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LifeLongLearning project KA3MP

KNORK

Promoting Knowledge Work Practices in Education

Agreement 2013-4764/001-001

D4.1 Summary of surveys, version 2, the "M12 report"

Internal summary of investigated courses - teachers' pedagogical practices and self-reflective experiences related to implemented courses

Data collection in the investigated cases between months 1-12 (until January 2015)

Klas Karlgren

Background and overview of the data collection

The aim of this summary ("M12") is to create an account of the teachers' and other stakeholders' descriptions of their pedagogical practices and self-reflective experiences related to the implemented courses aiming at developing students' digital and knowledge work competencies.

The previous M6 report, which this report builds on, had a focus on the pilot teachers' pedagogical practices, goals, expectations and plans for developing the practices concerning students' digital and knowledge work competencies. A next one is planned for month 24 which will bring up students' self-reflections concerning knowledge work practices related to their experiences in the implemented courses. But this report primarily focuses on the teachers' descriptions and experiences of the modified and implemented courses.

It can also be noted that in parallel, research-based material is created for the *Re-use library* at M12 and M27. The material will, e.g., be feedback from the pilot cases, guidelines and other research-based material for the practitioners.
Several cases were investigated in four countries – Bulgaria, Finland, Italy, and Sweden during 2014 (a list of cases can be found here: https://docs.google.com/spreadsheets/d/1zG1GIaPSnfj8T-l-nZHwQNYlH2XpLfF449IGPHdUW9k/edit#gid=0). Each case that was investigated is presented using the same structure in this document, namely:

1. A short introduction to the course, most of the pre-course data is however to be found in the M6 report
2. The second section is about data collection during courses and main findings from these
3. The third section presents post course data that was collected.
4. Finally, any 'educational design patterns' that were created based on observations made during the course are presented, see below for an explanation of the pattern concept.

A number of different data collection methods were used *during* ("a" below) and *after* ("b") the courses investigated (in addition, data was collected before the courses, see the M6 report).

1. A university level course in case studies in health informatics at Karolinska Institutet, Sweden.
    a. Observations, note-taking, group-interview with students.
    b. Post-course interview with the teacher, and students filled in the Contextual Knowledge Practices questionnaire at the end of the course (data was also collected before the course, see the M6 report).
2. A university level course in sensor technology at Metropolia University studied in collaboration with Helsinki University.
    a. Observations of the wiki site and meetings during the course.
    b. Post-course teacher interviews, students answered the same seven statements as before the course and five open questions .
3. Three upper secondary school courses in biology, chemistry and physics all concerned with the topic of energy at the Helsinki Upper Secondary School of Media Arts in collaboration with Helsinki University.
    a. Observations, note-taking, teachers answered reflective questions in writing.
    b. Post-course group interview with teachers, students answered the same seven statements as before the course and five open questions.

4. A number of courses on the level of higher vocational education in the area of food laboratory practice, sciences, Italian, ITC, Physics at the Salvemini institute (the professional institute of Services for the Hotel and Restauration) in collaboration with University of Rome.
    a. Researchers' field notes, video-observations, semi-structured questionnaire for teachers, teachers' self-evaluation about the trial and the effect of technology, online diaries compiled by teachers and students.
    b. Semi-structured questionnaire for students (KNORK pre-questions) and questionnaires for teachers.
5. University course on computer-aided design at the Technology School Electronic Systems associated with the Technical University of Sofia.
    a. Observations of the use of tools and resources and project management, and, analysis of students' forums, blogs and social media.
    b. Questionnaire to teachers using the five common KNORK questions. http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc

    Students answered the same seven questions as in the beginning of the course (the CKP prequestions).
6. University courses in ASIC design and VLSI design at the Technical University of Sofia.
    a. Observations and analysis of course products (in Google Docs, Google+, Google Calendar, e-mail etc).
    b. Teacher interviews.

    Students answered the same seven CKP questions as in the beginning and the three final open CKP questions and in addition two more open questions.
7. A university level course in health care organization and management in health informatics at Karolinska Institutet.
    a. Observations of the use of tools and resources and project management.
    b. Post-course interview with the teacher, and students filled in the Contextual Knowledge Practices questionnaire at the end of the course.
8. University course (bachelor's level, 3rd semester) on semiconductor devices at the Technical University of Sofia.
    a. Observations and analysis of course products during the course.
    b. Post-course: KNORK post questions, Contextual Knowledge Practices questionnaire at the end of the course, the same seven questions as in the beginning of the course and three open questions.

Educational Design Patterns to collect observations

Educational design patterns were suggested in the different cases. The reason for formulating patterns was to have a common way of documenting and sharing interesting findings. Design patterns are somewhat established as a structured way of collecting solutions that seem to work to solve recurrent problems. The notion of design patterns were widely popularized by the architect Christopher Alexander in the 70's but are today also used other areas such as information system development, human-computer interaction and education. By formulating interesting observations in a structured way, the solutions have a chance of being transferred to contexts outside the local context in which they were first observed. Collecting findings as

patterns also make the findings easy to present and find in the Reuse library. Design patterns are three-part abstractions of describing solutions to recurrent problems in a context; we have used the following format to structure them:

Name of the pattern

1. *Educational problem*: what is the educational or technological problem, challenge or issue being addressed?
2. *Solution*: what is the solution that seems to alleviate or eliminate the problem?
3. *Context*: in which contexts (e.g., educational level) is the solution expected to work?

At this point 13 patterns have been formulated on the basis of the cases but it is more correct to say that eleven of these are unique as two of the patterns are more or less identical due to that similar observations were made in different cases. The patterns in this report are tentative, first versions which will most likely be refined after further observations and discussions about their formulations.

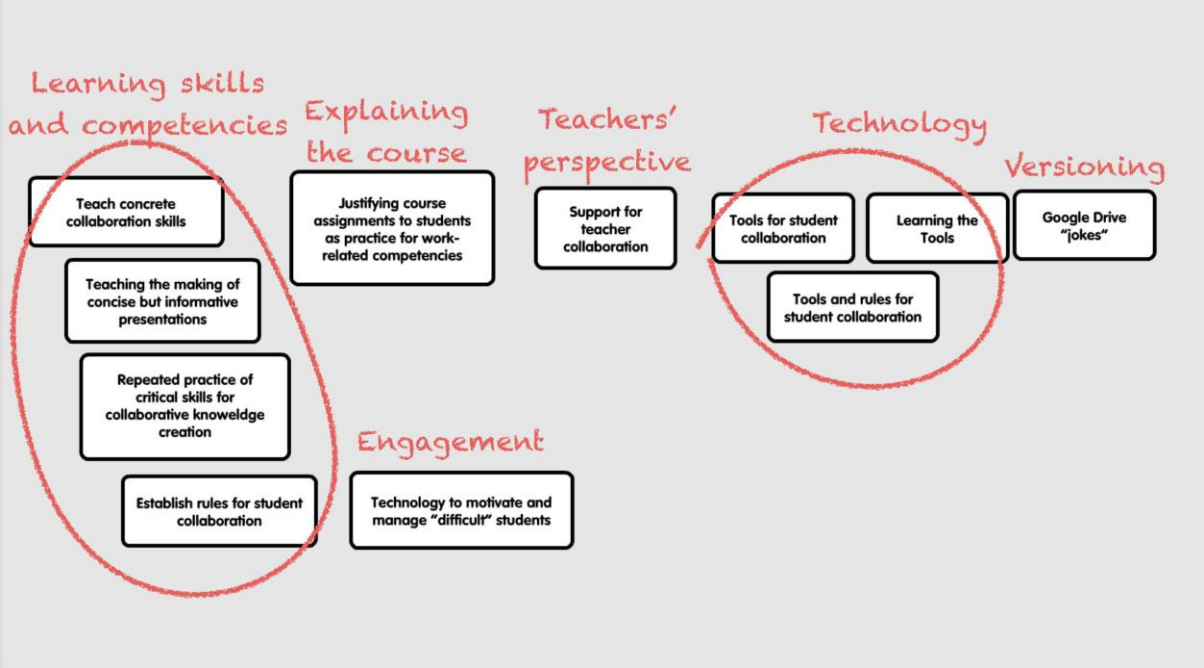


Figure. An overview of the educational design patterns and themes that they address.

The patterns address different aspects of implementing the trialogical approach in the cases, see the Figure above. Some patterns relate to the challenge of *supporting students' learning of important skills and competencies* (Teaching the making of concise but informative presentations[2] and Repeated practice of critical skills for collaborative knowledge-creation[2], Establish rules for student collaboration[1,8] and Teach concrete collaboration skills[3]). Case numbers in superscript indicate which cases the patterns originate from. In some cases, similar observations were made in the different cases and therefore the same or very similar or overlapping patterns were suggested as in the last mentioned examples.
Another slightly different type of pattern highlights students' need for *understanding and explaining the working methods of a course* (Justifying course assignments to students as practice for work-related competencies).

Other patterns related to *introducing, modifying and learning the technological and educational infrastructure* of a course in order to support collaborative knowledge work (Tools for student collaboration[1,7] and Learning the tools[7]) and encouraging students to decide on rules for collaborating with the tools (Tools and rules for student collaboration[6]).

Another perspective is taken in a pattern emphasizing the teachers' view on Trialogical courses (Support for teacher collaboration[3]).

Yet other patterns address ways of *managing negative, problematic issues* that may occur in the trialogical cases which have to do with different versions of work and motivational issues and lacking engagement (Google Drive "jokes"[4] and Technology to motivate and manage "difficult" students[4]).

Klas Karlgren

1. Karolinska Institutet, Health informatics course

Elnta Meragia & Klas Karlgren

1. Previous practices and goals, expectations, and, plans

The course where Trialogical learning was applied is called *Case Studies in Health Informatics* and targets first year health informatics master students at Karolinska Institutet, Sweden. Please see the internal M6 report which reports on (a) interviews conducted with the teacher of the course about expectations as well as a web questionnaire directed at participating students about their expectations and knowledge work practices, (b) a workshop introducing Trialogical learning and Trialogical design principles, (c) the use of the KNORK template for planning pedagogical scenarios, and, (d) a pre interview with the teacher of the course at the start of the course about expectations concerning the modified course.

2. Data collection during courses

In the course, students were asked to create groups in order to work around the shared object (which was the digital prototype solution) for the final two case studies. For each group the corresponding digital accounts were assigned and observations on their online work were done from the researcher, where notes were taken on how students used the tools for each case study.

Also, in the end of each case study, there was a seminar where students presented their finalized products and also commented on their group work. Throughout the seminars, notes were taken regarding the students' final work (digital solution) and their reflections on working with the tools.

In order to understand how groups worked throughout the group work around the shared object, a group interview was carried out in the end of the 3rd case study. The outline of the group interview can be found in this link:

http://goo.gl/forms/ifRrYGGF0b

(It should be noted that the observations worked as complementary data on the results from the group interviews and played a secondary role for this research)

Main findings

In the following table, the groups that were created are presented (and the study participants assigned to each group can be seen on column 3). The students created groups by themselves and the participants were randomly assigned to the groups. The group interviews were conducted in a way that at least one participant of the study from each group was present.

Group Number	Total Group Members	Participants in the study	Background
1	5	S1, S6	Medical: 4 Technical: 1
2	4	S10	Medical: 3 Technical: 1
3	5	S7, S9	Medical: 4 Technical: 1
4	4	S2, S3, S4, S8	Medical: 1 Technical 3
5	3	S5	Medical: 2 Technical: 1

For the group questionnaire, the following categories were created:

- Category 1 – Team Functioning (Related to DP1 & DP2)
    - o Sub-category 1 - Teamwork and engagement
    - o Sub-category 2 – Lessons learned
- Category 2 – Technology (Related to DP6)
    - o Sub-category 1 – Popplet
    - o Sub-category 2 – Padlet
    - o Sub-category 3 – Trello
    - o Sub-category 4 – Other tools and general comments

a1) Teamwork and engagement

Teamwork and engagement degree from the groups (G1: Group1 … G5: Group5) can be seen in the following table

KI Teamwork and engagement degree

	Team Function	Meetings and collaboration	Roles	Divide work	Comment or revise work
G1	Problematic	Not very often	Yes	Yes	Yes
G2	Good	Regular meetings	Yes	Yes	Yes
G3	Very good	Regular meetings	Not restricted	No	Yes
G4	Good	Regular meetings	Yes	Yes	Yes
G5	Good	Regular meetings	No	No	Yes

For G1, Team Functioning in general has been problematic as two members were not active as they were supposed to be. Due to tight schedule and the absence of the two members, meetings and collaboration were not that efficient. They met mostly virtually and collaborated physically only when they had to design the mock-ups for the digital solution. The members who actually worked on the case set up roles and divided work according to their backgrounds and experiences. They also made sure to comment and revise their work before the actual deadline by setting up

deadlines, which allowed one day for evaluation and one day for improvements.

The other groups on the other hand, commented that they worked quite well, without too many problems in general. More specifically, group three and five did not set specific roles in the group and did not divide their work. They had regular meetings (face to face and virtually) where each member contributed as much as possible and relatively equally. They also did revisions on their work together and made any changes instantly due to time restrictions.

Group two and four decided to set certain roles in the group members and also divide their work according to the backgrounds. They made sure though to comment and revise on each other's work by doing it altogether.

a2) Lessons Learned

	Problematic Aspects	Good Aspects	Do Differently
G1	• Communication • Collaboration • Mixed backgrounds • Tight Schedule	• Mixed backgrounds • Coordination	• Set rules early
G2	• Tight Schedule	• Mixed backgrounds • Good communication	• Set deadlines early
G3	• Not Any	• Each member contributed equally • Worked as a team	• Try other tools too
G4	• Tight Schedule	• Mixed backgrounds • Sharing team work	• Use Scrum methods
G5	• Not regular physical meetings	• Knew each other from before • Good communication	• Meet more frequently • Set sub-goals • Set deadlines early

Problematic aspects

For G1, the most problematic aspects have been communication and collaboration as not all members were active. Also, having mixed backgrounds was a problematic aspect for them. According to their explanation due to mixed backgrounds sometimes the members' opinions and ideas collided making it harder to provide one solution. Tight schedule was a problem for almost all of the groups making it harder to study thoroughly the cases and also not meeting as often as they would like to. G3 seemed to have quite a very good team function as they did not have any certain problems throughout the case.

Good aspects

Three of the groups recognized the benefit of having mixed backgrounds for the case according to whom this fact helped to look the case in a different perspective from what they would have done if they had to face it individually. Good coordination and good communication were two aspects, which were positively considered from two groups. According to them coordinating the group work from the beginning and having good communication between the members can help to address the case in a more productive way. One of the groups appreciated the fact that they had to work in a group and share the work between the members. Finally, another group said that knowing each other from before helped them have a better communication and therefore work better as a team.

Do differently

According to the problems the teams met, they showed awareness and insight to set up future goals for the next case study. G1 for example decided to set up rules early related to communication and collaboration in order to avoid non- participation as they faced it throughout the third case study.

For G2 the tight schedule made them decide to set deadlines early for the handling of the next case study.

For G3, as everything went fine, they decided to try the other tools that had been proposed as they only used one of them.

G4 decided to use Scrum methods for the next case in order to have more efficient meetings and collaboration between the members.

Last G5, realized the need to meet more frequently and set sub-goals and deadlines as early as possible in order to have more time for revisions and evaluations.

b) Technology

The mostly used tool throughout the modified course was Popplet, with Padlet and Trello following up

Tools	N1*	N2**	Reasons for Utilization	Reasons for non utilization
Popplet	5	0	Mind map and visualize ideas on the case problem and solution	-
Padlet	3	2	Share resources and comments	Lack of time Did not meet users' needs
Trello	2	3	Case analysis organization and management	Lack of time Did not meet users' needs

*N1: Number of groups who use the tool

**N2: Number of groups who did not use the tool

Popplet

All the groups used Popplet, as it provided a means for mind mapping their ideas on the case studies' problems and solutions. It was found to be easy, flexible and helpful. Only one group reported to have technical issues of non-synchronization when more people used the tool simultaneously.

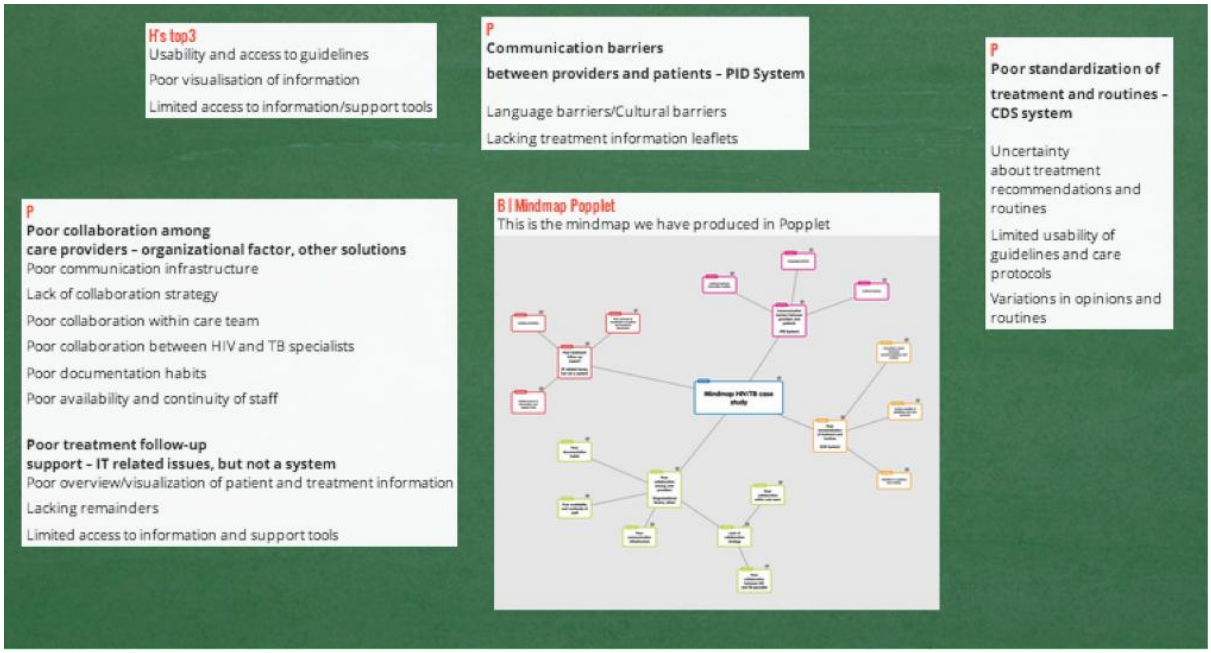
From the observations on the online work, it also became apparent that students used it to mind map their ideas. All of the teams, created Popplets (mind maps) by connecting ideas and solutions to the problems they had to deal for the cases. From the observations during the seminars, almost all the groups expressed their excitement for being provided with such a tool since it alleviated them from the process of reporting their rationalizations in big amounts of text.

