The introduction of new teaching methods in pharmacy education-II. The starting point

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Abstract
This article is the second paper in a series that describes the reform of pharmacy studies at the Vrije Universiteit Brussel (Belgium). This reform was necessary to prepare pharmacists to be able to face with the challenges of the 21st century. Here, we describe the main educational innovations in the first year of the Bachelors degree in Pharmaceutical Sciences. The focus is on the course “Line project I: from molecule to patient”. The basis of this course is project-based learning, but several other contemporary and original educational methods were combined. This course is the starting point of a “line project”, which continues throughout the three years of the Bachelors degree. Students can now explicitly demonstrate their newly acquired competences and also integrate them in a portfolio and in a public presentation. The portfolio is an instrument to show the development of competences and to reflect about these competences.

Keywords: Competences, line project, project-based learning, reflection

Introduction
In a previous article of this series (Petit, Foriers, & Rombaut, in press) we have indicated three incentives pointing out that a reform of the pharmacy studies and curriculum was necessary to prepare pharmacists to be able to face new challenges of the 21st century. These incentives are: (i) the profession of the pharmacist is changing rapidly; (ii) the Flemish higher education system (the Flemish community in Belgium is responsible for its own educational system) was reformed following the Bologna declaration, and (iii) an accreditation system installed by the government was implemented. For this new curriculum, goals and objectives were formulated. However, using the traditional educational methods some goals and objectives could not be reached. Therefore, educational innovations in the curriculum of Pharmacy education at the Vrije Universiteit Brussel were implemented.

In this paper, the main educational innovations in the first year of the Bachelor degree in Pharmaceutical Sciences are described. This is the course “Line project I: from molecule to patient”. The basis of this course is project-based learning, but several other contemporary and original educational methods were combined.

The goals and objectives of this course in this first year of the Bachelor degree are that it: (i) offers students a first impression of the profession of a pharmacist, whereby, the students receive a perception of pharmaceutical and medical terminology, the use of medicines and different administration forms of medicines, (ii) promotes teamwork, (iii) enhances the communication level of students (in general, but also specific pharmaceutical), and (iv) increases interdisciplinary and lifelong learning.

However, as or maybe more importantly, this course is the starting point of a “line project”, which proceeds throughout the three years of the Bachelor degree. In each year of their Bachelor studies, students acquire new competences. By following this course, they can demonstrate their newly acquired competences and
also integrate them in a (electronic) portfolio and in a public presentation. During their Bachelor programme, students receive an impression of the evolution of their competences.

The goal of our pharmacy curriculum is that the student acquires the competences necessary to practice the main tasks of pharmacy (wherever he/she works as a community pharmacist, in industry or in hospital; Petit et al., in press). In the goals and objectives that were formulated, knowledge is very important, but also skills and attitudes are equally so. As not all skills (communication, teamwork, critical reflection, developing a self-learning attitude [lifelong learning], taking responsibility for their own learning, and so on) can be reached by classical educational methods, new teaching methods were introduced. Using these new teaching methods the students were given more freedom, self-control and ownership over their own learning. Decision making and use of initiative is maximised throughout the project, from selection of information to design, production and presentation decisions.

We start with project-based learning in the first year of the Bachelor degree and the line project runs during the three years of the bachelor degree. It ends with a bachelor exam. During the first two years students work in groups, in the last year they work individually (Petit et al., unpublished).

Again, the basis of this course is project-based learning. This is a model for classroom activity that shifts away from the classroom practices of short, isolated, teacher-centred lessons and instead emphasises learning activities that are long-term, interdisciplinary, student-centred, and integrated with real world issues and practices. A major benefit of it, is that it can motivate students by engaging them in their own learning: it provides opportunities for students to pursue their own interests and questions and make decisions about how they will find answers and solve problems in professional life. It also provides opportunities for interdisciplinary learning: students apply and integrate the content of different subject areas at authentic moments in the production process, instead of in isolation or in an artificial setting. Project-based learning makes learning relevant and useful to students by establishing connections to life outside the classroom, addressing real world concerns, and developing real world skills. Many of the skills learned through project-based learning are those desired by today's employers, including the ability to work well with others, make thoughtful decisions, take initiative, and solve complex problems; http://pblmm.k12.ca.us/PBLGuide/PBL&PBL.htm; http://pblmm.k12.ca.us/PBLGuide/pblresch.htm; http://pblmm.k12.ca.us/PBLGuide/WhyPBL.html.

