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Karadechev, Petko; Petersen, Lone Stub; Børsen, Tom

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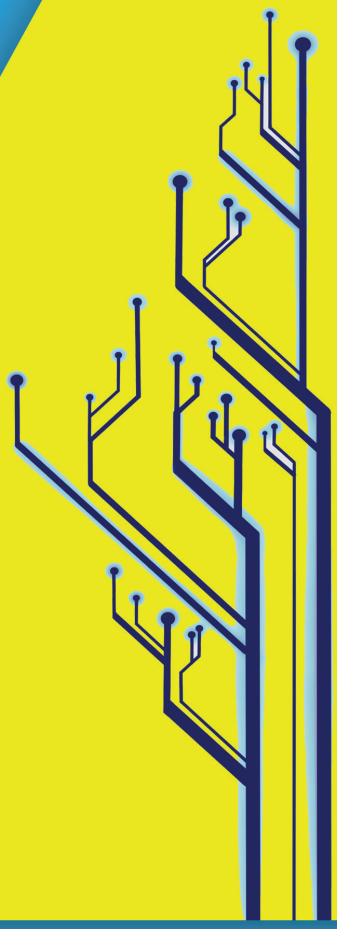

in the study program of

TECHNO-ANTHROPOLOGY

Petko Karadechev, Lone Stub Petersen and Tom Børsen

AALBORG UNIVERSITY PRESS

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Table of Content

CHAPTER 1:

Introducing the Complexity of Techno-Anthropology

Techno-Anthropology is the title of an interdisciplinary Master's program at Aalborg University. The study program is offered in both Copenhagen and Aalborg and involves about fifty teachers from the Technical Faculty of IT and Design, the Faculty of Humanities, and the Faculty of Science and Engineering.

The focus of Techno-Anthropology is on human—technology relations and draws on interdisciplinary approaches to understand and improve how people and technologies interact, form and constitute each other. The Master's program has a strong focus on technological change through inter- and transdisciplinary collaboration and sets out to educate change agents that can transform such collaboration and inscribe values, intentionalities, and user-friendly perspectives into technological solutions. Students in the program apply technical, natural scientific, anthropological, philosophical, and design-based literature, theories and methods, which allows them to understand and shape interactions between people and technologies in multiple ways.

In total, there are eighty places available on the Master's program in Techno-Anthropology, forty in Aalborg and forty in Copenhagen. In Copenhagen, all places are typically occupied. In Aalborg around twenty students enroll annually.

For students to enroll they need a qualifying Bachelor's degree. Students with one of the following Bachelor's degrees can be admitted:

- A BSc in Techno-Anthropology. Aalborg University also offers a Bachelor's program in Techno-Anthropology that generates

a legal claim to admission to the MSc program in Techno-Anthropology.

- Other interdisciplinary Bachelor's degrees that combine Natural / Technical Science with the Humanities / Social Sciences (e.g. Art and Technology, Communication and Digital Media, and Humanistic Technology).
- Bachelor's degrees in Social Science or the Humanities that provide competences in ethnographic research methodology (Anthropology, Market and Management Anthropology, Sociology, Psychology).
- Health-professional Bachelor's degrees (Radiographer, Nurse, Bioanalyst, Midwife, Occupational Therapist, Physiotherapist)
- A Bachelor's degree in engineering or natural science.

The ratio between the backgrounds of those admitted with a Bachelor's is typically as in Figure 1.1:

Techno–Anthropology : health professionals : other degrees = 1 : 1 : 1

Figure 1.1. Ratio between the backgrounds of the admitted bachelors.

In addition, both Danish and foreign students are enrolled. The purpose of enrolling students with so many different backgrounds is to translate the program's advertised interdisciplinarity into practical experience. During the program, students need to practice interdisciplinary collaboration by establishing fruitful collaboration in a highly heterogeneous group. This endeavor has not been free of challenges, sounding good in theory but being difficult to successfully stage and enact. For example, some Bachelor's students in Techno-Anthropology express concern about repetition, that is, that the Master's program will not provide them new insights and competences and that they need to act as Techno-Anthropology teachers for those of their peers who come from different backgrounds. Some professional Bachelor's student in health science find the program difficult because it is so different compared to the degrees they bring with them.

