Using Digital Homework Assignments,  
the case of Performance Engineering

Stefaan S.A. Ghijs MSc  
Delft University of Technology  
Delft, South-Holland, the Netherlands  
s.s.a.ghijs@tudelft.nl

Aldert Kamp MSc  
Delft University of Technology  
Delft, South-Holland, the Netherlands  
a.kamp@tudelft.nl

Prof. dr. Sicco C. Santema PhD, MSc, LL.M  
Delft University of Technology  
Delft, South-Holland, the Netherlands  
s.c.santema@tudelft.nl

Abstract:  
The Technical University Delft has been using E-Learning tools for 10 years. The school of Aerospace Engineering is now experimenting in a high-level E-Learning project. In this project the school tries to stimulate self-study of the students. A pilot was set up, aiming at an increase of the success rate. The pilot envisaged digital homework assignments within a propulsion engineering course, using multimedia, digital assignments as a means of increased interactivity. Based on feedback from the lecturers and the students it was concluded that the digital assignments improved the education and the success rate. However, some actions on the feedback and grading tools are needed. Also lessons have been learned on future implementation of E-Tools in the course.

Introduction

The Technical University Delft (TUD) this year (2008) celebrates its 10-th anniversary of the first broadcast of lectures as a means of using E-Learning tools in the educational system. Since then many initiatives have led to a increased usage of E-Learning tools. In the beginning TUD used WEBCT, now Blackboard is the single Learning environment, very well used throughout the whole university. First the university aimed at assisting the lecturer in his tasks of teaching (Santema, Genang 2001), then the university shifted more and more towards learner led learning (Veen et all, 2001). This also fits in the increasingly changing usage of E-Tools in normal life as well. Veen et all (2004) are even talking about the homo zappiens in learning environments.

Last years projects are aiming at the students themselves. Through using E-Learning tools the university is now aiming at the learning process, habits and abilities of the students. Within this new set of projects, the school of Aerospace Engineering has set up several pilots. This paper reports on one of these pilots, the usage of digital homework assignments. The goal of this pilot was to improve the orientation of the students towards the content of the course, especially during the moments of self study, which apparently accounted for almost 50 % of their total study time.

This paper is set up as follows. First the background of the pilot is given, including background and motivation of the pilot. In the next paragraph the goals of the pilot are illuminated, including the choice for one specific course. After that the set up of the pilot is described, followed by the results of the pilot. The paper concludes with conclusions and recommendations.
Background of the pilot

The educational program of the Bachelor (BSc) Aerospace Engineering (AE) of the school of Aerospace Engineering (AE) at the Technical University of Delft (TUD) consists of several elements, such as lectures, tutorials, laboratory experiments, projects, exams and self study. During a time studies, it appeared that the distribution of the time invested in the elements was quite diverse. Self study appeared to be even as high as 48 % and 46 % in the first two years. Table one shows the distribution of the time distribution over the elements.

<table>
<thead>
<tr>
<th></th>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>24%</td>
<td>26%</td>
<td>15%</td>
</tr>
<tr>
<td>Tutorials</td>
<td>12%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>Laboratory Experience</td>
<td>6%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>Projects</td>
<td>7%</td>
<td>17%</td>
<td>37%</td>
</tr>
<tr>
<td>Exams</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Self Study</strong></td>
<td><strong>48%</strong></td>
<td><strong>46%</strong></td>
<td><strong>27%</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 1: Time distribution of BSc AE Educational Program

Not only the lectures and exams, mentioned in the table, but also tutorials, laboratory experience courses, projects and exams are filled in with focused, typical course and teacher dependant educational and didactic materials and means. On the contrary to this, the self-study part needed to be filled in by the AE student. It also appeared that this self study lacked influence by educators, and had a low and un-organized educational and didactic platform. This low organized self-study part demanded for improvement, certainly when this part takes up almost half of the total student educational timeframe in the first 2 years of the BSc phase (see table 1).

On the other hand the study-effectivity and the student progression rate in the BSc phase projects very low and alarming figures (Table 2).

