Medialogy Design of a Trans-Disciplinary Education using a problem based learning approach

Nordahl, Rolf; Kofoed, Lise B.

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Medialogy - design of a transdisciplinary education using a problem based learning approach

Rolf Nordahl,
rn@imi.aau.dk
Lise Busk Kofoed
lk@imi.aau.dk

Medialogy, Aalborg University Copenhagen, Lautrupvang 15, 2750. Ballerup, DK
rn, lk@media.aau.dk

Abstract
In this paper we describe the progression of the Medialogy education, introduced in Denmark in 2002.
We discuss different criteria which need to be considered when designing a transdisciplinary education, such as the use of problem based learning as a teaching methodology, the role of the faculty and the key competences needed to be acquired by the students.

Keywords: transdisciplinarity, problem based learning, media technology.

1. INTRODUCTION

Different interdisciplinary educations in the field of media technology are constantly developed worldwide. However, it is still a challenge to define what are the key competences of such educations, their aim and their ability to provide new scientific paradigms and disciplines.

In 2002 Aalborg University Copenhagen introduced the Medialogy education, which sought to educate graduates with a firm understanding of developing media technology while maintaining focus on topics which are interconnected but often overlooked in traditional engineering educations, and with the goal of developing problem solvers in a digital age independent of tasks.

The name Medialogy (Medialogi in danish) derives from the words Media and *Datalogi*, which is the Danish term for computer science. In Medialogy, students learn theories and applications of media technology, and develop both technical and creative skills in this field.

The education was initially introduced as a means to provide a Bachelor degree to students educated in a Danish two-years degree called multimedia design. However, over the years it has evolved to a full five years curriculum, and has gradually moved away from simple joint combination of different disciplines towards transdisciplinarity.

This process has been facilitated by the problem based learning (PBL) pedagogical approach, on which Medialogy is based.

PBL has been adopted at Aalborg University since 1974, when the university was established [3,4].

One of the principles behind PBL is the fact that successful students need to be able to identify and untangle problems, cooperate with other students and have a strong knowledge of their own and related fields.

One of the key elements of PBL is problem solving through project work in groups. Each semester of the education has a specific theme, and students are asked to define a problem which addresses such theme.

In this paper, we describe how PBL helps supporting interdisciplinarity and transdisciplinarity, and discuss our reflections behind the development of the Medialogy education.

We believe that in this new era of integration, teaching primarily consists of providing methods and techniques to the students so they can obtain knowledge through project work, rather then traditional lectures. In PBL, the instructor plays the role of facilitator rather than traditional teacher or fact introducer, and students are encouraged to choose among different disciplines in which they want to acquire a deeper

knowledge.

2. TRANSDISCIPLINARY STUDIES

In recent years, a number of interdisciplinary educations in HCI and related fields have been developed worldwide [5,6].
However, it is still a challenge to design a coherent, comprehensive, and interdisciplinary curriculum [7,8].
As a matter of fact, many interdisciplinary educations show merely a combined effort of different competences from several faculty members put together.
It is also a challenge to find the core competences in a curriculum which is designed for students who can show interest towards different aspects of HCI such as the engineering side, the design, or human factors.
Moreover, the challenge of establishing a fruitful collaboration between different profiles is also still open [11] and applies to both students and faculty members.
As an attempt to bridge the gap, in Pausch and Marinelli [6] describe how in their Master education they started by teaching basic programming to artists, and humanistic subjects to computer scientists. However, this solution did not prove to be ideal. Instead, they preferred to mix the different profiles during project work.
The terms *interdisciplinary* and *transdisciplinary* are often used interchangeably. In this paper we adopt the definition proposed by Meeth in 1978 [1]. Observing the existing confusion in defining what an interdisciplinary education is, Meeth proposed a hierarchical classification, illustrated in Figure 1. At the bottom of such hierarchy he placed intradisciplinary studies, i.e., studies composed of a single discipline. At a higher level we find crossdisciplinary studies, i.e., studies in which one discipline is viewed from the perspective of another. An example of crossdiscipline is, as Meeth mentions, the study of physics of musical instruments.
Crossdisciplinary studies are relatively easy to establish, since they allow faculty members to remain in their own disciplines.
At the next level he placed multidisciplinary studies, i.e., the juxtaposition of disciplines, each offering their own viewpoint, but with no attempt of integration.
One level higher shows interdisciplinary studies, which attempt to integrate in a coherent and harmonious curriculum several disciplines which allow to solve a particular problem.
According to Meeth, the highest level of integrated studies is transdisciplinary studies. Such studies go beyond disciplines, since they start from a problem and, using problem solving, they bring the knowledge of those disciplines which contribute to the solution [1].
Therefore, as shown in Figure 2, while interdisciplinary studies start from a discipline and develop a problem around it, transdisciplinary studies start from a problem and find the related disciplines which facilitate solving it.
As also argued by Meeth, transdisciplinary studies are hard to design, since they require highly prepared and intellectually mature faculty members as well as students.