In student evaluations of the first semester of the Techno-Anthropology Masters' program in 2014, the following issues were raised:

- Students with a background in Techno-Anthropology felt that the 1st semester repeated content that had already been addressed in the Bachelor's program.
- Many students who had enrolled with a non AAU degree and were therefore not familiar with the Aalborg Problem-Based Learning (PBL) model complained about how PBL was introduced.
- All students had the perception that they needed help to integrate different disciplinary backgrounds in their projects.

The interdisciplinary challenge for the Master's in Techno-Anthropology has many parallel facets: two campuses, many nationalities, teachers from different faculties, and the enrollment of students from different bachelor's degrees.

1.1 Developing the overall competence profile of Techno-Anthropology

A first step in addressing the challenge of interdisciplinarity was to develop the curriculum so that it supports interdisciplinary studies. A committee tasked in 2015 by the Study Board for Techno-Anthropology and Sustainable Design to revise the curriculum developed the following overall competence profile for Techno-Anthropology, which lists in general terms the qualifications that a Techno-Anthropologist will possess after graduating.

Knowledge

- explain and compare a broad selection of socio-technical theories, that, in selected areas, is based on the highest international research
- explain and critically reflect on a broad selection of qualitative, interactional, interventional and ethnographic methods of

relevance to technology and innovation that in selected areas is based on the highest international qualitative research

- identify and critically evaluate key processes of technological development, including research strategies, development principles, institutional conditions, industrial dynamics, political regulation and knowledge controversies
- identify, explain and compare different perspectives on exemplary technology cases from different technological domains
- paraphrase and critically evaluate professional literature used in different technological domains

Skills

- develop new analyses and assessments of social, societal and ethical conditions, challenges and implications of complex technologies
- contribute through research-based advice on the management of social, societal and ethical conditions, challenges and implications of complex technologies
- engage in dialogue on professional, disciplinary and interdisciplinary topics with stakeholders, and representatives of different professions and disciplines within selected technological domains
- apply a broad selection of interactive, interventional, experimental and ethnographic methods

Competencies

- participate in initiation, mediation and facilitation of interdisciplinary team-based innovational processes
- participate in the management of complex work and processes related to the development of sustainable technological solutions that are professional and socially responsible
- support the transformation of technological opportunities into socially responsible products and systems that require new solutions
- take responsibility for own professional development and specialization

Boiling down the overall techno-anthropological competence profile to a few lines, we have underlined key concepts in the competence profile above and used them to condense the competence profile into a three line Techno-Anthropological "toolbox" consisting of:

- methods supporting the inscription of user-perspectives, ethical values, and other social elements into technological solutions, including problem-based learning
- socio-technical theories that capture different aspects of the human—technology interface
- approaches to extract insights from Techno-Anthropological case studies and professional literature

The toolbox requires not only that Techno-Anthropologists have knowledge of these elements, it also allows them to apply theories and methods to the analysis of concrete cases within domains of technological transformation, communicate their insights to different stakeholders and apply them in interdisciplinary project teams.

1.2 A socio-technical perspective on technology

A socio-technical understanding is fundamental to Techno-Anthropology. The committee tasked with revising the curriculum specified this understanding of technology in a one-page working document. Techno-Anthropology is founded upon research that argues for a contextual approach to technology and that is therefore critical of one-dimensional approaches to technology that hypostasize technological artifacts and neglects technology's cultural, institutional, legal and ethical contexts. The committee calls this position the socio-technical understanding of technology and used it as the basis for revising the curriculum.

The Techno-Anthropological understanding of technology is presented in the box on the following page (Figure 1.2).

The Conception of Technology in Techno-Anthropology

Techno-Anthropology is not based on any one particular view on technology but encompasses different concepts of it. However, the program is generally informed and inspired by analyses and conceptions of techno-science and technology that have been developed in the interdisciplinary fields of Science and Technology Studies (STS) and the Philosophy of Technology (PoT), among others. The overall tendencies of these interdisciplinary approaches are indicated by the binary table below.

