

# **STUDENT PERSPECTIVES ON INTERDISCIPLINARITY – FINDINGS FROM AN INTERDISCIPLINARY TWO-YEAR MASTER PROGRAM**

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## **ABSTRACT**

The business environment has changed significantly during the last decade; globalization and short innovation cycles have become every-day business. These changes have formed new conditions for the companies and organizations: few of the problems encountered can be answered within a single discipline. Hence in order to address contemporary problems, companies and organizations need to have labor and recruit students with interdisciplinary skills. Consequently higher education must correspond to the business world's changing needs by providing interdisciplinary programs. The purpose of possessing interdisciplinary knowledge and skills is to have the ability to understand the origin and nature of related disciplines as well as to relate these to its own discipline. Interdisciplinary skills could be viewed as an intangible type of knowledge that needs to be taught by and learned at the university. By possessing interdisciplinary skills, the labor and students will have a holistic view as compared the view related to one single discipline. The challenge, for the universities, lies in teaching and to ensure that the students possess interdisciplinary knowledge and skills. This paper focuses on students' perceptions of interdisciplinarity and where it is taught and learned in a two-year master program. The purpose is to identify and analyze students' perceptions of learning interdisciplinarity in a two-year master program. This paper is based on focus groups and personal interviews with students enrolled in the interdisciplinary two-year master program named "Innovation through business, engineering and design" hosted by the Linnaeus University. The two-year master program aims to enroll about 30 students each year from the disciplinary areas of Business, Engineering and Design. The paper concludes that the students perceive interdisciplinarity as challenging and that interdisciplinarity require disciplinary skills and competences as well as personal and interpersonal capabilities. The students' perceptions of interdisciplinarity learning appear to be in line with the notion that learning is primarily to see things from different perspectives. Interdisciplinarity appears first and foremost in team work and communication. Tendencies towards a modification of the disciplines were noticed by the authors, which might lead to new disciplines evolving, such as "innovation design" or "innovation engineering".

## **KEYWORDS**

Interdisciplinarity, Interview study, Ongoing two-year master program in innovation, Standards: 2, 7, 8, 12

## INTRODUCTION

The business environment changes continuously, implying that companies that want to succeed need to be able to continuously adjust (Eklund, 2017). Simultaneously, the society requires companies to take responsibility for their decisions and their impact on civilization. (Kanda et al., 2016). According to Annan-Diab and Molinari (2017), interdisciplinarity will increase the ability to understand complex challenges and to urge the development for a sustainable development. Companies are facing a business environment of constant change and they need to find a way to navigate for sustainable development. Altogether: few of the questions posed in companies today can be answered within a single discipline (c.f. Bolman and Deal, 2014) and therefore interdisciplinary competence is important for companies when recruiting future employees (Brassler and Dettmer, 2017). Consequently, there is a need to be able to identify and recruiting future employees with a continuous changing mind-set as well as knowledge of different disciplines. It is not enough, for students, to have knowledge of and skills to work with other students; the students' mind-set need to be addressed as well. As interdisciplinary programs are scarce, finding these individuals to employ might be difficult for companies (Geschwind and Melin, 2015). To meet this need, universities are encouraging interdisciplinary programs (Vanstone et. al. 2013) attracting students from different disciplines.

One of three main tasks for a Swedish university is to conduct education meeting the need from the surrounding community (<http://www.uka.se/fakta-om-hogskolan/universitet-och-hogskolor.html>). Linnaeus University, Sweden (further on referred to as LNU) has developed an interdisciplinary two-year master program involving three faculties: the Faculty of Technology; the School of Business and Economics and the Faculty of Arts and Humanities. The program is named "Innovation through Business, Engineering and Design" and is a two-year master program that serves as an example case throughout the paper. Throughout the **first year**, the students work in interdisciplinary groups consisting of two engineer students, two design students, and two students from business administration with briefs from local companies. Throughout the semester, there are lectures with subject knowledge within the discipline. In the spring semester, the students work, in the same manner, in interdisciplinary groups with multinational companies, non-governmental organizations, and other organizations. The **second year** consists of traditional advanced level courses offered in other master programs and a 30 credit thesis. These courses are given to the student by own discipline. The program encompasses the following dimensions of interdisciplinarity (Kans and Gustafsson, 2016): 1) students are working in cross-disciplinary teams (at least one student from each discipline, engineering, business and design), 2) the project assignments are real life open-ended problems delivered by industry, and interdisciplinary in nature, 3) the program is cross-departmental and the students are taught by teachers from different faculties.

