Implementation of the collaborative pedagogy model focusing on course integration and continuous assessment to the professional study modules in the degree programme in electrical engineering of the Helsinki Metropolia UAS.

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ABSTRACT

The curricula of the engineering degree programmes of Helsinki Metropolia UAS were completely renewed in 2014. The most effort was focused in creating larger course entities by integrating the contents of the the older curricula and renewing the pedagogical approach towards collaborative teaching and learning. Different engineering programmes and departments were able to apply this methodology in different levels with no exact and detailed specifications. The degree programmes in the department of Electrical Engineering (EE) were the ones together with the Information Technology (IT) degree programmes that made the most profound alterations and complete restructuring of the curricula by integrating all the studies to 15 ECTS courses applying the course integration as well as collaborative teaching in the deepest level. It is already shown that the student progression in these programmes is significantly better compared to the programmes who did the changes in minimum level. During the academic year of 2015-16 the same methodology was applied in practice for the first time to the professional studies of the second academic year as well and the results are even better than the results of the first year. A yearly

profound student satisfaction survey is completed on the university level for the second year students at the end of the third semester and the survey completed at the end of 2015 is the first survey for the students studying based on the new methodology and therefore the results are carefully analyzed and compared to the survey of the previous years. The results show that the students are more satisfied in the structure of their studies in all the engineering programmes then before, but only the programmes who did the fundamental change are able to show student satisfaction improvement in all levels of the survey when the results of the other engineering programmes are somewhat worse than earlier (as usually expected when new pedagogical methods are launched).

1 BACKGROUND

All the degree programmes in Helsinki Metropolia UAS went through a fundamental curricular reform in 2014. All the studies are to be arranged according to the principles of collaborative pedagogy [1] based on larger course entities in which multiple teachers work closely together with the students to reach the specified learning outcomes. The courses are integrated to form study modules to be arranged consecutively in order to facilitate the students to optimize their learning track and to give them more options to plan the contents and structure of their studies [2]. However, there were no strict limits to arrange the course structures in practice and therefore different fields of study as well as different degree programmes decided to follow different levels, methods and practices to organize their studies within these limits.

Simultaneously many degree programmes in the field of engineering had to be merged based on the new degree programme structure defined by the Finnish Ministry of Education. For example the two old programmes of Automation Technology and Electrical Engineering with two separate student intakes were merged to one single programme of Electrical Engineering and Automation Technology with one single intake and the students select their major in either Electrical Power Engineering or Electronics or Automation Technology after their first year of study. The new degree programme together with the parallel English language degree programme in Electronics decided to follow the course integration and collaborative pedagogy principles very deeply by integrating the old 3 ECTS courses to larger course entities of 15 credits. The same method of deep integration was followed for example in the Information Technology programmes when most other engineering programmes decided to organize their studies in 5 ECTS packages with only minor level of course integration. All the studies in the degree programme of Electrical Engineering and Automation Technology (as well as the DP in Electronics) were to follow the principles of countinuous assessment in all the courses. In practice this means that the end exams are omitted as a means of assessment and all the courses are assessed by smaller weekly tasks and frequent smaller exam-like sessions during the regular hours (definitely together with the assessment of projects, lab exercises etc.). In comparison the first year courses in the IT programmes are based on problem or project based learning.

It has been already shown [3] (based on the analysis and results of the first academic year 2014-15) that all the degree programmes that did the course integration in the deepest level did reach much better student progression results and a lower drop-out rate compared to those engineering degree programmes that did the integration at a significantly lower level. That was one of the aims of the reform since the student progression results are a key funding factor of the universities of applied sciences in

Finland together with the number of graduates (which is finally expected to improve as well due to the lower drop-out and better student progression). These results were achieved by reaching at least the same learning outcomes as before since the new model makes it necessary for the students to study continuously throughout the courses instead of mainly focusing on the end exams. There are some drawbacks however: it is more difficult for the students to do part-time work contracts as well as to speed up their studies.

2 MODULAR CURRICULUM AND COURSE INTEGRATION

The studies of the first year of study in the degree programme of Electronics as well as the one in Electrical Engineering and Automation Technology consist of many fundamental topics such as mathematics, physics, communication, programming basics, circuit theory as well as the fundamentals of electrical power engineering, electronics and automation. These topics were arranged as larger course packages, but the actual integration of the topics depended much on the individual teachers involved. Much integration was done through common projects but in some cases the actual integration and collaborative work between teachers was not quite as expected. In any case the results were significantly improved through the common continuous assessment principles and simply by the fact that the student were obliged to reach all the learning outcomes of the topics in due time.