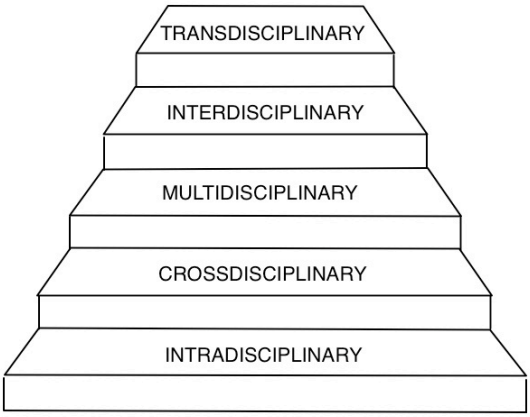

Figure 1: Representation of the hierachical educational structure proposed in [1].

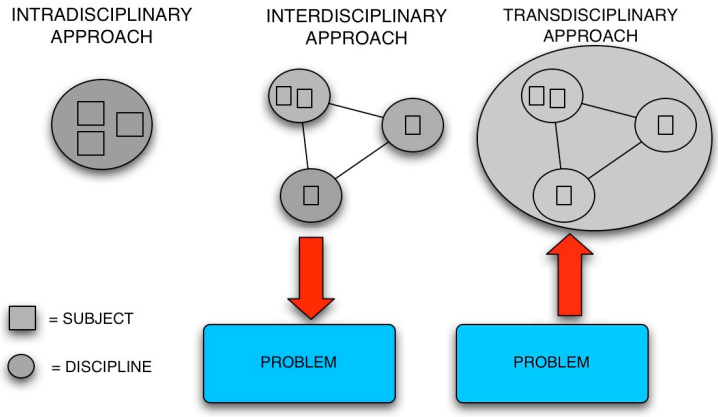

Figure 2: Disciplinary systems. Adapted from [8].

Interdisciplinary and multidisciplinary curricula developed and in use today represent initial steps on the road to a transdisciplinary curriculum. However, merely juxtaposing traditional courses from two or more disciplines in a curriculum were the foundation of these older concepts. There is usually little or no attempt to make individual courses multidisciplinary and blend the concepts from various disciplines together. Neither traditional textbooks nor university course organization make it easy to develop and deliver true transdisciplinary courses. However an ideal transdisciplinary curriculum consists of true transdisciplinary courses. Boundaries for transdisciplinary courses should be the boundaries of the problem being addressed, not the artificial boundaries of disciplines.
A transdisciplinary course must involve multiple faculty members or mentors so that the concepts covered can be presented from several perspectives and so that the integration of knowledge, skills and jargon can be more fully appreciated by the students. Each course should include project or laboratory exercise modules through which the course material will be presented and put into practice.

3. THE MEDIALOGY EDUCATION

The Medialogy education is an education in media technology which was originally introduced in 2002 [13,14]. The education is organized over 10 semesters. Six semesters are dedicated to the Bachelor level, while four semesters to the Master level. The first two semesters of the education, called Basis year, are standardized by Aalborg University for all engineering studies. The remaining eight semesters have been carefully designed by the founders of the Medialogy education since its inception.