Padlet

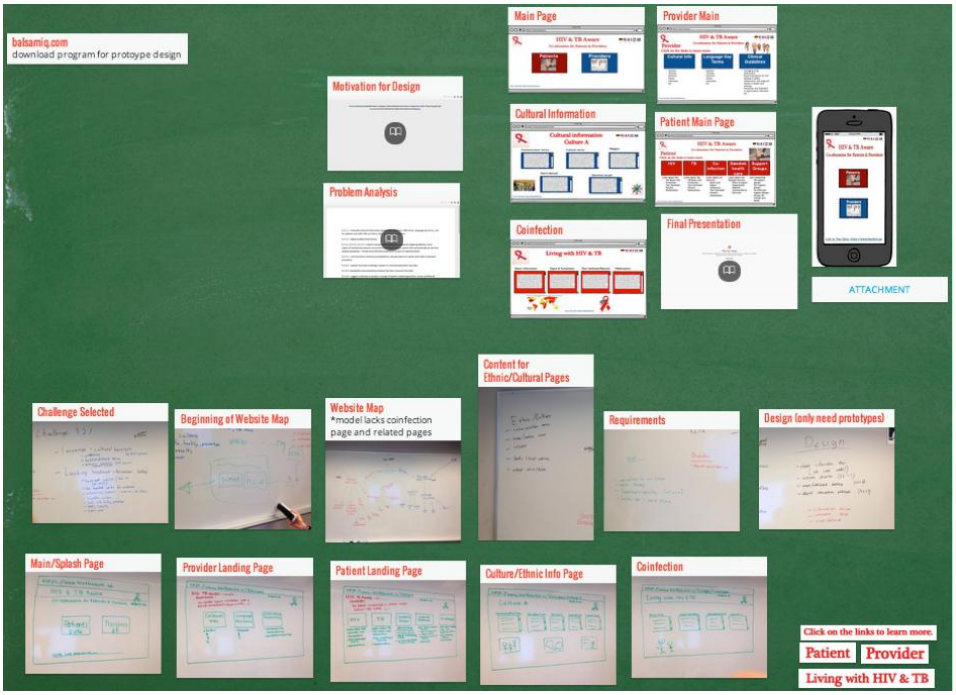
Padlet was used from three out of the five teams (where one team used it extensively and two used it quite simply). It was mainly used to share resources and comments through the digital wall. The two teams who did not use it explained that due to time constraints and not meeting their needs for the case studies, they decided not to use it at all.

Two of the teams who used it simply, found it hard to use it efficiently for the case studies' purpose. It did not meet too much their expectations and in the beginning they had to struggle to find out

how to build the digital wall. This could also be seen on the observations done on their online work. These groups shared only a few comments and resources and there was no apparent structure on the way the digital walls were built (see image below).



On the other hand, the team who used it extensively built the wall in a more structured way and it became obvious how they worked in order to build their analysis and solution (see image below).



Trello

Only one team used Trello in order to organize the case analysis and management and one team used it to see how it works. The others teams, said that they did not use it due to time limits and because of not finding it too useful for the case studies' needs.

Other tools and general comments

Other tools like Facebook, Skype and Google Drive were also used (G1, G4) for material sharing and communication.

One need highlighted by the groups for the digital tools that were proposed to them, was the possibility of getting instant notifications for changes. Neither of them (Popplet, Padlet, Trello) had proper notifications for the changes that took place which created some frustrations and raised the need for better traceability of who did what.

Also, it was mentioned that since the groups are so diverse, not one specific tool would be possible to cover everyone's needs. It depends a lot on the tasks the group had to accomplish and with whom you would have to cooperate. Especially someone mentioned that he would have preferred to have Padlet, Popplet and Trello as one tool while another one suggested to try and use tools that offer to- do-list functionalities.

3. Post course data

A post interview with the teacher of the course followed up in order to explore whether her expectations on the implementation of the design principles in the course were met.

The proposal for pre and post questions on five issues (1. Design principles/theory, 2. collaboration, 3. technology, 4. challenges in the background that motivate change, and, 5. issues

of concern) was used:

http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc

For the post interview, the following themes were created:

- Theme 1 – Design principles realization
    - Category 1 –Team Collaboration (DP1 & DP2 realization)
    - Category 2 –Technology (DP6 realization)
- Theme 2 – Challenges addressed and Future Implementation

Lastly, the students were asked to fill in the preliminary version of the Contextual Knowledge Practices questionnaire:

http://goo.gl/forms/1bLH18VHdW

Main findings

Teachers

a) Design principles realization

The general overview from the teacher was that the design principles were realized to a good degree. The tools that were proposed were used throughout the case, others more and others less. Some students used other tools too which were not proposed but they still collaborated to finish their assignments.

a1) Team collaboration

The teacher expressed that team collaboration was achieved to a good point but she had heard rumours that in some groups, collaboration was not achieved as it was hoped. Also, she saw an improvement on the individual assignments in comparison with previous years. She assumed that this might have been affected from the collaboration in the group work. Having different backgrounds could have helped the understanding of the problem more deeply and collaboration might have intrigued more analysis and critique.

a2) Technology

Regarding the digital tools that were used in the cases, the teacher mentioned that Popplet received a better acceptance than Padlet and it seemed that Trello was not used at all. She assumed that the reason for not using Trello was that the problems were short and there was not such a great need for planning. According to the teacher, picking one technology for a particular type of problem might have been more suitable than having predefined technologies for all the problems.

b) Challenges addressed and future implementation

According to the teacher, the cases were designed in a way to promote collaboration because of the challenges faced from previous years when students had to deal the cases individually. Now, by mixing the groups with different backgrounds helped to tackle this challenge as it provided a way to solve the problem using different perspectives and in a more thorough attitude. Also, by

using technology to visualize solutions instead of just report writing, helped students make their ideas clearer, which was a problem for them and the teacher to assess in the previous years.

Regarding future implementation, the teacher expressed that she will continue the cases by using group work and also she mentioned that she would continue to use technology to visualize ideas and justifications.

Students - CKP Questionnaire

The following table shows the mean average mean scores for each design principle, which were calculated from the Contextual Knowledge Practices (CKP) questionnaire.

The second column shows the results from all the participants (N=10). Since the participants had different backgrounds (medical and technical), a mean average score followed in order to assess the participants' results based on their backgrounds.

The third column shows the results from the participants with a medical background (n=5) while the fourth column shows the results from the participants with technical background (n=5). It is interesting to notice that students with a medical background agreed more on the implementation of the DPs while students with a technical background had much lower scores with only DP6 being the highest on agreeing on the degree of implementation throughout the course.

DPs	Average Mean Score from 1 – 5	Average Mean Score (Medical Background)	Average Mean Score (Technical Background)
DP1	4.063	4.309	3.818
DP2	3.853	4.05	3.667
DP3	3.825	3.975	3.675
DP4	3.825	3.975	3.675
DP5	3.914	4.171	3.657
DP6	4.271	4.371	4.171

Regarding the different degree of agreement between the students with medical and technical backgrounds, an assumption was reached that the students with medical background had had a previous experience with case studies during their studies (a fact which was found out throughout their first questionnaire regarding previous experience of case studies) and therefore might have the ability to relate this experience with previous experiences with case studies, making it easier for them to recognize and appreciate the application of the design principles throughout the cases.

On the other hand students with technical background had never experienced case studies before and especially health related ones. Therefore, it might have been harder for them to appreciate the application of the design principles the way the medical students did. Design principles 6 was the only one they actually had a higher score than four, which means that they managed to see its application throughout the course as they could relate it to their previous experience on the technical field.

Educational Design Patterns

Two tentative educational design patterns are suggested as a result of observing and analyzing the health informatics cases. The patterns - *Tools for student collaboration* and *Establish rules for student collaboration* - are presented below.

Tools for student collaboration

1. The educational problem

In some university courses, students may have many deadlines throughout the course and time and group management among the students may be crucial for passing the courses.

Students may need help in coping with the group work, the submission of assignments, and, with the workload in general both on an individual level as well as in the teams that they are engaged in.

2. The solution

Therefore, introduce tools/methods that enhance students' cooperation, collaboration and organization. One such tool is Trello which is a web-based tool that enhances collaboration, coordination, integration of activities, interaction within members and reflection. Trello may help students in developing artifacts and practices in the groups.

In practice, it may be a good idea to agree on the choice of tool together with the responsible teacher of the course. To get students started, set up accounts for the groups of students who are planned to be working collaboratively and share the links to their accounts during the first day of the course. Provide a few tips for better organization and collaboration in their group work. As a first step in order to orient and learn the Trello tool, ask students to set up rules for their teams and to post these on their Trello boards. In order to let students feel relaxed, teachers of the course should not be provided access to students' boards. After the first day, let students work as they like.

3. The context

University level courses which include collaborative student work and especially on digital objects/documents and where there is some preparedness on the part of the students and teachers to learn to work with new tools.

Establish rules for student collaboration

1. The educational problem

Not all students are equally active in student groups which may cause friction and conflict. Some students may be more inclined to or used to engaging in collaborative work. Tight schedules and absences may add to friction and meeting virtually may make it more difficult than when meeting face to face to handle issues about when collaboration is not satisfactory.

2. The solution

Therefore, encourage student groups to define roles and divide work in the beginning of the course paying attention to the different backgrounds of the participating students. Suggest that work is commented on and revised before actual deadlines by setting up deadlines, which allow one day for evaluation and one day for improvements. Plan for regular meetings (face to face and virtually) where each member contributes. Plan for carrying out revisions together.

3. The context

Student groups collaborating on tasks with tight schedules and where the contribution of each member is important, especially when student groups may varied including students with different (study or other) backgrounds.

2. University of Helsinki & Metropolia (Sensor Technology course)

Minna Lakkala

1. Previous practices and goals, expectations, and, plans

The case was a Sensor Technology course in Metropolia University of applied sciences for the students in information technology. The teacher had not run the course beforehand. The course was in the international study program, but also some students from the Finnish study program participated in it, which created a natural cross-fertilization setting.

Before the course, the teacher answered to the following pre-questions by writing (open questions answered in Google document): https://docs.google.com/document/d/1kPAaDgz_Wv92oPLFYpJnPkzexYdB_3PI4JfN6loO3nU/edit?usp=sharing

The students (N=11) answered (in paper) to the following seven statements and one open question before the course: http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/KNORK-Informed-Concent-and-pre-questions-for-students_UH-2014.docx

Please see the M6 report for findings about the previous practices, goals and expectations.

2. Data collection during courses

The wiki site constructed by students during the course is publicly available: https://wiki.metropolia.fi/display/sensor/Sensor+Technology+Home. In addition, the teacher used Moodle for organizing course activities and sharing materials, guidelines and assignments; access to the data have to be asked from the teacher.

The course consisted of eight course meetings, 3 hours 45 minutes each with one 20 minute break in the middle (weekly meetings between March 13th and May 8th, 2014; last two meetings in successive days in the same week). The first and the last two meetings were observed by a research and observation notes were written about the schedule and events during the meeting.

The teacher wrote answers (in a Google document) to the following reflective questions twice during the course (April 7th and May 5th, 2014): https://docs.google.com/document/d/1_d6nUNPTh9kG7Hl8D_nYURYUSkctTdaRtd7IXqDzHj8/edit?usp=sharing

Main findings

Course products made by students during the course included various wiki pages around the course theme. First, minor assignment included finding information about sensor markets and manufactures, which also worked as a practicing task for students to edit wiki pages. The main task was to write wiki articles in small teams about a chosen topic related to the course theme. The teacher created the structure and main themes for the wiki (based on a book about the phenomenon), but students had freedom to choose which topic they work on. All in all, the wiki activity can be regarded as quite trialogical, and the articles written by the students look professional and polished. Also another group of students with their teacher from another course participated in writing pages to the same wiki, which was a nice additional cross-

fertilization feature in the course.

In the next to last meeting, when the students started preparing final presentation (from another group's wiki article, not their own), the teacher introduced them a novel way of producing concise but informative presentations, called "Slidedocs" (see http://www.duarte.com/slidedocs/). The idea is that in a presentation made by a slide application (e.g. PowerPoint), each slide introduces one clear point with a combination of visualizations and readable text (no bullet points). The teacher gave a restriction that each presentation can include only five slides, which forces students to focus on central aspects of the topic.

Observations of the first and two last group meetings revealed that the course practices were strongly based on students' own knowledge creation for the shared wiki and collaborative activities. In the first meeting, students made wiki pages alone (a small writing assignment that was done during this one four hour meeting). In the two last meetings they prepared presentations in groups about some other groups' wiki pages, which was an interesting cross-fertilization activity: students had to learn the content made by other students and present it to others. In addition, the students also had peer-reviewing tasks: each student had to provide written feedback to some other students' work both in the first and in the last meeting. The teacher walked around the class and guided students with their work.

One noteworthy feature in the teachers' practices was that he very carefully structured students' collaboration activities (group formation and various group compositions in different phases, peer-commenting responsibilities, clear timetable for going through all final presentation in two groups), and cleverly used Moodle's Workshop assignment for organizing peer-feedback activities. For instance, in the final meeting, each student wrote written feedback to some other's work using a formula in Moodle including guiding questions (Is the material well organized, Did the material give good examples, Do you understand what presenters are talking about?, Did the material help you understand the topic?, Did the presenter answer well to the questions, Overall, was the presentation well done?).

The teacher also gave "metalevel" explanations to the students about the relationship of course activities with competencies relevant in working life. When the students started preparing their final presentations, a student commented that presenting to others makes him nervous. The teacher explained that students have to get used to giving presentations and it have to be practiced, because in work life it has to be done everyday (sell own ideas to others, sell own expertise to an employer etc.). Similarly, when students did not seem to start discussing about the presentations in the groups in the last meeting, the teacher stopped everybody's work and encouraged them to be active and take a bold attitude (like a coach). It appears to have been effective; the discussion was more active in the two groups after that. It seems to have been useful also that students' had possibilities to practice oral communication, because they went through several presentations in both groups; according to the observation, the communication improved during the activity.

Teacher's written reflections were collected two times during the course. In the first phase, about 4 and a half weeks after the course started, the teacher remarked that the working habit (writing articles in wiki, commenting through Moodle etc.) was also suitable for distance working; some international students who were not able to come to the sessions, participated actively on the discussions and wrote about their topics through the web. The teacher had also been concerned of the progression of the work of some Finnish students, and had given them some extra time during the course meeting to finalize the previous tasks, which had solved the problem. In the second phase a little before the end of the course, the teacher noticed that both the collaborative knowledge creation and weekly individual self-reflections had progressed well; the weekly individual assignments had worked a personal diary.

3. Post course data

The teacher was interviewed after the course. The interview was audiotaped. The following interview questions were used (in Finnish): https://docs.google.com/document/d/17uDbcogofaSMl_ACd1lKjAwupWmXvDo06jxh3zBZep4/edit?usp=sharing.

The students (N=15) answered (through Moodle) to the same seven statements as at the beginning of the course and the following 5 open questions:

1. How would you characterize your overall experience in the course?
2. How would you characterize your own participation and activity during the course? Please justify your answer.
3. What has been positive or impressive in the course?
4. What has been challenging or disturbing in the course?
5. How well were your goals and expectations for the course met? Please explain why.

Main findings

The teacher interview focussed on successful and unsuccessful aspects of the realized course, and the actualization of trialogical design principles. The course design and the process progression was also discussed through examining the digital platforms of the course in Moodle and wiki.

The teacher mentioned the following aspects as successful:

- The wiki pages made by the students. The teacher created the structure but all content is produced by the students themselves.
- It was interesting to test some tools of Moodle; e.g. the Workshop tool was useful when the students cross-evaluated each others writings, in addition to working on their own article for almost eight weeks.
- The usage of technology (Moodle and Confluence wiki) succeeded well; it is important to keep the structure of the virtual spaces simple enough.
- The organization of the last seminar where students had to make presentation from the article of some other group was an interesting experiment; they had to work for common good, not only for their own product.

The following issues were mentioned by the teacher as unsuccessful or in need of improvement in the next iteration:

- There could have been better introductory sessions before students' own work.
- The organization of the last seminar received critical comments from students; they thought that it was not a good solution to make presentation from some others' work. There has to be some way to promote cross-fertilization between groups, but the solution needs improvement; perhaps more commenting tasks throughout the course between groups, and also face-to-face interaction so that the students learn to discuss with others in a foreign language.
- Theoretical content learning goals were achieved well, but students hoped for having some concrete hands-on work or lab work with sensors too.
- One possible improvement content-wise is to make the topics even more open for students, not structured according to the source book.
- Guidance and supervision of the groups' work could be improved somehow; the teacher has to make sure that each group is progressing. Students should get immediate feedback for their tasks; perhaps the number of tasks (weekly self-reflection, writing wiki pages, peer commenting) should be decreased so that the teacher has time to give feedback when it is important.

The teacher hoped that the students learned skills for making "systematic exploratory work"; this could be explicitly defined as one competence in the course goals in the future. Also peer-evaluation was probably new for most students. The teacher himself learned that when using new ways of working, enough time should be reserved for practicing the new skills; you cannot expect that students manage the new practices at once. For instance, peer evaluation should be practiced with an exercise before it is actually used in the real task. All working methods should be structured and guided, and there has to be repeated possibilities to practice and improve the skills. The teacher should not give up if students do not manage well at once, but give more guidance and instructions, and encourage students to go on.