This paper focus on the perceptions of students of interdisciplinarity. The purpose is to identify and analyze students' perceptions of learning interdisciplinarity in a two-year master program. This in order to gain better understanding of how to overcome obstacles with interdisciplinary programs and thereby enable companies to employ personnel with interdisciplinary skills.

## THEORETICAL FRAMEWORK

The T-shaped student is a way to approach the new skills requirements of 21th century. The IBM Academic Initiative Director K. Faughnan explains the challenge and how it should be overcome: "We think all professionals need to be more multidisciplinary or T shaped", i.e. deep in one or more discipline and broad across many (Harris, 2009, p. 44-45). I-shaped students

are highly skilled in the own discipline, whilst T-shaped students combine deep disciplinary understanding with a broad number of multidisciplinary abilities. Moreover, these abilities are often referred to as generic or cross-disciplinary abilities, such as communication or group work skills. Students should for instance be able to communicate across disciplines which results in an improved product development process (Elmqvist et al., 2014) or gain deeper understanding by the synthetization of conceptual and theoretical knowledge with real-life knowledge in applied learning situations (Sanchez et al., 2016). The T-shape could also be described as the ability to think outside the disciplinary silo in an interdisciplinary manner (Bajada & Trayler, 2013). Boehm and Mobasser (2015) connect the T-shaped abilities with system thinking. According to the authors, a T-shaped person from a systems perspective is one with technical depth in at least one aspect or component of the system combined with understanding of several other aspects. While consensus seems to exist that the curricula need to include non-disciplinary skills as well as disciplinary, the nature of the broadening of skills is not as clear – is it cross, multi or perhaps interdisciplinary skills that are required? As a first step in settling this issue, a definition of the terms will be provided.

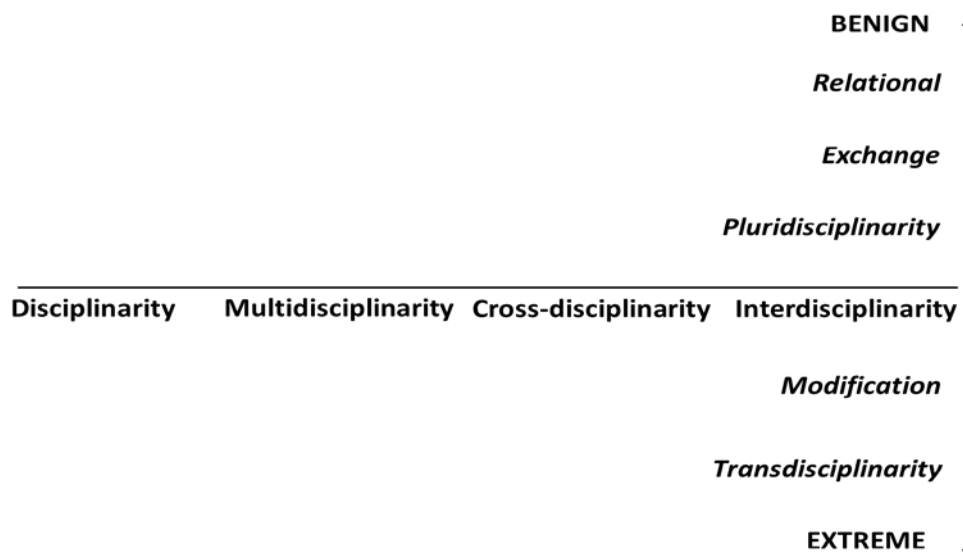


Figure 1. Dimensions of interdisciplinarity (Davies & Devlin, 2010)