As a consequence of the 'right column view', we believe that our contribution to technological development should be based on an interdisciplinary style of work and on a broad socio-technical understanding of technology

	Earlier and alternative conceptions of technology	***The Techno-Anthropological conception of technology (from STS and PoT)***
Matter:	*Technology consists of technical matter.*	*Technologies always consist of entangled socio-technical matters.*
Process:	*Technology reaches a final form under the process of research and development.*	*Technologies are endlessly developed, changed, and modified. Technologies have no original nor final form.*
Actors:	*Technology is the results of the inventive acts of uniquely creative individuals.*	*Technological innovation is always distributed, gradual, and contextual. Innovation always involves a multitude of actors.*
Effects:	*Technology has determinate and predictive effects on society.*	*The effects of social-technical ensembles are located, and to some extent unpredictable, and result from complicated interactive processes.*
Solutions:	*It is likely that societal problems will be fixed by technological means.*	*Problems are difficult to define, and solutions are only partial. Steve Rayner summarized it up similarly, when he described technological development in the following way: "Wicked problem, uncomfortable knowledge, clumsy solutions".*
Location:	*The crucial site of technological development is the R&D lab.*	*The crucial sites of technological development span the whole spectrum from social ideas about technological future over R&D labs to the appropriation and hacking of technologies by users.*
Politics:	*Technology is essentially a matter of rationality and calculation.*	*Technologies are entangled with societal and historical transformations and the production of difference and knowledge. Technologies are therefore likely to be controversial, provoking discussions about ethics, futures, politics, sustainability and humanity.*
Ethics:	*Technology is value-free, and ethics deals with the uses and misuses of technology.*	*Technologies are entangled with values and socio-technical imaginaries.*

Figure 1.2. Techno-Anthropological understanding of technology

1.3 Problem Based Learning and Interdisciplinarity for Techno-Anthropology – a guide

PBL is a central element in the teaching of all programs at Aalborg University. Through PBL, students engage in solving authentic, real-world problems, ideally with a focus not just on the technical but also the contextual aspects. In this respect, PBL supports and can be integrated into the teaching of interdisciplinary competencies for students in Techno-Anthropology.

To support the integration of PBL skills in the Techno-Anthropology program, the Study Board developed a PBL guide specifically for Techno-Anthropology. The process started in 2015, and the first draft became available for students in 2016. The draft was revised in 2020. The revised guide is included at the end of this publication as Annex 1.

The PBL guide's main purpose is to support Techno-Anthropology students in the use of PBL. However, the guide was not just developed as a tool for students. When joining different faculties and departments around an interdisciplinary education, many different interpretations can emerge of what learning with and through Aalborg's PBL model can mean. Having a shared guide and framework for teachers as well as students was an initiative to create a shared language and understanding.

The guide is based on existing research literature on PBL, as well as guides for students to the Aalborg model and to the university's PBL strategy (see the references in the PBL guide in Annex 1). The draft was reviewed at a workshop with multiple participants from Techno-Anthropology and the Aalborg Centre for PBL in Engineering, Science and Sustainability under the auspices of UNESCO (UCPBL) at the Department of Planning at Aalborg University. In drawing up the guide, dialogue and feedback from colleagues teaching Techno-Anthropology. Members of the C-Inter group on intercultural and interdisciplinary learning have also provided valuable inputs.

The reason for the guide was to create a framework for understanding how the interdisciplinary learning goals of the Techno-Anthropology curriculum is linked to PBL: In the PBL guide the Aalborg

PBL model is translated into the framework of Techno-Anthropology. Additionally, it was intended to leave room for the diversity of the teaching staff and their areas of expertise from analytical perspectives, over practical participatory design perspectives to engineering perspectives.

