on the basic level should evolve the students':

- Ability to make independent and critical judgments.
- Ability to independently distinguish, formulate and solve problems.
- Preparedness to meet changes at work

The law also states that students shall develop the following capabilities in their field of studies:

- To be able to search and validate information on a scientific level.
- Follow new developments in the field
- To be able to share and explain information to people without any knowledge in the field of studies.

The law states that students need to have knowledge defined as skills and abilities, which they can use in their future work and studies. Biggs and Tang (2011) state that explaining, hypothesizing, relating and problem-solving are some of the abilities that characterize the deep learning approach. Correlations between this statement and the law can be found. The easiest to see might be problem-solving and explaining since they are stated in both sections. Relating information are related to being well prepared for work and is of importance when following new developments in the field.

Memorizing and paraphrasing are examples of abilities used in surface learning. It takes less time and energy to use these abilities compared to abilities from deep learning. Majority of the students learn these techniques in elementary school, where learning by repeating is common. For example, vocabulary in languages, multiplications tables in math and important years in history. However, some minor usage of surface approach is relevant for a student since it could serve as a stepping stone towards deep learning. For instance, a physics student using deep learning usually starts by learning terminology, memorizing formulae and later using this to comprehend the main ideas of the subject. Surface learning is, therefore, a part of deep learning, but it is not beneficent on its own (Biggs and Tang, 2011).

1.2 Inspiration from previous work:

Similar studies have been conducted over the years, mostly on other university programs than physics. The following studies have all used surveys to answer their hypothesis and are used as inspiration for the present study. These articles do not only show what kind of learning approach the students use but also what influences the students.

The study on business students by Everaert, Opdecam and Masussen (2016) shows, inter alia, that students using a deep-oriented learning obtained a higher academic level parallel with getting better grades. It also stated that students with a high intrinsic motivation were more likely to adopt the deep-oriented learning approach. Even the students with an extrinsic motive had a slightly deeper approach towards their learning.

Floyd, Harrington and Santiago (2009) presented a correlation between motivation, deep-oriented learning and surface-oriented learning. They also found that students perceived course value can affect the correlation between the other three factors. Students with a positive view towards the course had a more extensive usage of the deep learning approach.

Other relevant research to the thesis concerns studies about supplemental instructions (SI). SI is a method introduced in the physics course (FYSA01) a couple of years ago. This method has existed since the 90's and is used all around the world. It consists of supervised hours where students practice talking and discussing physics in groups. The supervisor is a more experienced student with knowledge on the topic. Malm, Brygnfors and Mörner have over the years conducted a substantial amount of SI-studies on different programs at the Faculty of Engineering in Lund (LTH). The results showed a connection between high attendance on SI-meetings and high grade on examinations (Malm, Brygnfors and Mörner, 2011). The result of another research paper involving first-year engineer students concluded that all students with previously low, average or high academic accomplishments benefitted from attending supplemental instruction sessions. (Malm, Brygnfors and Mörner,2012). Supplemental instruction should help with the students deep learning approach in the FYSA01 course, at least if the result from previous studies is true.

1.3 Questionnaire R-SPQ-2F

The questionnaire used is called “the revised two-factor process questionnaire” (R-SPQ-2F). It is an improved questionnaire originated from a questionnaire created in the late 70s called “The study process questionnaire” (SPQ). The demand for more accurate questionnaire arose when teachers required a more suitable way to evaluate a student’s learning approach. (Biggs, Kember and Leung, 2001).

Biggs, Kember and Leung created the R-SPQ-2F in 2001, which has since then become a well-used tool. The questionnaire started out with around 45 questions but got reduced by using different statistical examinations. The final questionnaire contains 20 relevant and useful questions, which are divided fifty-fifty into two main categories; deep learning and surface learning. These two categories could be divided even further into four final subcategories; Deep motive, Deep strategy, Surface motive and Surface strategy.

The category “deep learning” contains the questions numbered; 1,2,5,6,9,10,13,14,17,18. While the rest of the questions (3,4,7,8,11,12,15,16,19,20) belongs to the category “surface learning”. The answer to each question is transformed into value. The values are added together for both groups, which results in a deep learning score and a surface learning score. The scores describe the student’s degree of usage for each learning approach.

2 Method

2.1 The structure of this bachelor thesis.

The bachelor thesis involves the usage of several questionnaires of the type R-SPQ-2F. Two questionnaires were distributed during the fall of 2017. The first at the beginning of the FYSA01 course and second at the end, right before the course examination. The rest of the questionnaires were distributed during the end and start of two previous FYSA01 courses. More precisely at the fall and spring semester during the year of 2014. The questionnaires from 2014 were created for a similar research like this thesis. However, the questionnaires did not get examined at the time. The first study got postponed and recreated into this thesis, which is why there is a gap in time. Future studies would benefit to have these questionnaires sent out every semester and in more advanced courses. This could help the physic department to follow the students’ progress over a longer time.

All the questionnaires are similar, but with slight differences. For example, the questionnaire distributed during spring 2014 was in English since this FYSA01 course is directed towards exchanges students. Another difference can be noted on the second questionnaire distributed during 2017. It had six additional questions that focused on motivation, time spent on studying and the labs performed during the course. The extra questions were added to further consider the types of influences that could affect the choice of approach. At least according to Floyd, Harrington and Santiago (2009).

2.2 Collecting results

The questionnaires contained 20 questions, where 10 of the questions measures surface approach and 10 measures deep approach. Students answers on a 5-point Likert scale starting with 1 (never true) up to 5 (always true). (Biggs, Kember and Leung, 2001). The points for each question were added together into deep-scores and surface-scores, where 10 points are the minimum score and 50 is the maximum score for each learning category. Higher scores equal a more extensive use of the specific learning approach. Previously mentioned studies established that high scores for deep learning are preferred since it indicates a high utilization of deep learning. Low scores are instead ideal for surface learning since students should avoid it.

The students are put into different categories depending on their deep and surface scores. These categories are modified to contain the percentage of the students having a certain score. By modifying the scores can the three semesters be compared more easily. The results are put into a chart of columns, where the columns illustrate the categories and the size represent the percentage of students in that category. A normal distribution curve was created over the columns to help illustrate the differences between the deep learning scores and surface learning scores. The normal distribution curve was calculated by using the following equation:

$$f(x|\mu,\sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Here is μ the mean value and σ is the standard deviation. The normal distribution curve yields a good estimation for a group of people where only a part of the group answered the questionnaire. Biggs, Kember and Leung (2001) did a similar approach in their study, which were used as inspiration for this calculation.

3 Results

This chapter starts with some explanations of all charts and how to interpret them. The first results presented are from the most recent survey, fall 2017. It is the core part of the thesis, since it is the most recent and relevant survey. The chapter continues later with results from the two older surveys conducted during 2014. The last part of the chapter displays differences and parallels between the different semesters.

3.1 Explanation of charts

The first charts in every subchapter consist of a pattern, making it easier to understand. The charts consist of six elements; two graphs (columns), two normal distribution curves and two points. See chart 1 below for a reference:

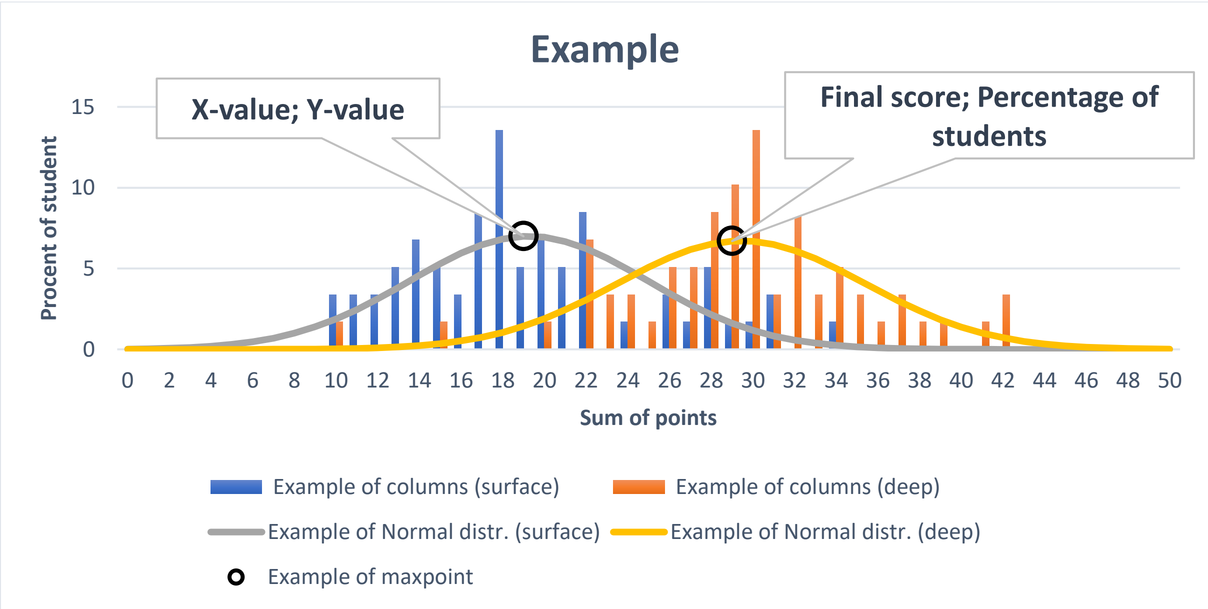

Chart 1: Example of chart with columns and normal distribution curves

The columns represent the raw data collected from the questionnaires and displays the percentage of students (y-axis) containing in a specific score category (x-axis). The blue columns in chart 1 portrays the surface learning values and the orange portrays deep learning values. The normal distribution curves display the probability of a student getting a certain score. Two curves are shown as an example in chart 1, where grey belongs to surface learning and yellow belongs to deep learning. The normal distribution curves have mean values at the highest peak which is marked in the example with a distinct black circle. These maximum points are used to compare the differences between the two data sections in a chart.