A discipline, according to Davies and Devlin (2007), is characterized by the presence of a community of scholars sharing a history or tradition. The discipline defines the requirements for what constitutes new knowledge as well as how data should be collected and interpreted. Meeth (1978) proposes a set of definitions for interdisciplinarity, spanning from intradisciplinary (studies within one discipline) to transdisciplinary knowledge (problem-centered studies requiring several disciplinary perspectives). Meeth (1978) defined cross-disciplinarity as studying another discipline wearing the disciplinary glasses, multidisciplinary as the involvement of several disciplines, and interdisciplinary studies as relating parts and whole in a systems approach. Davies and Devlin (2010) provide a slightly different interpretation, see Figure 1. Disciplinary, multidisciplinary and cross-disciplinary studies are all variations of disciplinary studies, Davies and Devlin claim. The student broadens its knowledge with further understanding in other disciplines, but no real transfer of methodologies occurs. Interdisciplinary is the integration of different methods and viewpoints. Relational interdisciplinarity occurs when a common subject is discussed using related disciplines as perspectives on the common subject. Exchange interdisciplinarity maintains the disciplinary

integrity while using other disciplines for exchange of perspectives. Pluridisciplinarity requires the integration of two or more disciplines for solving a problem. When the integration of disciplines leads to changes in the discipline or even the emergency of new disciplines, we face dimensions of modification and transdisciplinary.

In this study, the definition of interdisciplinarity according to Davies and Devlin (2010) is utilized, as it gives depth to the term interdisciplinary ranging from the benign to the extreme types as a clear distinction between disciplinary and interdisciplinary learning. The authors propose three main classes (disciplinary, interdisciplinary and transdisciplinary); see Table 1. The first describe learning that takes place within the discipline. The student acquires deepened disciplinary knowledge, extends the knowledge in another discipline, or broadens the disciplinary understanding by applying the disciplinary knowledge within another discipline. Interdisciplinarity describes learning that takes place between disciplines in form of joint discussions, exchange of perspectives, or joint work. The third class describes the changing of the disciplines or the emergency of new disciplines, for instance, when the engineering, design or business disciplines are modified towards innovation, or if the new discipline such as “innovation developer” is formed.

Table 1. Approaches to interdisciplinarity, based on Davies & Devlin (2010)

| <b>Disciplinary</b><br><i>(deepening or broadening within the discipline)</i> | <b>Interdisciplinary</b><br><i>(learning between disciplines)</i> | <b>Transdisciplinary</b><br><i>(emergency of new/changed disciplines)</i> |
|---|---|---|
| Disciplinarity  |   |   |
| Multidisciplinarity   |   |   |
| Cross-disciplinarity  |   |   |
|   | Relational  |   |
|   | Exchange  |   |
|   | Pluridisciplinarity   |   |
|   |   | Modification  |
|   |   | Transdisciplinarity   |

## METHOD

According to Bryman and Bell (2003) interviews are probably the most commonly used research method in qualitative research. By accomplishing interviews a basis for deeper understanding is created embracing numerous views on the phenomenon studied. Focus groups, one type of the interview method, stresses a phenomenon as well as it stresses the way the participants discuss and respond to views and perceptions on that specific phenomenon i.e. the topic the researcher is interested in. Furthermore, the method allows the researcher to develop an understanding of why the participants perceive as they do. Practically, the focus group ought to have one moderator. The aim of the focus group is to get the participants’ perspectives and hence the role of the moderators ought to be posing questions and ask for clarification when needed. The “questions” are provided as open topics for the participants to elaborate on. The participants should represent a specific organizational setting that have an interest in the topic. The group size may vary from two to ten. In order conduct this in a sufficient manner it is preferable if the session is recorded and transcribed. The study participants in this study were the students in their fourth semester. The program was initiated in 2011 and began in 2014 with 15 students (Business – 3, Engineering – 5, and design – 7), i.e. the total population. These students were writing their master thesis and were able to look back and reflect on their education. All students were invited, by the authors of the