The actualization of the trialogical design principles were evaluated in the interview as follows:

- DP1: Producing content about the topic as wiki articles. The wiki website was a shared objects for the whole course, and each group had their shared object in writing their own articles in wiki. Also the seminar presentations (Slidedocs) were shared objects that were produced and evaluated together in groups.
- DP2: Students were in a central role in knowledge production. Best students automatically took responsibility of the work. Some more shy Finnish students, who were not used to study in English, would have required more encouragement. The course tasks were a combination of individual tasks (weekly self-reflection, commenting other group's work) and group tasks (writing wiki articles); they could perhaps be better integrated with each other and decrease the number of tasks.
- DP3: Reflection was supported systematically by weekly self-evaluation, and peer-evaluation assignments after the production of first wiki pages and the final articles. The teacher structured both the self-evaluation and the peer-evaluation by guiding questions to be answered through Moodle. The course content concentrated perhaps too much on producing theoretical and written knowledge, some concrete examples and hands-on practices with sensors would have been needed.
- DP4: The working process during the course was sustained and long-term, because the students worked on their main wiki article throughout the course. Sustainability is also supported by the wiki website, which is supposed to be used, updated and constructed further in future courses.
- DP5: The participants of the course came both from the international and Finnish study programs, but there could have been more interaction between Finnish and international students. In the last seminar, the groups were mixed and the Finnish students had to communicate more in English. Also another group of students with their teacher from another course participated in writing pages to the same wiki, which was a nice additional cross-fertilization feature in the course. There were no working life contacts or expert guests; it could be a good idea to arrange some in future courses.
- DP6: The main digital tools used in the course were 1) Moodle for sharing instructions and course materials as well as organizing reflective tasks, commenting and discussions; and 2) Confluence Wiki for co-authoring articles about the course topic. The combination and integration of the two tools worked well. The teacher videotaped all course meetings and shared the videos through Moodle, which was a good service for students if they had to be absent from some meeting.

The students' answers to the seven statements after the course are reported in Figure 1 together with their answers to the statements before the course.

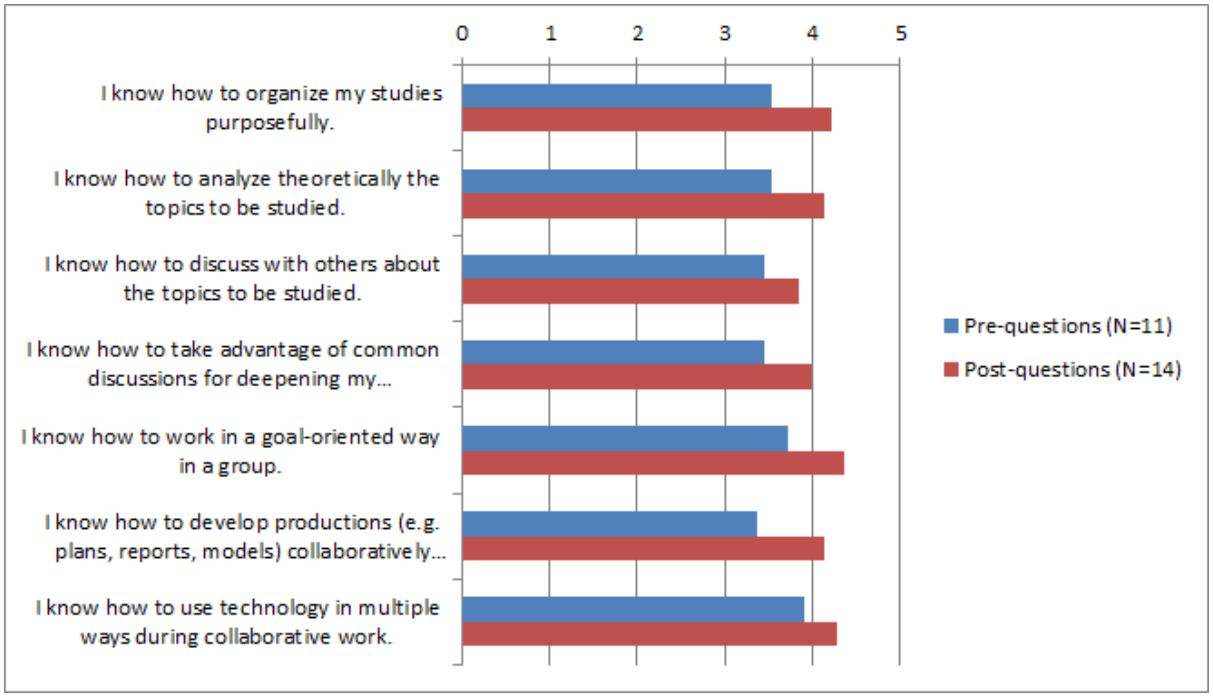


Figure 1. Average of the students' answers concerning the seven statements at the beginning and at the end of the course in the Sensor Technology course.

Students' answers to the open questions after the course were analyzed qualitatively. We focussed on the two questions about positive or impressive and challenging or disturbing issues (questions 3 and 4) because they were most revealing concerning the course design. In all, 14 students answered to the open questions, and total of 40 statements, each addressing a single issue, were selected for categorisation from the answers. In Table 1 below is a summary of the analysis:

Table 1. Summary of the students' evaluation of positive or impressive and challenging or disturbing issues in the Sensor Technology course.

Main category	*Positive or impressive issues*	*Challenging or disturbing issues*
Working methods (17)	Student interaction (3) Distance work allowed (3) Own research and information search (2) Making wiki pages (1) Possibility to focus on one topic (1)	Not all motivated in group work (2) No practical lab work (2) Way of organizing the final presentations (2) Should inform beforehand about atypical working methods (1)
Schedule (4)		Tight deadlines (2) Early mornings (1)

		Started the course late (1)
Technology (1)		Technical problems (1)
Guidance (3)		Structuring Moodle (2) Performance criteria not clear (1)
Skills (7)	Learning-to-learn skills (1)	Finding and producing information (5) Be interactive (1)
Outcomes (8)	Learnt new knowledge (6) Knowledge production in wiki (2)	

There were also a few suggestions for improvements in the students' answers to the last question about other comments. The following suggestions were mentioned: Practical work and concrete examples (4 students), Expert guests from industry (1), Different way of organizing the final workshop (1), and More theory lectures from the teacher (1). In general, the students were very pleased with the new type of practices and the novel experience they provided.

Educational Design Patterns

Teaching the making of concise but informative presentations

1. The educational problem

In addition to writing long essays or reports, students need to learn to present knowledge and get their message through in a concise but informative way. Students need models and examples about how to make good presentation, and they need opportunities to practice such skills. Making typical slide presentations (e.g. multiple PowerPoint slides with bullet points) is a convention that is not always the most useful.

2. The solution

Therefore, provide students a concrete, alternative model for creating presentations with slide tools (such as PowerPoint) and explicit assignments to apply the model in making their own presentations. Give concrete performance criteria that forces students to concentrate on critical features in making concise but informative presentations. Assign students also to give the presentations to each other and comment on each others' presentations in a safe and supportive atmosphere.

One useful model for making slide presentation is the idea of "Slidedocs" (see http://www.duarte.com/slidedocs/), which are presentations made by a slide application (e.g. PowerPoint) so that each slide introduces one clear point with a combination of visualizations and readable text (no bullet points). The layout of the slides is designed so that the presentation can be used both in screen and in print form. The teacher could restrict the number of slides (e.g. max 5), which forces students to practice focusing on central aspects of the topic. After making the presentations, students can be organized in small groups, where each presentation is

read and discussed by turns.

3. The context

The solution is suitable for any educational situation where the goal is to learn to produce knowledge in concise but informative form and to give oral presentations about an open topic. Younger students in lower school levels can make shorter presentations from easier topics, older students can make longer presentations from more challenging topics, but the way of working can be the same. The solution could be used in any educational situation where students manage the basic usage of the slide tool and there are computers available for the students' work. Enough time should be allocated in making and giving the presentations.

Repeated practice of critical skills for collaborative knowledge creation

1. The educational problem

The reason for implementing group work, project work and collaborative writing task in educational settings are twofold. *First*, such ways of working are proven to be more effective for learning the content under study than students' passive knowledge acquisition from books or lectures. *Second*, through participating in such practices, students are expected to learn skills and competencies required in these ways of working, such as social and collaboration skills, critical thinking, knowledge management and production skills, etc. However, many students do not succeed very well in group work or progress expectedly in finalizing their products, and teachers lose their faith in the power and benefits of these ways of working. The reason usually is that students are left too much alone in managing the new ways of working; they have to learn the critical skills spontaneously or through trial and error.

2. The solution

Therefore, it is not enough just to make students work in the new way, but they need good models and instructions from the teacher as well as time and repeated opportunities to practice the new skills, so that they can learn the complex skills gradually through multiple experiences and constructive feedback. Here are some examples of pedagogical solutions for supporting that:

- Give students first a smaller and less challenging exercise for practicing new skills before they have to be able to use the skills in a challenging, real course task: e.g. make students produce a small text from a limited topic in groups before they are engaged in a more long-term and challenging group production process (writing concept definitions in wiki before producing longer wiki articles about open-ended questions or themes); or make students give peer-feedback first in pairs, before they have to do it in bigger groups or publicly.
- Include repeated opportunities for practicing the central skills also inside one course or study unit. For instance, instead of one large inquiry or project work assignment that lasts the whole course, the course could consist of several smaller inquiry or project tasks, when the whole working cycle is repeated multiple times (e.g. weekly or bi-weekly). Similarly, instead of having peer-commenting only in the final presentation phase of the process, it can be included in every meeting or every phase so that it becomes a routine practice and gives students regular feedback from their work, without burdening the teacher to much.

3. The context

The solutions can be applied in any educational context, but the duration of the course or study unit should be long enough so that there is enough time for repeated practicing. This type of repeated practice is useful and beneficial especially in introductory courses or basic studies where

the students are introduced to the new working practices for the first times.

Justifying course assignments to students as practice for work-related competencies

1. The educational problem

Students do not necessarily understand the reason for the working methods in a course, e.g. why they have to work in groups or collaborate with each other even if they would prefer studying alone, or why they have to seek for information and produce reports themselves, when the teacher could give expert lectures for them about the same issues.

2. The solution

Therefore, the teacher should explain the reason for each task or type of working, and not only from the point of view of learning the necessary content of the domain, but also concerning generic competencies that the students much possess in future studies and work life. For every assignment of a course, the teacher could explicate the learning goals for students, both related to content learning and skill learning, and have "metalevel" discussion with the students about the goals. For example, in one higher education course for engineers, when one student remarked that it is distressing to present one's own work for other students, the teacher explained to the whole class how central it is in their future work to be able to express and explain their opinions to others and sell their ideas to colleagues, bosses and customers.

3. The context

The practice is useful (or even necessary) in every educational situation in all levels, but in the vocational education and higher education it is especially important to connect the working methods and related competence learning to the practices of students' future profession.

3. Helsinki University & Helsinki Upper Secondary School of Media Arts (Energy in Ecosystem assignment)

Liisa Ilomäki & Minna Lakkala

1. Previous practices and goals, expectations, and, plans

The case combined three courses (biology, chemistry and physics) for the first year upper secondary school students. About 70 students from three obligatory courses participated in the process. Otherwise the courses were conducted as usual, but there was one common assignment for the students of all courses concerning the topic of energy. The collaborative part took ⅓ of the time scheduled for the courses.

First the students had a joint brainstorming session about phenomena that interest them in the topic 'Energy in the ecosystem'. Students formed groups which had a task to create material about the phenomenon they have chosen to examine. All materials of the groups were supposed to be combined as a larger entity to be used as study material in future courses of the school. An expert from a solar system company participated in the process by giving an expert lecture to the students. Google documents were used for sharing and co-authoring material, and the final product was constructed as a Prezi presentation (https://prezi.com/vbyqsvhk9adz/energiaa-ekosysteemissa/?utm_campaign=share&utm_medium=copy).

Before the course, the three teachers answered the following pre-questions: https://docs.google.com/document/d/1kPAaDgz_Wv92oPLFYpJnPkzexYdB_3PI4JfN6loO3nU/edit?usp=sharing

The students (N=66) answered the following seven statements and one open question before the course: http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/KNORK-Informed-Concent-and-pre-questions-for-students_UH-2014.docx

2. Data collection during courses

The courses including the joint Energy assignment lasted 7 weeks, from the beginning of April to the end of May. In all, the courses consisted of about 38 lessons, but only part of them were dedicated to the Energy assignment. One researcher observed the following lessons where students worked on the Energy assignment:

1. At April 12th, a lesson (75 minutes) in the Physics course , and a lesson (75 minutes) in the Biology course.

2. At May 13th, a lecture (45 minutes) in auditorium for all students given by the expert from a solar system company, and, after that, a short lesson (30 minutes) in the Chemistry course.

Observation notes were written about the schedule and events during the lessons.

The teachers wrote answers (in a Google document) to the following reflective questions twice during the course (April 22dn; only one teacher; and May 26th; all teachers together): https://docs.google.com/document/d/1_d6nUNPTh9kG7Hl8D_nYURYUSkctTdaRtd7IXqDzHj8/edit?usp=sharing

Main findings

Observations in the lessons showed that the teachers had organized the work somewhat differently in three different courses. The practices could be unified and improved for the next iteration, especially the usage of digital technology as well as the sharing and commenting of the products. In the first course, the groups had made their products using different technologies (Word,

Google docs, Power Point etc.), and in the lesson all groups' drafts were looked at discussed together in turns. It was a good idea to make the groups comment on each other's work, but because they had not read the materials beforehand, they did not have much to comment. In the second course, the groups worked on their reports, which were all in Google documents; in the lesson, the groups continued their work, and the teacher walked around the class and helped groups individually. In the third course, the groups had produced material by PowerPoint, and in the observed lesson, they copied and modified the knowledge into a common Prezi presentation. Most groups worked well, but it seemed that groups were too big; in the groups of four to five students, only two or three students took responsibility of the task. At the beginning, there were some technical difficulties in creating Prezi accounts for everybody, but finally all groups managed to edit the common presentation.

Also the lesson including a lecture of an expert from a solar company was observed. A good idea was that also students from other courses were invited to participate in the lesson; there were about 90 students and teachers present. Students appeared interested in the content, and some students also made questions or comments. The teachers could have given students an assignment beforehand to prepare questions for the expert concerning their own energy topic. After the lecture, the teachers discussed with the students about designing the common Prezi presentation for all materials of the Energy project.

Teachers' written reflections were written in the third and at the last course week. According to the reflections, a central positive issue in the project was the possibility to concentrate on one topic for longer time instead of going through a lot of piecemeal knowledge, and it appeared to be motivating for students. Challenging was that the project was part of compulsory courses, where there is not so many degrees of freedom. There also were differences in the commitment of students. Because of the busy schedule and different schedules in the three courses, the cross-fertilization between the three domains remained minimal; new solutions should be invented to achieve that. Also the joint phasing and scheduling of the process between the three courses should be improved.

3. Post course data

A group interview was conducted for the three participating teachers. The interview was audiotaped, transcribed and analysed with ATLAS.ti software. The following interview questions were used (in Finnish): https://docs.google.com/document/d/17uDbcogofaSMl_ACd1lKjAwupWmXvDo06jxh3zBZep4/edit?usp=sharing.

The students (N=67) answered (in paper) to the same seven statements as at the beginning of the course and the following 2 open questions:

1. What has been positive or impressive in the Energy project?
2. What has been challenging or disturbing in the Energy project?
3. How would you characterize your own participation and activity during the Energy project? Please justify your answer.

Main findings

Results of the qualitative content analysis of the teacher interview:

- Teachers adopted new pedagogical practices compared to previous courses: longitudinal work which also supported students' more in-depth focusing, students' collaboration for a shared outcome, and the successful use of an external expert.

- According to teachers, the students learned knowledge work practices, such as information processing, analysis and presentation, sharing and versioning as well as commenting, longitudinal work, using digital tools and group work in general. These kinds of practices are still rare in upper secondary level. Students were motivated and they adopted this kind of working.
- Teachers' collaboration succeeded well, in general the large entity and the structure of the course was good, and furthermore, the use of digital technology succeeded well. Teachers felt that it is important that the new practices were successfully used for improving obligatory courses and for a large group of students, not only to small voluntary courses with especially motivated students.
- Teachers had not planned the processes well enough till the end of the process. For that reason they felt that the end was somewhat disintegrated. In addition, the intended collaboration and integration between the courses was too limited, similarly the use of the external expert.
- All teachers will continue with similar processes and they also plan to apply the practices into their other courses; they also had several ideas how to improve the integrated assignment.

Results of the student questionnaire (both pre- and post questions)

The students' answers to the seven statements after the course are reported in Figure 1 together with their answers to the statements before the course.