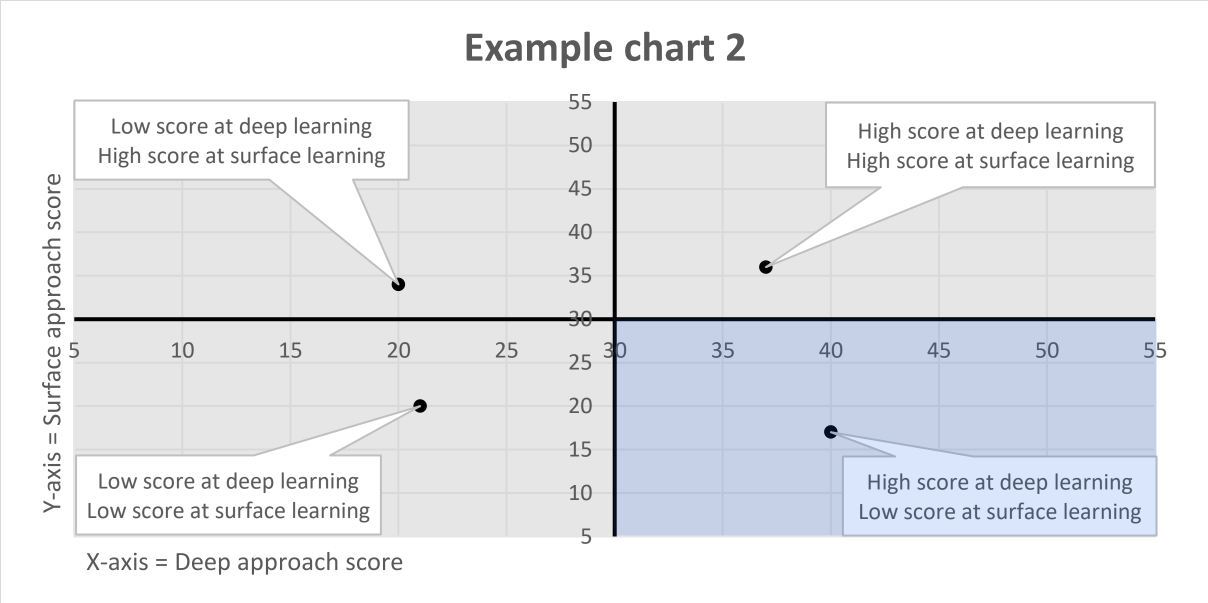

Chart 2: Example; chart with students total score of deep and surface learning.

In chart 2 are each student represented with a dot that displays the students deep and surface learning scores. The ultimate scores for a student are, as previously stated in chapter 1.1 and 1.2, a low surface score along with a high deep learning score. If a student has these scores he or she will be represented by a dot in the lower right box (marked blue in chart 2). The percentage of students in this box will be calculated and compared with the results from other questionnaires. The students learning scores are also compared with their exam result, similarly to mentioned studies in chapter 1.2. Students with a passed exam are represented with a green dot and students with a failed exam are represented by a red dots.

Chart 3 displays the mean change of each question from the first survey to the second survey. The numbers on the x-axis refer to the same question number from the survey and the questions belong to either deep or surface learning, as stated in the previous chapter (1.3). Both categories have two subsections; group change and personal change. The group change is calculated by taking the mean value of the group from the first survey and comparing it to the mean value of the group on the second survey. The personal change refers to the mean change of students that answered both questionnaires.

Similar values for the subcategories show a level of relevance. Comparing two questionnaires from the same students give a certain change of that individual. However, the number of students answering both the questionnaires is only a fraction of the group. Observing the group has a higher number of participants but are easily offset when students answering frivolous. Therefore, are both subcategories displayed in the chart.

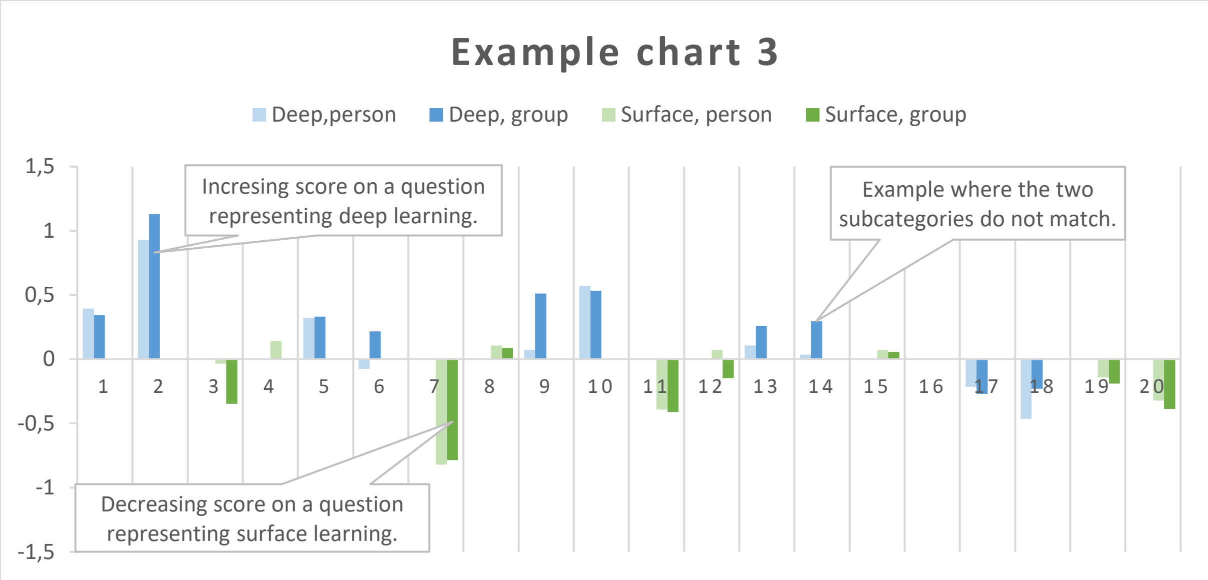

Chart 3: Example of chart where changes per each question are displayed

Charts like chart 3 identify questions of importance. Increasing values for deep learning questions and decreasing values for surface learning questions are, as stated previously, the most favorable changes. It also shows questions (education areas), where the physics department influences the students the most and the least. All the questions from the questionnaires can, if needed, be observed in appendix I.

3.2 Results from Fall Semester, 2017

Chart 4 and 5 displays the results from the first and second questionnaires during the fall of 2017. The first chart displays the students starting scores, with a difference of around 10 points between the max points of the surface and deep learning. The second chart displays the students score after the course and a shift of the max point can be observed. The difference between the max point is now around 15 instead of 10. It indicates changes in the student's choice of learning. Chart 6 and 7 illustrates these changes more closely.

Chart 6 shows the decrease of surface learning by 2 points; thus, the students have reduced the usage of surface approach. The max points for deep learning, in chart 7, has increased 1,39% on its height and 3 points on its mean value. This indicates an improved usage of deep learning for a majority of the students.

	N	Minimum	Maximum	Mean	Std
First Survey, Surface approach	59	10	34	19,25	5,70
First Survey, Deep approach	59	10	42	29,44	5,94
Second Survey, Surface approach	34	10	27	17,12	4,68
Second Survey, Deep approach	34	21	40	32,47	4,91

Table 1: Result in numbers, Fall semester 2017

Table 1 displays important values for following charts and were used to create the normal distribution curves in the charts. The two numbers displayed in the charts are connected to the maximum points of the normal distribution curve, hence the x and y values.