The (electronic) portfolio is the combining link. The purpose is that at the end of each year, both teachers and students can verify, if the goals were met and also how they were met. In a portfolio, students show a selection of what they have collected (evidence material) during a certain period (Strickland & Strickland, 1998; Driessen, Beijaard, van Tartwijk, & van der Vleuten, 2002; Janssens, Boes, & Wante, 2002; Mansvelder-Longayroux, Beijaard, & Verloop, 2002; van Tartwijk, Driessen, Ritzen, Kösters, & Stokking, 2002). It is also an instrument to show the development of competences: a structured collection of evidence material to show learning results and learning experiences. The term portfolio-learning is originally derived from the graphic arts. In practice, a portfolio consists of two major components: (i) a collection of events and experiences and (ii) a reflection on what has been learned (Friedman, Davis, Harden, Howie, Ker, & Pippard, 2001). This last component may include written reflective accounts on the submitted evidence or personal reflections kept in the form of a journal or diary. Typically, these would include reflections on problem areas, what has been learned, what has still to be learned and plans for how new learning will be tackled.

Reflection is a concept that is central to two major theories of learning, namely experiential and deep learning. In the context of experiential learning, reflection is the process of purposefully examining experiences in the practice-based setting in order to learn from them (Kolb, 1984). Kolb describes a learning cycle whereby learning needs are identified through structured reflection on experiences. These needs are then fulfilled by educational activities, and the cycle is completed by applying the new learning to professional practice and in the process, identifying further learning needs arising from the new experience. With deep learning there is an attempt made by the student to understand concepts, processes and ideas and to evaluate and build on previous knowledge.

Working with a portfolio has different advantages: (i) students learn to collect and process information in an independent way so that they learn to solve problems (they adapt knowledge, but also skills and attitudes); (ii) increased motivation; (iii) more active approach to learning with stimulation of constructive learning; (iv) adjustment of the learning process by reflecting: students are aware of their own knowledge, skills and capacities; and (v) evaluation of the end product as well as the learning process is possible (Dochy, Schelfhout & Janssens, 2003).

**Material and methods**

**Practical settings of problem-based learning**

**Size and selection of group.** Evidence suggests that the ideal size of a group for maximum interaction is between 6–8 students (Moust, Bouhuijs, & Schmidt, 1997). Due to a shortage in tutors, in some academic
The line project in pharmacy education

They can work during the project week. In this way, they are likely to make progress on the information, references, journal, and portfolio. On the last day of the project week students have contact hours with their tutor. The tutor guides, supervises and evaluates the students' evolution. For other problems they can contact the project leader who will visit also frequently the different groups.

After the project week there will be an interview by the project leader with every individual student. During this interview students give and get feedback about their individual reflection, the peer-assessment and the group work. There is also an evaluation of their development of new competences.

Instructions manual. On the first day of the project week students receive an instruction manual. During the introductory course the content of this manual and the used educational method is explained.

This manual consists of:

(i) A general part: with an explanation of project-based learning (competences, self-education, feedback, reflection, peer-assessment, interview), organisation of the project week, allocation of the different student groups, portfolio, presentation/poster, evaluation of their work (feedback)

(ii) A specific part: introducing the different pharmaceutical products for the different groups, presenting the responsible tutors with their coordinates, describing the goals students have to reach after the project week and finally adding some references for the students.

You can find an instruction manual on http://pointcarre.vub.ac.be/CMS/help/gebruikers/opleidingspecifieke/farma

Tutor. Every group of students has a tutor: this is a professor, member of the Faculty of the School of Pharmacy. He or she is responsible for the group. The tutor gets assistance by a junior staff in education.