<table>
<thead>
<tr>
<th>Time needed</th>
<th>1st Year</th>
<th>Time needed</th>
<th>BSc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>25%</td>
<td>3 Year</td>
<td>5%-9%</td>
</tr>
<tr>
<td>2 Year</td>
<td>35%-40%</td>
<td>4 Year</td>
<td>16%</td>
</tr>
<tr>
<td>&gt; 2 Year</td>
<td>50%-60%</td>
<td>5 year</td>
<td>32%</td>
</tr>
</tbody>
</table>

Table 2: Study Effectivity BSc Phase AE Between 2000 and 2002

Based on primary research on the student progression rate of the educational program within the master phase a study-effectivity of 63% is generated (The success rate is low and the average time needed exceeds 2 years). This low progression rate was awarded with mark 6 by ABET/VSNU in 2001, making the effectivity and progression rate a very important weakness for the AE education program (Reith B., 2004 & Gerritsma M., 2006).

Therefore the pilot was set up, using home work assignments within the university’s Electronic Learning Environment (ELE) “Blackboard”. While rolling out the pilot, the authors envisaged that current use of Blackboard was not optimal by the AE teachers. Nevertheless the system was considered to be a perfect basis. Reasons for the non-utilization are to be found within: the ignorance of the platform possibilities by the teaching staff and the forecasted additional operations and preparation time. So teacher oriented motivational activities where included in the pilot as well.

The pilot aims at using home work assignments in order to improve the progression rate of the AE students. The course ‘Performance Engineering’ was used as pilot course, as within this course the teacher was not using

---

1 Interview Director of Education, A. Kamp, 2006
2 Interview Education Director A. Kamp, 2006
Blackboard at all and there was no steering in the self study part. The authors thought that the room for improvements in this course was therefore the largest.

The goals of the pilot

In the pilot an Electronic and Multimedia (E&M) platform is used. The set-up and use of this platform supports the non-organized and only partly existing educative and didactic concept within the AE educative self-study part and is complementary to existing didactic and educational modes.

The goals of the pilot are:

1. an increased study effectivity and student progression rate;
2. improve student self-study;
3. better and efficient didactics for the educational staff of AE;
4. knowledge consolidation;
5. study improvement and innovation

Sensibilisation and motivation of the future stakeholders perform as sub-criteria for a successful mission accomplishment. In the end these goals should contribute to the students gaining most of the BSc competencies in shorter timeframes. The competences are competent in the domain of AE sciences, competent in research, competent in design, able to follow a scientific approach, able to apply basic intellectual skills, competent in cooperating and communicating and the consideration of the temporal and societal context.

The goal of the pilot also aims at reducing the current weaknesses of the AE curriculum (Reith B., 2004 & Gerritsma M., 2006): the low study effectivity, the low intensive use of electronic educative means and media (despite a relative high use of the Blackboard portal at the faculty of AE, the low on time grading of assessments (Focus on Education) and the educative quality assurance, to be improved by aimed E-supervision improvements.

The E&M platform also adapts to the AE improvement and changing issues as the intensification student’s self-study, the BSc and MSc student supervision and the didactic education of the teaching staff (e.g. online video recording classes are used as a reference for didactic improvements). On the other hand they may serve as a “fun” generator and factor, since they create additional time to give other applied course classes in the scheduled time in place of the theoretical classes. The theoretical classes are to be followed online.

The E&M platform is set up by using an intensified problem analysis generated through a breakdown model. The problem analysis resulted in the sub problems. Coupling sub problems with E&M means for solving measures generates pilots for future use of E&M platforms within the AE curriculum. This resulted in five pilots within five distinct courses. The courses were chosen based on their integral place within the AE curriculum, the field of expertise, the subject form (e.g. theory or practical minded), the E-adoption of the responsible lecturer, the amount of students participating in the course and whether problems/challenges within the respective course emerged. The teachers are motivated to use the E&M platform through using their knowledge in setting up the homework assignments. They were assisted by the Technology-in-Learning Team (TILT). This teams consists of students and instructors and it acts as an E-Learning service point within the faculty. Furthermore, teachers were informed through a sensibilization campaign including lunch seminars, workshops, professor meetings and teacher meetings. Through continuous sensitization and evaluation of all the stakeholders the implementation of the E&M platform was succesful.