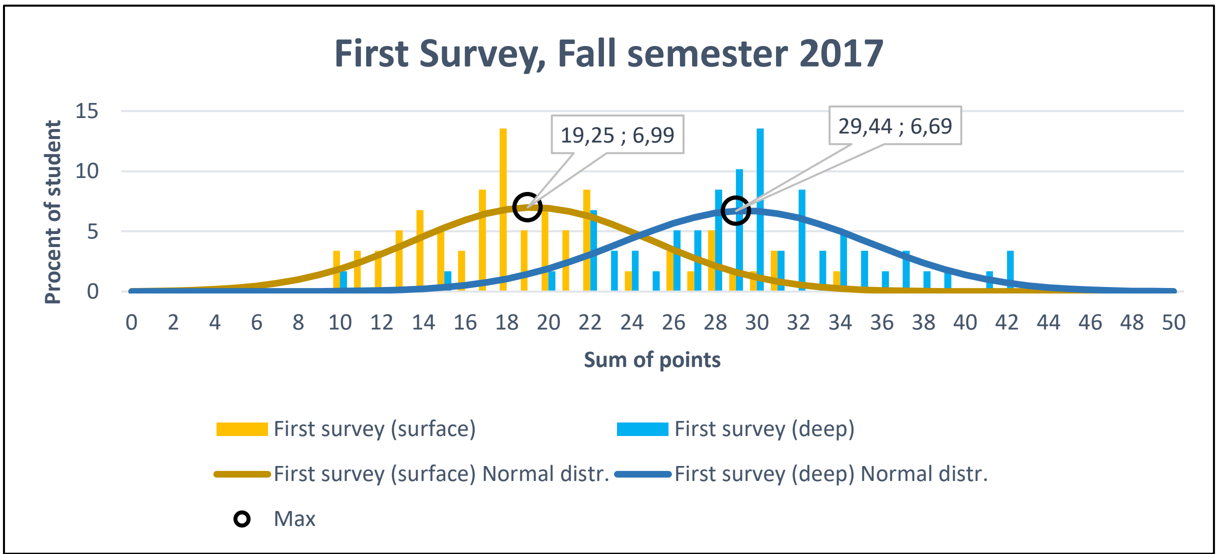

Chart 4: Result from the first survey, Fall 2017

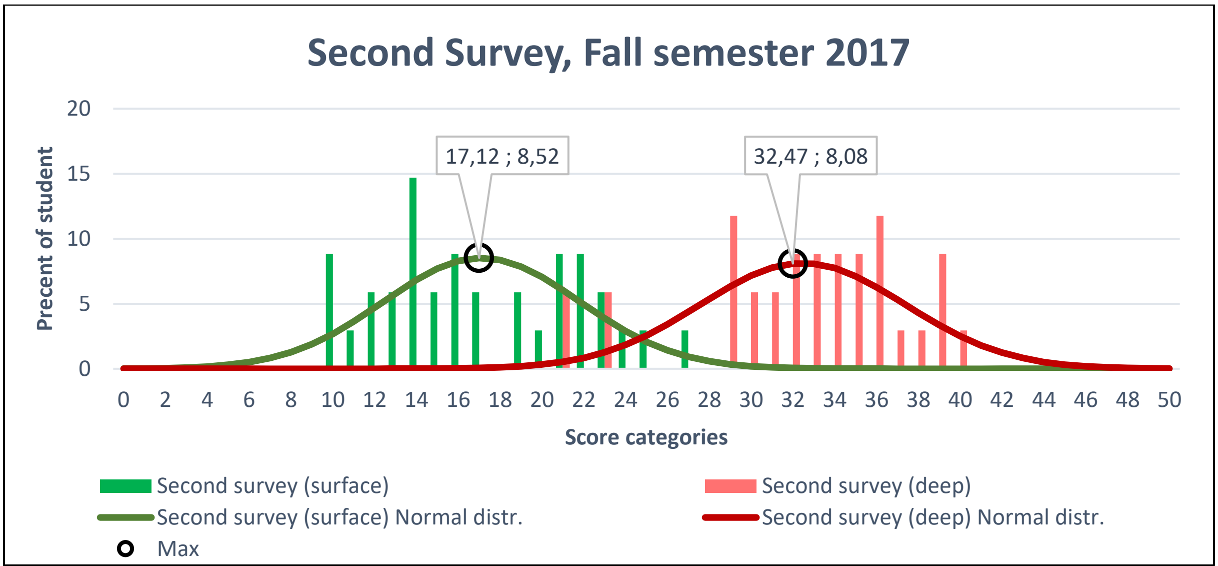

Chart 5: Result from the second survey, Fall 2017

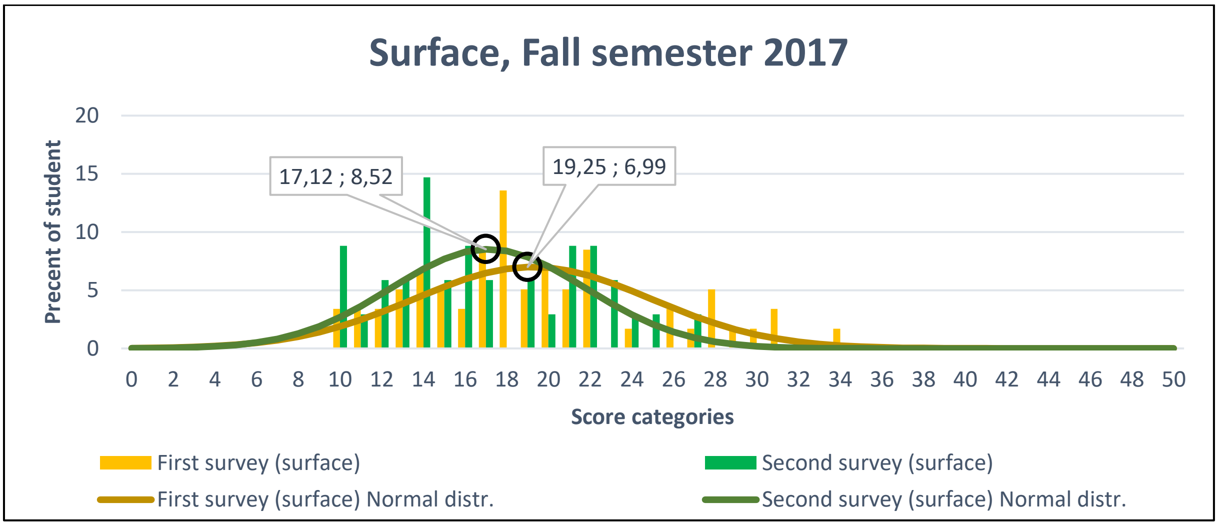

Chart 6: Changes in surface learning between first and second survey, Fall 2017

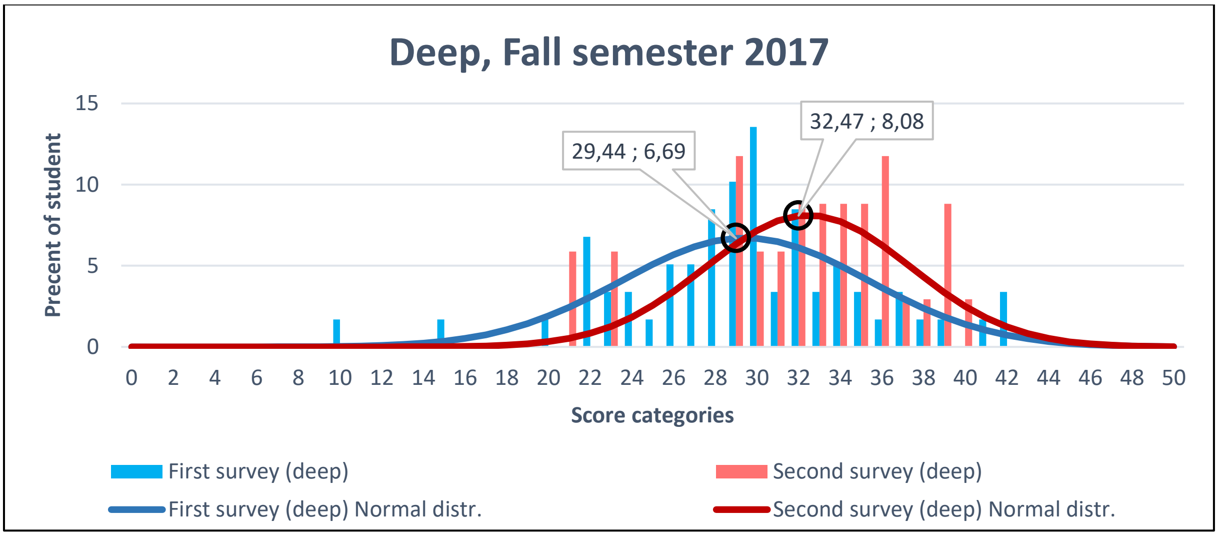

Chart 7: Changes in deep learning between first and second survey, Fall 2017

First survey	Number of	Percent
Participants	59	
Students in lower right box	29	49,15
The rest	30	50,85
Second survey	Number of	Percent
Participants	34	
Students in lower right box	26	76,47
The rest	8	23,53
Students with passed exam	28	82,35
Students with failed exam	6	17,65
Students in lower right box and with passed exam	22	84,62

Table 2: Values belonging to chart 8 and 9

Observing the complete starting scores for each student gives a better understanding of the results. Chart 8 shows that students starting the course in fall 2017, already had a low usage of surface learning nonetheless only half of these students had a high usage of deep learning.

The results from the second questionnaire (chart 9) show some slight changes from the first questionnaire (chart 8). The percentage of students in the lower right corner has significantly increased in chart 9 with around 27 percent. Which indicate that more students use a deep learning approach and validate the result from previous charts.

The percentage of students in the lower right box was 76,47% and 84,62% of them passed the exam. This correlates with the result from, inter alia, Everaert, Opdecam and Masussen (2016); Students with a high usage of deep learning are more likely pass the exams.

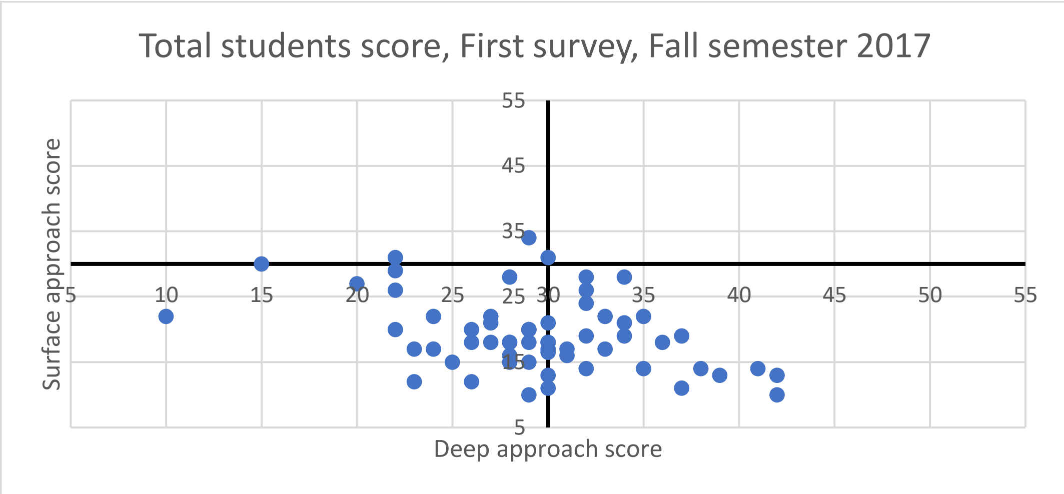

Chart 8: Students total score from the first survey, Fall 2017

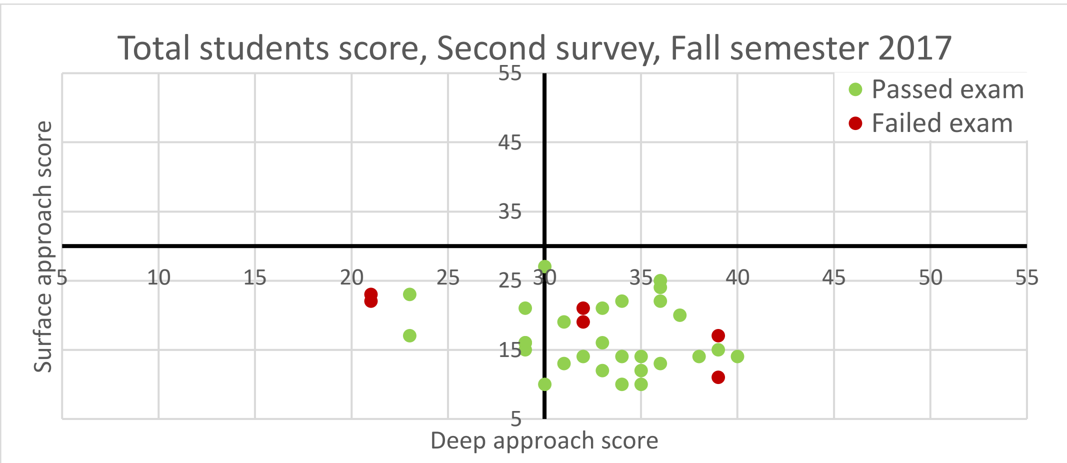

Chart 9: Students total score from the second survey, Fall 2017

Last chart (chart 10) from fall 2017 illustrates the changes in points on each question. The deep learning increased in value on eight of the questions. The two questions with the most change and a high relevance are number 2 and 10, see appendix I. Increasing values at question 2 shows that students after the course use more time to compose their own opinions on the subjects. Question 10 indicates that the students use more tests on themselves to completely learn and understand the important topics. The two deep learning questions with decreasing values are number 17 and 18. This decreasing change means that fewer students came with questions in mind to the lectures (question 17) and less student read the extra literature suggested by the teacher (question 18).

Most of the surface learning questions have all decreased in value especially question 7. The change on question 7 indicates that students worked even more than before on the parts they did not find interesting. Question 8 and 15 had a slight positive change and states that students are after the course more likely to memorizing important parts without understanding the context.