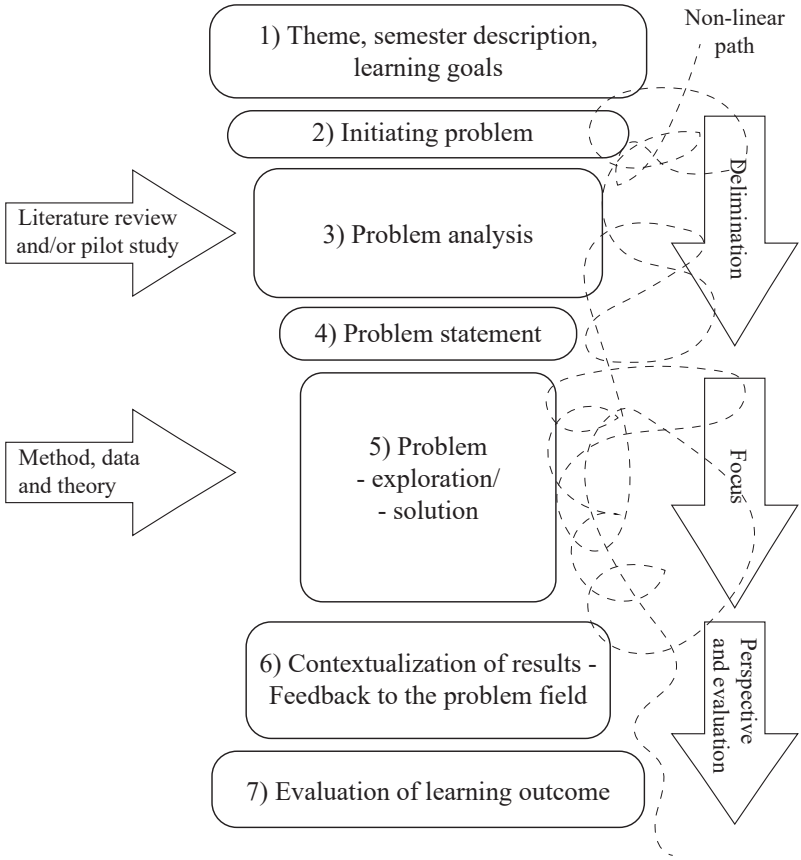

Figure 1.3. The Revised PBL model.

The guide emphasizes the non-linear process of PBL. When engaging in learning processes in a project, the core condition is the lack of a clear path. Therefore, you have very seldom finished with any particular part of the project until you can decide at the end on the main narrative and perspectives to include in the project. This is reflected

by an addition to the traditional representation of the AAU-PBL model, namely a dotted line signifying a nonlinear path (Figure 1.3).

The PBL guide in its current iteration consists of the following elements:

Problem-based project organized learning for Techno-Anthropology
- What is a problem?
- What is project work?
- What is a project group?

The project process and the types of projects
- Projects oriented towards analysis/assessment
- Projects oriented towards action/change

Seven steps in problem-based learning and projects
- Step 1. Theme framework, semester descriptions and learning objectives: relating to the theme, mapping of the problem area and conceptualization
- Step 2. Initiating problem: characterize and identify the problems in the problem area
- Step 3. Problem analysis: analysis of the problem area
- Step 4. Problem statement: delineate and argue for an authentic problem
- Step 5. Problem exploration/solution: study design and results
- Step 6. Contextualization of results: feedback on the problem area
- Step 7. Evaluation: reporting and reflections on the process

Overview and characterization of the different Master's semester projects

Figure 1.4. Elements of the PBL guide for Techno-Anthropology.

Other elements in the guide emphasize the literature review and quick and proper observations as methods to be applied in the problem analysis. This is specifically related to techno-anthropological project work and might not be relevant to other studies, e.g., in engineering.

Another key element of the guide is that it presents the different semester projects with core perspectives and recommended methods (see Table 1.1). This is supposed to support students and teachers in navigating and acquiring an overview of progression within the study program.

Table 1.1 Presentation of the different semester projects with core perspectives and methods recommended in the PBL guide for Techno-Anthropology.

Project / Semester	**Description**	**Research methods applied by students**
Interdisciplinary knowledge production / 1st semester	Practical experience with collaborative group work that involves international and multiple disciplinary backgrounds.	Literature review AND PBL.
Technological transitions / 1st semester	Apply Techno-Anthropological theories and methods to gain insights into key processes of technological transformations and to identify drivers of and barriers to responsible socio-technical innovation.	Revised literature review, two interviews with different stakeholders AND half a day's observations, analysis of websites, SoMe posts OR video clips.
Technological processes and design / 2nd semester	Improve or engage in the development or evaluation of an innovation process to design a technology or a specific technical product.	In-depth use of interventional OR ethnographic methods.
Professional development / 3rd semester	Acquire practical experience in solving advanced Techno-Anthropological challenges in a professional context.	Action research, participatory research OR ethnographic field work
Master's thesis / 4th semester	Carry out a Techno-Anthropological research project following good academic and professional practice that directly or indirectly contributes to the development of robust and socially responsible solutions to societal challenges.	Own choice

1.4 Where do Techno-Anthropologists work?

The students can themselves choose which technology domain they will work in while following the Master's program in Techno-Anthropology. To acquire an idea of what domains students can work in during their Master's thesis and in which domains they find work after they graduate, the Study Board has conducted studies of both topics.

Table 1.2. Master's theses: topics, and employment after obtaining the Master's for Techno-Anthropologists.