The first year of the BSc study AE is characterized by its diverse course package, lectured to the first year students. They get introduced in the basics of AE. Within this course package the course the teachers of the course Performance Engineering proposed to be one of the pilots for E-learning purposes. The academic year 2005-2006 showed to have low rates of success (including resits, lower than 50%). This low rate was partly explained (by students) because of time consumption of other courses at the same time and the lack of homework in which the content of the course could have been practiced. The responsible teacher of the Performance Engineering course added that the examination was potentially too difficult as well. It integrated two totally different subjects and the demand was high towards the amount of knowledge to be absorbed by the students at once. This also could (or should !) have been exercised during homework.
350 first year students were participating within the course in the academic year 2006-2007. 108 of them participated with the resit examination and had the chance in using this new innovative didactic experiment. The reason for piloting in the resit assessment is solely project time dependant. The course was already started and the development time of the digital assessment tool was projected to end 3 weeks before the resit examination date. Next to that the low success rate of the previous academic year ultimately made this course a very good candidate for the home work pilot within the more generic E-learning innovation AE project.

**The set up of the course Performance Engineering**

Before starting to implement an E-Learning method for pilot purposes within the course Performance Engineering, the faculty’s E-Learning project coordinator and a didactic expert from the central education department of the university followed the course. The inherent purpose existed out of didactic research towards the e-learning tool implementation.

The course was lectured in English and Dutch, with two lecturers in a standard amphitheater. One lecturer is a professor and responsible for the course, the other lecturer is a young doctor, which is currently taking over the formal responsibility of the professor because his emergent retirement. After the lecture, the findings were confronted towards the lecturers in a closed and separate session.

**Lecture**

The Performance Engineering course consists of four parts. First a brief introduction is given, thereafter aircraft engines are explained and models are introduced towards engine calculations; this in order to understand the physics within an engine. The third part is the core of the lecture series, namely Performance Engineering ending with the subject of application of aircraft navigation instruments. The core is characterized by its analytical build-up content and is placed perfectly within the total AE education curriculum. The fourth part aims at the usage of the plane.

The didactic material existed out of two related books, one reader and all the lecture sheets. They are made available as PowerPoint or Word documents throughout the universities electronic learning environment (ELE) Blackboard, within the performance course’s dedicated map. Also non-obligatory homework assignments, as preparation for the final examination, were provided. The lecture sheets form a good summary of the course. The teachers therefore regard this to be the most important didactic material within the course.

The lectures were focused on the reproduction of the lecture sheets by the teacher, who used a traditional blackboard to elaborate on subjects. The lecturer had a traditional, one-way (lecturer versus students) tutoring method, without interaction. Nevertheless the blackboard notes, overall existing out of formula deductions, showed a great deal of structure; the lecturer filled the blackboard with notes in a high speed, while standing backwards towards the “participating” classroom. This stimulated distracted and not content focused students having the intention to reproduce all the notes because of there aforementioned importance. Students started chatting when they lost a part of the blackboard, as it was erased by the fast writing teacher. There was no ‘learner led learning’ (Santema, Genang, 2001) applied.

The second part of the lecture presentation is characterized by real, tangible airline and air flight examples making the course content attractive to understand.

The course had not been changed for 10 years,. This was clear by the use of old, sometimes inaccurate, overhead sheets; regardless the current non-obligatory homework assignments. These were non obligatory and totally free to complete by the students and had no stimulating character.

As half of the lectures were lectured by the young doctor, the future course responsible, some innovations and changes were to be seen in his way of lecturing. A switch from overhead sheets towards PowerPoint sheets and an increased balance between interactivity and using the traditional blackboard. He remarks the difficulties incorporated with using a blackboard in a technological and analytical course, towards active education. Incorporating the whole classroom with little active assignments and questions seemed to be a difficult task with the course specifics and a very big participating student group. The big classroom also incorporated the consequence that some questions had the tendency not to be heard by the whole classroom. Obviously they need to be repeated by the lecturer in the front. Nonetheless the influence of the professor was apparent. The tangibility supported by real stories, in the second part of the lecture, was also here a positive continuous factor.
Interview and E-Learning Trade Off

The pilot started with an interview with the lecturers. The interview had the characteristic of being confronting. The choice of this course as a pilot initially created an intrusion intention on the professionalism of the responsible professor. This was projected on the multitude of reactions towards the didactic expert and the E-Learning coordinator. It was the professor’s intention to keep the classroom totally silent when students were reproducing his blackboard notes. The professor claimed that in that way, students get to know the course subjects better; this in stead of only paying attention and taking additional notes. The latter also makes it possible that deductions can slip the mind of the participating students. In this light it should also be said that all the sheets are published on the ELE before the beginning of the course. Moments of rest for content processing was rewarded to the students as the teachers created their recurrent blackboard notes review or when they cleaned the blackboard.

