Learning experiences from an interdisciplinary and cross-institutional innovation project as part of a Robot Festival

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This paper treats the possibilities of hastening the development of innovative robot and mobile prototypes based in PPU educational methods. Taking our point of departure in empirical assessments of the project, including user evaluations and innovation methods from the Innovation Camp theory, we also discuss the strengths and weaknesses of the PPU method as an innovation framework aimed at business studies.

Keywords: Exploratory learning; interdisciplinary; cross-institutional; innovation

This paper presents the educational and didactic considerations and experience from an interdisciplinary and cross-institutional project, called Summer Workshop (SW), in connection with the Robot Festival (robotsatplay.dk) in the summer and autumn of 2006.
The focus of that project, which included participants from AP educational programmes in DK, was on testing and assessing the benefits of project orientated teaching (PPU), including innovative approaches using concept development methods such as the Concept Workshop. The project aims at giving students a head start in their dissertation.

1. Point of departure

Since the educational reforms in Denmark in 2000, the AP educational programmes have focused on integrating innovation in teaching. This has materialised at South Danish University, Odense Technical College and Engineering College in Odense as a Knowledge Center for Technological Innnovation, that supports innovation projects, such as the present robotsatplay.dk, with teaching expertise, contact to local businesses and resources.

Robotsatplay.dk is an annual festival in Odense that started in 2006. It focuses on the use of funny robots according to various platforms. The festival is international and includes among others participants from Korea, Spain and Germany. Companies and educational institutions visit the festival and make their contributions of funny robots. Some of them include: dancing robots from Korea; robot table football from Germany; robot lawn mowers and robot poker table from Denmark; and several funny and innovative robot prototypes from educational institutions.

Part of the Robotsatplay was the SW project, where the main purpose was to introduce innovation theories and practices to students from the participating colleges, preparing and providing a kick start for the students' final exam project by developing innovative ideas and prototypes.
22 students and 7 instructors from the IT and Electronics Engineer (ITET), Multimedia Designer (MMD) and Datamatician (DM) programmes started on the project in June 2006, and continued into the middle of September 2006. Subsequently, two groups of students integrated the project work into their final exam projects in January 2006.

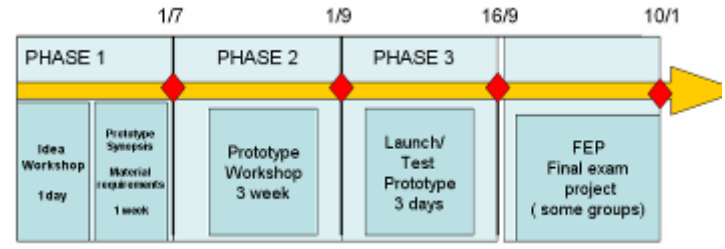


Figure1: Project timeline

The students worked on developing prototypes for a Mobile Payment solution for public transport, a Mobile Dating system, a Card Sorting robot for an online poker system and a Racing Robot. The project was divided into three main phases (see Figure 1).

Phase 1) Starting up phase:
The students received a short briefing prior to the Idea Workshop, which took place in mid-June. The purpose of the Idea Workshop was to develop ideas for the prototypes. Methods from Innovation Camp, like brainwriting and energizers [4], were applied.
Phase 2) Prototype phase:
This phase commenced with a three-week workshop aimed at developing functional prototypes. The instructor team was involved both physically and online so that the students could seek guidance when they needed it.
Phase 3) Prototype Launch phase:
The prototypes were introduced to an audience and were tested and evaluated in connection with the robotsatplay.dk festival.

The point of departure included building upon other institutions' experience with innovation programs, in particular Innovation Camps [6], which are often used. SW has aimed at culling the best from the Innovation Camps stemming from the participating colleges. There is often a lack of academic benefits and the opportunity to learn something new at the short Innovation Camps. In this respect, we understand learning as an integrated process that always includes three dimensions (cognitive, psychodynamic and social) and two types of processes (interaction and acquisition processes). Or more specifically: *"Processes based on previous experience that change, modify or expand their previous knowledge, competencies or values".[5]*

Seen from an educational point of view, the objective of SW has been to develop the following competencies:
Creative and innovative competence
- The ability to transfer and combine across disciplines.
- The significance of focusing and discipline.
- Experience with innovative space and processes.