The tutors help the students in searching the correct information. Tutors also help students to integrate their information and to make a good presentation/poster and provide them with guidelines for the oral presentation and the discussion. Tutors do not teach their group about the topic of the pharmaceutical product. Students have to search for information about their topic and discuss this with each other and with their tutors. The result is a collaborative working situation between the students and the tutors.
Feedback. Feedback can be a powerful instrument in the learning process of the students: it helps the student with his reflection on his own activities and the effect of these activities on the action of others.

When giving feedback, it is important to discuss not only the negative points, but also the positive remarks. Positive feedback is functional for the teamwork, and especially for the motivation that will result from it. Critical feedback has to be formulated in a way which makes it clear to the receiver what he has to do (always provide concrete behavioural suggestions when giving negative feedback).

Receiving feedback is a skill that students often have to develop. A lot of students will have a defensive attitude when receiving critical feedback, so it is possible that the learning process will be blocked at the moment of feedback.

When one asks to receive feedback, first formulate some points of attention and questions so the feedback giver knows what you want to know about your attitude and actions (Dekeyser & Baert, 1999).

Portfolio

A portfolio consists of three independent sections: (i) A curriculum vitae which contains for each individual student name, background, previous education, prior knowledge, experiences, personal data, etc. (ii) The data collection part is identical for each member of the group (because of the group work) and contains a selection of all the obtained information (also a selection of the collected information, references, a journal, slides for the presentation and the poster). In this first bachelor year, students make a paper portfolio in the second and third year they create an electronic version (see Petit et al., unpublished). (iii) The analytical or reflection part contains for each student the replies (with verification to material in the record part) of a set of the self-reflection questions prepared by the project leader (Table I), the peer-assessment, a report of the interview with the project leader after the project week (see Size and selection of group) and of the obtained competences, questionnaire with remarks.

Poster, presentation and slides

Students must make a poster (standardised format) about their topic and give an oral presentation at the end of the project. Students receive everything they need to make this presentation and the poster: computer with Internet access, print possibilities, coloured paper for the poster, etc. The goal of a poster/presentation is (i) to share information with others and (ii) to have the possibility to talk about it with other participants and share information about your investigation and thoughts.

With the poster and oral presentations the informative as well as the didactical-instruction part are important. A poster or presentation has to be clear and well organised. Using slides can be a useful guideline for the presenter and for the public.

The interview

Students take part in different forms of feedback: (i) self-assessment by the reflection questions; (ii) peer-assessment; and (iii) from the tutor and project leader (peer-assessment: see Petit et al., unpublished).

During the interview, students can discuss this feedback with the project leader and discuss the individual competence acquisition.

They must incorporate this feedback in the analysis part of the portfolio.

Questionnaire

At the end of the project, students must complete a questionnaire (see Table II). Here, there are two aims: (i) to compare the classical teaching method (teacher-centred) with the new education form, project-based learning (student-centred); and (ii) to optimise the line project by checking the remarks of the students.

The questionnaire consists of a series of questions, where students answer on a five point rating scale (Preston & Colman, 2000).

Table I. Reflections. Set of questions to be answered by each student and to include in the analytical part (part 3) of the portfolio.

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>1. What did you expect from the line project (on the first day of the</td>
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<td>2. course in terms of goals and objectives?</td>
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<tr>
<td>2. Now you have finished the line project, do you think these goals</td>
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<td>3. and objectives were reached? Do you see now other goals or objectives</td>
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<tr>
<td>4. covered in this course?</td>
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<tr>
<td>5. How did the project start? Give examples and explain.</td>
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<tr>
<td>6. By working on the project, what do you think are your strong points</td>
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<tr>
<td>7. and what are your weak points? Give examples, explain and refer to</td>
</tr>
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<td>8. material in your portfolio.</td>
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<td>9. Do you think you can further explore your strong points in order to</td>
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<tr>
<td>10. acquire more competences? Give examples to explain.</td>
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<tr>
<td>11. Did you already see an evolution in your acquisition of (i)</td>
</tr>
<tr>
<td>12. knowledge and of (ii) skills (e.g. working in group, oral and written</td>
</tr>
<tr>
<td>13. communication, collecting and selecting the information, making of</td>
</tr>
<tr>
<td>14. the poster/presentation) Give some examples and explain.</td>
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<tr>
<td>15. How would you evaluate your tutor? Give examples and explain.</td>
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<tr>
<td>16. What about the feedback you received? How was your impression of</td>
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<tr>
<td>17. the interview? Give examples and explain.</td>
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<tr>
<td>18. Do you have other remarks?</td>
</tr>
<tr>
<td>19. What do you expect from the line project next year?</td>
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Results