Figure 1 shows the structure of the modular curriculum in these degree programmes. The contents of the first academic year are exactly the same for all the students in these programmes the only difference being that the tuition in the degree programme in Electronics is in English (instead of Finnish). The studies of the first year consist of four consecutive courses (duration 8-10 weeks each) of 15 ECTS and these courses include contents of the fundamental topics as well as some academic contents. The students select their major after the first year of study. They have three options to choose from: 1) Electronics, 2) Electrical Power Engineering and 3) Automation Technology. All the students that select Electronics as their major will complete all the remaining studies in English. There are no limitations in the selection, i.e. all the students having completed all the four courses of year one may freely select the major.

After the first selection process we had approximately 60 second year students in each of the majors in the beginning of the autumn term of 2015. Two consecutive study modules (equal to one course of 15 ECTS each) were arranged for each of these three groups in September - December 2015 and those were followed by two modules in the spring term of 2016. The second year student survey was completed during the second module/course of the autumn term of 2015 thus the students had completed already altogether five courses/modules based on the new methodology and they were in the middle of completing the sixth one.

The contents of the third and fourth academic years consist of two modules/courses of their major, two completely optional modules (most students most probably selecting modules closely related to their major however), two ten week internship periods, the third year innovation project (in groups of 4-6 students from different disciplines) and finally their final year project (bachelor thesis; individual). All these studies are to be arranged again in 15 ECTS course packages and the students may plan their studies quite freely depending on their module selections and timing of their internship periods. Currently the courses/modules of the third academic year are in the planning phase and the first courses will be arranged in the autumn term of 2016.

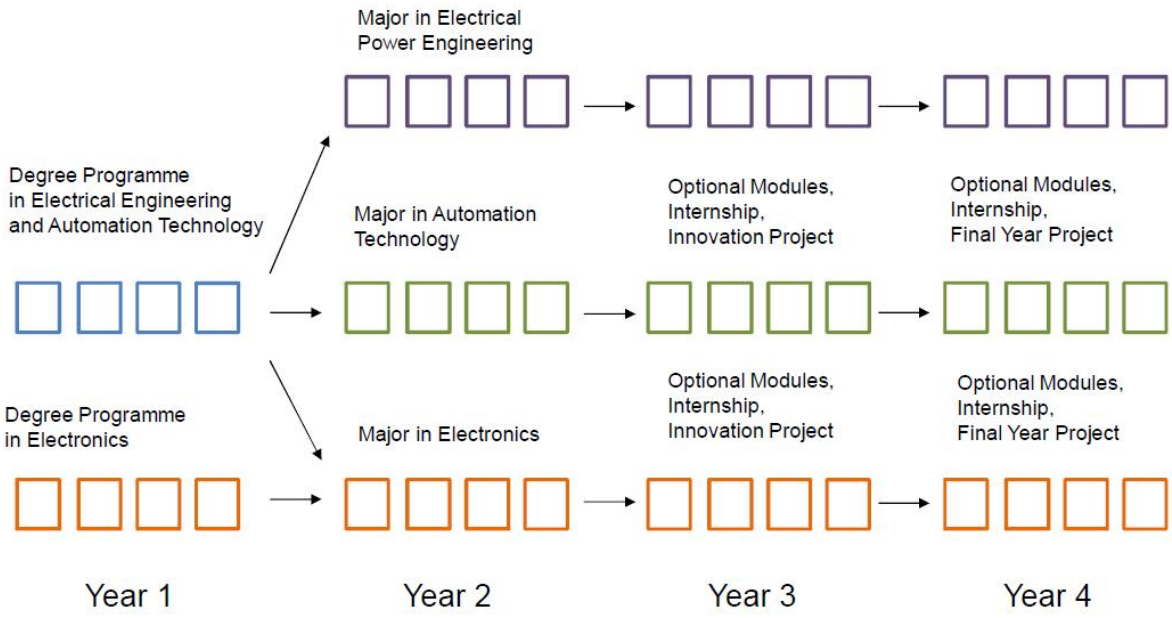


Fig. 1. The modular curriculum of the degree programmes of the department of Electrical Engineering and Automation Technology [2]