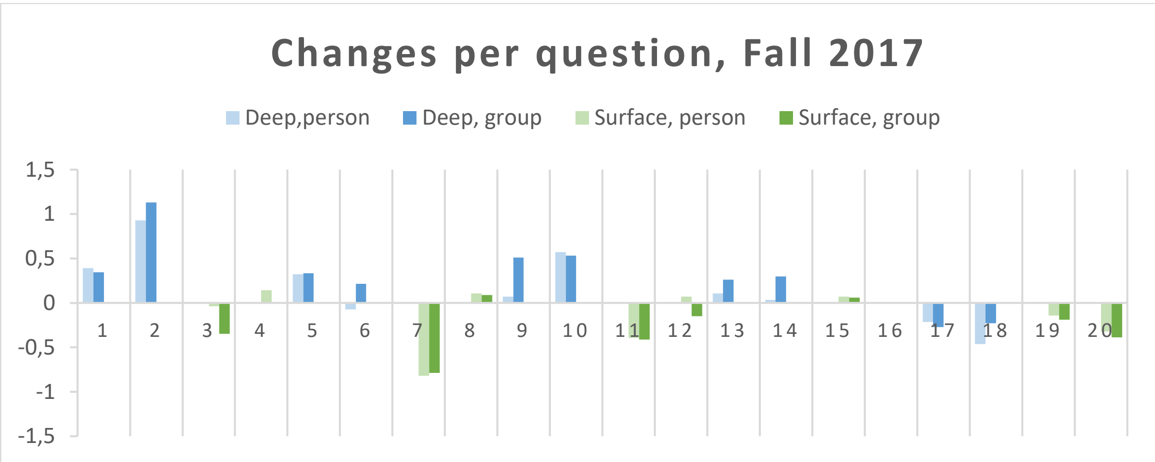

Chart 10: Score changes per question, Fall 2017

3.3 Results from Fall semester 2014

	N	Minimum	Maximum	Mean	Std
First Survey, Surface approach	79	9	50	22,24	7,73
First Survey, Deep approach	79	16	50	31,66	7,07
Second Survey, Surface approach	59	6	45	19,10	6,58
Second Survey, Deep approach	59	10	38	32,20	6,91

Table 3: Result in numbers, Fall semester 2014

The results from questionnaires handed out in the fall of 2014 show a similar pattern like the result from fall 2017. There is the same split of 10 points between the max values in the results from the first survey. This split increases on the second survey to 13 points, which is 2 points less than the result of fall 2017. It implies that students did not improve their learning approaches as much as the students during fall 2017. The charts 13 and 14 displays the shifts more closely for each learning approach. The surface learning has decreased in value with 3 points while there is no visible change in the scores belonging to deep learning. It would indicate that the physics department only succeeded in lowering the student's usage of surface learning.

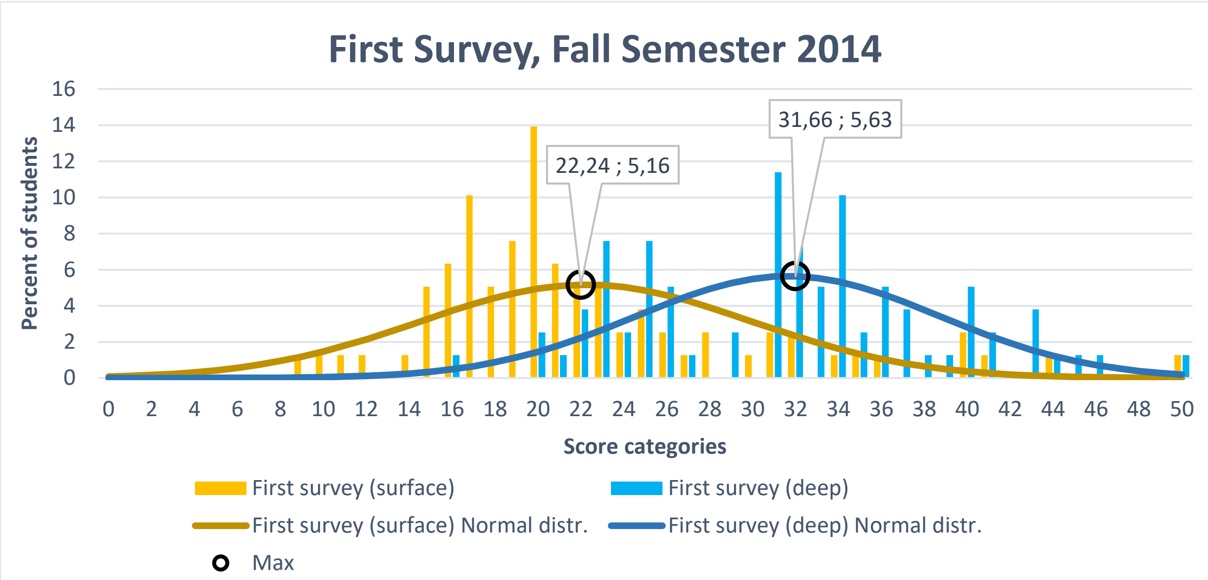

Chart 11: Result from the first survey, Fall 2014

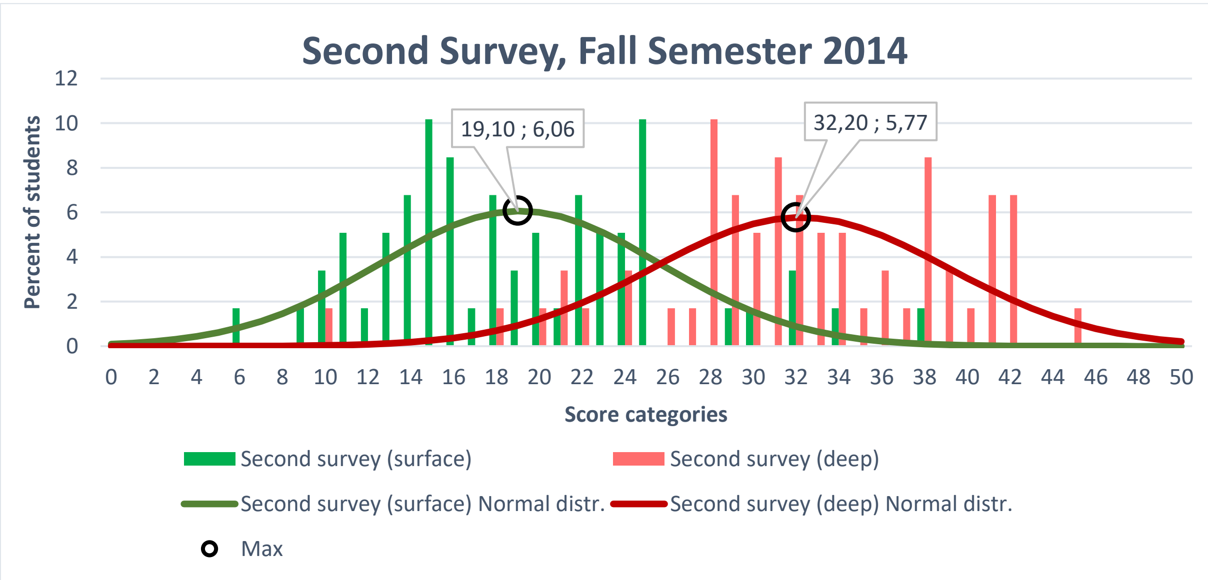

Chart 12: Result from the second survey, Fall 2014

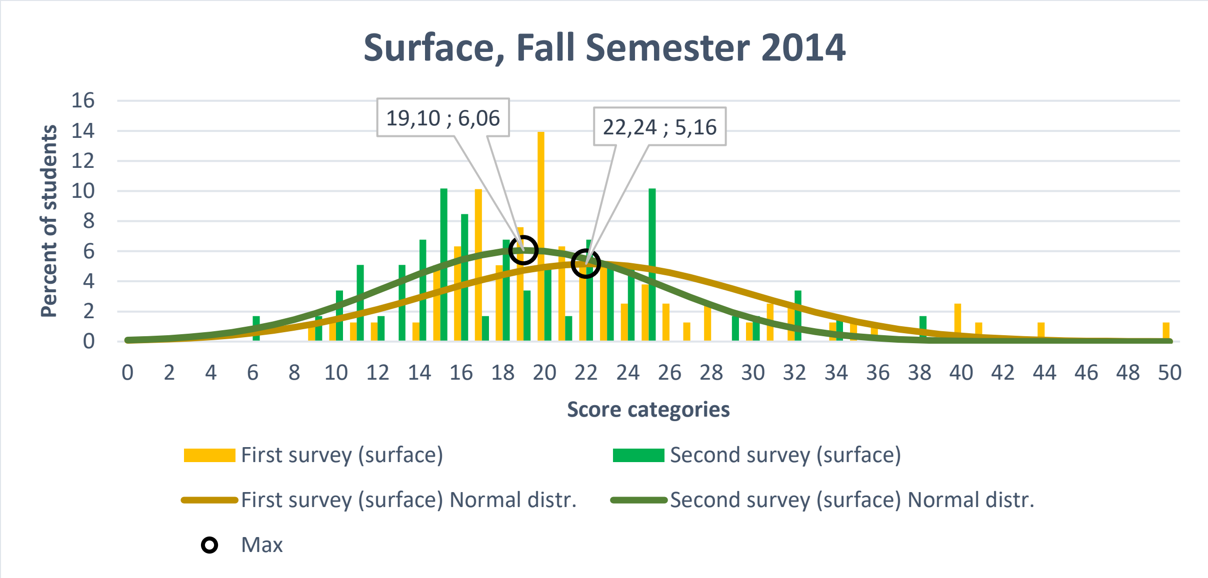

Chart 13: Changes in surface learning between first and second survey, Fall 2014

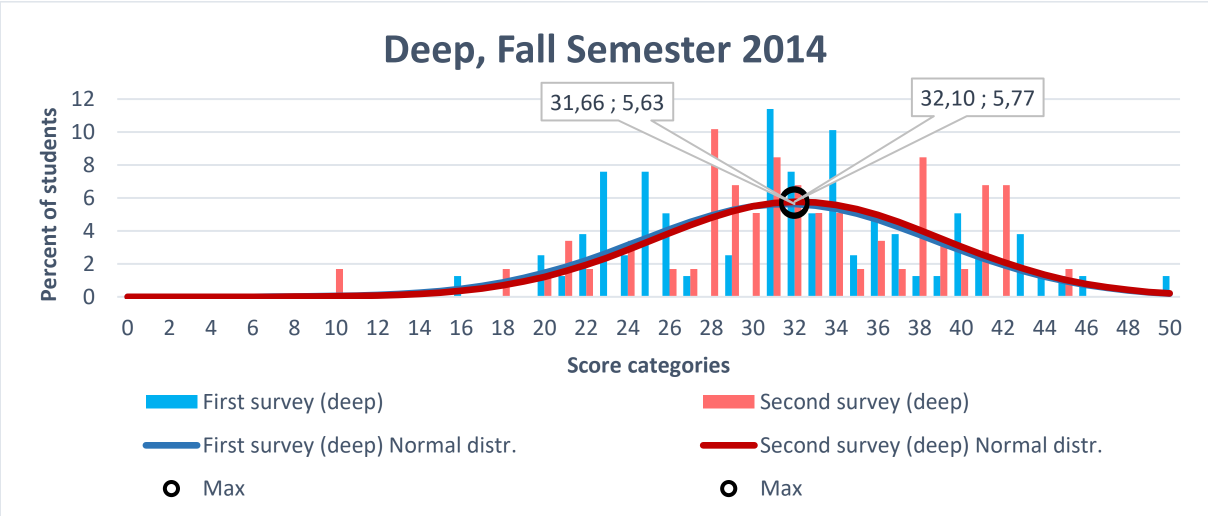

Chart 14: Changes in deep learning between first and second survey, Fall 2014

First survey	Number of	Percent
Participants	79	
Students in lower right box	45	56,96
The rest	34	43,04
Second survey	Number of	Percent
Participants	59	
Students in lower right box	36	61,02
The rest	23	38,98
Students with a passed exam	39	66,10
Students with a failed exam	20	33,90
Students in lower right box and with a passed exam	28	77,78