The use of a tablet or interactive whiteboard (e.g. tablet or “SmartBoard”) could be a good solution; it saves the dynamic part of writing course ware on a digital blackboard. This mean also gives the opportunity to save these notes which ultimately can be send to the students. They therefore don’t have to hesitate to lose important notes; they can pay attention and write notes when needed.

Justifying the non-interactivity in the lecture the teachers use the uncomfortably feeling of students in answering questions or proposing themselves in answering. Based on the fact that the participating student group within this large class is intermediated young (ca. 18 years old), inexperienced (1st year BSc students), an electronic voting system could have an added value towards the students’ uncomfortably feeling because of the anonymous voting and a structured incorporation of every student within the voting; eventually creating active education. The voting can be used for theory application or rehearsal questions. Results of the voting are ultimately to be seen. On the latter the teaching lecturer can create immediate conclusions towards the purposed student content processing in his course.

With regard to homework assignments, the lecturer scheduled real application examples in the second hour of the lecture. The reason given is that students are getting less sharp and pay less attention towards the end of the lecture. Different and variation in didactic styles creates focus. In the light of creating even better and innovative education in this particular part of the lecture, it was proposed to use different means in presenting these tangible stories. Means like little movies, simulation projections, etc.

As mentioned the course used to have obligatory homework assignments. Changes in the AE BSc program did not leave any opening towards continuation in this form. The assignments were originally set-up towards self-study stimulation and therefore only graded based on handing in. Currently they don’t project any active fundation. It was in the professor’s wish to check whether E-Learning techniques could be used complementary to these assignments, in that way making them stimulating. Old assignments were translated into digital assessments in the ELE, including automatic grading and feedback. They were set-up with different solution set-up forms.

Homework assignment implementation

Taking into account all the drivers described above and the special demand towards E-Learning actions in favor of the homework assignments, it was chosen to make these digital and support the teacher in this process. Initially it was chosen to implement the digital assessment within the education purposing to make it obligatory for students wanting to participate with the resit examination. In this way the self-study awareness of students should be improved and drive the students for succeeding the first examination, with a minimal seizure of time by the lecturer. This creates an efficiency gain in grading examinations. Unfortunately this implementation was not possible anymore as the course contents for the academic year 2006-2007 were fixed already. Alternatively the assessment was eventually provided on a free basis. The initial total time investment existed out of developing the digital assessment as grading and feedback of the assessment is done automatically.

The digital assessment was set-up within the test/assessment tool of the universities ELE Blackboard and divided in five distinct parts (series of questions) in order to generate clear subject distinction. The distinctive subjects not related towards the mentioned course subjects are seen as requisite knowledge. The first three parts were projecting obligatory course ware.

The old homework assignments were digitalized, with the help of a student assistant familiar with the course subjects in cooperation with the university’s ELE support for the more technical side. Afterwards the responsible

4 Mail adres: blackboard-support@tudelft.nl
teachers evaluated the digital assignments. To make the assignments stimulating they were set-up in a form in which different questions demanded different solution forms like: multiple choice, correct answers within a margin, hitting the right place within a picture, etc. The ELE also supports the use of formulas as a grading generator, generating different versions towards the basic question by the use variable margins. In this way every digital assessment participant will have to answer the same question but with different variables, promoting independent assessment solving. Making the assessment attractive with pictures and small movies, an increase in stimulation towards self-study is generated.

The five series of questions were organized such that students are able to solve questions of series more than one time after finishing and resetting the series. Moving to the next question in a series prevented changes to the previous answer. Restarting a series of questions, had the consequence that some questions based on a formula generator will change their used variables and therefore demand another numerical answer. Also the grades history for the respective student is erased when restarting. The latter activity was programmed on purpose as the digital assignments had not the objective to assess the students.