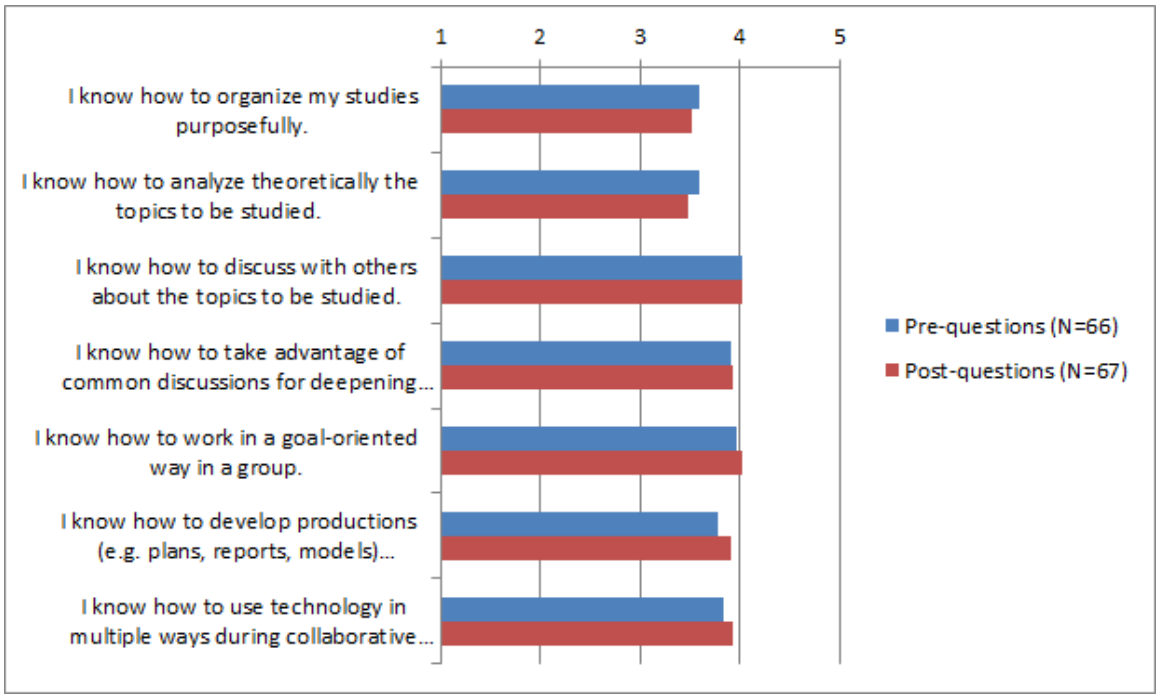


Figure 1. Average of the students' answers concerning the seven statements at the beginning and at the end of the courses in the Energy assignment.

The differences are small between the pre- and post-test. From the statements, students regard their competencies high in Discussing with others about the topics to be studied and in Working in a goal-oriented way in a group.

Students' answers in the open questions of the questionnaire: ⅔ of 67 students answered also in open questions in the questionnaire. The students liked "learning new things", probably meaning the content in general, and collaboration in groups. The main challenges were issues related in

information processing and the group work.

The case and some results are describe also in the conference abstract: http://www.iced2014.se/proceedings/1579_Karlgren.pdf. Please see the M6 report for findings about the previous practices, goals and expectations.

Educational design pattern: Support for teacher collaboration

1. The educational problem

Many **t**eachers are not familiar with collaborative planning and managing an integrated large course. For this reason, planning and managing a new innovative course is often conducted only partially, the course activities remain less integrated and students' learning activities do not succeed as well as they could.

2. The solution

Therefore, provide support for teachers during the first iteration of a new type of course, and not only for planning. Also support the teachers in reflecting on the process and the outcomes to improve new iterations. In addition, see to that teachers have structural possibilities for collaboration; common time organised for the weekly time schedule. The principal should organise resources for teacher collaboration.

3. The context

Teachers face the problem in various types of collegial collaborative activities at all levels of primary and secondary schools because the school structures are planned for individual teacher work.

Educational design pattern: *Teach concrete collaboration skills*

1. The educational problem

Because students are not used to collaboration for creating something new in longitudinal processes they lack concrete skills for such collaboration. School group work assignments are typically (often) voluntary, students' assignments do not require several versions and iterations and they do not require students' knowledge creation. As a consequence, students do not know how to engage in more demanding collaborative activities, such as inquiry or knowledge creation. Students have difficulties in making plans about how to work collaboratively, reflect on their process and outcomes, improve versions, and give feedback and utilise it. In addition, they are not used to collaborating with all students and some students prefer working alone.

2. The solution

Therefore, allow students to engage in different types and sizes of collaborative learning activities throughout the school years. Students should work in various groups and with various other students. Teachers should also consciously teach how to collaborate and model productive collaboration. Such meta-level learning should be integrated in collaboration activities, and even short-time sessions (15 mins) are useful and enough when conducted regularly.

3. The context

Collaboration for learning is a method for all levels of education. Already in primary school pupils should learn to create collaboratively and they should also learn good practices for it. In schools, teachers should together share the responsibility of teaching collaboration skills to students.

4. University of Rome and Salvemini

Nadia Sansone, Maria Beatrice Ligorio & Donatella Cesareni

1. Previous practices and goals, expectations, and plans

Before the trial, a semi-structured questionnaire (http://knork.metropolia.fi/intra2/?page_id=672) was sent to 7 teachers to verify in advance their technological expertise and at the same time to understand how and if they used technology to foster knowledge building or any practices of collaborative learning.

Teacher workshops were carried out (3 on the trialogical approach and 2 in order to give information and specific training on technological environments and tools) and the first versions of pedagogical plans were written (http://knork.metropolia.fi/intra2/?page_id=672).

Please see the M6 report for findings about the previous practices, goals and expectations.

2. Data collection during courses

During the trial, data were collected through:

1. A semi-structured questionnaire for teachers (N = 5) monitoring the ongoing activities and promoting teachers' self-evaluation about the trial and the effect of technology (http://knork.metropolia.fi/intra2/?page_id=672). We set up the questionnaire using Google Drive Sheet. The questions:

A. Are you satisfied with how the trial is working in your class? Yes-No

B. Are you experiencing any difficulty in the trial? Yes-No

C. Specify the type of problems detected - with respect to: (Open Question)

   a. classroom management area;

   b. emotional area;

   c. time management area

D. What role does technology play in your trial? - with respect to: (Open Question)

   a. classroom management;

   b. relationship with colleagues area;

   c. communication with research team;

   d. planning activities

E. What would you need to continue in the trial? (Open Question)

F. How is it going with the writing of the pedagogical scenario? (Open Question)

G. How is it going with the writing of the diary? (Open Question)

H. Write down any other issues you want to highlight or share (Open Question)

2. Researchers' field notes taken during the classroom activities of each of the 4 courses activated in the trial: a) Menu, b) The hoover, c) Video-Game and story-telling d) Hypermedia on nutrition (see: https://docs.google.com/spreadsheet/ccc?key=0Aj9JhqXPAWUEdEhFNFNxYTdUYnRkaHlYa2pMOWl4X0E&usp=sharing#gid=0 and http://knork.metropolia.fi/intra2/?page_id=672)

3. Video-observations during classroom activities

4. Online diaries compiled by teachers and students

We consider each type of data as coming from a specific point of view: students', based on questionnaires and diaries; teacher's via questionnaires, diaries and the pedagogical scenario; researchers', via field notes and videos. Considering these data, we aimed at composing the trialogicality.

Main findings

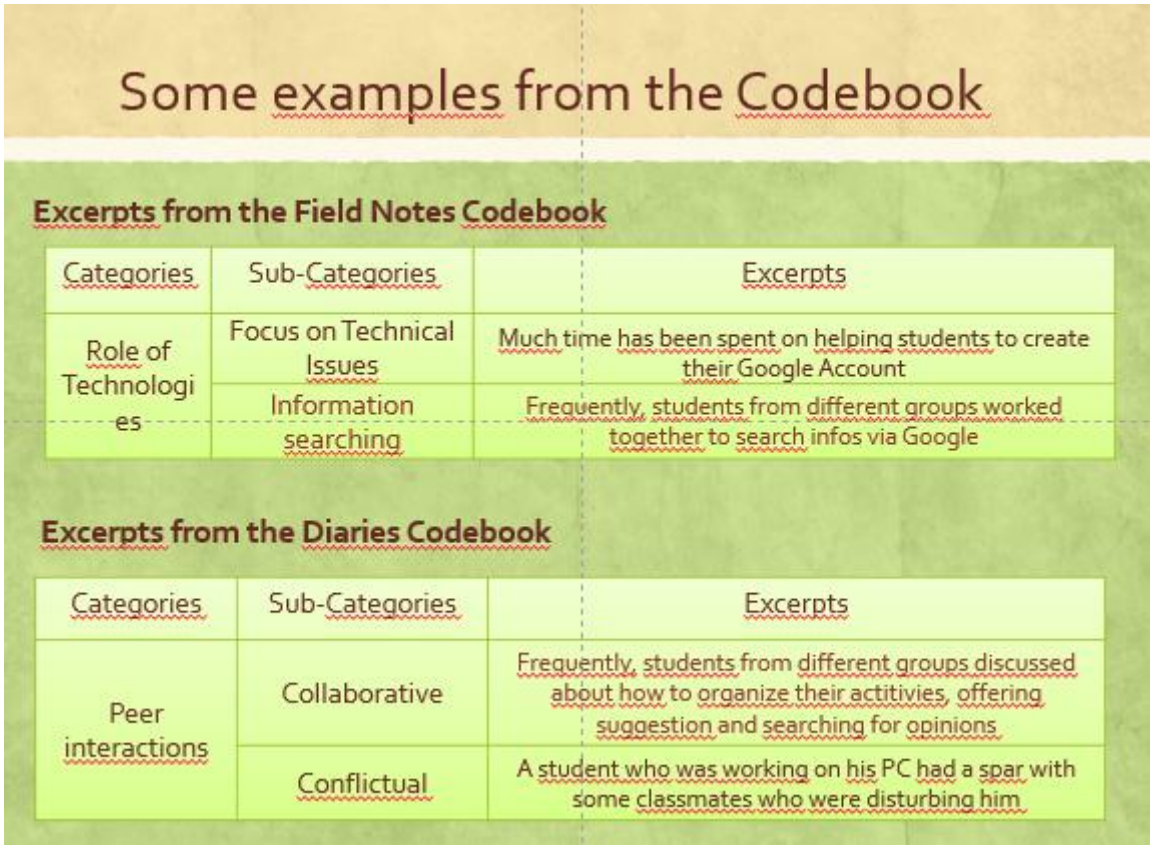
1) Main findings from teachers' ongoing questionnaire:

- Technologies regarded as an essential tool to promote collaboration (between students, between teachers, with the research team), to create new knowledge and support effective work with a considerable saving of time; nevertheless they are seen as a distraction for students with already existing motivational issues. It is clear, in this case, the expectation/fantasy of some teachers that technology could change some of their students and improve overnight the classroom climate. However, technologies are seen as a general positive innovation (with a particular enthusiasm for the possibilities offered by tools like Google Drive in order to support students in a targeted manner and in real time)

- Difficulties related to time-management and internet connection, as well as to - what they called - an unexpected low students' technological literacy

- Finally, diaries and pedagogical scenarios are seen as tools to support planning and reflection.

2.3.4) Field notes, diaries, and videos have been qualitatively analyzed through codebooks purposely created for each type of data, through a Grounded Theory approach (Glaser & Strauss, 1967). Each codebook consists of a set of categories, which correspond to a number of subcategories. Several cycles of looking at the data and re-defining categories were performed. Three researchers were involved in any cycle. They first analyzed individually the data; later they compared results and discussed instances, until they reached consensus on the categories to be attributed to the data.



The codebooks were used to categorize the data and frequencies and percentage for each category have been calculated. TLA principles offered a common matrix to compare and triangulate the results obtained by each type of data analyzed. In this way, we could grasp the specificity of each point of view, together with the complexity of the overall case.

By considering the applications of the codebooks to each data collected, it emerged that:

a) Students developed skills related to collaborative work. For instance, categories referring to effective communication and constructive social interactions show an increase of 43%, when comparing the outset of the course with its final stage;

b) Teaching practices changed from a strong focus on giving instructions or assessing content acquisition, to promoting cooperation and students' active role (increase of 36 %);

c) Technology was more and more used (increase of 33 %) to perform collaborative activities, rather than just to learn how to use a specific software or tool.

From the triangulation of results, it seems that using technology for educational purposes and object-related collaborative work – which are two of the TLA principles - were the main flywheel triggering changes in our case. Furthermore, the method we developed allowed us to preserve the specificity of each point of view and the complexity of the case study. For instance, students especially appreciated the novelty of the teaching style, including the use of technologies as a mean for collaboration. The teacher was over-concerned about technical troubles and time-management. He also felt disappointed about students' initial low level of technology skills and the minor impact of the project on students with motivational problems. We also gathered some unexpected feedback, such as the great appreciation for the presence of the researchers on site, which both the students and the teacher considered as a recognition of how much important their activities were.

Find some more information about one specific case (the Salvemini combi oven) here: http://knork.metropolia.fi/intra2/?page_id=1572

3. Post course data

At the end of the trial, we again used Google Drive Sheet in order to set a semi-structured questionnaire for students (N = 26) and teachers (N = 4).

Both the questionnaire were inspired to those provided by the KNORK group (http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/KNORK-Informed-Concent-and-pre-questions-for-students_UH-2014.docx and http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc), even if with some revisions meant to compensate the absence of a pre-questionnaire and to adapt the items to the specific context of the respondents.

Teachers' questions: 1) According to you, were you are able to realize the principles of the trialogical project in your trial? Yes No - Comment 2) How much has been achieved in collaboration you had planned? Likert scale 1-4 - Comment 3) How do you rate the use of technology in your project? Likert scale 1-4 - Comment 4) What would you do / will you do differently in the next experimentation?

Students' questions: 1) After having participated in the activities of the project, I think I have improved my skills in these aspects (Likert scale: not at all-not much-enough-very): [Being able to discuss the topics of study with my classmates] [Know how to benefit from discussion with others to better understand][Know how to work in groups around a specific objective] [Being able to create products together with other (reports, documents, ppt, etc.).] [Knowing how to use technology during group work in ways that I had not thought of before] [Know how to seek and find information useful to the work group]; 2) How would you describe your participation in the project? 3) How would you describe your work in the project? 4) Which were the positive aspects, in your opinion? 5) Which were the negative aspects, in your opinion? 6) Did you expect something different that has not happened? If yes, what?

Main findings

We summarized the main findings of both the questionnaires (http://knork.metropolia.fi/intra2/?page_id=672):

Teachers:

Teachers believe they all implemented the model successfully, promoting the type of collaboration they had in mind and wel exploiting technology opportunities

Specifically, they refer to practices and techniques they used (brainstorming, jigsaw, etc.), to the collaborative construction of knowledge around the object, the enhancement of students' creativity and active engagement; finally the importance of considering the artifact as a point of arrival of the first phase and as the beginning of the next

They especially appreciate the full collaboration between all involved actors, exceeding expectations (given the structural and personal technological limits); the importance of continuous feedback; the value of a discreet and not-conditioning observation.

They think about the next implementation "with optimism and a desire to learn more about some tools to broaden the set of available technologies, considering them as a mean to stimulate attention and interest of the less motivated and 'difficult' students "use them with the students", they also want to give more attention to students showing difficulties in the use of technology by assigning small tasks with more achievable and suitable goals. Finally they plan to take into account those aspects previously given for granted (e.g. pc and / or internet connection for students at home).

Students:

With respect to the abilities eventually improved after their participation to the trial (see above), students are all quite enough satisfied. The majority of them think that skills and competencies have been well enhanced thanks to the project, particularly group working around a specific objective, the ability to collaboratively create products, knowing how to use technology during group work in ways that they had not thought of before, knowing how to seek and find information useful to the work group.

With respect to their participation, some students describe it with a quantitative self-evaluation (from good to very good), some other give details and explanation about it, referring to what they think supported it (or not): difficulty of the task / relationship with the group / teachers' support / strong interest in the technology / quality of the project / task distribution. Finally, some few students describe their participation in terms of utility for the group and cooperation in specific activities

Also with respect to their specific work, students are divided between those who describe it with a quantitative self-evaluation (this time from sufficient to excellent), and those others who give details and explanation about it, specifying how it was related to their understanding of the objectives and again defining it in terms of utility for the group. It emerged a positive general evaluation linked to the self-perceived commitment and sense responsibility.

The positive aspects identified from students are mainly related to the possibility to know and learn new tools, to study in an innovative and engaging way, to have constant support from researchers and teachers.

Less than half of the students believed that there were also negative aspects, and finds them in the technical difficulties (already reported by teachers) or in the behavior of some colleagues, which they hoped would change as a result of the project (we found the same expectation in teachers' questionnaire). Most of the students are however satisfied with the trial and declares that their expectations were exceeded.

Educational design pattern

Google Drive "jokes"

1. The educational problem

Shared environments for collaboration such as Google Drive offer the opportunity to create and edit documents collaboratively. Students may realize that they prefer an earlier version of a document that they are working on. Once students discover the function of editing documents, some may - for fun - alter the documents of the other groups. This risks resulting in the loss of important data.

2. The solution

Therefore, inform students about the possibilities of exploring changes and retrieving older versions through the version history offered by the environment or tool being used (e.g., Google Drive). If openness cannot be maintained, teachers may consider managing shared folders from an individual account and creating shared documents for each group that can only be accessed from the participants of that specific group.

3. The context

In addition to school contexts, this solution can also be adopted in work and / or research contexts, because it could happen that documents shared on Drive are accidentally modified.

Technology to motivate and manage "difficult" students

1. The educational problem

Within the class, sometimes you can have one, more or all students presenting some behavioural issues, often disturbing the lesson, or which are just unmotivated.

2. The solution

Teachers have adopted different solutions, based on the number of students and kind of issues registered:

- one "difficult" student > teachers have personally supported this guy in the creation of a draft spreadsheet to be used for data analysis. The goal was to stimulate his concentration on a specific goal and let him go over some basic math.
- many unmotivated students. In these cases, the teacher involved a colleague of his/hers with whom he/she co-managed the time devoted to the KNORK project. In this way the two teachers were able, on the one hand, to manage those students; on the other, to follow more closely the various groups of which the class was made-up for the realization of the work.
- almost nobody interested. The teacher defined specific goals in the short term, also including intermediate evaluation tests. The clarity and familiarity of the defined objectives promoted students' proactive attitude.

3. The context

Respectively:

- In school contexts in which the use of technology could help students recover bad grades. It could also be a mean to motivate students' with disabilities and to focus their attention.
- In learning contexts in which there are two or more teachers working together.
- In working and teaching environments in which the ultimate goal is unfamiliar or not clearly defined.