Table 4: Values belonging to chart 15 and 16

Comparing the students starting point with their finishing scores, similar to the result from fall 2017, shows an increasing percentage of students with a high deep learning score and a low surface learning score. Hence, 4,06% more students in the lower right box. It can also be noted that students with a high usage of surface learning have lowered, which correlates with chart 13. The fact that this semester didn't influence the students as much as in 2017 can be noted when looking at the percentage of students in the lower right box after the course. 61,02% of the students are put in this box and only 77,78% of them, compared to 84,62% in 2017, passed the exam. Assuming, of course, that the exams are testing the students on the same parts of the course with the same level of difficulty.

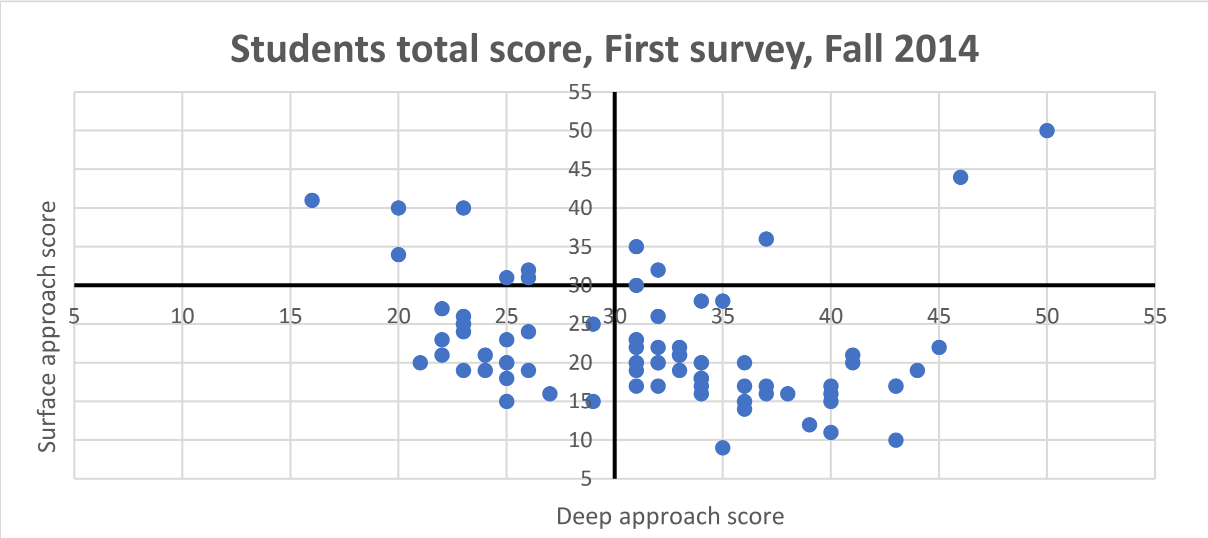

Chart 15: Students total score from the first survey, Fall 2014

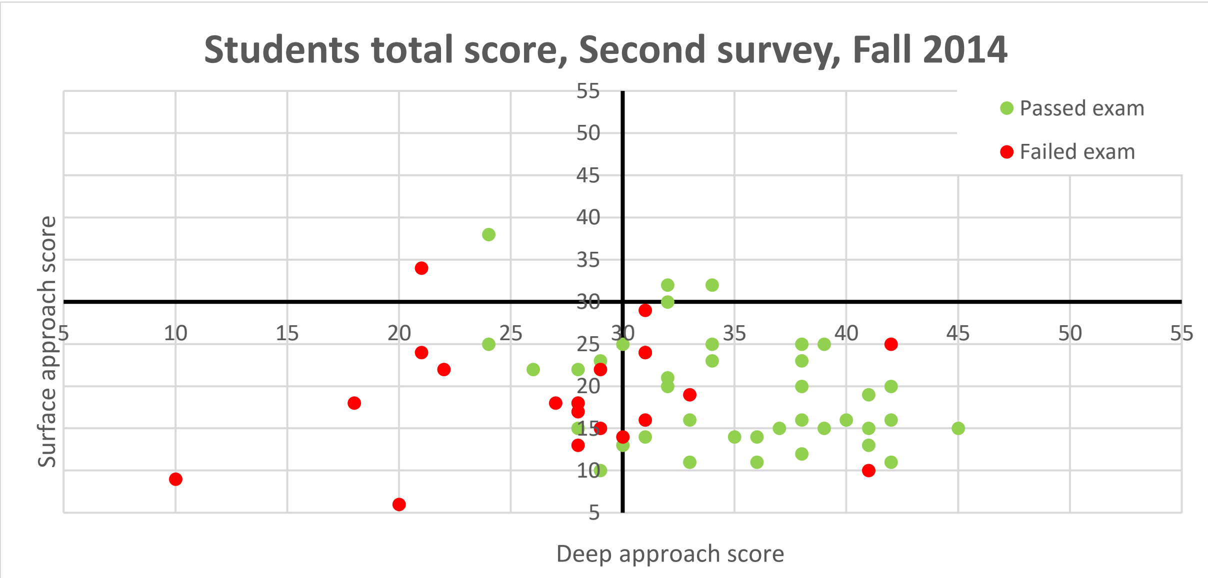

Chart 16: Students total score from the second survey, Fall 2014

The main changes from this semester are from questions belonging to surface learning. Three questions seem more relevant due to the similar size of both subcategories. These questions are 15,16 and 19. The decreasing change of question 15 is especially interesting since it had an increasing change in fall 2017. The two other questions are similar in their statement and showed that students at the end of the course chose to learn everything and not only the parts they knew would be at the examination. Observing the questions belonging to deep learning shows a weaker but a similar change as in 2017. Thus, the mean scores for question 2 have increased and the mean scores for question 18 have decreased.

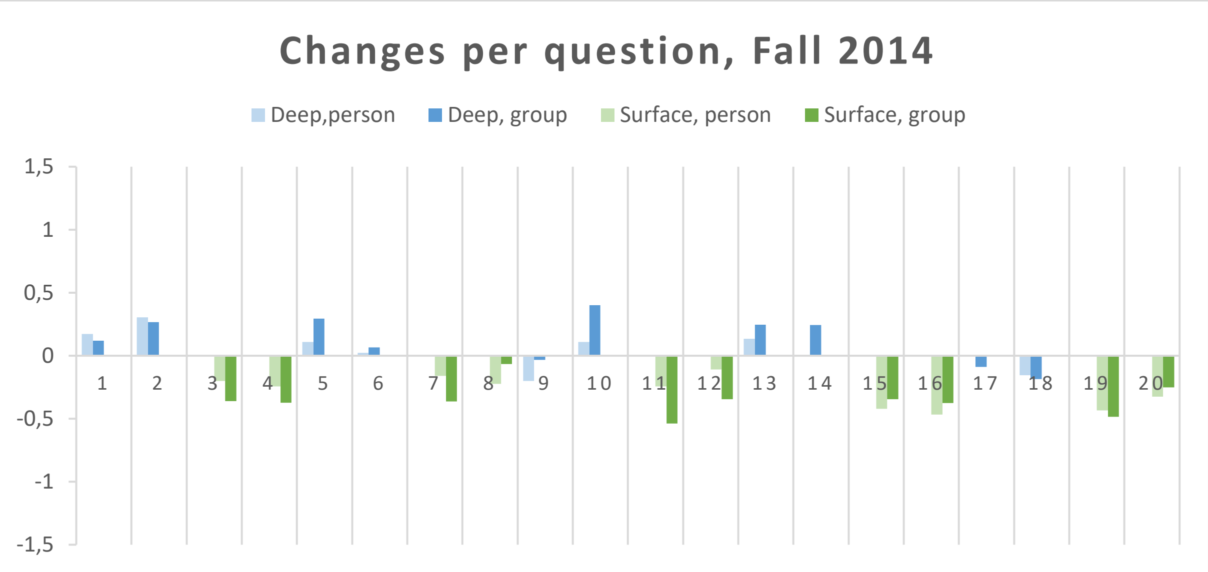

Chart 17: Score changes per question, Fall 2014

3.4 Results from Spring semester 2014

	N	Minimum	Maximum	Mean	Std
First Survey, Surface approach	26	10	29	20,92	6,95
First Survey, Deep approach	26	20	43	32,92	6,09
Second Survey, Surface approach	15	10	29	18,60	6,46
Second Survey, Deep approach	15	25	50	35,00	6,14

Table 5: Result in numbers, Spring semester 2014

Charts 18 and 19 show the results from the questionnaires handed out during spring 2014. Remember that the course this semester was given in English since it mainly contained exchanges students. The first chart displays a similar result as the two previous semesters. The first chart starts with a difference of 12 points and is increased with 4 points in the second. Deep learning has increased by 2 points and surface learning has decreased by 2 points. Which put the degree of changes between the two other semesters.

