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The Digital HealthLab: Supporting Interdisciplinary Projects in Engineering and in Health Education

Ilona Heldal[a], Carsten Helgesen[b]

Western Norway University of Applied Sciences, Inndalsveien 28, 5063 Bergen, Norway
[a] ilona.heldal@hvl.no,[b]carsten.helgesen@hvl.no

Abstract

The importance of promoting interdisciplinary educations is recognized, however, initiating collaborative interdisciplinary educational projects is challenging. In this paper, we will present the Digital HealthLab (DHLab), an educational optional, yearly educational module developed to define systematic support for students who wished to work with interdisciplinary projects in their bachelor or master thesis. The students were from computing and from health and social care, and their projects influenced by issues regarding technology development and use. By presenting DHLab, we aim to contribute to a deeper understanding of challenges and benefits with initiating interdisciplinary education at universities. Data was collected during the initiation and evaluation of DHLab from observations and group interviews. Our experiences are important to highlight since there is limited knowledge on starting and running interdisciplinary educational modules in areas without already established collaboration traditions, even if actors from the areas are geographically close to each other. Our results showed that using processes for planning educational activities was essential to understand needs, requirements, and possibilities from the different types of educators. However, future research is needed to determine key activities systematically supporting the start of interdisciplinary student projects with a focus on the role of the different participating environments.

*Keywords:*Interdisciplinary education; technology development; technology use; engineering;health and social care; processes; collaboration.

1. Introduction

The need to foster interdisciplinary education aligned with societal changes (Colovic 2014), especially in the domain of health informatics (Brittain & Norris, 2000), is recognized earlier. Engineering solutions can ‘contribute significantly to improvements in healthcare delivery in the short, medium, and long terms’ and professionals need to ‘identify engineering tools and technologies that could help the health system overcome … crises and deliver care that is safe, effective, timely, patient-centered, efficient, and equitable’ (Reid, Compton, et al. 2005). However,

interdisciplinary education is challenging to start, especially in environments where there is a lack of experience with such collaboration (Carlisle, Cooper, et al. 2004).

Here, it is important to note the differences between interdisciplinary, multidisciplinary and transdisciplinary education (Collin 2009). For transdisciplinary education, the aim is to define a common base, e.g., theories and methods affected by the involved domains, and for multidisciplinary educations, the members of the different domains work independently on different parts of an often larger project. In this project, we focused on interdisciplinary education, i.e., the intention is to strengthen the own discipline with lessons from and collaboration with another discipline. In computing, BSc or MSc theses focusing on developing technologies for healthcare can be strengthened by knowledge about needs from healthcare. Such knowledge can be achieved via discussions about concrete needs and possibilities with students and professionals from health and social science. Similarly, in health and social science, BSc and MSc theses can be strengthened by knowledge about existing and possible technologies for the respective studies. This knowledge can be achieved via discussions with students and professionals from the area of computing and informatics.

This paper is based on the experiences gained from the educational module Digital HealthLab (DHLab), which brings together students from computing (CE) and from health and social care (HE) educations interested in carrying out interdisciplinary work. The DHLab educational module was held in 2016 and 2017 and planned to run again in 2019. While in 2016 and 2017 the start-up was mainly externally financed, the university recognized the benefits of it, and it is planned to run in 2019. Its main goals were: 1) to increase the quality of engineering education by acquiring knowledge from needs and possibilities from health and social care environments, 2) to improve the quality of health and social care education area by increasing knowledge about technical possibilities, and 3) to provide information on interdisciplinary collaboration usable for bachelor (BSc) and master (MSc) theses. Communication with professionals was determined to contribute to these improvements. During the activities of DHLab, the students could discuss with researchers and practitioners in the involved areas. These expert and students discussions can support defining a plan with important issues beneficiary for BSc or MSc theses.

By presenting the initiation of the DHLab, and evaluations from students after the activities, together with observations from the involved teachers and researchers, the paper aims to contribute to a deeper understanding of problems and benefits with initiating interdisciplinary education at universities, especially for implementing interdisciplinary educational modules between nearly co-located environments without earlier collaboration experiences.

While there are several lessons for planning new educations *within* health informatics (see, e.g. (Dorsey, Clements, et al. 2015)), the goal of DHLab is not to define a new educational focus or to change the main focus of the participating engineering or health and social science environments.