Each of the 15 ECTS courses/modules are taught by a number of professors (typically 3-5) who design the course contents and select appropriate assessment methods to meet the assessment criteria of the learning outcomes. All the courses of the first academic year as well as most of the courses of the second include learning outcomes of the fundamental studies (mathematics, physics and communications/languages) besides the professional contents. It is encouraged to arrange common project type activities to integrate the fundamental studies to the professional ones. The assessment of the course has to be based on continuous assessments and no heavy end exams are allowed. During the first realizations of the courses the professors have relatively free hands to arrange the course package and the aim is to include more and more project type activities after the first round based on the experiences and best practices from different professor groups arranging the integrated courses. An example of one such a course is given in the next chapter.

3 EXAMPLE: COURSE IN TELECOMMUNICATIONS AND RADIO TECHNOLOGY

The 15 credit course in Telecommunications and Radio Technology was organized for the first time in the second half of the spring term in 2016. This course is the fourth professional module during the second academic year in the major in Electronics. Two thirds of the students are students of the English degree programme in Electronics when one third are students of the Finnish programme in Electrical Engineering and Automation Technology having their major in Electronics.

Altogether four professors were involved in the actual teaching process. The course description and the learning outcomes included as well subjects related to mathematics and physics besides the actual professional contents. The learning outcomes were first divided under five major subjects: signals and integral transforms (mathematics), electromagnetic theory (physics), electromagnetic compatibility, wireless communications and fundamentals of radio engineering. Since mathematics and physics were included in the contents, the professors decided to use the

assessment method widely used in the first year courses in the degree programme focusing on mathematics and physics as well. This assessment method (picked out as one of the best practices of the previous year) includes a large number of compulsory weekly assignments for the students as well as smaller exams throughout the course finally used to give the final grade to the students. No end exam(s) were organized.

The duration of the course was eight weeks and the students had to complete one assignment per week in each of the five subjects. The total number of such assignments was thus 40. All the assignments were given to the students through the university intranet (the course workspace) and they had to return the assignments there as well. Some of the assignments were traditional mathematical problems, some were laboratory assignments, projects, CAD design exercises, etc. Some of the assignments were relatively tedious and some were quite straightforward problems, but the aim was not to give the students too difficult (mathematically) problems, since they had to complete successfully 34 out of the 40 assignments to pass the large course and finally these assignments do not have any effect on the final grade. The grades were finally defined by the smaller exams throughout the course. At least 4 exams were organized in each of the five subjects; i.e. altogether more than 20 exams were organized (typically multiple exams each week). These exams were more difficult than the weekly assignments, since the purpose was to verify that all the learning outcomes are reached and to define the final grade. Typically the topics of the exams were already rehearsed in the weekly assignments and finally the performance verified in the exam.

The total number of the students in the course was 69 and only four of the students did fail the course. Some professors did arrange smaller exams very much equal to the problems in the end exams of the previous year just to compare the degree of learning between the methodologies and it seems to be evident that the learning is more efficient in the system based on continuous assessment compared to the previous assessment methods.

It has to be however highlighted that in this particular course the amount of project work and other activities linking and integrating the subjects together was smaller compared to most new courses in the programme (typical to the courses including mathematics and physics), but the integration will be more and more deeply focused in the future implementations of this course as well.

4 STUDENT FEEDBACK

The student progression rates of the first two modules of the second year of study are analyzed and the progression results are even improved (compared to the first year). This was expected, since most dropouts usually take place during the first year somewhat worsening the first year results when the students in the professional second year courses have already completed all their studies of the first year and are not lacking any fundamental knowledge of the first year.

A comprehensive student feedback survey was completed for all the students of the university in December 2016 and the results were available in late February 2016. This survey is of utmost importance this year, since now it’s done for the first time with students studying based on the new curricula / pedagogy. The students had to evaluate altogether 22 statements with grades from 1 to 5. The graphs below show the

difference of these mean grades between years 2015 (new curricula) and 2014 (old curricula). Our university is divided to altogether 17 departments including 7 departments in the field of engineering. The graphs do show the results of all the seven engineering departments. One department may run multiple degree programmes and these results show the average value of the programmes within one department. Comparing the departments one must remember than on the department of Electrical Engineering and Automation Technology (EE in the graphs) and the department of Information Technology (IT) did integrate the courses of 15 ECTS, when all the other departments did the integration in a lower level. These two departments (EE and IT) are shown in the first two graph columns and the remaining 5 may not be identified.