Self-management competence
- Setting ambitious goals and believing in them.
- Taking responsibility for a joint assignment.
- Working under pressure.

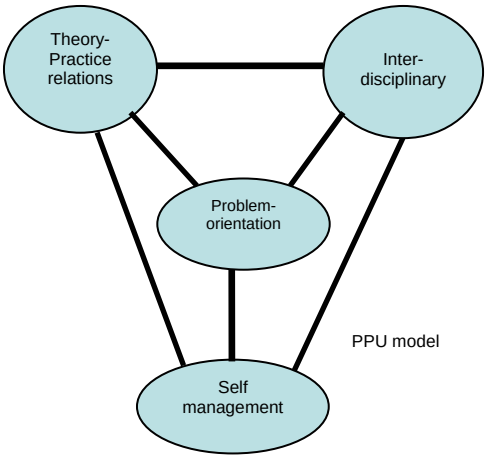
Social competence
- Ability to quickly build relationships in new and efficient teams.
- Ability to network across groups to gain solutions.

Communicative competences
- Expedient conflict management.
- Balance of power.
- Creating a joint reality and joint goal for the team.

Cultural competence
- Respect for other participants' educational standards and points of view.

- Understanding of own educational identity and culture.

2) Point of departure in project-oriented teaching

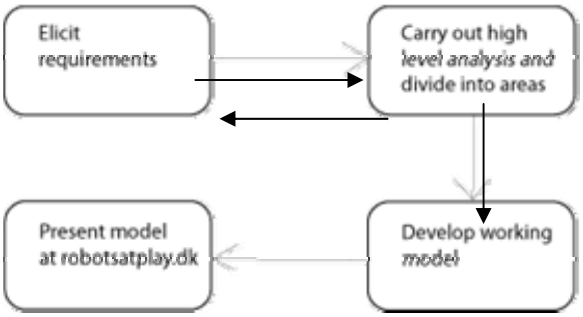


In order to develop the above-mentioned competencies, the teaching team behind the SW project and participants from three institutions (ITET, MMD and DM,) took their educational point of departure in PPU. PPU is a model that promotes students' problem-oriented work on a project.
PPU, which has evolved from a Scandinavian educational and didactic tradition [3], is relevant as a framework for scientific innovation, because it is based on exploratory learning processes focused on problem solving and resulting in faster prototype development across disciplines combining theory and practice and managed to a great degree by the participants. The goal is to produce independent trouble shooters.

Our experience shows that PPU matches to a high degree the students' preferred learning style, which for 80% is Activist-oriented. The MMD students' learning styles can be seen on the college's online portfolio [8].

Interdisciplinary
From the beginning of SW, the students were placed in interdisciplinary groups (ITET, MMD, DM). ITET is an education that focuses on developing, designing and programming software and hardware for robotics. DM focuses on developing, designing and programming software and hardware for administrative systems and mobile devices. MMD focuses on multimedia development, design and the programming of Internet systems and mobile devices as well as corporate communication and business studies. The three educations offer a wide range of competencies for solving how to develop, design, program and test prototypes.

Theory/practice
The development of a system is divided into several stages and the progression of a system through these stages is known as the system life cycle. The PPU model is in this project based on the life cycle using prototyping.



Prototyping is based on the concept of a working model. The students chose the prototyping model called *rapid prototyping*.

The aim was to develop the prototype into the final system and thereby save a lot of time. As the students only have a total of 3 months for their final project, this seemed to be the perfect solution.

As rapid prototyping must be based on extensive analysis of the problem and some kind of automated tools, the students divided their groups into two areas. One area contained the analysis of the problem and design solutions and the other group contained the development of the model.

In the PPU model this means that the groups partly divided the groups according to the area *"Theory/Practice relations"* to try to solve the problem at hand. This also reflected the fact that many students are based on "Practice" or "Theory" when they work.

Self-management
The rapid prototyping model is also based on time limits and therefore the students tried to organize themselves into project groups based on the traditional project model with a project manager.
The project was based on interdisciplinary work and the students soon organized themselves according to interest areas. The areas were analysis/design and programming.

Problem-orientation
The problem for each group to solve was already defined in phase 1 and therefore the group could focus on solving this.

3) User Experience

The project has been evaluated via questionnaires and qualitative interviews with the students. In general, the students are positive about the experience and express that it has been of benefit to their work with developing innovative ideas and prototypes. Below is a summary of our questionnaires.