Other Pedagogical cases

In the second part of the year 2014, we had different courses which were applying the Trialogical approach:

- Salvemini courses started in Spring 2014 and continued in Autumn,
- Salvemini courses started in Spring 2014 and still active,
- Sapienza and Bafri Universities courses started and completed in Autumn 2014,
- Cerdo School course started in Autumn 2014 and still active.

For all courses, we have collected extensive data research, but we do not have results ready at the time. We will have some preliminary results in the next few months.

The following table shows the status and progress of courses and correspondent analysis.

School University	Project Name/ object	Target	Period	Status	Data Collection	Analysis
Salvemini School	The Menu	Adult class of a VET for cooks	March-June 2014; September	Started in the Spring 2014	Researchers' Field notes. Teacher' s pre-	Quali-quantitative analysis of researchers' field

		and hotel managers (28 students, avg age: 35 – from 18 to 60). South Italy	2014 >		post questionnaire and diaries. Students' pre/post-questionnaires. Video/Audio recordings	notes, teachers' questionnaires and diaries, students' pre-post questionnaires and diaries. Specific video-analysis
Salvemini School	Proper nutrition ipermedia	Ninth grade of a VET for cooks and hotel managers (16 students, avg age: 14). South Italy	April-June 2014; September 2014 >	Started in the Spring 2014	Researchers' Field notes. Teacher' s pre-post questionnaire and diaries. Students' pre/post-questionnaires. Video/Audio recordings	Quali-quantitative analysis of researchers' field notes, teachers' questionnaires and diaries, students' pre-post questionnaires and diaries. Specific video-analysis
CERDO	The Physicario	First year of the University School for Osteopaths (18 students, avg age 20). Rome	October 2014 - June 2015	From October 2014 >	Researchers' Field notes. Students' pre/intermediate/post-questionnaires. Teacher's Diaries. Students' online interaction. Students' individual and collaborative artifacts	Quali-quantitative analysis of researchers' field notes and of students' Pre-intermediate-post questionnaires. Teacher's diaries Content Analysis. Qualitative analysis of students' individual and collaborative artifacts / interactions.
Sapienza University	The pedagogical scenario	Third year of a University Course in Psychology. (32 students, avg age 21). Rome	September - December 2014	From September to December 2014	Researchers' and students' Field notes. Students' pre/post-questionnaires. Students' final group interview. Students' online interaction. Students' collaborative	Quali-quantitative analysis of researchers' field notes and of students' Pre-post questionnaires. Qualitative analysis of students' individual and collaborative artifacts / interactions.

					artifacts	
Bari University	An observational grid for E-Learning Courses	First year of the University Course for Work Psychologist (33 students, avg age 23). Bari	November 2014 - January 2015	From November 2014 February 2015	Researchers' and students' Field notes. Students' pre/post-questionnaires. Students' online interaction. Students' individual and collaborative process/artifacts. Video-recording	Quali-quantitative analysis of researchers' field notes, students' pre-post questionnaires and diaries. Specific video-analysis

Apart from research data, Salvemini Teachers presented a summary of their activities, describing their experiences with its main strengths and weaknessess: http://knork.metropolia.fi/intra2/?page_id=1572

5. Technology School Electronic Systems associated with Technical University of Sofia (Computer Aided Design course)

Stela Stefanova

1. Previous practices and goals, expectations, and, plans

The course at the Technology School "Electronic Systems" associated with Technical University of Sofia (TUES) is a specialized course in the field of Computer Aided Circuit Design in Electronics (CAD).

The CAD course teacher answered the proposed KNORK pre and post questions on five issues. (http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc): 1. Design principles/theory; 2. Collaboration; 3. Technology; 4. Challenges in the background that motivate change; 5. Issues of concern.

The project involved 52 students. In the beginning of the course students answered the seven CKP pre-questions and one open question:

1.1 I know how to organize my studies purposefully.

1.2 I know how to analyze theoretically the topics to be studied.

1.3 I know how to discuss with others about the topics to be studied.

1.4 I know how to take advantage of common discussions for deepening my understanding.

1.5 I know how to work in a goal-oriented way in a group.

1.6 I know how to develop productions (e.g., plans, reports, models) collaboratively with others.

1.7 I know how to use technology in multiple ways during collaborative work

The answers of the open question: What do you want to achieve by taking part in the course?

Please see the M6 report for findings about the previous practices, goals and expectations.

2. Data collection during courses

The practical training of the students in the CAD course consists in two major approaches - weekly assignments and three month long term project. The course is held for 18 weeks 5 hours per week - 2 hours theory and three hours practical training in the period from February 6th to June 30th, 2014. Weekly assignments are distributed in 12 tasks thematically related to theory topics for group work during February 26th to June 5th, 2014. The long-term project is divided into seven partial reports where are developed and are reported parts of the project. The deadline for submission of all project files and project documentation created as a shared document in Google Docs was May 15th 2014. Until the end of the school year the results of the project were reported, explained by all student groups and evaluated by the teacher.

The students had weekly assignments, developed collaboratively–shared presentations in the field of Analog and Digital circuits design and simulation. These homework activities are presented, discussed and analyzed in class.

The long term projects are developed by groups of students. They need to gather information, discuss the given problem in collaborative environment, analyze and simulate the digital or analog circuit using specialized CAD software - SPICE, Orcad and other CAD tools for circuit design. Prolonged working process with iterative circuits simulations – performing number of analysis of

the designed circuit to refine the circuit parameters and characteristics

The schedule and topics for the weekly homework assignments and schedule for delivering parts of the three-month project have been developed.

The students documented their work at every step of the development process. Planning and writing the documentation, sharing the drafts, asking the teacher and other students for feedback improving the project and project documentation, submitting respective report and presenting the obtained design and simulation results.

Students use forums, blogs and social media for discussing problems and talk about their points of view and opinions. They were encouraged to use collaborative professional tools in order to plan, organize, and execute the project tasks and write project documentation

- Face to face and virtual meetings (Skype).
- Share materials/comment easily - Google Apps.
- Google Docs for collaborative editing and commenting.
- Google Drive for file sharing. Google+ for discussions.
- Project management – Google Apps (free edition).
- Google Calendar - useful for project scheduling.

Main findings

All participants are divided into groups of two and the principle of selection of team members is free according to the preferences of the students. For the purposes of communication between students and teacher for both classes are created groups in Google Groups APE-11g-2014 and APE-11v-2014, where they can send e-mails and messages.

For each team have created separate workspaces in Google Drive to upload materials for weekly assignments and for a long time project tasks according to a pre-established schedule.

Sharing folders for each team is done so that all the other teams can see the results and comment, but without the right to edit and change. Finalized document on the long-term project is created in Google Drive as a shared document with the possibility of collaboration between the team members and comments from the teacher. In shared space it is possible to upload files with simulation results, Word documents, Power Point presentations and PDF files and other materials.

https://drive.google.com/folderview?id=0B70xRVoq4zvJc0RCQ2E5QTFFMjQ&usp=sharing

https://drive.google.com/folderview?id=0B70xRVoq4zvJU3RKZHdkemVFOWs&usp=sharing

A Web site on CAD course is developed and its navigation includes access to lectures and study materials, documents for weekly assignments and complete set of files for the long term project, the results of pre- post- questionnaries of students.

https://sites.google.com/site/cadtues/

At the end of term, the projects were presented by the teams.

The scores were based on the project outcome, the individual homeworks and the activity of the student. Weekly assignments are assessed individually for them to form an overall assessment of current practical work during the term.

The complex assessment includes the following criteria:

- Collection and analysis of information from the Internet for study of the project

- Evaluating the synthesized and simulated scheme by blocks and complete electrical scheme;

- Evaluation of the documentation and reporting of the project;

- Compliance with pre-established schedule for completion of each phase of the project;

- Evaluation of individual project work, presentation and analysis of results for each team member.

Summary of the positive and negative outcomes of the pilot CAD course in TUES

The results obtained from collaborative teamwork based on shared documents and contents, and successfully application the principles of trialogical approach are analyzed and discussed. It can be summarized that the advantage of the new pedagogical practice and positive outcome are the students' abilities to:

- Use modern professional tools for circuit design and simulation;

- Work efficiently as a group;

- Use collaborative tools and on-line resources;

- Manage their work in terms of tasks and time distribution for achieving deadlines;

- Present and report their work considering the problems they face;

- Hold and evaluate, discuss and justify the proposed solutions;

- Make peer reviews and comment results.

As a negative outcomes and problems can be pointed the following issues:

- The need to synchronize approved mandatory curriculum subjects, schedules, distribution of educational content with new design principles of the course based on trialogical approach;

- Insufficient coordination and uneven distribution of responsibility between team members;

- Insufficiently tested and optimized criteria for the assessment of group work and individual contributions.

3. Post course data

The teacher of CAD course answered to the proposal for post questions to teachers on five issues. These five questions try to follow the pre questions, but are slightly reformulated to make sense.

https://drive.google.com/folderview?id=0B70xRVoq4zvJTlRzMjdhSUo2dTQ&usp=sharing

The students (N=30) answered to the same seven statements as at the beginning of the course and the following 5 open questions:

1. How would you characterize your overall experience in the course?
2. How would you characterize your own participation and activity during the course? Please justify your answer.
3. What has been positive or impressive in the course?
4. What has been challenging or disturbing in the course?
5. How well were your goals and expectations for the course met? Please explain why.

Main findings

The students' answers to the seven statements after the course are reported in Figure 1 together with their answers to the statements before the course.

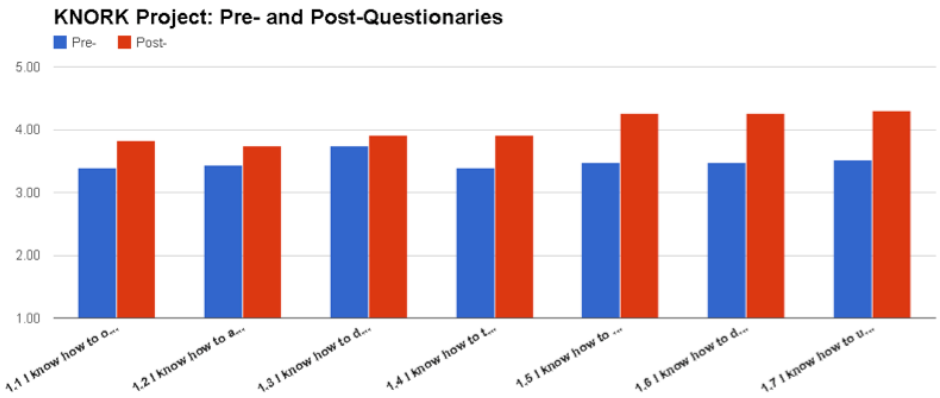


Figure 1. Average of the students' answers concerning the seven statements at the beginning and at the end of the course in the CAD course.

Students' answers to the open questions after the course are summarized for two classes and can be can be accessed at the following link:

https://drive.google.com/file/d/0B70xRVoq4zvJR1B6TnpBY196a1k/edit?usp=sharing

https://drive.google.com/file/d/0B70xRVoq4zvJSUxNTUl5dzhVZW8/edit?usp=sharing

A teacher workshop was organized for 34 teachers from TUES in Bansko town, Bulgaria on June 28th, 2014. TUS was responsible for presentation of KNORK project objectives, knowledge work competences and design principles of trialogical learning. Practical examples of CAD course program restructuring and examples of already conducted pilot in TUES were considered. Main activities were done by TUES – example of course redesign, students' collaborative group work results and discussion of already delivered pilot in TUES. The teachers were impressed from pilot results at their school; ask many questions and give ideas.

https://drive.google.com/folderview?id=0B70xRVoq4zvJZGRVR3RvQ1pBWGs&usp=sharing

6. Technical University of Sofia (ASIC Design & VLSI Design courses)

Tania Vasileva, Vassiliy Tchoumatchenko

1. Previous practices and goals, expectations, and, plans

This case investigated ASIC and VLSI design courses for bachelor and master degree students in electronic engineering at the Technical University of Sofia. Before restructuring the pedagogical practices used in our teaching, we have carefully reviewed our courses, their positive outcomes and drawbacks. Currently, to the students in the laboratory are given many unrelated tasks they perform in groups of 3-4 people. Each student should individually prepare a separate report on the outcome of the practical work. Teacher guides individual student when needed.

We decided to reconstruct the courses to give students opportunity to work collaboratively in group in common work. The goal was to increase students' motivation, to engage them to collaborative team work, to help them to learn through technology and to explore tools and environments widely used in industry. Instead of giving students many separate or loosely connected tasks we provide them with a large task (a three month long project), continuous working process, shared research plan and final presentation in groups. All group activities are organized around shared objects – collaboratively development of common project, and preparation of shared report, by applying trialogical design principles

Project development in such practice permits for self-selected time and place allocation of the participants and teachers. Guidance is provided through systematic instructions and group work rules. Assessment includes process and product assessments, group's self-assessment, and contribution evaluation of each participant to the collaborative project development.

The teachers had previous experience in applying project based learning and trialogical approach, but without using cloud computer technologies and tools for collaborative work. Before the course, the teachers answered to the proposed KNORK pre-questionshttp://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc

The students (N=20) answered (in paper) to the following seven statements before the course: http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/KNORK-Informed-Concent-and-pre-questions-for-students_UH-2014.docx

1.1 I know how to organize my studies purposefully.

1.2 I know how to analyze theoretically the topics to be studied.

1.3 I know how to discuss with others about the topics to be studied.

1.4 I know how to take advantage of common discussions for deepening my understanding.

1.5 I know how to work in a goal-oriented way in a group.

1.6 I know how to develop productions (e.g., plans, reports, models) collaboratively with others.

1.7 I know how to use technology in multiple ways during collaborative work

2. Data collection during courses

The pilots were conducted with two classes – fourth year bachelor (10 weeks) and first year master students (15 weeks). In addition to the project work, students were required to submit five individual homework assignments. Each team had to choose a project subject from a list provided

by the teacher. Two project milestones were set – intermediate report and final report.

Students were encouraged to ask for help or advice, via email, at any time and not to wait for the scheduled classes. Usually they were getting a response during the same day. Announcements were made on a Google+ hangout and via email. For student-teacher communication we use Google tools: Gmail, Docs, Talk, Drive. Each class had a Google calendar with all relevant milestones and class schedules.

At the end of the semester, the projects were presented by the teams. The scores were based on the project outcome, the individual homework and the activity of the student during the semester (email, participation in discussions, git commits).

Main findings

Working in teams of 2-3 persons, the students are required to design a digital integrated circuit. The design workflow is based on modelling, verification and synthesis. Most of development takes place outside the regular classes. For their intra-team communication, the students are free to choose whatever tools they prefer (chat, conferencing, email).

The environment consists of public cloud based services in a way that supports collaborative team work. The main design artefacts (VHDL models and test-benches) are text files; therefore we are able to borrow many tools and workflows from the software development community. The build infrastructure consists of Jenkins continuous integration server and Xilinx FPGA design tools Projects are hosted on GitHub. All participants had to register individual Google and GitHub accounts. The teacher was responsible for creating a Google Docs document for each project report and sharing it with the team. Teachers have established a working environment for students to collaborate in, but also to discus, review, comment, reflect on, provide and receive feedback.

Team members have a collaborator rights for the respective repositories, but they were asked not to commit directly. Each change had to be peer reviewed before it can be committed to the project repository. In parallel with the code development, the teams are required to create and maintain a Google Docs document which is one of the major deliverables. Initially the document contains the technical specifications of the design. Later on, the students have to add description of the implemented algorithms and architectures, argumentation of the tradeoffs made and the results from the simulation, synthesis and physical design.

Web sites on both courses are developed and their navigation includes access to lectures and study materials, calendar for learning activities, documents for the long term project and weekly assignments, VHDL models used and the library with additional materials.

http://lark.tu-sofia.bg/mpis/

http://lark.tu-sofia.bg/psis/

Course products

Completed document on the long-term project is created in Google Drive as a shared document with the possibility of collaboration between the team members and comments from the teacher and peer review. In the shared space it is possible to upload files with code review with Gerrit, simulation results, Word documents and other materials. Student projects are on:

https://drive.google.com/folderview?id=0B12QGlYWGyf-d3Q3NTVHdVdVV00&usp=sharing

Observations

Introducing new technologies and paradigms in established engineering courses is always challenging. In addition to the core subject matter, students had to learn new tools and development workflows. In a whole, it has been a rewarding experience for both students and

teachers. This approach permits for educational methods of direct student-educator contact that are not face-to-face, but are mediated through new communications technologies. Online communication allows students and academics to remain separated by space and time, but to sustain an ongoing dialogue.

3. Post course data

After the course, the teachers answered to the proposed KNORK post-questions.

The students answered to the same seven statements as at the beginning of the course and the following 5 open questions:

1. How would you characterize your overall experience in the course?
2. How would you characterize your own participation and activity during the course? Please justify your answer.
3. What has been positive or impressive in the course?
4. What has been challenging or disturbing in the course?
5. How well were your goals and expectations for the course met? Please explain why.

Main findings

Teachers believe they all implemented the model successfully, promoting the type of collaboration they had in mind and well exploiting technology opportunities.

The teacher's reflections are summarized below:

- The students appreciated the visibility of their contributions to the project – git commit history and Google doc revision history.
- Playing (and learning) with new technologies is fun. Although the students had no previous experience with version control and code review tools, they were not intimidated. Most of them enjoyed playing with the new toys and learning "cool" new skills.
- The immediacy of the help provided via email, compared to the scheduled face to face meeting, was cited as a major plus in the post-course surveys. Students were doing most of the thinking and development during the weekends and evenings. Being able to receive a timely advice on their design problems was highly regarded.
- The introduction of relatively complex, "real world" design workflows and tools highlighted even more the difference between the motivated teams and the students that just wanted to "get over it". This observation was confirmed by the scores distribution – most were clustered in the top and bottom of the scale with very few in between.

The students' answers to the seven statements after the course are shown in Figure 1 along with their answers to the statements before the course.