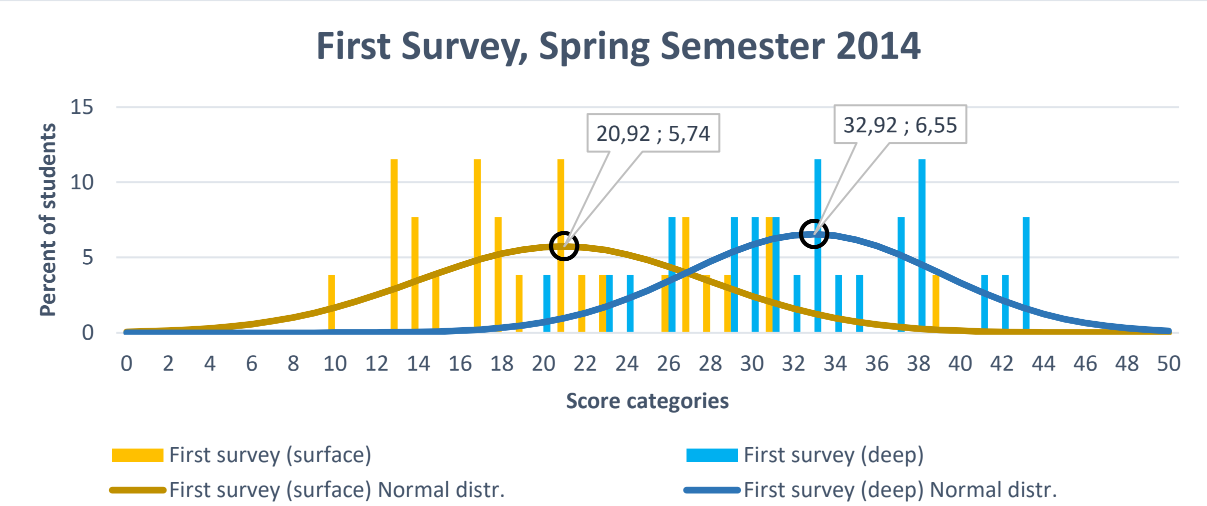

Chart 18: Result from the first survey, Spring 2014

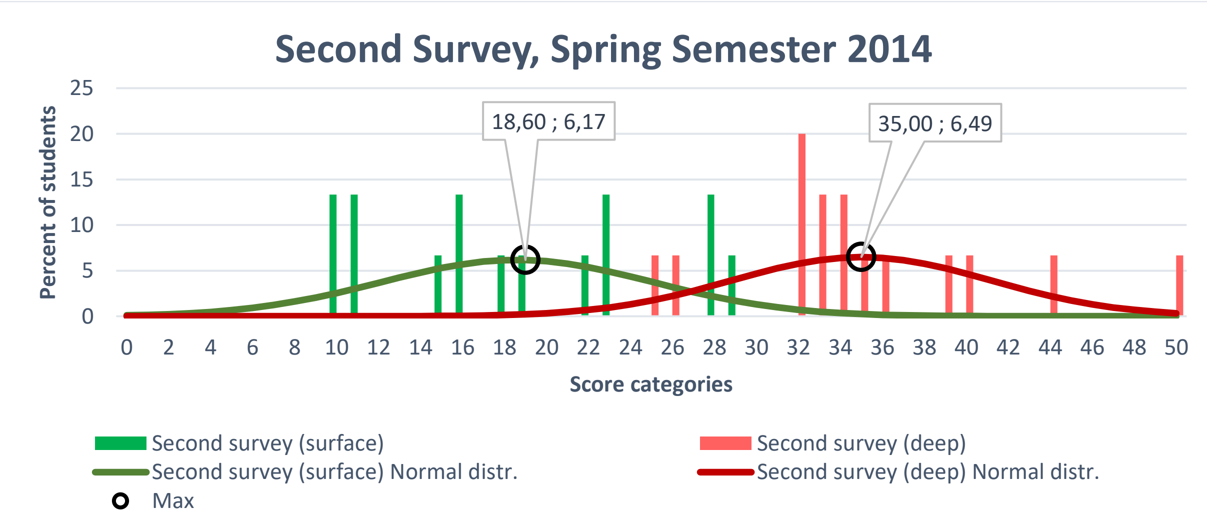

Chart 19: Result from the second survey, Spring 2014

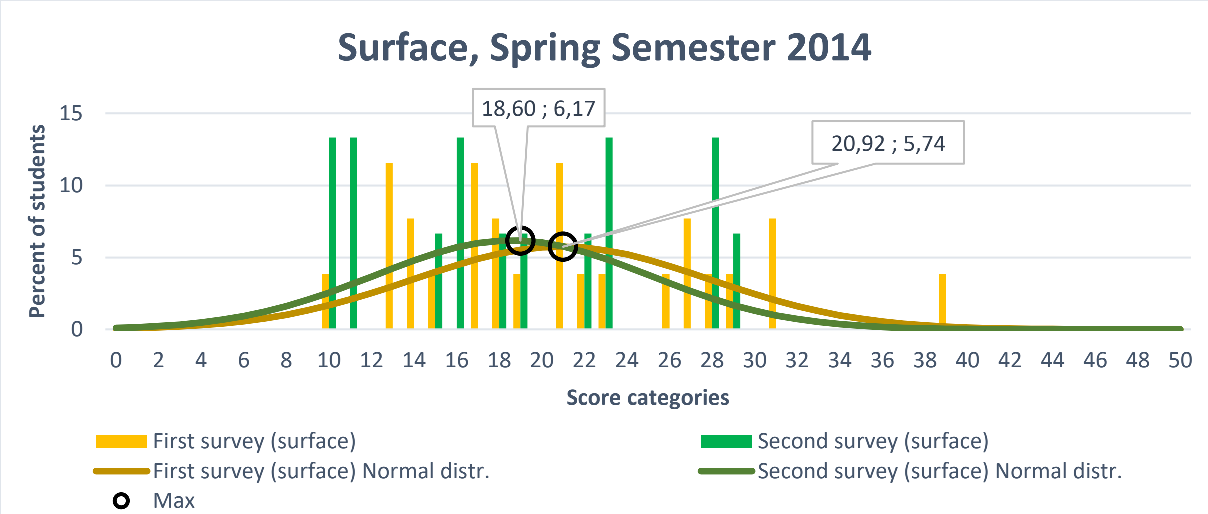

Chart 20: Changes in surface learning between first and second survey, Spring 2014

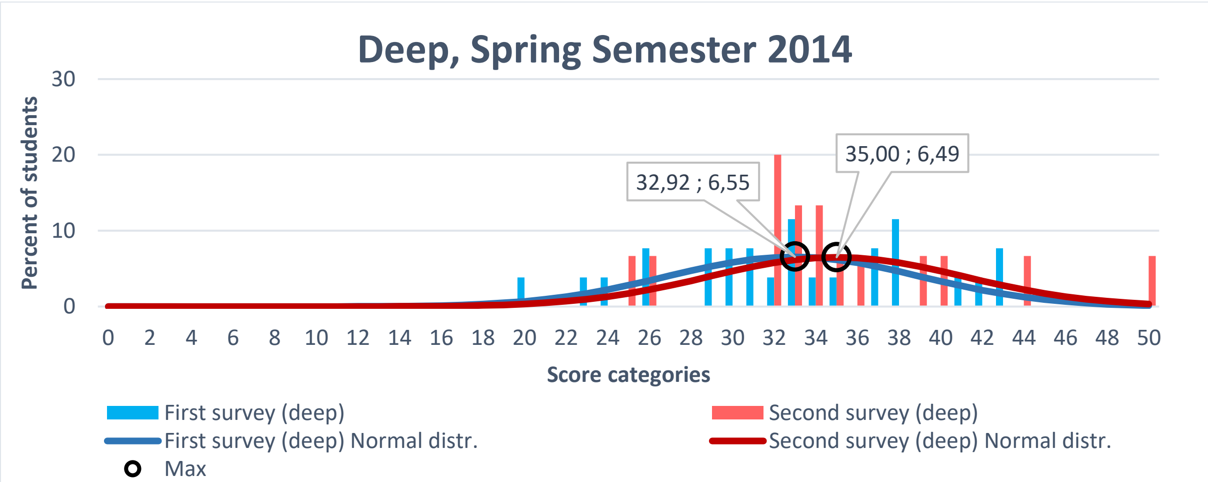

Chart 21: Changes in deep learning between first and second survey, Spring 2014

First survey	Number of	Percent
Students	26	
Students in lower right box	18	69,23
The rest	8	30,77
Second survey	Number of	Percent
Students	15	
Students in lower right box	13	86,67
The rest	2	13,33
Students that passed exam	14	93,33
Students that failed exam	1	6,67
Students in lower right box and with passed exam	12	92,31

Table 6: Values belonging to chart 22 and 23

The decreasing usage of surface learning can be further observed when comparing chart 22 and 23. At closer inspection of the starting values in chart 21, shows a significantly higher percentage of students in the lower right box than in previous semesters. Hence, there are more students this semester that starts with low surface learning scores and high deep learning scores. This result reflects a difference between Swedish and international student's previous education, since the two other semesters are with Swedish students. The international students seem to attain a higher deep learning and a lower surface learning in high school compared to the Swedish students. Assuming, of course, that the majority of the students during this semester (spring 2014) are exchange students. The percent of students with a low surface learning score and a high deep learning score increases from 69,23% to 86,67% at the end of the course. This final value is the highest value for all three semesters, however, the change between the first and second survey is higher for fall 2017.