Acquisition of goals and objectives

The introduction of this course “Line project I: from molecule to patient” in the first year of the Bachelor of Pharmaceutical Sciences has two main objectives:

(i) to create an environment where the pharmacy student has a first contact with the profession of pharmacy and, in particular, pharmaceutical products
(ii) to provide the pharmacy student early in the curriculum with competences essential to current practice which cannot be provided with classical educational methods. These are communication skills, teamwork, ICT and data presenting.

Table III summarises the goals and objectives which should be acquired after the course regarding the pharmaceutical products. After three years of experience, we can state that these requirements are easily reached by at least 90% of the students. Examples of posters, portfolio’s and presentations can be found on http://gf.vub.ac.be/~zscj

Table II. Questionnaire Line project: set of questions to be answered by each student after the project week.

<table>
<thead>
<tr>
<th>I. In comparison with the classical educational methods, I experience:</th>
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<tbody>
<tr>
<td>1. The line project as</td>
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<tr>
<td>2. The gaining of knowledge as</td>
</tr>
<tr>
<td>3. The absorbing of skills as</td>
</tr>
<tr>
<td>4. The gaining of attitudes as</td>
</tr>
<tr>
<td>5. The teamwork as</td>
</tr>
<tr>
<td>6. The collection of information and data as</td>
</tr>
<tr>
<td>7. The processing/selecting of data and information as</td>
</tr>
<tr>
<td>8. The development of the portfolio as</td>
</tr>
<tr>
<td>9. The preparation of the (powerpoint) presentation as</td>
</tr>
<tr>
<td>10. The presentation itself as</td>
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<table>
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<tr>
<th>II. Study time measurement.</th>
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<tbody>
<tr>
<td>The average time that I've worked at the line project: ... hours/day</td>
</tr>
<tr>
<td>17. The time investment in the line project enables me to reach the goals and objectives of the course</td>
</tr>
</tbody>
</table>

| III. What are your remarks about the educational method, this course, the organisation, ...? |
| IV. Give your suggestions to optimalise this line project |

Student evaluation of the Line project I compared to other courses in the first Bachelor of Pharmaceutical Sciences

In order to evaluate the introduction of a new course into the curriculum the evaluation of Line project I was compared with the student evaluation of all courses in the first year of the bachelor degree.

The course evaluation is conducted on-line after each semester and covers all courses. Responding to the survey is optional and the participation is anonymous. Table IV shows the student evaluation for three consecutive academic years. The Line project I, scores higher then the overall rating of all courses in the first year of the Bachelor programme. This means that the Line project I, was well accepted by the students.

Another interesting aspect is that the scores of the students (scores given by the professors and examination) for this course was also consistently higher then the average of the students for all the courses in the first year of the Bachelor programme (results not shown). This means that the Line project I is not only accepted by the students, but also that students acquire more easily the goals and objectives of this course.

The tutors were also very impressed by the cooperation of the students during the project week. Also, members of the judging panel were impressed by the quality of the presentations and the posters at the end of the project week.
Further evaluation of Line project I by use of the questionnaire

In order to get a better insight into how students perceive the line project, which included new educational methods such as project-based learning and portfolio handling and how they compared these methods with classical teaching methods, they were asked to complete a questionnaire after taking the course (see Material and methods). This questionnaire (see Table II) consisted of closed questions, which could be answered with a five point rating scale.

In Figure 1, we compare the answers to some significant questions. We compare results from the start of Line project I in the academic year 2001–2002 until the academic year 2006–2007.