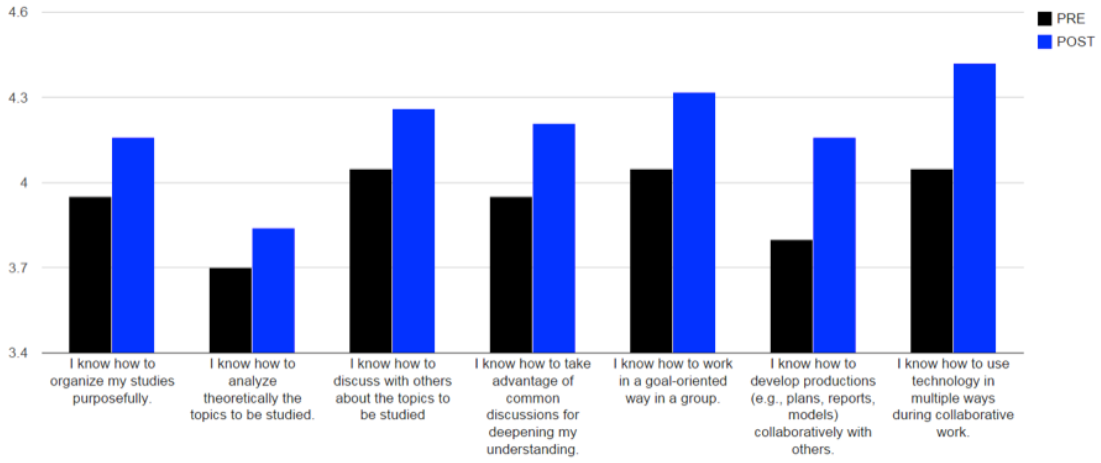


Figure 1. Average of the students' answers concerning the seven statements at the beginning and at the end of the courses in the ASIC & VLSI Design.

Below is a sample of the students' open questions answers. The four participants are identified by numbers from 1-4.

Q1: How would you characterize your overall experience in the course?

1. One of the best courses during my education
2. Acquainted with the programming language VHDL, with the design of digital integrated circuits and the use of FPGA.
3. Poor
4. Bad, but funny

Q2: How would you characterize your own participation and activity during the course? Please justify your answer

1. I would characterize myself as fairly active; I did all homework and lab exercises, but was unable to attend every lecture.
2. I appreciate my activity as good by participating in discussions during lectures and labs. Also I have no problems with homework.
3. Very limited. I`m trying to figure out but I can`t.
4. Scary

Q3: What has been positive or impressive in the course?

1. The fact that we can almost always ask a question and automatically get an answer, and not only once or twice a week; The fact that we did a lot of personal work (the homework), which helps develop our skills and way of thinking, and not just the lab exercises like in other courses.
2. I consider positive up-to-date themes and style of teaching during the course.
3. Ways of teaching and good dialogue with the teacher.
4. Attitude of the teacher

Q4: What has been challenging or disturbing in the course?

1. Some of my colleagues did not seem very interested in the subject, which kind of slowed

the whole group.

2. Coursework is challenging, but it was too late set.

3. To acquire the ability to understand and do what is asked of you.

4. VHDL at all was disturbing

Q5: How well were your goals and expectations for the course met? Please explain why.

1. I was expecting just another course where we barely study the programming language and take half of the semester trying to figure out the User Interface of the software

2. I was nicely surprised that it turned out to be something different.

3. I cannot say that I had some concrete expectations, but the course was interesting and useful.

4. I had higher expectations for them.

It can be summarized that the advantages of the new trialogical approach introduced in the pedagogical practice for students are as follows:

- Increased motivation and engagement to learn;
- Improved ability to use professional tools for digital circuit design;
- Improved opportunities for effective collaborative work in team ;
- Experience in using collaborative cloud computer tools and on-line resources;
- Experience in manage their work in terms of tasks and time distribution for achieving result in fixed deadlines;
- Experience in making peer reviews and commenting others' results.

Overall, the trialogical approach was well accepted and considered as an appropriate path for transforming students' individual course work into more collaborative activities.

4. Educational design pattern: *Tools and rules for student collaboration*

1. The educational problem

The time and group management among the students may be crucial for passing the courses. Students may need help in coping with the group work, the submission of assignments, and, with the workload in general both on an individual level as well as in the teams that they are engaged in.

2. The solution

Therefore, introduce tools/methods that enhance students' cooperation and collaboration. In practice, it may be a good idea to agree on the choice of tool together with the responsible teacher of the course. The main design artefacts (VHDL models and test-benches) are text files; therefore we are able to borrow many tools and workflows from the software development community. To get students started, set up accounts for the groups of students who are planned to be working collaboratively and share the links to their accounts during the first day of the course. Provide a few tips for better collaboration in their group work.

Projects are hosted on GitHub – one repository per project. The code review was done on Gerrit. When a team member submits a change for code review, the project is automatically built and the tests are executed. The outcome of the build job is reported back to Gerrit as +1 (pass) or -1 (fail) vote, but they are not enough to approve or reject a change. Another team member shall perform a code review and either approve the change (+2 vote) or return it to the submitter for rework. Gerrit allows the reviewer to attach comments to a source code file or a particular line inside the

file.

3. The context

University level courses which include collaborative student work and especially on software development and where there is some preparedness on the part of the students and teachers to learn to work with new tools.

7. Karolinska Institutet: Health care organisation and management (fall of 2014)

Elnta Meragia & Klas Karlgren

1. About the course and pre-course data

Background information

Educational level: Postgraduate/Master

Topic: Health care organization and management

Subject domain(s): Health informatics

The educational problem

The course where Trialogical learning was applied is called Health care organization and management. Health care organization and management, is a compulsory course in the domain of health informatics, targeted at first semester health informatics students (with technical background) in Karolinska Institutet, Sweden. The course was set up in order to run for five weeks, from 27th of October 2014 until 28th of November 2014. The aim of the course was to help health informatics students to develop insight into the mission, function, organization, and the unique characteristics of their future work environment - health care. The course was designed to introduce them with a basic knowledge about current existing health systems and health care organization.

In the course participated one teacher and twelve students. The course consisted of a number of lectures and study visits related to the context of the course. As far as assignments were related, students were expected to work both individually and in groups. The learning management system that was used is called Ping Pong and which offered the following functions: messages, common folders, learning material sharing, group discussions, reminders, assignments submissions.

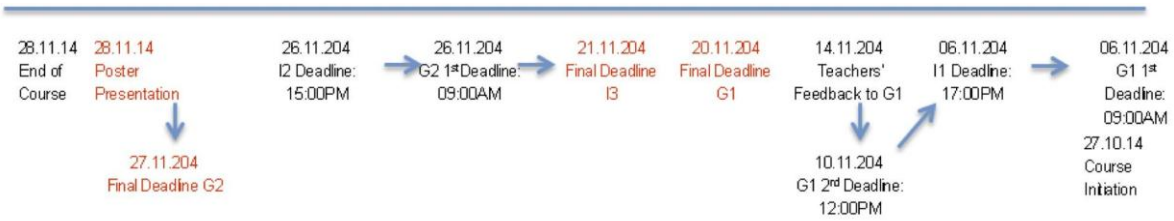
In total there were created three groups of four students and during their group work students had two assignments to complete:

1. Group Assignment 1: Health System Description (G1)
    a. The group was expected to describe in a document the health system in a selected country. They should use the Health system framework by WHO (health services, human resources, health informatics, medicines and technology, leadership and governance, financing and overall goals/outcomes) as a framework for analysis/description
    b. The group should also identify a problem, formulate a problem statement and suggest how health IT could be part of the solution to the problem
2. Group Assignment 2: Poster Presentation (G2)
    a. In the poster the group was expected to give an introduction to the problem that they had selected and argue why the problem was important
    b. Then the group should present the ICT tool that they believed could eliminate the problem by focusing on the main functionalities of the system. A discussion would follow up and finally, a conclusion.

During their individual assignments, students had to carry out the following tasks:

1. Provide peer feedback to Group Assignment 1 (I1)
    a. The goal of this individual assignment was to provide helpful, constructive feedback to the group assignment 1 from one group to another. So, members from Group 1 would provide peer feedback to members in Group 2, members from Group 2 to members in Group 3, and members from Group 3 to members in Group 1.
2. Provide peer feedback to Group Assignment 2 (I2)
    a. The goal of this individual assignment was to provide helpful, constructive feedback to the group assignment 2 from one group to another. So, members from Group 1 would provide peer feedback to members in Group 2, members from Group 2 to members in Group 3, and members from Group 3 to members in Group 1.
3. Write individual reflections on study visits (I3)
    a. As part of the course, the students had a study visit to a pediatric emergency room in a hospital. The task for this assignment was to collect observations and information about structure and management of the emergency room, and especially how health informatics tools were used in management and development of care.

For the assignments, a number of deadlines were set up in a way that students could improve their submissions but also be able to reflect on their solutions. Below there is time schema showing how the assignments submission and poster presentation were done throughout the course period. Students did not only have the chance to improve their solutions based on their peers' feedback but also based on the teachers' feedback. Their final submissions were only done after at least one type of feedback was given.



It can be seen that in total the course was quite "trialogically" built. Almost all of the design principles were reflected. The activities were organized around shared objects, the integration of personal and collective agency and work was highly supported. Development and creativity through knowledge transformation and reflection was also emphasized. Throughout the course, it was given the possibility to foster long-term processes of knowledge advancement.

However, what missed from the course was a tool/method that would enhance students' cooperation, collaboration and organization; a way that would help them both in the teams and individually to cope with the group work and assignments submission and generally the workload. As it can be seen from the time schema, many deadlines followed throughout the course, and a good time and group management was necessary since Ping Pong was not enough to support that.

The solution

In order to provide a solution to this problem, it was decided together with the teacher, that Trello was going to be used in the group work as the flexible tool that would help the development of artifacts and practices in the groups. Trello is a digital tool that enhances collaboration, coordination, integration of activities, interaction within members and reflection. The accounts for the three groups were set up and the links to their accounts were shared during the first day of the course.

Since students were quite early in their studies (just in their 3rd course in the first semester), together with the teacher it was decided that we would provide a few tips for better organization and collaboration in their group work. As a first step in order to orientate and learn more the Trello tool, it was asked from them to set up rules for their teams and put them in their Trello boards. In order that the students would feel relaxed and use Trello as they wished, the teacher of the course was not provided access to their boards. After the first day, they were left to work as they liked.

Key experiences

The main success for this course was that students were exposed to "trialogical" learning in an almost complete way. That means that all of the design principles where emphasized except maybe for design principle 5 where there was not that much interaction with experts on the field and communication with them. Regarding technology, students were quite early exposed to a tool that they will use in their future studies and will know what kind of possibilities and functions it offers. The main challenge is that students were not that mature in this early phase of their studies in order to undertake overall responsibility. It was quite hard for them to organize their individual learning and group communication and organization. The students needed all the time to be told from the teacher what to read and what to do. So, regarding technology, it was a challenge to successfully introduce Trello to them as they could not see it as a tool but just as a mean for passing the course. Therefore, some time was devoted to them during the class to just orient them around it in order to be able to learn the main functions it can offer. Still one two students questioned its usability for the course.

(This section is optional, not included in all case descriptions)

Detailed description of the pedagogical implementation

Implementing the trialogical design principles

Design principle	*Implementation in own teaching*
DP1: Organising activities around shared objects	**Shared Objects:** - Trello: Private group boards to organize time and activities around the group assignments - A shared document to describe a Health Care System in three settings - Poster solution from each group - Ping pong **Activities:** Three groups of four students with technical background collaborate (face to face or online) to create a document describing a health care system (Uganda, Croatia or India), the groups also create a poster with a possible solution around the problems they described in the first group assignment and individually the students write individual feedback and an individual assignment based on a study visit. **Processes:** 1. Students and the teacher meet and have class activities where the teacher presents the theory of the course. 2. Students form three groups of four and start working on the group assignments. They are expected to create a document describing the health care system (Uganda, India or Croatia) in one setting and create a poster related to the problem they would like to deal with. 3. Individually the students provide feedback on the assignments and submit an individual assignment based on a study visit. 4. The groups submit once their group assignments, get feedback from the students, make changes, then get feedback from the teachers and then make the final modifications as needed. (G1 + G2) 5. In the final stage, students prepare the poster and present it during the last day of the course.
DP2: Supporting integration of personal and collective agency and work	**Participants:** The groups consist of students who take positions according to their experiences and background (In this case, we have students with technical background) **Collective activities:** Students take the responsibility for the group assignments. They are expected to set rules and define roles in the groups so that everyone can contribute equally. **Collective responsibility:** All members are expected to contribute to the group assignments. It is up to them how to collaborate and share the work. Through Trello, all members of the groups can see who did what and also improve what has already been done.

DP3; Emphasizing development and creativity through knowledge transformations and reflection	**Practical Problems:** For the group work, the tool (Trello) has already been set up for the students in order to start using it the way they feel most comfortable with. Through Trello they can organize and manage their time plan and also share resources. In the common forum offered through Ping Pong, students can take part in discussions. **Reflection:** Students are expected to provide feedback and reflect on the group assignments on an individual basis.
DP4: Fostering long-term processes of knowledge advancement	**Previous achievements:** The course is conducted in the beginning of the first semester of the first year of the master. Students are not expected to have previous experience on the subject. **Iterations:** Students are offered the opportunity to improve their submissions throughout time for all of their assignments. **Planning use for the outcomes:** To help health informatics students to develop insight into the mission, function, organization, and the unique characteristics of their future work environment - health care. **Extending idea development:** The course gives basis on real health informatics issues that are identified in other courses in the program.
DP5: Promoting cross-fertilization of knowledge practices and artifacts across communities	**Things to consider in the future** **Collaboration with professionals:** The issues that the students are expected to work with, are examples from real health informatics settings where they are expected to offer related health informatics solutions. However, no contact with clients will be possible. (The course is too basic and too early in the process) **Shared problem:** The students and the teachers have different backgrounds and expectations and collaborate in order to achieve the requisites of the course. **Templates and tools:** Students are free to choose templates and tools that best fit for their needs. For the poster session they have a pre defined poster template on which they can build their solutions. **Reflections:** Students can reflect throughout the course lectures or through the forum where they can express their ideas and views on the course. Also, in the end of the course, they are expected to provide feedback on the overall view of the course. Reflections are also possible through the groups. Discussion forum provides the possibility for formative feedback to adjust the course according to the needs.
DP6: Providing flexible tools for developing artifacts and practices	Ping Pong is used as a Learning Management System (LMS) and which provides certain functions (e.g. PIMS, messages, common folders, learning material, group discussions, reminders etc) that facilitate the students. **Tools and organization:** Ping Pong, Trello **Tools and learning community:** Ping Pong, KI email **Tools and shared artifacts:** Common folder through Ping Pong, common board for time management, resources sharing and organization through Trello **Tools and reflection:** Discussion forum in Ping Pong

Learning goals

Aim

The aim of this course is to help health informatics students to develop insight into the mission, function, organization, and the unique characteristics of their future work environment - health care.

Outcomes

Knowledge and understanding

- Identify and describe the goals of a health system and explain the building blocks using the WHO health system framework
- Differentiate and describe the different challenges that health systems face in countries with different income
- Explain the organizational complexity of health care and identify the management challenges in delivering value-based health care
- Describe the burden of disease and disability on population level, both globally and locally
- Elaborate the role of health informatics in supporting health care organization and management in different contexts (low-, middle- and high-income countries)

Skills and abilities

- Compare how different health care systems use organisational and financial management to achieve the criteria for STEEEP*
- Propose how health informatics tools can be designed and adapted to current conditions in different health care systems

Assessment ability and attitudes

- Assess the similarities and differences in health cares' organizational and managerial challenges
- Argue on using different health informatics tools depending on the health care context

Preparations before the course

In order for the course to be properly built according to Trialogical learning, it was essential that a number of steps would follow up in order to inform the teacher about it and also start building the course accordingly.

1. A workshop was organized with the teacher of the course and where the ideas of KNORK project were presented, what trialogical learning is and its design principles were analyzed. Examples from previous implementations of trialogical learning were also presented and important lessons learned where discussed.

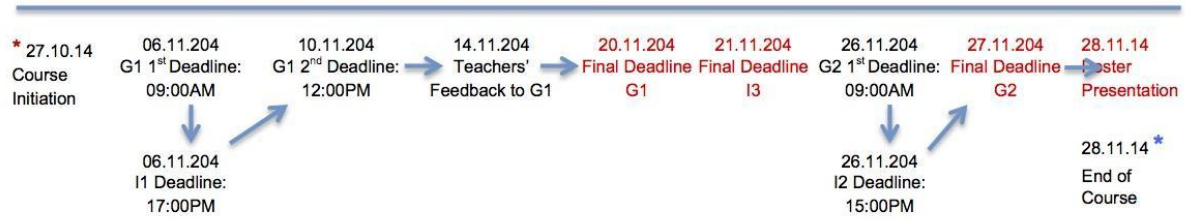
2. A second meeting with the teacher followed up, so that we would see how the course could be built:
    a. The design principles were analyzed and discussed for the purpose of the course
    b. Agreed on what kind of technologies would be used regarding group assignments
    c. Discussed about the researcher's role throughout the course (e.g. the researcher would facilitate either face to face or digitally the students regarding the use of digital tools)
    d. Agreed that the researcher would set up the accounts on Trello and the teacher would not have access on that material
    e. Together with the teacher the pedagogical scenario was written and discussed
3. A third meeting with the teacher followed up right before the initiation of the course in order to interview her and learn more about her views, expectations and concerns regarding the implementation of Trialogical learning in the course
4. An online pre questionnaire stating the purpose of the research and asking for permission to use data from the course was prepared and sent to the students of the course prior to the beginning of the course
5. Trello boards were created for the groups and invitations were sent to the members of the groups.
6. During the first day of the course, a presentation regarding KNORK project and the role of the researcher was given to the participants of the course. Also, a presentation of Trello and its main functions and possibilities were also exhibited.