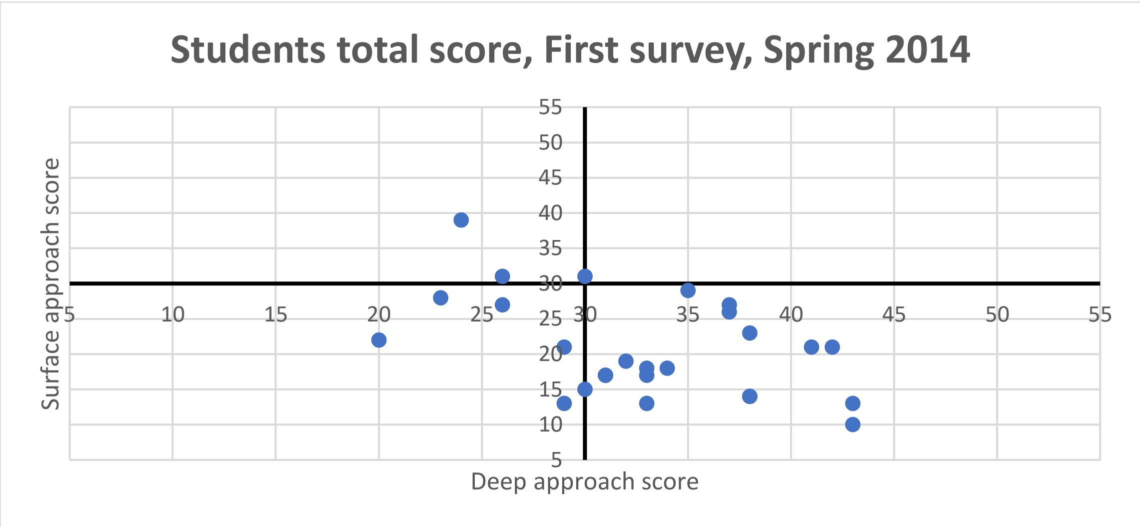

Chart 22: Students total score from the first survey, Spring 2014

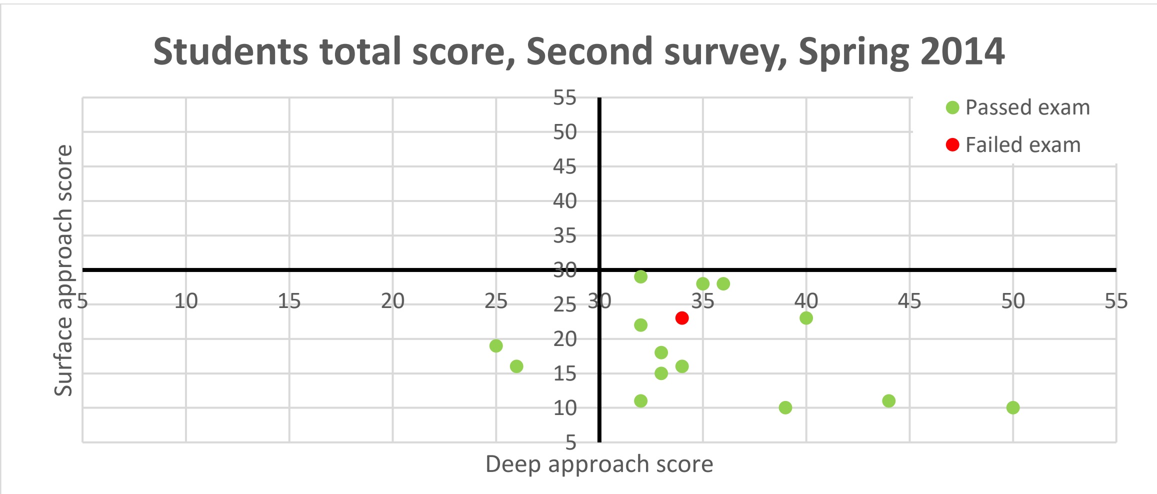

Chart 23: Students total score from the second survey, Spring 2014

Changes per question are more difficult to retrieve from this semester since it has fewer students answering both surveys. However, there is a similar change in surface learning as in the other two surveys. Noteworthy is question 20 that has the opposite change. It's an indication that students learned to pass an examination by remembering the answers to likely question. The deep learning has two questions with major changes, an increase in question 17 and a decrease in question 2. It is an opposite change compared to the two other surveys. The result indicates that students now bring questions to the lecture and they do not spend a lot of time to form own conclusions.

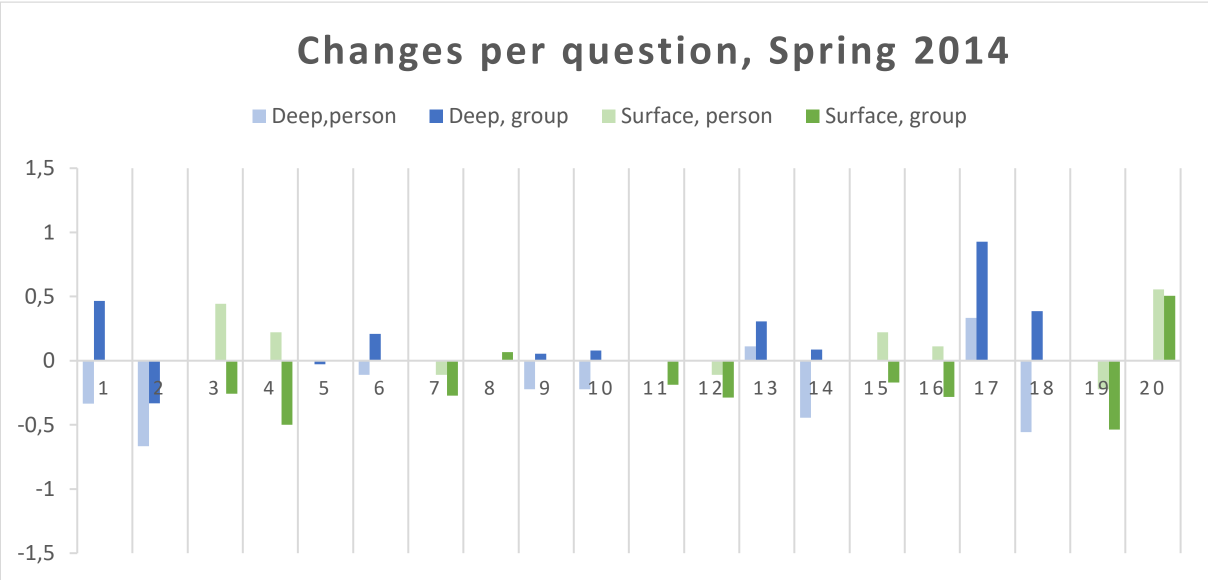

Chart 24: Score changes per question, Spring 2014

3.5 Difference between semesters

This part of the chapter describes the differences between the semesters more closely. These charts use only the normal distribution curves from the previous charts to make it easier to observe. Starting values for surface learning is close to each other, the highest value belongs to the student from spring 2014. Which indicates that international bachelor students have a slightly higher use of surface learning at the start of the course than the Swedish students. It also seems that the starting scores for surface learning have decreased over the three years. All scores for surface learning decrease with almost the same amount on each semester.

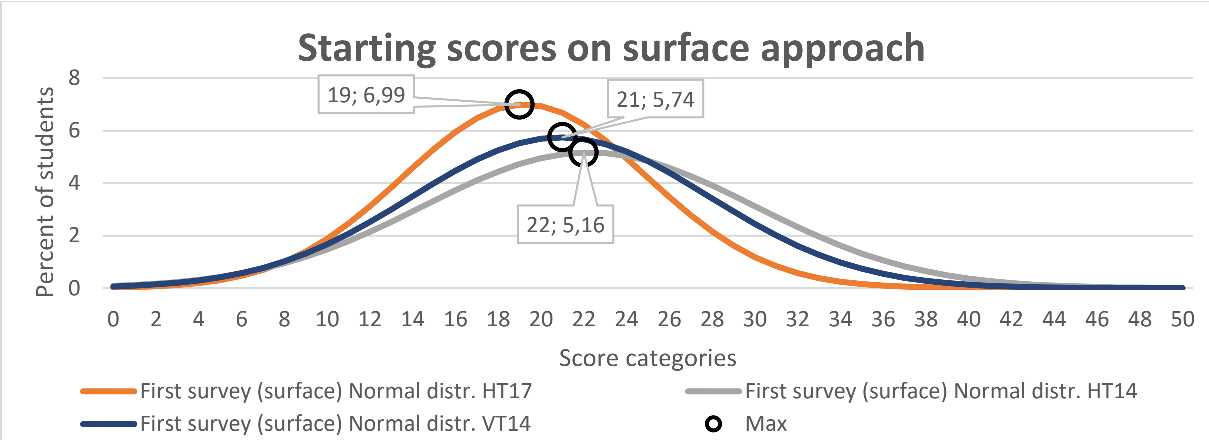

Chart 25: Starting scores for all three semesters, surface learning.

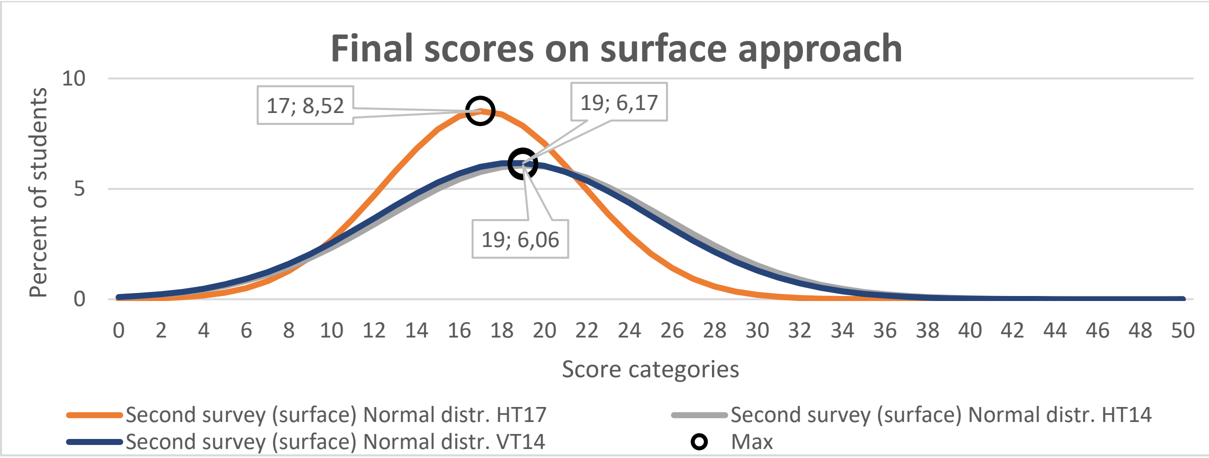

Chart 26: Final scores for all three semesters, surface learning.

Starting scores for deep learning have almost the same split as the surface learning. The students from fall 2017 have yet again the lowest score. Students from both fall 2017 and spring 2014 increased their usage of deep learning with 2 points, however, students from fall 2014 did not change their usage of deep learning.

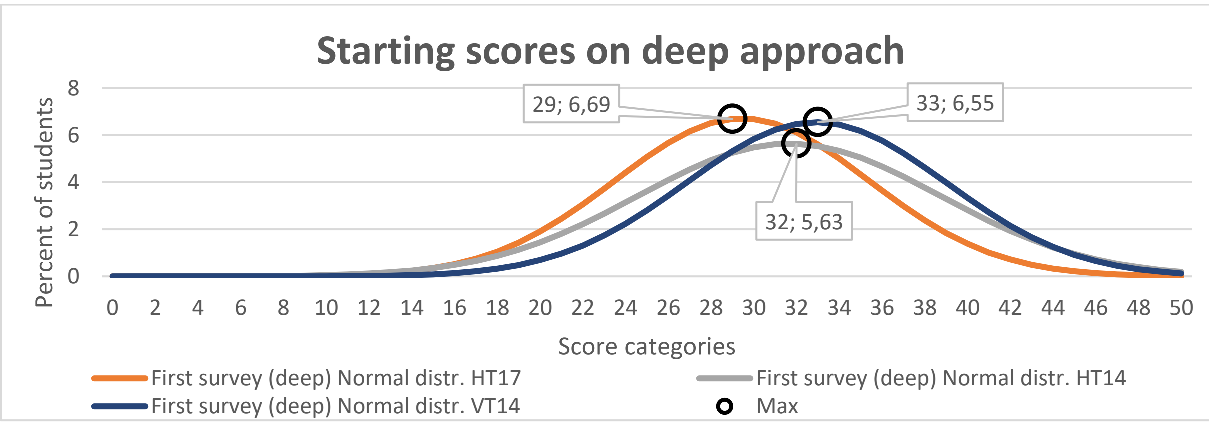

Chart 27: Starting scores for all three semesters, deep learning.