Technology sector	Thesis in 2017 and 2018 (N=78)	Employability in 2016 and 2017 (N=34)
Health and welfare	*40%*	*40%*
Other IT (not in health and welfare or environment and sustainability sectors)	*25%*	*30%*
Environment and sustainability	*20%*	*20%*
Other technology sector	*15%*	*10%*

In 2017 and 2018, most theses addressed a problem in one of the following three technology sectors: Health and welfare, Other IT, or Environment and sustainability. In total, all 78 graduate theses were included in the analysis from both Aalborg and Copenhagen. It is also in one of these three sectors that most graduates find a position. Here, numbers are based on a survey circulated to the graduates one year after graduation. The reply rate was 50%. All percentages are rounded to nearest 5% interval.

The graduate analysis identified more frequent occupations as

1. User Involvement and User Experience (UX)
2. Project Management and liaison between people, technology and professional groups
3. Technology Assessment, Technology Planning and Technology Design
4. Research and Teaching

Their most frequent tasks in their posts are (in alphabetical order).

- Broad understanding of technology, as well as methodological and theoretical overview
- Ethnographic methods (participant observation, interviews and cultural understanding)
- Liaison expertise between technologies, users and experts
- Project management and management
- User-involved design of technological solutions

The graduates work in private companies (35%), governmental organizations (25%), regional organizations (20%), municipalities (15%), and NGOs (10%).

Several Techno-Anthropology graduates are portrayed, and their occupations introduced, on the website of the Master's program in Techno-Anthropology, on which there are at present eleven portraits:

Table 1.3. Examples of techno-anthropologists by occupation (based on the testimonials found here: https://www.en.aau.dk/education/master/techno-anthropology/job-and-career/)

Name	Working tasks
Sana (CPH airport)	"I work at Copenhagen airport. I observe and analyze human behavior in the airport every day and use my knowledge in order to improve passenger experiences."

Sarah (NETS -- digital payment systems)	"I work as User Researcher, and have contact with our users and customers, for instance, businesses with terminals. I conduct many interviews, and I use all of my anthropological methods on a daily basis. Everything is about user involvement."
Daniel (GETS -- branch organization for public and private tech collaboration)	"In my job today, I am in contact with many stakeholders with different backgrounds, and at the same time, I have to provide service to the managers from the institutions and collaborate with my co-workers. My primary job is analysis consultant. I look at numbers and analyses and find clues and stories that can be significant in a political context and that can 'make numbers speak.'"
Peter (Zealand Business College -- institution of higher education)	"I'm the project manager setting up technical education. Here I use my competences from Techno-Anthropology to ensure that the culture and values we want to teach are also reflected in the technologies we use. I evaluate technology on a daily basis, both the very practical application of the technologies, and also in relation to a strategic development plan."
Anna (South Danish Health Care Innovation)	"I am a project manager focusing on attracting more young people to the STEM field. In this project we collaborate with different educational institutions and work with teaching in new and innovative ways. "
Anna (User tribe -- UX)	"I help involve companies' customers and future customers in an ongoing development process to ensure that new solutions are developed in line with customer needs, experiences and behavior. I help develop our methodology, while also using my anthropological background to analyze the data we have, to ensure that companies are moving in the right direction when developing new solutions or services."
Mischa (LEO Innovation Lab -- Private health tech innovation / implementation)	"I am responsible for user feedback and testing of the digital products that we develop. My work tasks entail, among other things, recruiting users, the planning and execution of interviews, together with analysis and reporting of insights. The last mentioned is particularly important, as it is my job to translate qualitative results into action-oriented solutions.
David (Event Collective -- Online booking platform)	David is the founder and CEO of eventcollective.dk. Only an interdisciplinary profile can meet these needs.

Jeanette (CIMT -- Public health tech innovation / implementation)	"I have been working the tents where we perform COVID-19 testing. Here we use a different IT system, which I helped implement. I have been to various test tents and helped health personnel get started with this new IT system, which enabled them to swab and print labels in connection with this. I also helped optimize their workflow, which enabled them to attend to a citizen/patient within 3-5 minutes. In this way, we eliminate queues."
Anders (New Hospital North Zeeland)	"I am a project manager, and I consult on equipment. A new aspect in my work concerns the fact that I am now examining what equipment can be shared across departments. I am looking at the use of the equipment in many different specialties."
Aqqalu (Danish Institute of Fire and Security Technology)	"I work on combining Fire Safety Engineering with anthropological methodology, as well as developing video services for the department. I work closely with engineers to create a new methodology for risk analysis and fire scenario development. This cross-disciplinary approach is a fundamental part of my techno-anthropological background and, combined with a strong anthropological toolbox, is vital for my current work."