ICT tool(s)

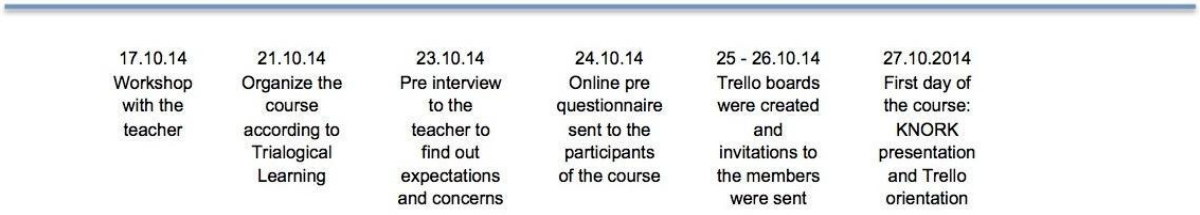
Digital Tool	Trello
Description	Trello is a free collaborative project management tool that can help users to manage their projects by organizing them into boards. In these boards, the users can add other users and assign activities or resources and see what needs to be done and who is working on what.
Characteristics relevant in regard to the pedagogical objectives	Collaboration Coordination Community formation (Integration of people) Interaction Co-construction of shared practices Reflection Knowledge building environment

Schedule and working phases

As previously described, this is the timeline for the course, regarding its implementation. Most of the work was carried out before the course initiation and after the course was ended (which will be called pre and after phases).



Below is the timeline regarding the preparations before the course started (*) (More information regarding the preparations can be seen in the Preparations before the course section):



In the end of the course (*), a number of steps were followed as well, as it can be seen below:

28.11.14 Observe the poster presentations	05.12.14 Post interview with the teacher to find out if expectations were met	28.11.14 – 20.12.14 Final CKP questionnaire was released to the participants of the course	20.12.14 – 10.01.15 Questionnaires data analysis Interviews analysis

Student evaluation

In total, 9 students only managed to finish the course. Therefore, in the end there were 2 groups, consisting of four and five participants. The participants' demographic data can be seen in the following table. As it is mentioned earlier, all of them had technical background:

#	Sex	Age
1	F	23
2	M	27
3	M	27
4	M	23
5	M	26
6	M	37
7	M	23
8	M	23
9	M	23

Experiences and suggestions for improvements

As it has already been mentioned, the course was already quite "trialogically" oriented. Students said that in the end they were satisfied by the structure and had an overall positive experience although it was quite rush and demanding.

The students found many positive things about the course such as the interaction with experts through the study visits, the team centered activities, the poster presentation. They appreciated the fact that they could both give and take feedback on their work. They liked it that it was a course that offered collaboration and the possibility for iterations.

What they found challenging was that the time allocated for the course was not enough. Deadlines were quite close to each other and time restrictions made it harder to manage in a good way their team collaboration and interaction.

The fact that the course was built around activities and shared work is something that worked really well. What did not work that well is the dynamics of the groups. In the end, one of the three groups collapsed since three students decided to drop out. That had a negative impact on the students.

Regarding the technology that was introduced, Trello, was not appreciated as much as it was expected. The students had a technical background and maybe they expected something more complex than a management system. Together with the fact that they did not have enough time due to time restrictions, its usage was not exploited to its maximum. A improvement to this issue would be that there was more time devoted to the course so that it run a little bit longer and that the teacher would actually contribute to the groups' boards. This is a suggestion for the future. Maybe next year that the course runs again, there is another digital tool that can cover the students' needs as they prefer to.

2. Data collection during courses

Before the beginning of the course, a pre interview was conducted to the (N=1) teacher of the course following the proposal of pre questions to teachers, and which included the following questions:

1. Challenges in the background that motivate change

How is your plan different from the previous implementations of the course and why?

2. Issues of concern

What bothers or puzzles you in the implementation of the new course plan?

As far as the students (N=10) are concerned, a pre questionnaire was sent to them in the beginning of the course, were their consent to gather data for this study was asked and a few questions were raised (see questionnaire here: http://goo.gl/forms/WAHGmAVscY)

Main findings

Teacher

Regarding the first question: "How is your plan different from the previous implementations of the course and why?" the teacher said that she has been giving this course for three years and there have been changes all the time in the sense that she would like to see more collaborative work between the students. She would like to have more integration between the students on issues like how students work together, how do they support each other during the learning process. So, the first change that she made on the course was the type of assignments and group work that students had to carry out. The second change was that students had the opportunity to visit a hospital and where they could see with their own eyes the healthcare environment.

All in all, the teacher highlighted that this is a course given in basic level, not in advanced level like the rest of the courses that are given in the program. Therefore, the expectations, the assignments and the learning outcomes should be aligned to that level.

As far as the second question is related, "What bothers or puzzles you in the implementation of the new course plan" the teacher mentioned two concerns that bothered her.

The first one was related to the fact that a lot of success in the course depends on the group work. Her concern was if she was going to support the students enough in order they would be capable of achieving a good group work. It does not mean that if you are in a group with your friend that it is going to be a good experience of a good group assignment in the end.

The second concern was if she could provide the students everything she could in order they could reach the learning outcomes. This always depends on how willing the students are. If the students feel that what they learn is not relevant for their future profession then they will not appreciate it.

Students

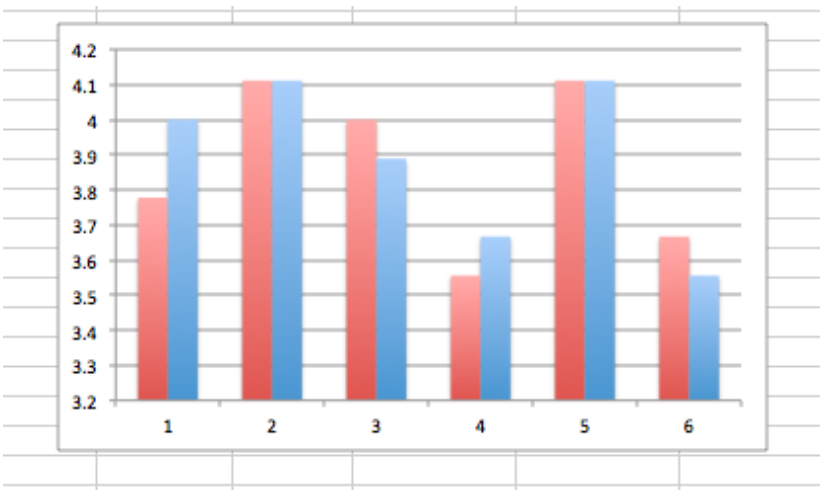
Relating to the question of what they would like to achieve by taking part in the course, the following replies were given:

Learn how to learn by working in groups **Understand** how can vary healthcare organization in different countries
knowledge on a field different from my major.

Better understanding of how health systems work in order to have a successful future career as a health informatician
I also want to develop a **great collaboration** and **group work** with my fellow students.
To **gain in-depth knowledge** of healthcare organizations and their health systems.
By taking part in this course I want to get more **practical knowledge** of working in group as I expect the course will be done mostly in groups
1.I want to gain an **understanding** on how health systems do works, possible constraints towards provision of efficient and equitable healthcare. 2.I want to **understand** how health informatics can play a role in improving on health systems. 3.Learn from **experiences** by the course facilitators.

As far as the following questions are related, the students gave the following replies

1. I know how to organize my studies purposefully
2. I know how to analyze theoretically the topics to be studied
3. I know how to discuss with others about the topics to be studied
4. I know how to take advantage of common discussions for deepening my understanding
5. I know how to work in a goal-oriented way in a group
6. I know how to develop productions (e.g. plans, reports, and models, collaboratively with others.



Answers prior to the beginning of the course
Answers in the end of the course

3. Post course data

In the end of the course, a post interview was carried out to the teacher of the course in order to explore her views on the trialogical learning following the following suggested questions:

Post course

These questions try to follow the pre questions, but are slightly reformulated to make sense

1. Design principles / theory

Look at the design principles together:

Did the design principles get realized in the course plan as intended (how did they contribute?)?

2. Collaboration

How successful was the planned collaboration (what worked well and what should be done differently?)?

3. Technology

How would you evaluate the usage of technology (what succeeded well and what should have been done differently)?

4. Challenges in the background that motivate change

Did the course successfully address the challenges of previous implementations of the course?

5. Issues of concern

What would you do differently if the course were implemented again?

As far as the students are concerned, the Contextual Knowledge Practices questionnaire was sent to them in order to fill in electronically (see http://goo.gl/forms/AAS7vL1x4w)

Main findings

Teacher

1. Regarding the first question (**Did the design principles get realized in the course plan as intended (how did they contribute?)?**) the teacher felt that most of the design principles were quite well implemented in the course. The 1st and the 6th one were mostly emphasized. The 2nd, 3rd and 4th design principles were kind of part of the design of the course while the 5th design principle she mentioned that it was not possible to implement in this course due to the nature of the course itself.

2. As far as collaboration was concerned **(How successful was the planned collaboration (what worked well and what should be done differently?)?**) the teacher spoke on two levels. The first one was about the preparation and design and the second level was about the implementation. The course was designed in a way that grades were highly connected to the level of collaboration and help that students would provide to each other both individually and in their groups.

The teacher mentioned a few challenged regarding collaboration:

- Students are on their first year of their studies in term one
- They come from different cultural backgrounds
- They have different practices and skills on how they would do team work
- There is not so much space in the course to support collaboration
- In this course they are a small group of students and if someone dropped out it could create a huge disturbance in the group dynamics and the course design

She said that she tried to overcome these challenges in the beginning of the course by teaching them how group works, how groups transform, the need to create basic group rules. But then they were left to work in their own.

3. As far as technology is concerned (**How would you evaluate the usage of technology (what succeeded well and what should have been done differently)?**) the teacher mentioned that the students used the technology despite their first resistance. However, having so many resources and spaces for collaboration, interaction, information sharing did create some confusion to the students.

4. Regarding the challenges (**Did the course successfully address the challenges of previous implementations of the course?**) the teacher said that in comparison to the previous year, all the

challenges were addressed. However, a challenge that rose this year (2014) was that students wanted to get more knowledge in micro and organisation level. They wanted more hands on work or study visits or even lecturers on health organisation level and not only on health systems level.

5. As far as **issues of concern** are regarded the teacher again mentioned the need for more hands on work experience. Students are assumed to have knowledge that they do not have and there is a need to cover that. Another thing that she stressed was the group formations and the group dynamics. That one needs to be prepared and create a risk factor and a risk plan for students that might drop out from a course and endanger the whole design which is based on group work.

Students

As far as students are regarded, the following results came from the CKP Questionnaire

The median score of the questions related to learning in the course was 4 (the scores range from 1 - 5, where 1:totally disagree - 5: totally agree), which means that the students were agreeing to the questions related to gaining knowledge and skills during the course.

The median score of the questions related to learning in the groups was 4, which again meant that the students were agreeing to the questions related to practices in the group work.

As far as the design principles are related, the following median scores came up

	Score (1 – 5)	Score (1-5)-Group 1	Score (1-5) - Group 2
DP1	4	4	4
DP2	4	4	3,7
DP3	3	3	3,7
DP4	4	4	3,2
DP5	4	3,5	3,7
DP6	3,5	4	3,2

How would you characterize your overall experience in the course?

Very good. Better than my initial expectations regarding a theoretical management course.
I was generally satisfied with the structure and presentation of the course
Experience was new, but overall positive since I was not used to participate in such a collaborative and interactive environment. I gained new perspectives on how to think and how lectures should look like.
I have learned group working skills, using feedback and developing and presenting Posters.

It was nice to get an overall perspective on how healthcare is structured and to an extent, managed and governed.
It was good, I really liked the group-work and the poster-session, that was something new and exciting.

What has been positive or impressive in the course?

participation of experts, study visits. poster session
The inter-activeness of the lectures and the team centered activities
Cross feedback, professional poster making,etc.
New way of lecturing with more interactions, ability to criticise already established norms, this way makes lectures more memorable and also encourage imagination which is usually discouraged.
The group work was very centered to the course and it has been done in appropriate steps with feedback from both other students and the course Leader.
Our highly collaborative and iterative work! Also, the dedication of our teacher that enabled very good lectures and class discussion that were relevant for us and our future work.
The poster-presentation!

What has been challenging or disturbing in the course?

too much management oriented.
Total time allocated for this course is not enough. One week more is better.
Coordination of group work and what to focus on, more practical information on more specific processes in healthcare, how can knowledge gained here be applied in a real life environment and in our future careers as health informaticians
1. The deadlines for different assignment were to short 2. Some individual works were a bit confusing so I was able to understand what I'm supposed to do at the last minute.
How little preparation or feedback we got for and from the individual work. A lot of work was done on our own, with little knowledge on what our teacher considers 'good'.
That the grades rely on simple individual assignments.

Educational Design Patterns

Tools for student collaboration

1. The educational problem

In some university courses, students may have many deadlines throughout the course and time and group management among the students may be crucial for passing the courses.

Students may need help in coping with the group work, the submission of assignments, and, with

the workload in general both on an individual level as well as in the teams that they are engaged in.

2. The solution

Therefore, introduce tools/methods that enhance students' cooperation, collaboration and organization. One such tool is Trello which is a web-based tool that enhances collaboration, coordination, integration of activities, interaction within members and reflection. Trello may help students in developing artifacts and practices in the groups.

In practice, it may be a good idea to agree on the choice of tool together with the responsible teacher of the course. To get students started, set up accounts for the groups of students who are planned to be working collaboratively and share the links to their accounts during the first day of the course. Provide a few tips for better organization and collaboration in their group work. As a first step in order to orient and learn the Trello tool, ask students to set up rules for their teams and to post these on their Trello boards. In order to let students feel relaxed, teachers of the course should not be provided access to students' boards. After the first day, let students work as they like.

3. The context

University level courses which include collaborative student work and especially on digital objects/documents and where there is some preparedness on the part of the students and teachers to learn to work with new tools.

Learning the Tools

1. The educational problem

Students have different experiences of and skills in using specific tools. When introducing new tools to a course some students may already be skilled in using the tools while other students may be unfamiliar with the tools. There is a risk that tools which are suddenly introduced disrupt more than they support individual learning and collaboration among students.

2. The solution

Therefore, provide time so that each student feels comfortable with a tool that is introduced during the course. A good idea is that the teacher/researcher introduces the tool to the students and students are asked to work individually first with the tool in order to learn how to best use it for themselves. In that way, students have the time to learn the best practices of the tool and how they can best use it before they are asked to use the tool in a team. After getting comfortable with the tool, it will be easier to contribute more efficiently throughout the group work.

3. The context

Courses where new tools are introduced and where some students may have more experience of the tools than others. Especially courses where students are expected to collaborate using the tools.

8. Technical University of Sofia: Compulsory course on Semiconductor devices

Tania Vasileva, Vassiliy Tchoumatchenko

1. About the course and pre-course data

The Semiconductor device course is a basic compulsory course delivered to the huge amount of students in 3-th semester of bachelor study.

So far, practical training was carried out in the laboratory, where to students are asking unrelated tasks given many unrelated tasks they perform in groups of 3-4 people. Each student should individually prepare a separate report on the outcome of the practical work. Teacher guides individual student when needed.

This way of conducting training allows some students just to attend in classes without being actively involved in the tasks during the semester. Teachers cannot assess the progress of students as they evaluate the final product of their work. Since the multiple tasks are the same for all students most of them just copy the reports from their colleagues without understanding. Because assessment is based on individual final product, the teacher has thoroughly to conduct face-to-face examination of each student in order to evaluate him correctly.

The educational challenge was:

1. To increase the commitment and motivation of students
2. To meet the requirements of business for:
    - Better practical training;

- Team work on common task;
- Shared responsibility for the quality of the overall product;
- Distribution of tasks in line with the specified deadline

The problem was how to restructure the Semiconductor Devices course in order to:

- Obtain better students' knowledge and competencies,
- Obtain better systematic training during the semester,
- Stimulate circuit design and simulation for project verification,
- Transfer the initiative towards student- teacher direction

The teachers had experience in using trialogical approach to learning, but in this case the problem was that the students are too many and have not enough engineering background to develop collaboratively long 3 months project. Before the course, the teachers answered to the proposed KNORK pre-questions http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/Proposal-for-pre-and-post-questions-to-teacher-first-version.doc

The students (N=98) answered (through SurveyMonkey) to the following seven statements before the course: http://knork.metropolia.fi/intra/wp-content/uploads/2014/01/KNORK-Informed-Concent-and-pre-questions-for-students_UH-2014.docx

2. Data collection during courses

In order to achieve the above mentioned objectives and resolve problems a course was restructured. A new trialogical educational approach was introduced with

- Using cloud computing technologies,
- Up-to-date communication tools for student-teacher connection
- Continuous monitoring and assistance students' activities

Trialogical approach was used to address

- Team work on shared object (report)
- Continuous and prolonged work (within 2 weeks) before the laboratory work.
- Strengthening the tasks of circuit design using devices' data sheets and simulation of the circuits, calculations of circuit's currents and parameters
- Continuous monitoring and teacher assistance in this process, providing help on request
- Reporting on the individual contribution of each team member to the overall project
- Respect to meet the deadline (after the prescribed date the project is locked for editing)

Main findings

Two-week cycle for two practical exercises is used. The main phases in each cycle are:

- Pre-lab phase (Design & Analysis tasks – circuit design, parameter calculation, simulation)
- Face to face session (Discussion on common problems, faced by most students, answering difficult subject questions)
- Pre-lab tasks continue (Design & Analysis)
- Laboratory work (Practical measurement)
- Project finalization (final preparation of shared report including measured data)

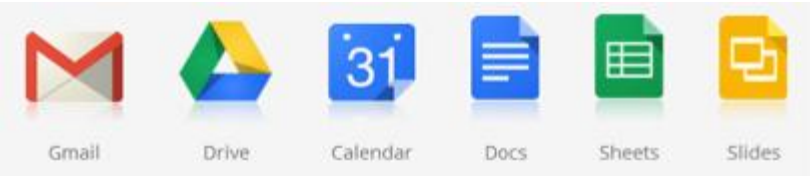
Before the course starts are done: Teams' formation; Gmail accounts of all students; Development of documentation templates with tasks to be done for all pre-lab project and final report; Guidelines for students for practical sessions; LTspice tutorial. All necessary materials (lecture slides, guides for practical work, guides for simulation tool used, e-learning trainers with interactive animation and Java applets, are on developed Web site of the course and in the Moodle system.

http://lark.tu-sofia.bg/ppe (in Bulgarian)

http:/lark.tu-sofia.bg/sd (in English)

During the course we use cloud & communication tools and specific tool for simulation. Google Tools are used for collaborative development of a common shared object in the cloud– Google Drive, Docs, Sheets; Google calendar – to set deadlines and to monitor progress – assignments, intermediate stages reporting, deadline for submission of project.