Students solved all the questions, by saving and submitting. Finishing a series of questions created a feedback on the results with additional references in case of faulty answers. All the students attempt answers can be seen in the ELE, BlackBoard by going to the Control Panel of the course and then hitting Gradebook Views > View Grades by Item > Assessment Attempt Details. A screen follows with a projection of the attempt statistics for the respective item or series of questions. Conclusions can be drawn to subjects not well understood by the students. It gives an insight for a changed focus on the subject within the course or for rehearsal demand, whether a subject seemed to have a low grade and less understood.

The results of the pilot

The results of the pilot are measured in different ways. First the students perspectives have been measured through a questionnaire. Next to that, the point of view of the teachers is described. Furthermore, authors take a look at the quantitative results.

Student Qualitative Evaluation

After the resit examination students were asked to fill out an evaluation form. The form included questions about the quality of the digital assessment and the use of the assignments in the students’ self-study program towards the exam. Overall the digital assessment was graded positive. Nonetheless the ELE provided not enough or bad automatic feedback in case of wrong answers. The programmed feedback included references to parts of the texts on the ELE which could help to solve the question in a second chance.

Table 3 reflects the answers on two questions of a survey, completed by 60 respondents. These two chosen questions show noteworthy feedback. A large group, 61% of the respondents, used the assessment to check whether they understand the course content. 72 % of the respondents tried assignments more then once, concluding that a learning stimulation was emergent. In table 3 the results are shown in greater detail.

<table>
<thead>
<tr>
<th></th>
<th>#</th>
<th>Blanco</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>never</th>
</tr>
</thead>
<tbody>
<tr>
<td>On average, how often did you make each assignment? (++: 4 or more, +: 3, 0: 2, -: 1, --: never)</td>
<td>60</td>
<td>6</td>
<td>17</td>
<td>22</td>
<td>33</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>I have prepared parts of the exam before making the assignments.</td>
<td>60</td>
<td>14</td>
<td>61</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Digital Assessment Student Evaluation
Figure 1 indicates a decrease in completing the series of assignments towards the last two series of questions. The 4th and 5th series show non-conformant results versus the other series because these parts were not included in the obligatory course content. The decrease in fulfilling the assignments is explained by the respondents that they lost the stimulation effect of not having enough time left (to work on the assignments). The increase of the number of students that solved all assignments (light blue in figure 1) described that they were extra stimulated as the exams came up soon of liked the avionics subject better than the others. It should be noted by the way, that completing an assignment did not necessarily mean that the solutions were correct.

![Figure 1: number of assignments solved](image)

Concluding the evaluation by the students, the home work assignments are seen to be more fun to accomplish and are accessed efficiently. They are internet based and they can be made where students want and when students want. This generates a positive evaluation. Otherwise students rather want to see the result of an attempt immediately after the submitting the answer, instead of the series of questions. Next to the demand for a feedback quality increase, the answer input mode needs to be straight forward.

**Teacher Qualitative Evaluation**

Overall the lecturers were positive about the digital home work assignments, nonetheless they acknowledge that a review towards the implementation is of the utmost importance. The digital home work assignment project had a good quality in content and form. It is also proven that a knowledgeable student assistant can reform perfectly written assessments towards a digital form; as the questions slightly deviate from the original ones as to comply towards the automatic grading and feedback algorithms within the testing tool of the ELE. Nonetheless the assignments are not 100% representative for the exam; in the future a sixth series of questions based on old examinations will be introduced.

The ELE proposed no real difficulties towards generating very specific questions, although automatic substantiated answers checking is something next year will be evaluated towards implementing within a digital question. Currently the feedback generator only checks unique logical answers.

Also the lecturers agreed that references towards ELE documents should be adhered towards recommended literature references, hints and short summaries. This also accounts for the grading module to be switched towards immediate grading per assignment. The form on the other hand was proposing enough multimedia examples towards stimulation.

The opinion of the lecturers projects the difficulty in making conclusions on the influence of the digital assessment towards the success rate, because of multiple factors play a role in the grading process. Next to that the zero reference possibilities are narrowed towards students which didn’t do the digital assignments, but participated in the exam. This can be explained by the resit examination, in which this e-learning pilot was performed, projected a lower assessment level compared to the regular examination (despite of the low success rate, see table 5). On the other hand a lower amount of students participated in the resit exam compared to the regular one. Even a reference towards last year’s exam was impossible, as the course assessment content changed this year.