2. Developing processes to overcome interdisciplinary barriers behind technology development for healthcare

Despite modern technologies populating operation and nursing rooms, medical offices, and the presence of similar technologies in education rooms developed specifically for professionals, many systems are not sufficiently user-friendly or trustable to use. The presence of technology in the classroom, as well as at a working place, does not guarantee valuable use. Missing information, or misinterpreting existing information, time pressure, not user-friendliness, or even unintended consequences of use can result in problems for seamless use at the working places, and in the working routines (see, e.g. (Ash et al., 2004; Hagiwara et al., 2013)). Although technologies can promise several benefits, they are not necessarily easy solutions to adopt. Several studies are investigating barriers to overcome to achieve a seamless introduction of new technologies. As an example of such barriers, Taniverdi and Iacono identified the values of considering technical, financial, behavioral, organizational, and knowledge barriers (Tanriverdi and Iacono 1999). Understanding of these barriers was further researched by Suneson and Heldal by illustrating the need for lowering the inter-organizational barriers. Organizations without earlier communication and collaboration experiences need to allocate resources for building common support for their new collaborative activities (Suneson and Heldal 2010). To lower or overcome these barriers can be difficult, and requires a deeper understanding from both technology developers and healthcare professionals. The interdisciplinary collaboration requires being able to communicate well (Hermans 2011) and that all participants have a common understanding of their shared problem. It is necessary to understand the practical issues around the solution - the workflow it shall support, the needed human-computer interaction, other systems and processes being involved, e.g., the value generation process with the technologies (Melville et al., 2004). Professionals involved need to understand each other’s perspective; only one profession cannot solve the problems. Understanding and practicing interdisciplinary collaboration already at the universities may lower these knowledge barriers later, at the workplaces, so future nurses and social workers can plan better, with engineers, for future technologies supporting healthcare.

At the same time, the students with diverse background need to understand how they can handle the complex information from these different domains, and how they can generate values for themselves. They need to know how to process voluminous information, what they need to prioritize or to neglect. In general, using process steering instruments helps to keep the focus of

attention in such complex activities, with recognizing core values, longitudinal activities, planning collaboration and defining multidisciplinary assessments for core competencies (Carlisle, Cooper, et al. 2004). The knowledge from one environment does not necessarily flow over seamlessly to another, without additional support. Not only domain knowledge, but also knowledge about tools and methods to work in the interdisciplinary arena is necessary, e.g., planning this type of teamwork and processes supporting these.

DHLab recognized this importance for defining processes, an approach supported by necessities and benefits to plan education in general (Biggs, 1996; Och and Ney, 2003), and in particular for this case. Being able to understand each other for CE and HE students, and enhancing activities focusing on the willingness to collaborate and develop new ideas together needs resources and plans (Chau and Hu 2002). DHLab tries to tackle this issue by illustrating concrete issues and real problems around working and problematic communication, cooperation, and idea initiation (Frenk, Chen, et al. 2010). Such training may strengthen the CE and HE students' competence for developing meaningful solutions, with increased social responsibility.

3. DHLab – environment supporting interdisciplinary projects

At the Western Norway University of Applied Sciences (HVL) several BSc projects at different computer and engineering educational programs focus on developing new technologies and applications for health. There are also a few BSc student projects from health educations (HE) considering modern digital technology use. These BSc projects are time and resource limited, and seldom include resources to investigate expertise from other domains than the own domain. The ultimate aim of a BSc project in engineering is to demonstrate knowledge, skills, and competencies within engineering. Therefore, CE students seldom discuss ideas or test their prototypes with professionals from other domains. Similarly, HE students seldom talk about other possible technical solutions with technical experts during their project work.

Many different universities have environments with teaching and research expertise in health informatics, a natural arena for issues regarding development and use of technologies supporting health and social care. Such an environment does not exist at HVL, while research and teaching within engineering and within health and social science, separately, have already established traditions. DHLab was motivated based on regional needs for student projects with interdisciplinary competence. Private and communal organizations showed interests in strengthening their collaboration with the university with such interdisciplinary projects, which may begin with student projects. Such organizations were Haukeland University Hospital, Avans, Bergen municipality, the simulator center at Haukeland University Hospital, etc.

4. Planning and starting DHLab

DHLab contains five half-day meetings with collaborative discussions and presentations from educators and researchers from the involved environments and practitioners from health informatics. Particular topics addressed are:

- learning to use digital tools,
- providing examples on current digital tools for healthcare,
- providing a basic understanding of technology development,
- discussing needs in health care,
- encouraging and supporting the development of new ideas for interdisciplinary cooperation.