In Figure 1(A), students give an answer to the question of how they experience the gaining of knowledge in project-based learning compared to the gaining of knowledge in classical teaching methods: students experience the contribution to their knowledge every year as better (58–86%) compared to classical teaching methods or even much better (7–31%).

In Figure 1(B), students experience the contribution of project-based learning to absorb skills every year as better (51–86%) or even much better (11–40%) than using classical teaching methods.

Students were also asked how they experience the contribution of project-based learning to gain professional attitudes (see Figure 1(C)). Students of the first bachelor have more difficulties in answering this question: they experience no difference (10–54%) or better (43–72%) as compared to the classical teaching methods. They do not have a good idea of the term “attitudes”.

Students had to give their opinion about how they dealt with the gaining of teamwork (Figure 1(D)). Here, it is shown that project-based learning is contributing to teamwork better (38–61%) and much better (26–59%) than classical educational methods. Although, students are used to working in groups during practicals (average of two students), in this new situation, they must work in a larger group (average of six students): they have to work collaboratively, discuss and agree with each other, take responsibility over their work, and present.

Students also had the opportunity to provide comments (see Table II) when completing the questionnaire. The main conclusion from these comments was that students were very motivated to perform this course (Table V).
Figure 1. Evaluation of Line project I during six academic years (academic year 2001–2002; academic year 2002–2003; academic year 2003–2004; academic year 2004–2005; academic year 2005–2006; academic year 2006–2007). (A): How do you experience gaining knowledge in Line project I (due to project-based learning) as compared to classical teaching methods? (B): How do you experience absorbing skills in Line project I (due to project-based learning) as compared to classical teaching methods? (C): How do you experience gaining professional attitudes in Line project I (due to project-based learning) as compared to classical teaching methods? (D): How do you deal with gaining teamwork in Line project I (due to project-based learning) as compared to classical teaching methods?

Table V. Selection of remarks found in the filled questionnaires. Students receive this questionnaire after Line project I (see Material and methods).

(a) Remarks in academic year 2001–2002:
- students do not have special remarks: everything is good
- one negative remark: period of the project is organised to late in academic year (project education: in week 11 of 2nd semester)

(b) Remarks in academic year 2002–2003:
- students ask for more project-based learning (also in other courses) because they enjoy it
- they are now more positive about the period of the project in the 2nd semester (week 7 of 2nd semester)
- some students ask to be informed earlier of the pharmaceutical product (before the start of the project), so they can start to assemble information on their product

(c) Remarks in academic year 2003–2004:
- Project-based learning is very interesting and instructive. It promotes interaction between students
- Suggestion: project to be run twice a year

(d) Remarks in academic year 2004–2005:
- Students enjoy the experience of more practical aspects of the profession.
- Students have to work more actively. By doing so, they can absorb the knowledge over a longer period
- Due to the interaction in the group, they learn how to deal with other opinions.
- the number of students in each group is too large. The ideal numbers is five students.

(e) Remarks in academic year 2005–2006:
- Students learn how to work with a sense of team spirit
- Students are free to do what they want, when they want. There is no real steering, but they frequently receive feedback from the tutor and the project leader
- Students get more insight into the working of a pharmacy. This is very constructive and stimulating.
- Students absorb knowledge more, better and for a longer period, because they search for relations and connections between different topics
- Students see an evolution in their skills
- The number of students in a group should be restricted to 6.

(f) Remarks in academic year 2006–2007:
- It is more constructive compared to a classical course: they learn more
- Their attitude towards thinking has changed: they become more curious about medicines
- Some students chose this School of Pharmacy because they have contact with the profession and pharmaceutical products during the first year: they learn skills that they otherwise would only obtain later in the course.
- The number of students in a group should be restricted to six.
were not successful (Petit et al., in press).

So, we had a close look at learning innovations introduced in other Schools of Pharmacy. We chose a combination of two learning innovations which had been introduced by two Schools of Pharmacy previously.