Concluding the lecturers confirms that next year, the series of assignments will be used again in the course. It will be implemented as a ticket for the resit examination and all assignments will be posted on the ELE form the start of the course. This purposes stimulation in making the assignments and creates study flexibility. The students will also be
updated by this digital possibility offered to them, by a small and real-time ELE introduction in the first lecture, next academic year.

**Quantitative Evaluation**

For all assignments, the number of hits (students taking the assignment) were tracked by the tracking function of the ELE. The hits were counted on a per day basis, starting from the day the assignments were posted.

![Figure 2: Number of hits of home work assignments 1 to 5, on a daily basis](image)

Figure 2 shows the hits after the day the home work assignments were posted on the ELE. The measurement is projected from the day of the posting of the respective home work assignment till the date of the examination. The primary three series show the same trend: the day of posting shows a big increase in hits compared to the next days, while the day before the examination a peak occurs. Assignments 4 and 5 (please note that the axis of the figures differ) have circa half the amount of the hits compared to the first three. The reason was that these series of home work assignments were non-obligatory course ware. The decreasing usage trend is also remarked within the amount of users (see table 4). The amount of users (users can make multiple hits) was counted till the day of examination. The high amount of users for the first three series, compared to the amount of exam participations, namely 108, is explained by the high subscription amount of students for the resit examination, 212 subscriptions. This results in 78% of the exam subscribers which looked at the respective series.

<table>
<thead>
<tr>
<th>Series</th>
<th>Amount of users</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>166</td>
</tr>
<tr>
<td>2</td>
<td>166</td>
</tr>
<tr>
<td>3</td>
<td>148</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

**Table 4: Number of students that took the digital home work assignments**

Next to the above authors compared and studied the success rates of the students that did take the home work assignments and the ones that did not (see table 5). Not knowing the background of the individual students, this statistic show a disappointing result. The percentage that failed the exam of the students that took the home work assignments through ELE is higher than the percentage that did not take the assignments through ELE.

And on the other hand, table 5 shows a decrease of 4% for the good to successful results (grade 6 to 10 and higher). The reader is invited to take these results under serious consideration due to the mentioned highly diverse dependency drivers on success and the fact that the results of the home work assignments in ELE are not incorporated. They were not incorporated as they projected to be incomplete for most of the participants and showed intermediate low grades. Taking also into account that the assignments were not obligatory to the students, no comparison was made. The other reasons are mentioned in the previous paragraph.

Obviously, these conclusions have to be investigated into much more detail before conclusions can be drawn.
### Conclusions and Recommendations

Concluding a good start in the use of digital home work assignments in an AE course within an ELE is to be remarked. One can say that self study was stimulated, because of the high amount of participating students in the ELE assignments series, the amount of subscriptions for the exam and the non obligatory tag. Whether there is an increase in success rate is to be discussed, too many drivers play a part. The effect may be even bigger as the assignments are imbedded in the course; annotating the importance towards the success of the use of digital assignments and the recommendation in using the assignments as a ticket for the next resit examination.

Other (more stimulating) results of the pilot are that the lecturers were stimulated in using ELE as a means of increasing the contacts wit the students. Also the use of a digital tablet in stead of the classic blackboard was promising. Recording the classes gives the learners the opportunity to review (parts of) the classes, which enables them to intensify their learnings.

Within the digital home work assignments the feedback and grading generator needs to be reviewed and optimized. Grading should be done after each question and the feedback generator should give more diverse, detailed, tangible and usable information, probably relating the feedback to recorded (part of) the recorded parts of the lecture.

Authors conclude that the original goal of the pilot has been reached. The goal was to improve the orientation of the students towards the content of the course, especially during the moments of self study, which apparently accounted for almost 50 % of their total study time.

Authors recommend that the pilot on home work assignments in ELE is further expanded to other courses. Also further research is needed to investigate whether students grades really go down after using digital home work assignments. Preferably, a good explanation is to be found. Another recommendation is that the pilot is also integrated into the regular course, including the first round of examination (not only the resit).

### References