Idea workshop
The students thought that it was good to begin SW with an idea workshop. The workshop gave the students in-put from various academic directions and plenty of space. Moreover, it gave the group the opportunity to socialize with future groups.
"It gave some new ideas for brainstorming. It was a good way of getting to know the people working with you and that made it easier to work with new people".

Interdisciplinary integration
Many students perceived it as an advantage to form project teams with students from other institutions. One student said that it was also good to be able to test whether the FEP idea could stand closer inspection:
"For me it was very important to be able to group up with some new people who had different experience and knowledge than me. And of course you have a second chance in attempting a good FEP because if you are not satisfied or you see your product is not turning the way you want you can always start another one after the workshop." (Male student)

Also it gave students "real life" experiences:"*Working with the other 2 students was good because it's just like in a project where everybody has his own obligations. Those 2 guys were students I didn't meet them before and we had to adapt to their way of working. Just like in a company…" (Male student)*

Self-management
Self-management was the greatest problem. Even though the students had experience from previous projects, it was obvious that the groups ran into problems when working with people from other institutions. The groups were quick to divide into specific fields, some as programmers and some as analysts/designers. Communication between the two groups was not optimal and a common perception of self-management and project planning did not appear to exist. Self-management was especially apparent when a decision regarding which design features should be included in the prototype. Often these cases led to democratic management where a group would reach agreement by referendum.
"*I think we did ok. But what was missing was the project manager*" and "*Anyway – we missed the communication between the programmers and rest of the group*".

Problem orientation

The groups mention that it was particularly difficult to work with non-knowledge [1]. The groups met daily and applied methods such as brainstorming and "posing questions" in order to reveal their non-knowledge. Research consisted of a combination of articles from the internet, code snippets from the internet and books. The students also mentioned that they would have liked to have had access to a wider range of sources in this stage.
"*We solved the problems by asking the teachers and looking on the internet for the best way of doing it. Also we tried to come up with a few ideas individually and then we would discuss them and vote on the best one and go for that one*"

In general The groups mentioned that a SW was a good idea, because it was bound to a real project, robotsatplay.dk, where the groups could participate and show their projects. It provided greater incentive to solve the problem. They also mentioned that free tickets to the cinema or other social activities could help forward socialisation in the groups.
"*Always try to find motivation for the people, also try to make them meet in different environment that the one they are working in (give them movie tickets so they get to know each other), this will develop a stronger bond between them*"

4) Suggestions for further development

Our evaluation reveals in particular that self-management is a big problem in the PPU model. Overall, focus has remained on the development of a typical project. This has given problems when in reality, the project period has been, what the Danish innovation researcher Lotte Darsoe [1][2] defines as a *preject*, i.e. the period of time leading up to the start of the project.

Darsoe [2] suggests that in the preject, the previous phases of an innovation project, "chaos time" rules, whereas an actual project is linear and limited in time. Thus, what is needed is not project management, but preject management.

Darsoe states, that it is possible to practice management in the preject based on an innovation model consisting of four parameters: knowledge, concepts, relations and non-knowledge, each of which must be involved in order for the innovation process to succeed. Thus, there are four management roles that can optimise the preject management:
- *Innovation gardener*, who is responsible for developing relationship competencies.
- *Innovation court jester*, who helps the group examine what it does not already know.
- *Innovation agent*, who helps the group describe and explain information and knowledge in different ways.
- *Innovation challenger*, who assists the group in building up substantial knowledge.

The project phase must therefore be divided into two phases: preject and project. Moreover, a model and methodologies should be included to help during the preject phase.
An example could be the Kubus Method [7]. This model provides a series of promising tools that can solve several of the problems mentioned above, such as self-management and non-knowledge. In this context recent Innovation camp approaches, such as the Solution Camp sessions shows promising potentials and results [6], combining the fields of innovation, entrepreneurship and business development.

5) Conclusion

Experience from SW shows that the idea of short, joint session with an Idea Workshop, Prototype Development based on the PPU model and the subsequent public festival presentation of a prototype is a good educational methodology to pursue, and which can provide real benefits for the students.

But SW also indicates that self-management is a weakness in a PPU based approach, which has to be taken care of. Similar approaches in the future might benefit from adapted methods from the field of contemporary innovation research and practices.

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