For inter team communications students can choose their preferred tools (chat, conferences, e-mail, forums). For student – teacher communications are used Google applications: Gmail, Calendar, Drive и Google+.



As a Specific tools for analysis phase is used *LTspice*® – Free Circuit Simulation, Schematic Capture and Waveform Viewer Tool.

Course products

During the semester every team needs to prepare within fixed deadline 8 (two week long) reports, concerning features and characteristics of different semiconductor devices. Completed document on the long-term group work is created in Google Drive as a shared document with the possibility of collaboration between the team members and comments from the teacher. In the shared space it is possible to upload files Word documents, graphics, pictures and other materials as well as measured data during practical exercised in the labs (there is Wi-Fi in the classroom and students are allowed to use their laptops or smartphones to access shared report). Shared students' reports are on:

https://drive.google.com/folderview?id=0B4SeESYr1Tj3fnJTdG9xRnAwNlhuNXNfamdiNTRwM3VSbFZxSTRmVV9UREdYcVV1Q3FFb1k&usp=sharing

Students' knowledge is evaluated continuously during the semester and by final exam test. The shared report grade is based on next criteria: material/organization, presentation, depth of material, handling of questions, solving problems and conclusion on simulation and measurement results. Commenting activities and communications between students - teachers are also appreciated.

3. Post course data

After the course, the teachers answered to the proposed KNORK post-questions.

After the course the students answered (through SurveyMonkey) to the same seven statements as at the beginning of the course as well as to many other questions concerning learning, practices and experience of the course, given at:

Contextual Knowledge Practices questionnaire + scales English final 2014

https://docs.google.com/document/d/1WVidUAnIHKSiNP3dpSUmy4FhaTzhMkzjetS7yAQUYXc/edit?pli=1

In order to describe their opinion and experience of the course students are asked to answer to the following open questions.

4.1. How would you characterize your overall experience in the course?

4.2. What has been positive or impressive in the course?

4.3. What has been challenging or disturbing in the course?

Main findings

The students' (N=97) answers to the seven statements after the course are shown in Figure 2 along with their answers to the same statements before the course.

Scale (1 - 5)	1	2	3	4	5

1.1 I know how to organize my studies in an appropriate way	3 (3.09%)	7 (7.22%)	18 (18.56%)	36 (37.11%)	33 (34.02%)
1.2. I know how to analyze theoretically the topics to be studied.	0 (0%)	11 (11.34%)	25 (25.77%)	39 (40.21%)	22 (22.68%)
1.3. I know how to discuss with others about the topics to be studied.	1 (1.03%)	5 (5.15%)	15 (15.46%)	35 (36.08%)	41 (42.27%)
1.4. I know how to take advantage of discussions for deepening my understanding.	1 (1.03%)	6 (6.19%)	15 (15.46%)	52 (57.61%)	23 (23.71%)
1.5. I know how to work in a goal-oriented way in a group.	0 (0%)	4 (4.17%)	13 (13.54%)	30 (31.25%)	49 (51.04%)
1.6. I know how to develop course products (e.g., plans, reports, models) collaboratively with others.	1 (1.04%)	5 (5.21%)	11 (11.46%)	39 (40.63%)	40 (41.67%)
1.7. I know how to use technology in multiple ways during collaborative work.	1 (1.03%)	6 (6.19%)	15 (15.46%)	30 (30.93%)	45 (46.39%)

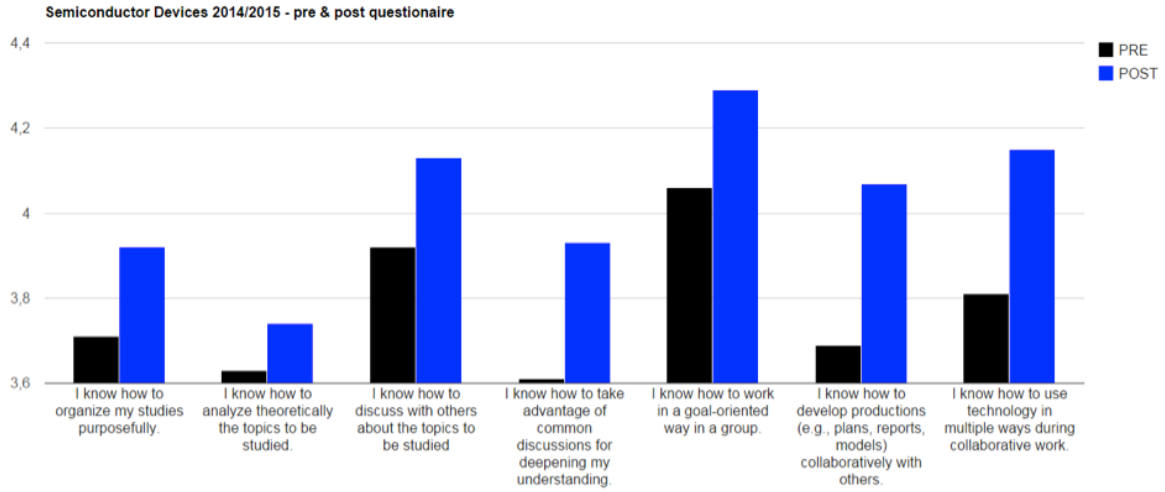


Figure 2. Average of the students' answers concerning the seven statements at the beginning and at the end of the course in Semiconductor Devices.

Answers of questions concerning learning, practices and experience of the course are given below:

2. Learning in the course

During the course I have learned

Scale 1 - 5	1	2	3	4	5	0
2.1. To evaluate the development of a shared product.	4 (4.17%)	2 (2.08%)	12 (12.5%)	23 (23.96%)	33 (34.38%)	22 (22.92)

2.2. To work on products that are used later by others or myself.	3 (3.13%)	5 (5.21%)	11 (11.46%)	19 (19.79)	21 (21.88)	37 (38.54%)
2.3 New aspects about the practices of different organizations.	5 (5.21%)	4 (4.17%)	21 (21.88%)	11 (11.46%)	9 (9.38%)	46 (47.92%)
2.4. To ask questions relating to the practices of another field.	11 (11.46%)	4 (4.17%)	15 (15.63%)	26 (26.32%)	40 (42.11%)	14 (14.74%)
2.5. To use technology to advance collaborative work.	2 (2.11%)	3 (3.16%)	11 (11.58%)	25 (26.32%)	40 (42.11%)	14 (14.74%)
2.6. To understand how important the expertise of others is when developing products.	1 (1.04%)	4 (4.17%)	18 (18.75%)	23 (23.96%)	35 (36.46%)	15 (15.63%)
2.7. To use various digital applications and use them together whenever needed.	1 (1.05%)	1 (1.05%)	9 (9.47%)	29 (30.53%)	51 (53.68%)	4 (4.21%)
2.8. To coordinate the development of products (e.g., plans, reports, models) together with others.	1 (1.04%)	1 (1.04%)	9 (9.38%)	37 (38.54%)	37 (38.54%)	11 (11.46%)
2.9. To work on the shared products by improving them iteratively.	1 (1.04%)	3 (3.13%)	13 (13.54%)	24 (25%)	37 (38.54%)	18 (18.75%)
2.10. To take responsibility for the shared group work.	2 (2.08%)	2 (2.08%)	11 (11.46%)	29 (30.21%)	42 (43.75%)	10 (10.42%)
2.11. To define sub-goals for the collaborative work.	3 (3.06%)	6 (6.12%)	17 (17.35%)	45 (45.92%)	23 (23.47)	4 (4.08%)
2.12. To understand the benefits of working in collaboration.	1 (1.04%)	3 (3.13%)	12 (12.5%)	32 (33.33%)	46 (47.92%)	2 (2.08%)
2.13. To present my expertise to representatives of another field.	2 (2.04%)	5 (5.1%)	16 (16.33%)	29 (29.59%)	21 (21.43%)	25 (25.51%)
2.14. To understand the possibilities of digital technology better than before.	3 (3.06%)	3 (3.06%)	21 (21.43%)	30 (30.61%)	30 (30.61%)	11 (11.22%)
2.15. The practices of people with different kinds of expertise.	0 (0%)	5 (5.15%)	22 (22.68%)	24 (24.74%)	26 (26.8%)	20 (20.62%)
2.16. To evaluate how much effort is needed to develop a product.	1 (1.02%)	2 (2.04 %)	12 (12.24%)	24 (24.49%)	40 (40.82%)	19 (19.39%)
2.17. To develop products collaboratively by using technology.	0 (0%)	3 (3.09%)	13 (13.4%)	19 (19.59%)	38 (39.18%)	24 (24.74%)

2.18. To collaborate with representatives of other fields.	5 (5.1%)	6 (6.12%)	15 (15.31%)	18 (18.37%)	13 (13.27%)	41 (41.84%)
2.19. To receive feedback on my products (e.g., plans, reports, models) for developing them further.	1 (1.02%)	4 (4.12%)	13 (13.4%)	28 (28.87%)	27 (27.84%)	24 (24.74%)
2.20. To accomplish challenging tasks in collaboration with others.	2 (2.06 %)	7 (7.22%)	13 (13.4%)	32 (32.99%)	34 (35.05%)	9 (9.28%)
2.21. To present knowledge in various forms.	3 (3.09%)	4 (4.12%)	18 (18.56%)	33 (34.02%)	31 (31.96%)	8 (8.25%)
2.22. To evaluate the effectiveness of my working practices.	2 (2.06%)	2 (2.06%)	16 (16.49%)	35 (36.08%)	27 (27.84%)	15 (15.46%)
2.23. To comment on the work of others.	4 (4.08%)	8 (8.16%)	19 (19.39%)	30 (30.61%)	26 (26.53%)	11(11.22 %)
2.24. To plan the collaborative work.	2 (2.06%)	4 (4.12%)	16 (16.49%)	32 (32.99%)	40 (41.24%)	3 (3.09%)
2.25. About the practices of work-life experts.	5 (5.1%)	5 (5.1%)	15 (15.31%)	20 (20.41%)	8 (8.16%)	45 (45.92%)
2.26. To develop ideas further together with others.	0 (0%)	4 (4.08%)	11 (11.22%)	33 (33.67%)	38 (38.78%)	12 (12.24%)
2.27. To understand the value of commenting work in progress.	13 (13.27%)	0 (0%)	16 (16.33%)	38 (38.78%)	33 (33.67%)	10 (10.2%)
2.28. How useful it is to learn the working practices of other fields and organizations.	1 (1.02%)	2 (2.04%)	15 (15.31%)	24 (24.49%)	17 (17.35%)	39 (39. 8%)
2.29. To have patience when finalizing products.	1 (1.02%)	8 (8.16%)	20 (20.24%)	20 (20.24%)	33 (33.67%)	16 (16.33%)

3. Practices of the course

Scale 1 - 5	1	2	3	4	5	0
3.1. I was able to pursue both my own interests as well as advance the work on shared products.	1 (1.02%)	5 (5.1%)	21 (21.43%)	33 (33.67%)	31 (31.63%)	7 (7.14%)
3.2. The course products were developed in a persistent way.	3 (3.06%)	11 (17.35%)	21 (21.43%)	24 (24.49%)	21 (21.43%)	12 (12.24%)
3.3. The web applications used in the course supported my own work.	1 (1.02%)	2 (2.04%)	26 (26.53%)	24 (24.49%)	37 (37.76%)	8 (8.16%)

3.4. Comments from other course participants supported the advancement of course products.	4 (4.08%)	4 (4.08%)	14 (14.29%)	32 (32.65%)	37 (37.76%)	7 (7.14%)
3.5. All group members committed to work on the products.	9 (9.18%)	13 (13.27%)	12 (12.24%)	14 (14.29%)	45 (45.92%)	5 (5.01%)
3.6. Different viewpoints of the participants helped us develop the products further.	5 (5.15%)	5 (5.15%)	19 (19.59%)	31 (31.96%)	32 (32.99%)	5 (5.15%)
3.7. It was interesting to gain knowledge from work-life experts.	2 (2.08%)	1 (1.04%)	11 (11.46%)	22 (22.92%)	32 (33.33%)	28 (29.17%)
3.8. Products made collaboratively turned out better than if I had developed them on my own.	9 (9.28%)	3 (3.09%)	16 (16.49%)	24 (24.74%)	33 (34.02%)	12 (12.37%)
3.9. I will be able to make use of the course products later.	10 (10.2%)	3 (3.06%)	19 (19.39%)	30 (30.61%)	29 (29.59%)	7 (7.14%)
3.10 We used digital technologies efficiently when creating the shared products (e.g., plans, reports, models).	4 (4.08%)	3 (3.06%)	13 (13.27%)	23 (23.47%)	49 (50%)	6 (6.12%)
3.11. Feedback helped to develop our course products further.	2 (2.04%)	3 (3.06%)	15 (15.31%)	21 (21.43%)	52 (53.06%)	5 (5.1%)
3.12. All participated in working on shared products as agreed.	11 (11.22%)	9 (9.18%)	14 (14.29%)	15 (15.31%)	46 (46.94%)	3 (3.06%)
3.13 In my future studies, I will be able to make use of and develop the knowledge produced during this course.	4 (4.08%)	6 (6.12%)	16 (16.33%)	32 (32.65%)	37 (37.76%)	3 (3.06%)
3.14. It was good that the course involved collaboration with experts.	1 (1.02%)	1 (1.02%)	10 (10.2%)	20 (20.41%)	44 (44.9%)	22 (22.45%)
3.15. The web applications used in the course supported collaboration.	1 (1.02%)	2 (2.04%)	18 (18.37%)	27 (27.55%)	43 (43.88%)	7 (7.14%)
3.16. As a group, we collectively took responsibility for the work.	6 (6.12%)	4 (4.12%)	15 (15.46%)	20 (20.62%)	52 (53.61%)	0 (0%)
3.17. We received feedback on our products from the experts participating in the course.	2 (2.04%)	3 (3.06%)	8 (8.16%)	21 (21.43%)	42 (42.86%)	22 (22.45%)
3.18. We evaluated the progress of the products together during the course.	2 (2.04%)	2 (2.04%)	15 (15.31%)	30 (30.61%)	36 (36.73%)	9 (9.18%)
3.19. It was meaningful to work on the course products because they	4 (4.12%)	7 (7.22%)	19 (19.59%)	26 (26.8%)	30 (30.93%)	11 (11.34%)

will be used in the future.						

For the students this was their first course in which they work in team and they consider this very positive, challenging and useful to understand the benefits of working in collaboration. Most students appreciated the fact that they had to work in a group and share the work between the members by using technology. They said that they have understood how important is the expertise and commitment of others when developing common products. They also noticed that during team work they started knowing their colleagues better than before, which helps in improving their everyday social contacts and even make new friends.

Innovative way of working in teams using up-to-date digital technologies was appreciated. The positive aspects identified from students are mainly related to the possibility to know and learn new tools, to study in an innovative and engaging way, to have immediacy support from teachers by receiving timely feedback and help. They consider positively the opportunity to work at any time at any place, which helps them to manage their free time in more effective way. Some students complain that part of the team does not work well and do not contribute to the quality of common work. Most of the students are satisfied with the new way of course delivering and declares that their expectations were exceeded.

Teachers adopted new pedagogical practices compared to previous courses: longitudinal work which also supported students' more in-depth focusing, students' collaboration for a shared outcome. According to teachers, the students learned knowledge work practices, such as information processing, analysis, presentation and sharing, longitudinal work, using digital tools and group work in general. The teachers felt that it is important that the new practices were successfully used for improving obligatory courses and for a large group of students. All teachers will continue to apply the practices and this course and into their other courses.

What was considered positive?

- Greater interest and involvement of the majority of students.
- Besides their knowledge on the subject students acquire skills to work in a team and to use advanced tools for collaboration and communication in the network.
- Better preparation for laboratory work – students are acquainted with the problems, with devices' mode of operation and the characteristics, which they will explore
- Avoiding the problem of copying reports from one to other and their delivery to the end of the semester (the project is locked after the deadline).
- Control of the process and the contribution of each participant – notes and comments of the teacher in total shared reports during its development in the Google docs' document.

What was mentioned as a problem?

- Difficulties in precise evaluation of personal contribution of each team member to common work
- Problems how to force lazy students to work well
- Extremely heavy-duty of assistants not only in classes but also in the preparation of assignments for individual & shared work and continuous consultations, monitoring and evaluation of many students' reports.

How we try to improve the solution in next course release

- We will try to divide role between students in the team and to rotate this roles during the semester
- We will reward and punish student by bonus points, contributing to their final score
- In order to stress not enough active students to participate we will force the students to comment

on each other's work throughout the course

- We will try to reduce teaching load by giving students less number but bigger reports (which will be more easy to be monitored) and by minimizing face to face seminars through development of guides how students to use cloud tools.

4. Educational design pattern: *Establish rules for student collaboration*

1. The educational problem

Not all students are equally active in student groups. Some students are more engaging in collaborative work, than others. Some members of a team are lazy and rely on others' work.

2. The solution

Therefore, encourage student groups to define roles and divide work between participating students in the beginning of the course and change these roles during the course. Suggest that work is commented on and revised before actual deadlines by setting up deadlines, which allow one day for evaluation and one day for improvements. Plan for regular meetings (face to face and virtually) where each member contributes.

3. The context

Student groups collaborating on tasks with tight schedules and where the contribution of each member is important, especially when student groups may varied including students with different motivation to study.