The participants are expected to achieve knowledge about trends for what is new and interesting within health technology and to build up a common understanding of each other's academic language from the involved domains. Furthermore, they should gain skills needed for planning a joint project and using digital solutions to communicate within a project, and get experience with methodologies supporting the development of interdisciplinary projects. Students from different faculties are introduced to e-learning resources for different kinds of digital collaboration tools to practice professional communication.

DHLab was developed to support BSc projects, but student interests extended to MSc projects, already during the first year.

The different interdisciplinary project ideas for BSc or MSc thesis will be developed into descriptions for BSc and MSc theses with clear demarcation of involvement from both areas. Thus, a good BSc project in engineering should include a clear description of the motivation and need in the health care domain, as well as concrete ideas for user involvement, e.g., possible user tests. Similarly, a good BSc project in the health domain should discuss possible technologies and motivations for the chosen involved technologies.

At the present stage, it is not possible for CE and HE students to work together on a joint BSc project due to study regulations. Cooperation between a CE and an HE student would give rise to two separate BSc theses, with separate formal requirements. This makes close cooperation on a joint interdisciplinary project difficult.

DHLab was taught for the first time in autumn 2016, then it was improved and run for the second time in 2017. Both years the educational modules were run during autumn, beginning in early September and ending at the end of November.

In 2016, seven students participated, and in 2017, 14 students participated and followed all the DHLab activities. In addition, at several meetings, we had a few more students attending who

chose not to follow the entire module due to several reasons. The students were recruited from several courses. After the first year, the BSc students from the first year acted as ambassadors for recruiting new students.

After each year, a few months after the module, an evaluation was scheduled for all participants. The set up was as a semi-structured group interview, about general impression, main opinions, what was good and what was less good, what are the impressions about possible BSc/MSc project follow-ups, suggestions about structure. This was followed by an open discussion about general values related to such interdisciplinary modules, needs, and possibilities to follow it. Each meeting lasted approximately two hours. The results come from these evaluations, participant (teacher) observations, and summarizing reflections discussed together with the planning activities.

5. Activities in DHLab, and process support

To plan courses that are not compulsory for students is challenging. Therefore, to define and align activities and possible assessments process steering instruments was discussed (see, e.g., Briggs, 1996). Since the background of BSc and MSc theses is interdisciplinary and also should be used with interests from mainly regional organizations, several project support tools from the university and industrial organizations were considered. There are several models aimed to support projects in general, e.g., Lean is used in several parts of the health care (Brandao de Souza 2009), even together with other process support systems (Weber, Reichert, et al. 2008). There are process models developed to support communication activities (Hibbard and Peters 2003) or to measure progress (Purbey, Mukherjee, et al. 2007) during the length of an educational module (Kember 1989). Due to the focus on communication between two different stakeholders the Thesis Steering Model (TSM, see Heldal, 2016) was modified for DHLab 2016, but changed to a seemingly easier model.

5.1. About TSM

Thesis Steering Model (TSM) (Heldal 2016) is a process steering instrument which was earlier applied for supporting industrial doctoral projects. The familiarity with this instrument, and the fact that it incorporates two, often contradictory interests from industry stakeholders and academic stakeholders, motivated the use of the model. DHLab incorporated interdisciplinary collaboration between CE and HE students, and practical engineering and healthcare environments. Based on this model, the Digital Helselab process Model (see 5.2) was defined.

The TSM is an instrument for longitudinal support based on seven or so gates (see Fig. 1) with a special focus on the first gates until idea identification and generation. The four streamlines in TSM represent the constantly reoccurring interests in an industrial doctoral project, i.e., to obtain

research values (1) and business or organizational values (2), and perform necessary activities in the Ph.D. process (3, the examination management) and a separate streamline for project control (4). This fourth integrate the three important areas with a focus on quality, time, cost and content of the project. The examination can also be defined through the gates representing activities in time, through the Licentiate (Lic) means a mid-term examination and later Ph.D. examination. These activities had to be evaluated in all parts of the milieu with different activities. One of the main benefits of this model is to allocate enough time to identify the common idea, interesting enough for the two environments, and sort out communication problems.