paper, to participate in focus groups to discuss “interdisciplinarity”; meaning and content. The students who expressed an interest in contributing participated. The researchers acted as moderators posing topics (see Appendix 1, Interview guide). The authors had been active in teaching and administration of the program and knew the students beforehand. This facilitated for the researchers as the discussions were frank and friendly, where all the participants listened to each other's comments, while the authors could counteract biases through phrasing and rephrasing questions. In order for the students to be admitted to the program they required a bachelor degree in their respective discipline. When doing these focus groups, the authors choose disciplinary groups as they perceived that it be easier to relate to the interdisciplinary work amongst peers. The focus group was deemed as the best choice of method, but due to geographical and time differences, two of the focus group was replaced by semi-structured interviews (i.e. the mean applied was aligned with convince). Table 2 identifies the interview context; overview of respondents, mean and location. In total four sessions were held, either physically at the campus (LNU) or on Skype. The focus groups and interviews were recorded and transcribed. The empirical results were analyzed using content analysis. The authors first applied labels to the interview results according to the theoretical classification of interdisciplinary described in the previous section. Thereafter illustrative quotes for describing different aspects on interdisciplinarity were identified.

Table 2. Overview of respondents as well as mean and location

| Respondent' faculty | Number of students | Mean               | Location |
|---------------------|--------------------|--------------------|----------|
| Business            | 2                  | Focus group        | LNU      |
| Engineering         | 1                  | Personal interview | LNU      |
| Engineering         | 1                  | Personal interview | Skype    |
| Design              | 2                  | Focus group        | LNU      |

Scientific criteria for qualitative research are referred to as credibility, transferability, dependability, and conformability. (Baily, 2006) These have been secured in this paper accordingly;

- *Credibility* implies believability, authenticity and plausibility of the results (Miles and Huberman, 1994). Credibility for this study has been achieved by using appropriate methods for collecting and analyzing data as well as the conclusion are derived from the data as recommended by Lincoln and Guba (1985).
- *Transferability* refers to the applicability of findings beyond the research setting (Stake, 1995). Transferability for this study has been achieved by the usage of a theoretical framework that allows for replication of the study in other settings, situations, and with other participants.
- *Dependability* refers to internal consistency among core elements (such as research questions, data collection, and analysis). In order to enhance dependability in this study a detailed account of the research process that shows correspondence between methodology and conclusion as recommended by Baily (2006).
- *Conformability* implies that the findings can be supported by data (Baily, 2006). The findings of this study are clearly supported by the empirical data. The analytic process was influenced by grounded theory as well as content analysis; the authors applied labels to the empirical data, and thereafter the labels were compared and related to the analytical framework (see table 2 and section Results).

## RESULTS

The following section accounts for the students' perceptions on interdisciplinarity. Illustrating quotes are found in Table 3 and referred to in the text according to the continuous numbering. The quotes are aligned with the proposed theoretical framework (i.e. disciplinarity, interdisciplinarity, and transdisciplinarity according to Table 1).

The design students discussed the importance of disciplinary knowledge when studying an interdisciplinary program (see Q1). During the education, the design students had specific sessions aimed at strengthen their disciplinary knowledge, reasoning and understanding. They also reflected upon the risk that the disciplinary depth is diminishing at the expense of broadening the knowledge, as well as a changing perception of the design discipline during the studies (see Q2-3). The students pointed out that each student must take responsibility for their own disciplinary knowledge. The students stress the interest in the discipline and the ability to define the discipline-related problems within the project (see Q4). All student groups identified the driving force to apply for an interdisciplinary program was the possibility to broaden their disciplinary knowledge with knowledge within other disciplines (see Q5-7). The interdisciplinary approach in the program was thus explicitly mentioned while the interdisciplinary dimension was related to the individual projects. The mindset and practical work was characterized by interdisciplinarity, and not the formal lectures.