Each semester has its own theme, which is supported by different mandatory courses. The skills provided in the courses are determined by the faculty members in order to support the semester project.
The theme of the third semester is *Human Senses, Digital Perception*. Students learn principles of human perception and computer vision, as well as skills in mathematics, programming and aesthetics and design.
The theme of the fourth semester is *Interaction Design*. Students learn how to design and evaluate interfaces embedded with sensors, which have a significant auditory feedback. The theme of the fifth semester is *Animated Environments and Visual Effects*. Students learn theories and techniques behind computer graphics, screen media and animation.
The theme of the sixth semester is *Interactive media systems*. During this semester, students work on their Bachelor thesis.
From the 7th to 10th Semester, students work on a Master education. During the Master education, students have possibility to choose courses to follow, which is not possible during the Bachelor education.
The theme of the seventh Semester is *Merging of the Senses*. Students learn how the human brain processes and combines information arriving to different senses, and how multimodal systems can be simulated.
The theme of the eight Semester is *Immersion and Interactivity*. Students learn how to design immersive virtual worlds. On the ninth Semester, students are encouraged to spend a semester abroad or to work in an internship in a company.
The tenth Semester is fully dedicated to the Master thesis. (More information about the Medialogy education can be found at www.media.aau.dk).
In each Semester students need to write a report and deliver a product with it. The project requires approximatively 500 hours of workload per student. Students work in a group of about 6 people at the Bachelor level, and about 3 people at the Master level.
Master thesis are usually carried out individually or by couples of students.
The design of the curriculum is a continuously evolving process which is still under development.
As also stated in [8], the first step in achieving a transdisciplinary education is to extract common elements, methods, design and processed from existing disciplines and synthesize them into the foundations of the new transdisciplinary area.
We believe that this is an extremely important and complex task, but fundamental to allow the shift from multidisciplinarity to transdisciplinarity.
The integration of disciplines is still a work in progress, but we realized that a somehow imposed communication and co-supervision between faculty members whose disciplines are usually kept apart was extremely beneficial for both students and instructors, and solidified the identity of the education.
As an alternative to finding a single Renaissance Individual with all the skills required, we believe there is a need for individuals who have expertise in forming problem-solving teams and functioning effectively within those teams working with transdisciplinary solutions.
In Medialogy, we encourage students to approach HCI from the "big picture", and we developed our program in order to attract individuals who appreciate conceptual approaches to problem solving, critical thinking and creativity.

4. MEDIALOGY AND PBL

In the Medialogy education we adopt the PBL methodology to train students and faculty members to evolve from crossdisciplinary and multidisciplinary to interdisciplinary and transdisciplinary.
PBL becomes interesting when a variety of disciplines need to be incorporated to address the problem.
We support students to structure problems in such a way that they are able to integrate and apply knowledge from different disciplines.
This allows students to see connections among disciplines and promote carryover of knowledge from one discipline to another. In this situation, PBL facilitates transdisciplinarity, since students are exposed with a problem, and need to find the relevant disciplines and connections among them which allow to solve the problem.
Most of the problems addressed by students in the different semesters are transdisciplinary by nature, since they start from a given theme, finding a problem to solve, and use several disciplines to address it and solve it.
Another positive element of PBL is a higher degree of learning; PBL projects require a high level of social, communication and co-operative skills among students. These skills are highly demanded in the professional work. Given the high amount of workload which a project requires, usually the final results are

very satisfactory.
PBL has been widely adopted in several educations worldwide, among other things for its ability to develop problem solvers and for giving the possibility for students to work in groups solving issues close to the real world. PBL has especially proven to be particularly suitable for educations dealing with design of interactive system [9] and multidisciplinary settings [10].

5. THE ROLE OF THE FACULTY

Obviously the choice of the faculty members is fundamental in the development of any education. Established long running educations usually hire faculty members which fit into the teaching and research plans of the department.
In newly created interdisciplinary educations where the curriculum is continuously questioned, two different approaches can be used in hiring faculty members. The first approach consists of designing a curriculum and then hiring faculty members based on it. The second approach consists of hiring faculty members with different backgrounds, and then allow them to design different courses which together will form a curriculum.
The advantage of the first approach is that it provides a more coherent education, but the different faculty members will feel they do not completely own the education.
In the second approach there is a high risk of having a multidisciplinary education in the sense described by Meeth [1], i.e., simply a juxtaposition of disciplines each offering their viewpoint but not real attempt of integration.
In Medialogy, the challenge to move away from a multidisciplinary education towards a coherent transdisciplinary one with a defined identity was addressed in different ways.
First of all we identified the key competences of next generation HCI experts, from the technical and human factors point of view.
One way that proved to be quite effective was to create teams of projects supervisors, each coming from a different background. As an example, students are usually supervised by both a contextual and a technical supervisor. The contextual supervisor is mainly responsible for the problem analysis and problem formulation phase, while the technical supervisor is responsible for problem solving. Both supervisors are present at all meetings, which are usually held weekly, and are required to be prepared in all the components of the project.
Both supervisors assess the students at the end of the semester. This approach is particularly beneficial for those faculty members previously trained in unidisciplinary educations.