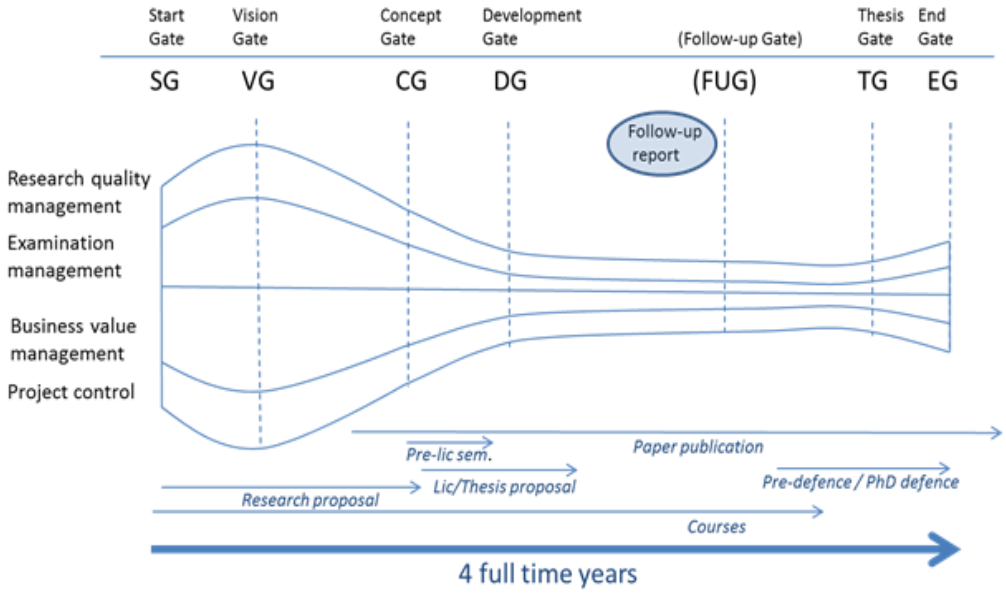

Fig. 1 A general overview of a doctoral project via the process model: TSM.

Each gate involves an associated gate meeting with systematic and thematic questions that are set out in templates. The answers to these questions require a great deal of teamwork on the part of the project group involving stakeholders from the different environments.

Thus, the TSM is not a quick fix guide to get past the gates, but more a process tool to get communication flowing in the project group and to harmonize the members' expectations. It is a method used to identify and discuss scientific requirements and find associated business values. Probably its most important benefit is the two first meetings, the start gate, and the vision gate. These meetings are planned to allow the members from the different interdisciplinary background not only to generate ideas, but also to communicate and sort out basic misconceptions due to their different domain knowledge (Martin, 2010). By using the model the participants can be supported to generate ideas carefully, anchor it, and plan activities, and *when* they should be done (by identifying important phases and elements as 'gates'), but leave the *how* question to the project group. This provides guidance and quality assurance for the research projects by going through a

series of gates. By using TSM the communication between the different partners is systematically followed up and documented.

5.2. TSM adapted to DHLab

The starting point of the DHLab module corresponds with the start goals (until the gate idea definition) to TSM, albeit this project is much smaller in scale. Since the creation of new ideas is important and requires intensive negotiation of possible ideas and contributions from the involved parties, taking this step for granted does not necessarily result in good collaboration from all parties. Already in this initial part of the student projects, communication can be difficult as shown by, e.g., using the same terms for different meanings, different cultural or organizational background, priorities and regulations.

For structuring the facilitation of communication and development of ideas, four gates covering at least five meetings were defined (see Fig. 2 and Table 1). Between the last two gates, the students could book a meeting(s) with involved teachers from the different professions. The gates were planned seminars together with a group work between CE and HE students and teachers or the involved professions. DHLab is short, including only five meetings, and the four streamlines of TSM were reduced to two in DHLab: focus on valuing ideas for engineering and health and social care.