One of the key motivations in the reform was to improve the study progression of the students, since it is as well one of the major funding factors of the universities of applied sciences. This may be analyzed through one of the statements of the survey: *(statement 1.14.) The curriculum structure is such that it makes it possible to complete all the required 60 ECTS per year*. The student feedback differences between years 2014 and 2015 for all engineering departments regarding that statement are shown in Figure 2. It may be clearly seen that the curriculum reform has been really successful with that respect in all the engineering programmes. However significant improvement in the student progression in this study group has been taken place only in the programmes integrating the courses to 15 credits (EE and IT). Since the results shown in Figure 2 show even more improvement in other departments, there has to be some other reasons as well.

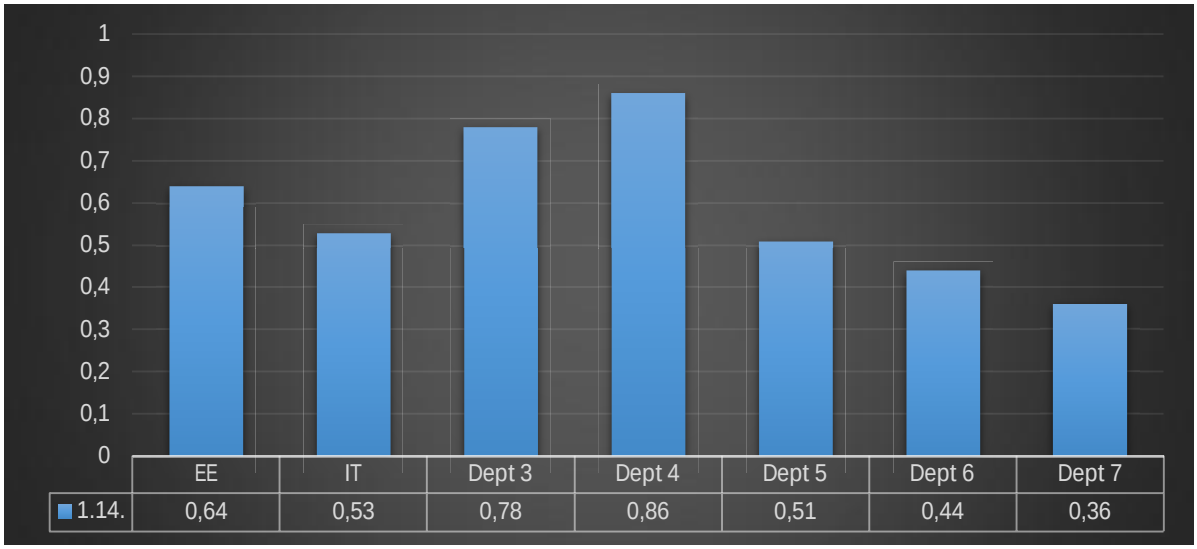


Fig. 2. Second year student survey difference (years 2014 and 2015) of all engineering programmes in the university for statement: *The curriculum structure is such that it makes it possible to complete all the required 60 ECTS per year*.

Even though one of the main goals of the renewal was to improve the student satisfaction, it was still expected that in a reform of this scale the student satisfaction results might however decrease, since it definitely takes some time to motivate and mentor the teaching staff and apply the changes in deeper level. This may be seen in Figure 3, which shows the averages of all the statements for all the seven engineering departments. The average has been improved only in the departments with deeper integration of courses even though all the departments show improvement in the

statement focusing only on the curricular structure (Fig 1.). Thus there must be other factors in the improvement of these two departments.