All student groups recognize that the projects require analytical competencies, applying experimentation and investigation as well as a systems approach (see Q8-9). In addition, the individual student is constantly challenged by the other students and faculty members (see Q10). According to the students, interdisciplinarity happens in the projects. Factors of importance are not the typical academic, but group dynamics and to define a common goal. The group dynamic is a pre-requisite and fosters interdisciplinarity (see Q11-13). Communication skills are very important according to the students. Being able to communicate across disciplines as well as understanding other disciplines is a basic prerequisite for conducting the interdisciplinary group work (see Q14-16). This includes the ability to express disciplinary knowledge as well as listening and interpreting others (see Q16). One business student identified report writing as important, thus written communication, but the common understanding was that the oral communication is the most important, and challenging.

Transdisciplinarity evolves extending the perception of the students' discipline. By working interdisciplinary, the original discipline blends with the other involved disciplines (see Q17-18).

Table 3. Students' perspectives on disciplinarity, interdisciplinarity and transdisciplinarity

|                     |  |
|---------------------|--|
| Disciplinarity      | <p>Q1) <i>"we had something called community of practice...//... discussing the projects"</i> (design student)</p> <p>Q2) <i>"...self-confidence, that was going down in my own profession, in my own discipline."</i> (design student)</p> <p>Q3) <i>"they were expecting something material but for me when I learned during the project and what I liked about design has changed a lot with this program, is something that has not to be physical. It was more a strategy, a tool to design things."</i> (design student)</p> <p>Q4) <i>"you have to be really interested in your own discipline and be able to define your problems within the project"</i> (design student)</p> <p>Q5) <i>"It would be more interesting to do the others work and learn that as well... "stay in the box, but think outside the box"."</i> (engineering student)</p> <p>Q6) <i>"I mean, the problem owners, even if they were not working in an interdisciplinary way...//... the project was usually to be approached in an interdisciplinary way"</i> (design student)</p> <p>Q7) <i>"I do not know which lecture was about interdisciplinary work?"</i> (engineering student)</p>  |
| Interdisciplinarity | <p>Q8) <i>"Working with different perspectives on the same goal."</i> (engineering student)</p> <p>Q9) <i>"We had to take the three aspects and put them together."</i> (design student)</p> <p>Q10) <i>"To constantly be challenged by the others; Flexible learning and being able to listen, it is important when you take the program"</i> (business student)</p> <p>Q11) <i>"From working in a team, we have learned ... not exactly the academic"</i> (business student)</p> <p>Q12) <i>"It's about working together with an open mind. To...because to work together you need to be open, to learn from each other"</i> (design student)</p> <p>Q13) <i>"Work in process with other disciplines towards the same goal, but also in conversation"</i> (engineering student)</p> <p>Q14) <i>"How to cooperate and communicate...//...and report writing."</i> (business student)</p> <p>Q15) <i>"What I see, each discipline has its unique language"</i> (engineering student)</p> <p>Q16) <i>"I need to know how to explain to my colleagues what design is about; it's not about visualizing and presentation it is also about this and this. So I think the learning is the discussions when you meet your group."</i> (design student)</p> |
| Transdisciplinarity | <p>Q17) <i>"but for me when I learned during the project and what I liked about design has changed a lot with this program, is something that has not to be physical. It was more a strategy, a tool to design things"</i> (design student)</p> <p>18) <i>"I can't explain it as working together as it is beyond it. Work in process with other disciplines towards the same goal, but also conversation."</i> (engineering student)</p>  |