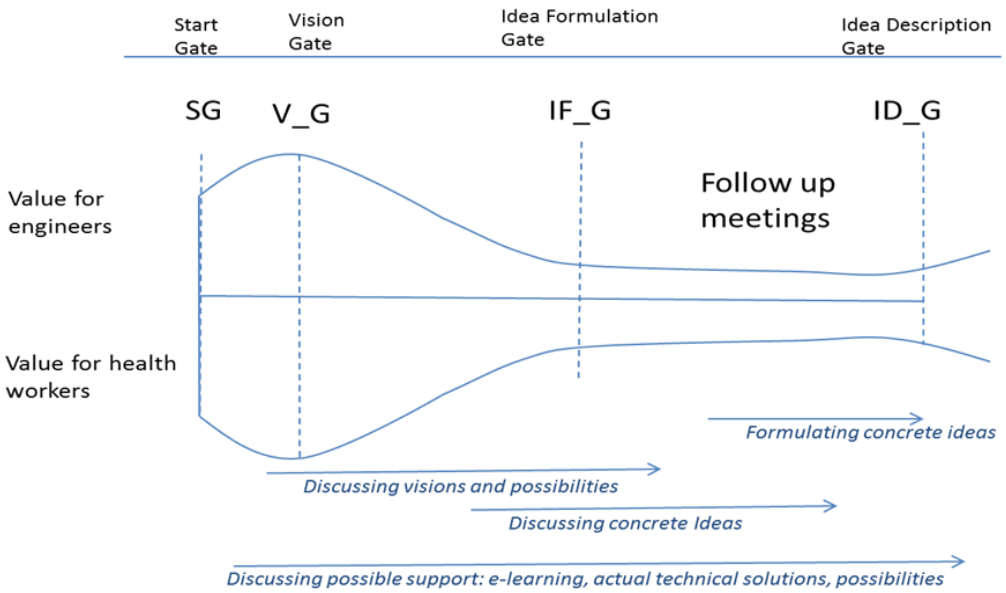

Fig. 2. A schematic picture illustrating the main elements of DHLab Process Model.

The projects within DHLab begin with a general overview (SG), followed by idea generations and discussion (V_G). At the start, it was important to have separate activities for forming the working groups with members from both CE and HE educations. To identify common ideas,

interesting enough, for the two environments, and to allocate enough time was considered important. Therefore, a separate 'gate' was planned for discussions about possible and less possible ideas, associated to the own ideas of the students. These were performed in different possible group coalitions, involving different students, teachers and also representative people from organizations (IF_G). After a task with the idea descriptions (the suggestion for own BSc and extended to MSc theses), these had to be reformulated and discussed, again, by professionals from the different area, during follow up meetings planned by the students. These final ideas were described at the last seminar to both organizers and students. This description included clear involvements (from idea generation to communication and tests) with students or professionals from the other profession.

Table 1. Main activities starting DHLab and their correspondent gates.

Seminar	Activities	Gate
1	• Present participants • State-of-the-art overview, lectures • Initial ideas, brainstorming • Elaborate further follow-up ideas	**Start Gate:**Present the structure of the seminars including the process steering model.
2	• Discuss ideas and visions • Establish a common language and understanding for goals • Create interdisciplinary groups, to cooperate on a common idea.	**Vision Gate:**The project group is formed, and the project vision and expectations are formulated in general terms and are agreed to commence the preparing the project. Initial scanning of related work is carried out with a focus on novelty assessment.
3	• First elaborated version of idea • Focusing on clear vision • Identifying stakeholders • Describing novelty • Judging realism.	**Idea Formulation Gate:** Multiple project visions are generated. Several possible ideas are investigated, and possible goals and research problems are formulated. Related research and potential external cooperation environments are considered. The vision of the project has now become clearer.
4	• Second elaborated version of idea • Moving from idea to product • Security and ethical aspects • Selling points.	**Follow up meetings:** The main feasible research goals are discussed, and ways of reaching these are examined. The research background needed is discussed together with possible experts.
5	Final presentation of idea, sufficiently well described to be accepted as a BSc or MSc project.	**Idea Development Gate:** Here clear targets, plans, and methods to achieve the research aims are formulated. The resources needed to do so are planned and secured from all stakeholders, and therefore presentations were done at

'While TSM meetings were for project groups including interdisciplinary members, here a meeting included several project group. In order to know if the students are on the right way towards generating manageable project ideas, we need to measure progress during the time. These measurements are collected before the second (number of ideas generated), third (number of presented complete ideas), fourth (number of meetings required by experts) and fifth (number of final presentation of a proposed BSc or MSc project) seminars. The DHLab Process Model describes partial goals for the five meetings, and it also gives a systematic method for measuring the progress of the students' work (see Table 2).

Table 2Measuring progress through the seminar process

Seminar	The focus of activities	Progress measures (answers)
1	• Present participants • State-of-the-art overview • Initial ideas, brainstorming • Elaborate ideas for next seminar	After seminar: How many ideas have emerged? • from health students • from engineering
2	• Elaborate on ideas, categorize • Common language and understanding • Create interdisciplinary groups, to cooperate on one common idea each.	How many ideas after "homework"? • the groups´ "own" ideas • clarity of the idea at this point • interdisciplinary character (observation)
3	• Present first elaborated version of idea • Focusing on clear vision • Identifying stakeholders • Describing novelty	How clear is the idea at this point? • groups cooperation (observation) • groups communication (observation) • external help needed
4	• Present second elaborated vers. of idea • Moving from idea to product • Security and ethical aspects • Selling points.	How clear is the ideas at this point? • groups cooperation • groups communication • external help needed
5	Final presentation of idea, sufficiently well described to be accepted as a BSc or MSc project plan (good enough sketch).	How many well-described ideas were developed? • How many hours of work has been done during the cooperation? • How have the participants experienced the course?