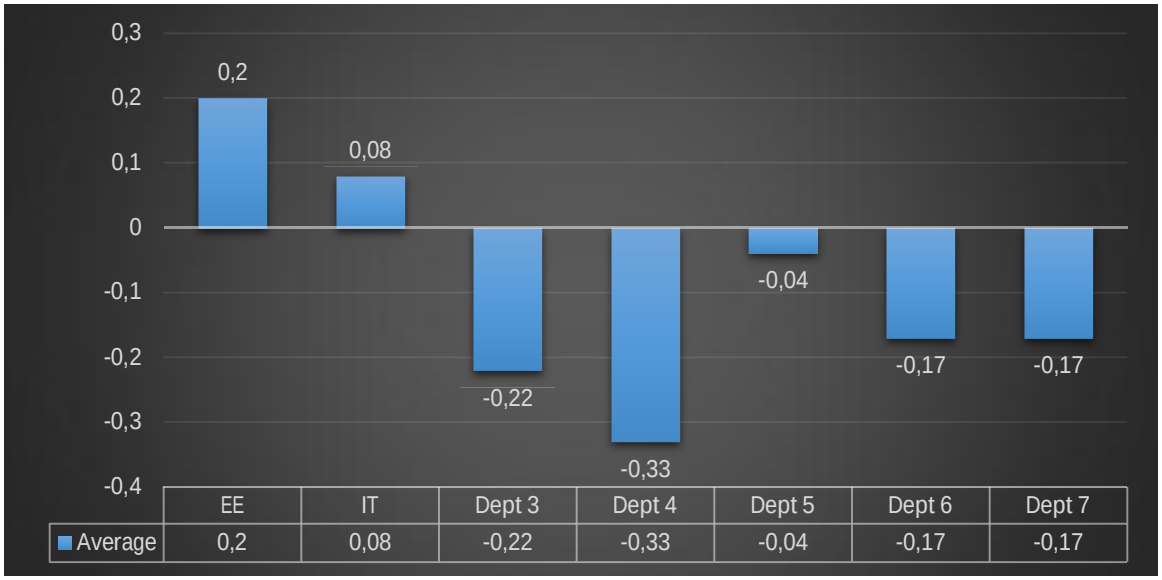


Fig. 3. The total improvement (average of all statements) in the second year student survey difference (years 2014 and 2015) of all engineering programmes in the university.

Figures 4 and 5 show the student feedback result differences of some selected statements in all the engineering degree programmes. The same tendency goes through all the omitted statements as well (most omitted statements are somewhat too general, irrelevant to pedagogical matters or somewhat overlapping with the statements presented here).

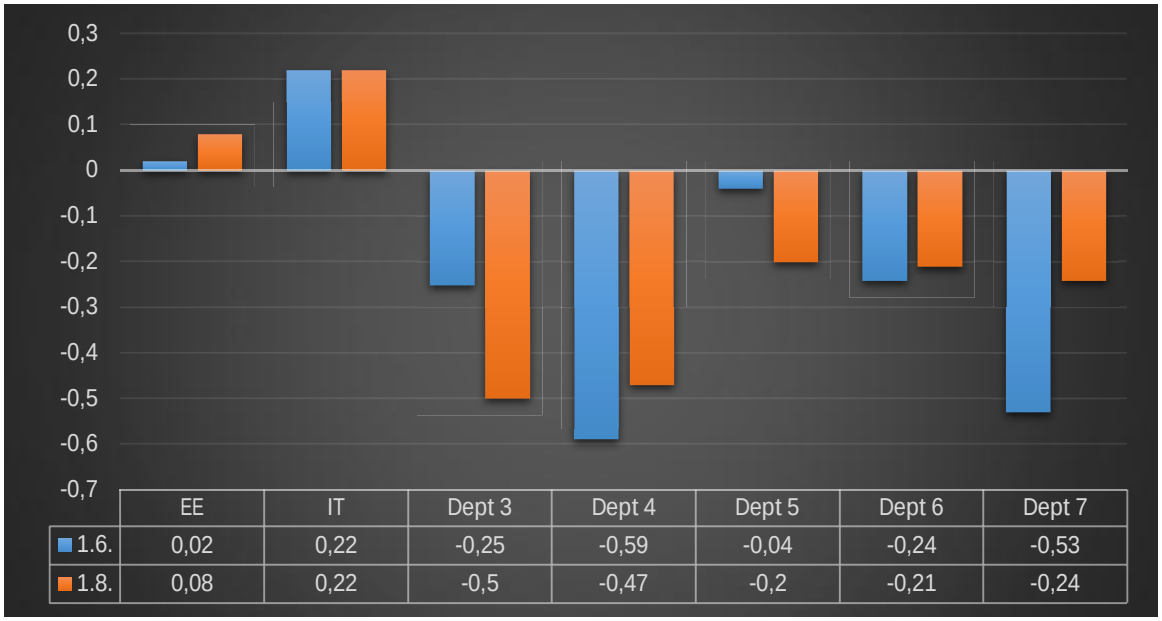
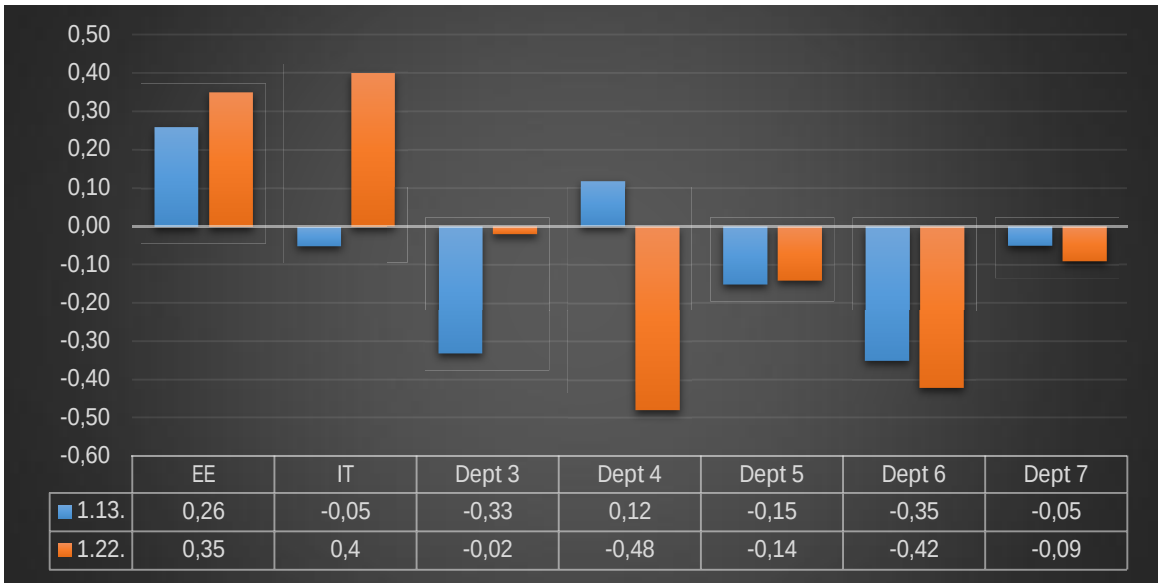