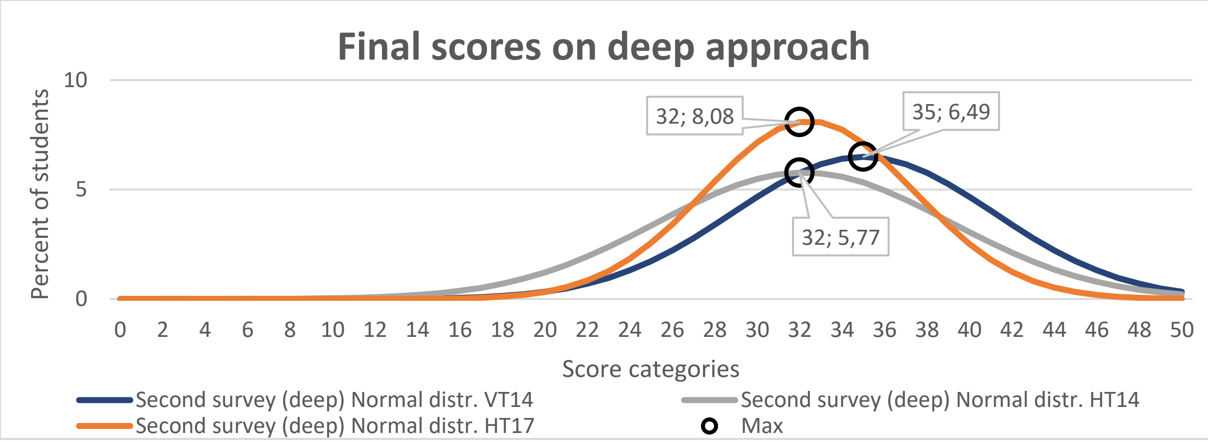

Chart 28: Final scores for all three semesters, deep learning.

4 Discussion and conclusion

The aim of the present research was to determine the learning approach promoted by the physics department in the FYSA01 course at Lund University. The result of this investigation shows that students amplified their use of deep learning in fall 2017 and in spring 2014. It also shows a decreased use of surface learning for all three semesters. The changes for the most recent survey, fall 2017, are substantially larger than the two semesters in 2014. This might indicate that the physics department has changed their education towards the better over the years. However, further research should be done to investigate it more closely.

A closer inspection of the students total learning scores were made on all three semesters. This revealed a correlation between a passed examination and high use of deep learning. These results support the idea of Everaert, Opdecam and Masussen (2016), where deep learning contributes to a higher grade.

Viewing the changes per question from the most recent questionnaire (fall 2017) revealed important topics that could improve the course further. For instance, one of the questions that students answered with a low score was: “I come to most classes with questions in mind that I want answers too”. By making students prepare questions before a lecture would increase the students deep learning, since it will help the students to reflect over problems they have encountered while trying to understand the subject. Another question with low scores was: “I make a point of looking at most of the suggested readings that go with the lectures”. Teachers should urge the students to read or at least look through the literature before a lecture. Which leads to more students being more prepared and engaged in the lectures.

The SI-meeting that are implemented in parts of the course is a possible factor that helped improve the student’s choice of learning approach in all three semesters. Studies made by Malm, Brygnfors and Mörner (2012) showed that all students benefitted from SI-meeting and it also increased the student's grade. Another factor, to the increasing change of deep learning, is the peer-learning during the lectures of a sub-course. During part of the lecture, the teacher asks questions related to the lecture content and the students reply via a response system that directly let the teacher know if students have understood the lecture material. Extra time will be set aside to discuss the question if the majority of the students answered incorrectly. The teacher might even go over the information again if the discussion did not help.

Both the peer-learning and the SI-meetings are only implemented into one sub-course of FYSA01. The other sub-course running parallel with the first use a more traditional way of teaching. One could argue that students would increase their deep learning even more if both sub-courses had peer-learning and SI-meetings.

In near future will the physics department implement another teaching method called flipped classrooms, which will enhance the student’s degree of deep learning even further. This method changes the lectures considerably. The lectures will change from the traditional teacher-centered lecture to a lecture where the students discuss and explore the subject more thoroughly. The traditional lecture moves to the web where the student can watch it before the actual class. This could help improve one of the questions from the questionnaire. Where students should have questions in mind entering the lecture.

A recent study by Samuel-Peretz, et al. (2017) found that students felt that social media made learning more fun and easier when integrated into the course. The students also felt that it enhanced their deep learning. A suggestion of an improvement to the physics department could be to implement more social media modules into the course FYSA01. The flipped classroom will be one step in that direction since it uses online platforms. Some universities have tried to implement social media tools like WordPress into a subject like social studies. WordPress is used to enhance the students deep learning by having the students writing down thoughts on the course’s material and activities. Other students could then read and comment this to start an online discussion. Facebook is another example used in several also used occasionally by courses where online discussions can take place. Both social media tools can be thought of like an SI-meeting online, where the student’s discussion problems with each other. However, social media might be hard to implement into a physics course like FYSA01.

There is always a something influencing the results, for instance, questionnaires are answered by people. People read and interpret questions differently. They have different backgrounds and experiences. Some participants answered seriously while others didn't.

5 Outlook

This study showed that the physics department at Lund University promoted deep learning toward their students in the physic course FYSA01. The result also indicates that the physics department successfully fulfilled the requirements stated in law (Högskolelagen, chapter 1 §8). A secondary result confirmed the correlation, described in the study by Everaert, Opdecam and Masussen (2016), between a high utilization of deep learning and passing the exam.

More comprehensive studies are recommended on missing aspect of this study. There are interesting variables to take into consideration for the next similar study. For example; The number of times a student attended an SI-meeting. Connect the results of the student's laboratory reports and their grades on the exam. Closer observation on their motivation and time spent on studying. Even the timeframe ought to be increased for the next study. Observing the students over the first course is a bit too narrow since some students might need more time to change their approach to learn. A survey with questionnaires distributed at the end of each semester and covers all three bachelor years could be a promising study. Following the same group of students during the bachelor program could give some interesting insights. For instance, if the courses are collaborating or counteracting each other's teaching methods and strategies.

Bibliography:

Biggs, J., Kember, D. and Leung, D.Y.P, 2001. The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of 0Educational Psychology,* [e-journal] 71, 133-149. Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 10 October 2017]

Biggs, J. and Tang, C., 2011. *Teaching for quality learning at university*. 4th ed. Maidenhead: Open University Press.

Elmren, M. and Henriksson, A.S., 2010. *Universitetspedagogik*. Nordsteds

Everaert, P., Opdecam, E. and Maussen, S., 2017. The relationship between motivation, learning approaches, academic performance and time spent. *Accounting education,* [e-journal] 26(1), 78-107. Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 10 October 2017]

Floyd, K.S., Harrington, S.J., Santiago, J., 2009. The effect of engagement and perceived course value on deep and surface learning strategies. *Informing Science: The international journal of an emerging transdiscipline.* [e-journal] 12, 181-190. Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 10 October 2017]

Fuglestad, O.L., 1997. *Pedagogiska processer*. Translated from Norwegian by S. Andersson. Malmö: Holmbergs

Hedin, A. and Svensson, L., 1998. *Nycklar till kunskap.* Lund: Studentlitteratur AB.

Högskolelagen Act 1992. (c.1). Sveriges Riksdag

Justicia, F., Pichardo, M.C., Cano, F., Berbén, A.B.G. and De la Fuente, J., 2008. The revised Two-factor study process questionnaire (R-SPQ-2F): Exploratory and confirmatory factor analyses at item level. *European Journal of Psychology of Education.* [e-journal] 23(3), 355-372. Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 17 November 2017]

Malm, M., Brygnfors, L. and Mörner, L.L., 2011. Improving student success in difficult engineering education courses through supplemental instruction (SI) – what is the impact of the degree of SI attendance? *Journal of peer learning.* [e-journal] 4, 16-23. Available at: <http://ro.uow.au/ajpl/vol4/iss1/4>

Malm, J., Brygnfors, L. and Mörner, L.L., 2012. Supplemental instruction for improving first-year results in engineering studies. *Studies in higher education*. [e-journal] 37(6), 655-666. Available at: <http://ro.uow.au/ajpl/vol4/iss1/4> Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 5 March 2015]

Samuels-Peretz, D., Dvorkin Camiel, L., Teeley, K. and Banerjee, G., 2017. Digital inspired thinking: Can social media lead to deep learning in higher education? *College Teaching.* [e-journal] 65(1), 32-39. Available through Lund university libraries website: <http://eds.a.ebscohost.com> [Accessed 10 October 2017]

Sjøberg, S., 2009. *Naturvetenskap som allmänbildning – en kritisk ämnesdidaktik*. 3rd ed. Translated from Norwegian by S. Andersson and A. Cleasdotter. Lund: Studentlitteratur AB.

Viennot, L., 2002. *Teaching physics.* 2nd ed. Translated from French by M. Greenwood and A. Moisy. Dordrecht: Kluwer Academic Publishers.

6 Appendix

I. Questions from the English survey

Questions from the English questionnaire distributed during spring 2014. The questions on the Swedish surveys are a direct translation from this.

1. I feel that studies give me a feeling of deep personal satisfaction.
2. I feel that I have to spend so much effort in an area that I can form my own opinion about it, before I am satisfied.
3. My aim is to pass the course with as little work as possible.
4. Whether I have the time or not, I think it is useless to seek information outside of literature, so I am studying just seriously what it says on the literature list specified by the teacher or handed out in class.
5. I think that most subjects can be very interesting, once I got into them.
6. I think most new topics interesting and often spend extra time trying to obtain more information about them.
7. I do not find my course very interesting, so I keep my work to the minimum.
8. I learn some things by repetition, going over and over them until I know them by heart even if I do not understand them.
9. I find that studying academic topics can at times be as exciting as a good novel or movie.
10. I test myself on important topics until I understand them completely
11. I find I can get by in most assessments by memorizing key section rather than trying to understand them.
12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.
13. I work hard at my studies because I find the material interesting.
14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.
15. I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.
16. I believe that lecturers shouldn’t expect students to spend a significant amount of time studying material everyone knows won’t be examined.
17. I come to most classes with questions in mind that I want to be answered.
18. I make a point of looking at most of the suggested readings that go with the lectures.
19. It is pointless to learn material which most likely will not be on the exam.
20. I find the best way to pass the examination is to try to remember answers to likely questions.