5.3. The Double-diamond model

After the evaluation of the educational module in 2016, the students did not understand the value of the DHLab Process Model process model clearly, and one of the involved teachers argued for the benefit and the easiness of using the double-diamond model (Howard, Culley, et al. 2008; Design Council 2018). Double-diamond is a model for a creative process which unifies the process used by many design disciplines, with two broader focuses. First, in the left diamond, on exploring and discovering the essence of a problem, in order to define the problem as correctly as possible, and secondly, in the right diamond, on exploring possible solutions to the defined problem(see Fig. 3).

The processes in the first area (or diamond) gives good guidelines of how to work in the cross-disciplinary teams with focus on "Discover" – getting as much insight as possible about the problem area and its context using divergent thinking - and subsequently focus on "Define", - using convergent thinking to reach a problem definition. The second area of the diamond involves creating a solution to the defined problem, by exploring potential solutions and concluding with a solution that is implemented. The students' work at DHLab clearly falls within the first diamond, while (possible) further work on the idea will happen if they adopt the idea for a BSc or MSc project.

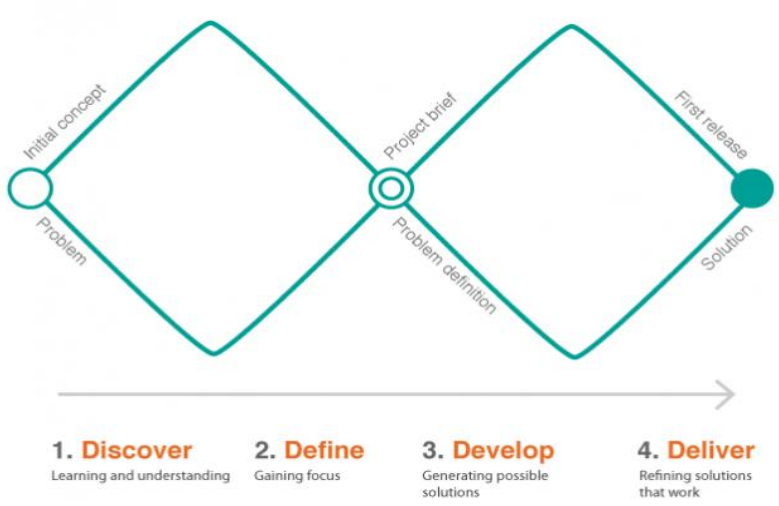

Fig. 3. Double diamond design process.

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https://www.ebi.ac.uk/training/online/course/user-experience-design/phases-design

The double diamond model was used to support and motivate activities in 2017, and explain the processes leading from an idea or a need to a problem definition.

6. Reflections and results for organizing DHLab

6.1. Recruitment

Recruiting students turned out to be harder than we expected, particularly the first year (2016). Many students are reluctant to spending time on activities which do not “pay off” with ECTS, and many students have social activities in the afternoon and evening. Some of the students also have paid work, which is prioritized above extra-curricular activities. During each meeting there was 8-10 participants, but the number of constant followers was seven in 2016. These students followed all activities this year. This number increased to 14 participants during autumn 2017. This second year, some student groups from a compulsory course on innovation, chose to cooperate on projects involving digital solutions for health and social care innovation, and they also joined the DHLab.

6.2. Resulting projects

The following are finished suggestions for BSc projects which were later implemented:

- A dynamic digital form for collecting data from patients, about their pain registration
- A “Digital Pictogram” for communication between people without common verbal language
- A common calendar to improve communication between home nurses, patients and next of kin
- A method to discover risk of overdose with drug addicts

Two of these projects were continued as BSc thesis projects by the CE student themselves, and one was implemented by other students. Furthermore, two health care students used the overdose prevention idea for their joint BSc thesis in nursing.

The group that came up with the idea for creating the dynamic form for pain registration consisted of students both from CE and HE. However, the HE student had to drop out due to lack of support (due to formal problems) for working with the suggested BSc thesis. Additionally, discussing processes influenced an MSc student who developed an idea about process support via a mobile application for future parents (mParent App, Heldal et al 2018).