Fig. 4. Second year student survey difference (years 2014 and 2015) of all engineering programmes in the university for statements: *Different courses in the curriculum form a clear and understandable structure* (1.6.) and *the pedagogical methods in the degree programme support my learning* (1.8.)



	EE	IT	Dept 3	Dept 4	Dept 5	Dept 6	Dept 7
1.13.	0,26	-0,05	-0,33	0,12	-0,15	-0,35	-0,05
1.22.	0,35	0,4	-0,02	-0,48	-0,14	-0,42	-0,09

Fig. 5. Second year student survey difference (years 2014 and 2015) of all engineering programmes in the university for statements: *I have achieved the specified learning outcomes* (1.13.) and *I am satisfied with the tutoring and study guidance processes of the degree programme* (1.22.)

When the two departments did the reform more profoundly, very much effort had to be focused on the whole reform and they had to solve other important questions besides the actual course structure. These matters include all the problems related to assessment, student guidance and pedagogical methods. They have a significant effect as well on the study progression as well as to student satisfaction. The programmes in the department of Electrical Engineering and Automation Technology had to rearrange as well many student guidance related processes and definitely put much focus on the assessment of the learning outcomes and it seems that the assessment methods and study guidance do have a stronger impact on the student progression (statements 1.8., 1.13. and 1.22.) than the course structure itself (statements 1.6. and 1.14).

5 CONCLUSIONS

In the total curriculum renewal process in Helsinki Metropolia University of Applied Sciences some engineering departments made significantly more profound changes than others focusing more deeply in collaborative pedagogy, integration of studies, modular curriculum, continuous assessment and/or project based teaching and learning. It has been already shown that the study progression improvement in these programmes has been significantly better. Based on the first profound student survey results it seems evident that the reason for this improvement is not just the improvement of the course structure, but even more the changes in the assessment methods, study guidance procedures and other pedagogical changes that were necessary in a reform of this scale. The more profound curricular reform you make the more you have to focus on other relevant pedagogical issues besides the course structure and it seems to be these improvements that pay you back.

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