## **RESULTS DISCUSSION**

According to the empirical findings, it appears to be important for the students and their interdisciplinary learning to have a strong basis in their main discipline in order to succeed with interdisciplinary studies. According to Säljö (1982) there are two dominated categories for how students perceive their learning; one category believes that learning is associated with solving the actual tasks whereas the second category are those who believe that they will find meaning through the actual tasks (i.e. they see things in a new light and relate tasks to earlier experiences). In our case, the students appear to perceive learning aligned with the second category as they relate to interdisciplinary learning and they think interdisciplinary learning changes them in some way. This categorization is further expanded and refined by Giorgi (1986) and Marton, Beaty, and Dall'Alba (1993). Working interdisciplinary may change the disciplinary knowledge; there is a risk of losing in-depth knowledge, but also an opportunity to expand the knowledge horizon, which is consistent with the definition of modification interdisciplinarity according to Davies and Devlin (2010). The driving force for entering an interdisciplinary program appeared, interestingly, to become multi or cross disciplinary. The students in this study recognized the multi-disciplinary program content while interdisciplinarity was rather seen as a working method, and not as formalized knowledge or skills.

The students perceived the interdisciplinary program to be challenging and demanding extraordinary personal and interpersonal abilities. The ability of listening is as important as the ability to express. The empirical findings suggest that communication skills and team work are perceived as most important for learning to work in an interdisciplinary context. It is hard to pinpoint when and where interdisciplinary is thought and experienced, according to the students. Connecting to Davies and Devlin (2010), the students seem to perceive the projects and the project-based learning as being pluridisciplinary. However, the students can experience learning differently depending on the learning context and requirements (Marton and Booth, 2000).

## **CONCLUSIONS, IMPLICATIONS AND FUTURE RESEARCH**

In order for companies and organization to meet changes in business environment, the new generation of students needs to have a continuous changing mind-set as well as knowledge of different disciplines. The students' perceptions of interdisciplinary learning appear to be in line with the notion that learning is primarily to see things in a different way and to seek the meaning (aligned with learning conceptions by Marton, Beaty, and Dall'Alba, 1993). This study concludes that it is difficult to identify when interdisciplinarity occurred. From a teaching perspective, it must be clarified how, where and when interdisciplinary is thought, particularly as the difference between multi-disciplinarity and interdisciplinarity is not clear for the students. In this particular case, the students from all involved disciplines mainly perceive that interdisciplinarity occurred with regards to team work and communication. Interdisciplinarity appear to be a process, where the main learning takes place in the projects. This is aligned with Vygotsky (1896-1934) who claimed that students develop knowledge in interaction with each other (Strandberg, 2006).

Moreover, it is important for the faculties to find a balance between disciplinar and interdisciplinary teaching, as the interdisciplinary learning requires a solid disciplinar foundation. It is not enough to base this on previous and existing disciplinar knowledge; the students' develop in their disciplines during the program as well as become interdisciplinary.



Also, setting a program structure allowing for flexibility is important in order to support the open and real-life learning settings and challenge the students out of their comfort zone. The purpose of the master program is to provide interdisciplinary knowledge and abilities to the enrolled students while deepening their disciplinary knowledge. This is mainly also as it is perceived by the students. However, tendencies towards a modification of the disciplines were noticed by the authors; the students' challenged their own perception of the discipline. This might lead to new disciplines evolving, such as "innovation design" or "innovation engineering". This paper focuses on the students' perceptions and meanings of interdisciplinarity and learning interdisciplinarity in an ongoing master program, however in order to shed a light on the concept of interdisciplinarity future studies need to be conducted focusing on the faculty members' perception as well as different possible teaching modes in order to teach, and the students to learn, interdisciplinarity skills.

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## BIOGRAPHICAL INFORMATION

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## Appendix 1

### **Interview guide**

1. How do you define interdisciplinary? (This question was repeated in the end of the interview)
2. What does interdisciplinarity mean for you?
3. How does interdisciplinarity appear in the program?
4. Where/how does interdisciplinary take place?
5. Which stakeholders are involved?