Here it should also be mentioned that two nursing students who participated in the first year, were not recommended to choose the project they wished initially, due to the regulations for the BSc project in healthcare.

6.3. Reflections from evaluating DHLab after the meetings in 2016

There were six students present at the final evaluation. Almost all students are appreciated the longer time allocated for and spent with idea creation. Here are some citations:

"I learned a lot, and I know that I can still innovate because I have ideas ... I also can play with the ideas and see it and examine it from different angles, both as ideas or as a suggested solution..." (Stated by an HE student, who appreciated the different role of an idea for a BSc work, but also for future users.)

"It is great to contribute to the technical solution. I did not have any idea that I [could do it] earlier." (Said another HE student.)

"I think it would be better to work with real practitioners. It was interesting to see what they believed to be usable… it was different from what I thought from the beginning." (The insight of a CE student, about the value and the difficulties of involving users in testing prototypes.)

Negative experiences were related to use of the chosen digital tools. Students did not appreciate tools, recently recommended by HVL, such as OneNote, SharePoint. Since the involved students were from the third year from their education, and already familiar with using digital tools for their work, they did not understand why they should choose another tool as they are used with. They used tools for sharing documents, e.g., Google docs, or communicated via Facebook instead. Neither did they appreciate the e-learning resources about how to use these tools. The added value of the new tools was too low.

"Why should we learn another tool when the existing ones are working?" were the opinions from both CE and HE students.

Most of the students appreciated the work within DHLab, and except from one HE student all wished to suggest it for their fellow students. This HE student was disappointed, due to not having the possibility to work with a CE student on the idea interesting for her. The general comments showed that HE students had higher difficulties to realize their ideas and combine the activities within DHLab with their activities for BSc or MSc work afterward. However, another HE student, who had a great idea realized by only CE students (with small modification) said that she is not disappointed since after all her idea was used and generated a good engineering work. Here, it has to be mentioned that the structure of DHLab's activities followed rather the BSc activities planned within the education for CE students with clear, separated time allocated for practical and theoretical issues.

While we had a structure for the meetings and planned for the presentation of the idea work as it progressed, the students did not remember the process steering instrument being used. This was a surprise, since it was used continuously, even if names (of gates, deliveries, etc) at the meetings were not used explicitly, except in the first two meetings. During these two meetings, the progress of the project was discussed more in detail. The students also said that they missed a much more "clear red line" through the seminars.

6.4. Evaluation from 2017

For this evaluation, again, all participating and partly participating students were invited, but only five participants met the organizers for a final evaluation of the module from 2017. The discussions were set up as a group interview about the general impressions: what was good or less good and needed to be improved for the students to be sufficiently satisfied with the time and the content of the meetings to prioritize the module.

The main opinions varied a lot 2017. The main obstacle to follow the module was the fact that it is time and activity related, and difficult to set in in their own plans. Several students agreed that it would be beneficial to have a similar type of educational module, mainly to train interdisciplinary collaboration in general, and not necessarily to prepare activities for the next coming thesis work. All students agreed that it would be great to have the possibility to work as an interdisciplinary team, and they wished to have obligatory education about tools and processes supporting interdisciplinary education. Most of them agreed that having the possibility to work on the same BSc thesis for students from different environments, would beneficiary. Even if the initial opinions about the 'type of the students' studying in the other domain was not without stereotypes, the general impression after the collaboration was good.

During 2017, more students worked with OneNote and SharePoint than the year before, when information about this tool was enhanced and discussed in the module. A reason for using these tools was formulated by one of the students: 'Yes, we use it since we are obligated to use it in another project.' Does this mean that students need motivations from several other projects for using a tool? - and, in general, there are too many tools, so they need to minimalize the usage of these to the most necessary?

Strangely enough, the students, still do not remember about process steering instruments, but appreciated the systematic planning and would require even more implicit systematic plans, including more feedback from the other area.

"I found a bit stressful to not have an idea until the third meeting, but it was OK. Now I understand that the earlier discussions led to something. Actually, I wished to have more feedback from all, from teachers, but most of all from practitioners", according to a CE student.