6. STUDENTS IN TRANSDISCIPLINARY EDUCATIONS

Terry Winograd, professor of Human-Computer Interaction at Stanford University, claims that to get design into effective practice, one needs to train designers and also to teach the people they work with how to understand, incorporate and foster design. This philosophy is also at the heart of new programs around the world like the Stanford d.school which talks about creating T-shaped people.
Such people maintain the depth and focus of a single discipline while adding a crossbar of design thinking that drives the integration of multiple perspectives into solving real problems [2].
As shown in Figure 3, in Medialogy we also believe in the importance of educating T-shaped people.
During the Bachelor education, students are exposed to different topics in media technology, ranging from technical implementations of input-output systems, to psychology, measurement of user experience and media sociology.
During the Master education, students can choose to specialize in one area of interest. Four different areas are offered: computer games, visualization, interaction, and sound.

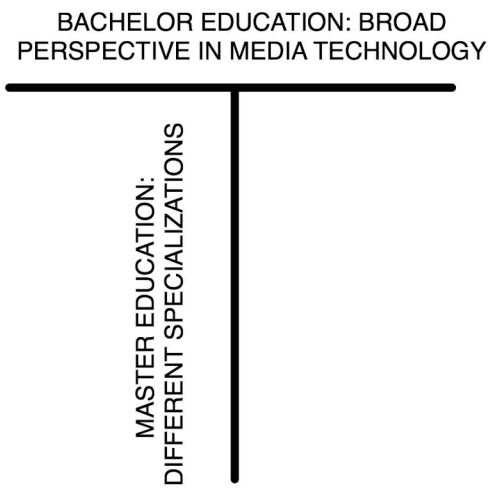

Figure 3: The T-shape model for the Medialogy education.

The T shape can differ. The horizontal line can be shorter or longer related to the broad understanding of the Medialogy. The vertical line also can be shorter or longer related to how deep the specialization is. The challenge is to find the balance of the T related to the goal of the education. But also the faculty members have to understand their special knowledge as part of the T- illustration. They have to be aware of their special expertise as well as their broad knowledge so they keep their balance as well. Some faculty members are so specialized that they cannot relate to an understand other's expertise when working In a cross disciplinary fields. Other faculty members are so eager to learn about the broad perspective so their vertical line will be too short - they loose their expertise. One cannot work in a cross disciplinary environment if (s)he has enough expertise with which s(he) can contribute. So the faculty members also have to keep the balance of the T when developing their knowledge and expertise [12].

5. CONCLUSIONS

In this paper we analyzed the foundations of the Medialogy education, and discussed different elements which contributed to its current status as a transdisciplinary education.

We believe that PBL provides a coherent framework in which students can express their creativity in the design of novel human computer interaction paradigms. The projects completed by the students, infact, largely vary in the contextual issues they address, and they reflect the interests of the different groups of students. However, they all reflect a common paradigm of defining a problem and finding the right disciplines which allow to address it.

Technology is not anymore the main issue in designing novel interactions between humans and computers. Nowadays, it does not require highly skilled engineers to fully develop novel interfaces for different applications ranging from entertainment, art or rehabilitation.

While progressing through the education, students get exposed to more and more advanced technical aspects involved in the design of interactive systems, starting from simple computer vision algorithms, and moving to sound processing, sensors technology, computer graphics, artificial intelligence and virtual and augmented reality technology. They also learn how to integrate such technologies, which becomes an issue especially when projects become rather complex as it is the case during the Master education.

An evolution of the students' ability to reflect and to work problem based is also achieved by developing their contextual skills and their evaluation techniques, offering courses in media sociology, measurement of user experience, interactive media theory and human perception, cognition, media psychology and theory of science.

In Medialogy, we particularly value the ability of PBL to train problem solvers as opposed to users of tools, which is what the market needs. We believe on the importance of supporting and offering true transdisciplinary semesters, where boundaries are the problem being addressed and not the boundaries of disciplines. Within the semester, each course can be considered as intradisciplinary. The next step would be to support transdisciplinary courses inside a transdisciplinary semester.

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