Some years ago the School of Pharmaceutical Sciences of the University of Leiden (The Netherlands), introduced a course in the first year of the Bachelor, which was called “Introduction to pharmacy”. Students had to find out information about a drug and the disease it treated. They also had to make a poster and give an oral presentation (Scheffer & Kruijer, 2005). The Pharmacy department of the University of Malta (Faculty of Medicine and Surgery) introduced a comparable project, called: Pharmacy Practice Project (Serracino-Inglott, Azzopardi, & Zarb Adami, 2004).

Students start with this project in their first year of studies and they proceed with it during the following five years of their studies. In Leiden, the project is a group work, whereas, in Malta, the project is studied individually. We decided to take the best of both these innovations and to combine them. The practical settings of our course are described in the Materials and methods section. The most important elements of this course are teamwork, critical reflection, communicative skills, developing an attitude of lifelong learning, taking responsibility for their own learning.

Here, we have described in detail and will discuss the function of this line project in the first year of the Bachelor programme. But it must be emphasised that in the following two years (the second and third year of the Bachelor programme), students were invited to use their new competences from the Line project I, and the competences acquired during other courses to increase and complete the goals and objectives for their pharmaceutical product. This will be published elsewhere (Petit et al., unpublished).

Discussion of the remarks after Line project I

After the project was completed, students received a questionnaire (see Table II). They also had the opportunity to provide remarks and suggestions. Table V gives a brief overview of these remarks. A lot of the student remarks are appropriate and useful. The main reason we evaluate the project every year is to be able to react to suggestions and remarks given by the students and to adapt the project when and where necessary. Such a project should be always dynamic. Since, the implementation of the project, the following changes were made to improve the value of the project:
Students indicated that the time period in which the project was organised, was not convenient (week 11 out of 13 of 2nd semester). We also came to the conclusion that it would be better if the project took place earlier in the 2nd semester. Therefore, we have re-scheduled the project (week 7 of 2nd semester) and in the subsequent academic years, students evaluated the schedule as ideal.

Another suggestion was that the size of the groups was too large. Every year, we try to have enough different pharmaceutical products so that the groups are not too large.

Students ask for more comparable projects. This is anticipated in the following years of the Bachelor programme. The line project proceeds in Years 2 and 3 of the Bachelor programme. Moreover, other projects and problem-solving learning is introduced in three years (Petit et al., unpublished).

Another remark of both students and teachers was that this new educational method requires more work (both from students and teachers), but that the benefits resulting from it compensate for this problem.

Conclusion

As a result of the introduction of this project-based learning with a portfolio, students gain new competences, which are difficult to acquire with the traditional educational methods. Although, we have only a few years experience, we see that after one course of Project Based Learning, students already have acquired some important competences:

- Students show a sense of responsibility in their learning process. The reason for this is that the teaching method is based on a self-learning approach: students become more engaged in the learning process. They have the freedom to choose their own strategies and approaches to solving problems. Students gain valuable experience in setting their own goals, get a sense of ownership and control over their own learning, have a say in how and what they learn, and build intrinsic motivation towards problem-solving. This is in agreement with previous findings (Dekeyser & Baert, 1999; Duch, Groh, & Allen, 2001).

- Students also talk and discuss more during the project as compared to the classical lectures approach. As a consequence, students acquire communication skills.

- By using project-based learning, students start to study immediately (because the project ends after one week). This is in sharp contradiction with classical lectures; where students listen and tend to study just before the start of the exams.

- An increase in student motivation cannot be denied. Students will work cooperatively with peer-students and tutors. Projects challenge students and motivate them towards gaining competences. The fact that there is now closer contact with several aspects of the profession, is also a main motivation for the students in their study.

- Due to project-based learning, students approach other problems in other professional situations with an open mind. Moreover, they acquire communication, collaboration, planning, and self-evaluation skills.

- Students also reflect about the evolution of their competences.

Finally, as discussed earlier, Line project I in the first year of the Bachelor programme is the starting point of a larger project, which will continue in the following years of the Bachelor programme. It is also the starting point for the introduction of other new educational methods, which will be presented elsewhere (Petit et al., unpublished).

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