"I also found it difficult to connect to and wait for people… I have contacted other people, identified to be relevant stakeholders for my project, from physiotherapy but I do not obtain an answer, and I felt it was much time spent with waiting for answers. During this time I would need information about what I would need to work between meetings, or after the next step when I have or not have the help needed. I think more agile planning would be more beneficial." Said another CE student. This is a lesson, probably for the organizers, to focus on planning activities even for situations when students need to wait. Suggestions about handling these waiting-periods would also be appreciated. Several others agreed that not only the actual next step and activity,but an orientation between the steps and activities and other involved actors would be necessary.

7. Concluding remarks

This paper illustrated a number of benefits, but also difficulties with starting up a required educational module in an area needed to be developed at a university in Norway. It was shown that geographical closeness does not necessarily foster collaboration if other resources are not allocated for the module, and if the research and education areas do not have earlier collaboration traditions. Interests from students and some teachers can start up collaboration, but for longer-term planning, systematic resource allocation and harmonization to the different educations would be necessary.

While students overall appreciated DHLab to be helpful for thinking and planning their coming BSc or MSc projects, it was realized that some obstacles on the road towards full collaboration need to be handled. While several process steering instruments were applied, the connections between the activities and concrete support for activities have to be more accentuated. Many

students are less interested in participating in voluntary activities which do not produce ECTS or other direct results. Also, many CE students can be uncertain about engaging in other areas, e.g., with a health professional, which is seen as unknown territory. The same situation is seen from the other side; the HE students have an almost none existing timeframe in their plans for extra-curricular activities. It is even more difficult to define a course module, such as DHLab as a formal part of their studies. While interests from some of the teachers and researchers were easier to obtain, their interests lessened during the time. There were also professionals who have been more reserved and do not see the usefulness and relevance of close cooperation from the beginning. Being situated in neighboring physical buildings and having common interests in developing teaching environments and research areas in focus was not sufficient to establish a longer-term collaboration. Recruiting students was also a challenge.

Many of the attitudes and thoughts from 2016 influenced the planning and the outcome of this educational module in 2017. However, it is dangerous to rely directly on some evaluations. After the outcome from the evaluation from 2016, seminars for using new digital tools from the activities were removed – but the students have begun to use these by themselves. The process steering model was changed from TSM to the Double Diamond model, but the students required, again, even more, the explicit connections between the different activities, requesting a clearer red line. Maybe process steering instruments should be explicitly included as a separate seminar during the educational module? Evidence on the benefits of steering instruments was not found, but the need for was accentuated. Which one, and how to find these forms, are questions for further research. For planning the next educational module for 2019, it would be important also to involve third expertise, the educators, people knowing more about pedagogical models and processes. There are clear descriptions for requirements for the quality and the content of a thesis report at the different levels, so maybe questions can be formulated more precisely for interdisciplinary BSc and MSc projects with help from the experts in pedagogy.

Certainly, the use of the chosen or the applied models could also be improved, based on the students' requirements, since it produced results and showed progress for the organizers. The main challenge, according to the organizers is to have the environment to prioritize time and resources to develop plans for collaboration. While meetings are considered to be necessary, they are hard to prioritize without explicit resources for them. Great modules cannot be created without great content, which needs time and meetings to plan. To support the common ground of the students, the educators and researchers need to establish basics for collaboration earlier. Hence, according to the experiences of the organizers, more focus on emphasizing the importance of strategies and processes need to be prioritized. However, how to handle these strategies and processes and

exactly who should handle it in environments without collaboration traditions, need further discussion.

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Short professional biography

Ilona Heldal, PhD is Professor of Informatics (Interactive Systems) at the Department of Computing, Faculty of Engineering and Science, Western Norway University of Applied Sciences, Norway (HVL). Her research projects focuses on user studies and technology acceptance and management. These projects regards developing new information and communication technologies, especially by utilizing visualization, simulation and serious games for collaboration. She is responsible for research projects focusing on using new technologies for health, simulation and serious games for emergency management. She started several educational programs, most recently in Responsible Innovation for Regional Development. She is in the Board of Directors of

ISCRAM (Information Systems for Crisis Response and Management), and VSMM (Virtual Systems and Multimedia), in the ed. Board for the Springer Journal of Virtual Reality and for the Journal of Multidisciplinary Social Research (JMSR).

Carsten Helgesen, PhD is Associate Professor at the Department of Computing, Faculty of Engineering and Science, Western Norway University of Applied Sciences, Norway (HVL). He has extensive experience from both academia and private business in application of informatics and digital solutions in interdisciplinary projects. His interests are innovation, and interdisciplinary cooperation on projects in the health and social care area, with particular focus of applying methods like Design Thinking. Helgesen is a member of IEEE.