1.5 Study program revisions

The Master's program in Techno-Anthropology has been revised twice, in 2016 and in 2020, since being launched in 2011. The purpose of the revisions has been to accommodate students' suggestions for improvements and to strengthen the program's interdisciplinary character. During the revisions to the study program in 2016 and further in 2020, the following changes were made in curriculum (see Table 1.4).

Table 1.4. Curriculum changes (major changes are shown in bold red text).

Original curriculum of 2011	New curriculum of 2016	Revised curriculum of 2020
1. SEMESTER		
Project (15 ECTS): Expert Cultures and Responsible Technology	*Project* (5 ECTS): **Interdisciplinary Knowledge Production** *Project* (10 ECTS): Technology in Practice	*Project* (5 ECTS): Interdisciplinary Knowledge Production *Project* (10 ECTS): **Technological transformations**

Course (5 ECTS): Responsible and Innovative Knowledge Production	*Course* (10 ECTS): **Techno-Anthropological Problems and Theories**	*Course* (10 ECTS): Techno-Anthropological Problems and Theories
Course (5 ECTS): Organisational Culture: Expertise, Innovation and Responsibility		
Course (5 ECTS): Elective	*Course* (5 ECTS): **Ethnographic Methods OR Emerging and Cutting Edge Science and Technology**	
2. SEMESTER		
Project (15 ECTS): Anthropology-based Product Development	*Project* (15 ECTS): Technological Innovation and Design	*Project* (15 ECTS): **Technological Processes and Design**
Course (5 ECTS): Product Development: Value-sensitive Design, User-driven Innovation, Technology-based Service or Scientific Advice *Course* (5 ECTS): Elective	*Course* (10 ECTS): **Facilitation of Design Processes and Technological Innovation**	*Course* (10 ECTS): Facilitation of Technological Design Processes and Innovation
Course (5 ECTS): Mapping Controversies		
3. SEMESTER		
Project (20 ECTS): Field Work	*Project* (25 ECTS): Ethnographic Fieldwork OR **Action Research** OR **Academic Internship**	
Course (10 ECTS): Reflection and IT Tools Supporting Analysis of Qualitative Empirical Material	*Course* (5 ECTS): **Reflexive Project Design**	*Course* (5 ECTS): Reflexive Project Design **and Competence Development**
4. SEMESTER		
Project (30 ECTS): Master's thesis		

In the first semester, a 15 ECTS project was divided into two smaller projects. The first small 5 ECTS project was designed to facilitate knowledge-sharing between students from different backgrounds so as to create a constructive learning environment, and to collect knowledge from different disciplines. The larger project of 10 ECTS would

then address a problem and generate knowledge within a specific technology domain. In 2020 the topic of the main project was changed from analyzing a technological practice to analyzing a technological transformation.

The second change in the first semester of 2016 were the merger of two small courses into one central course, "Techno-Anthropological Problems and Theories". This is thought of as a so-called signature course for the program because it presents knowledge of two important central elements in Techno-Anthropology: theories and cases.

The third change in 2016 concerned elective courses of 5 ECTS that were not specified in the curriculum. The new curriculum specifies that students who have used ethnographic methods in at least two semesters in their Bachelor's studies are required to follow and pass the course on "Emerging and Cutting-Edge Science and Technology". Other students must follow and pass the course on "Ethnographic Methods".

In the second semester, the focus of the project work has always been on technological design and product development. In the curriculum for 2020, the focus was placed on technological processes that lead to responsible and user-friendly technological solutions. In 2016 two courses were merged into another signature course presenting the methodological palette of Techno-Anthropology. The course module "Mapping Controversies" was retained.

In the third semester, more project possibilities were included in 2015 to complement the possibility of doing an ethnographic field study. The added project possibilities were oriented more towards intervention. The second change was a reduction of course work from 10 to 5 ECTS. The topic of the course in 2011 and 2016 was curricula support to the project's work. In the 2020 curriculum, attention to competence development and liaison with to the labor market were added to the course.

The progression of the program in Techno-Anthropology is shown in Figure 1.5.

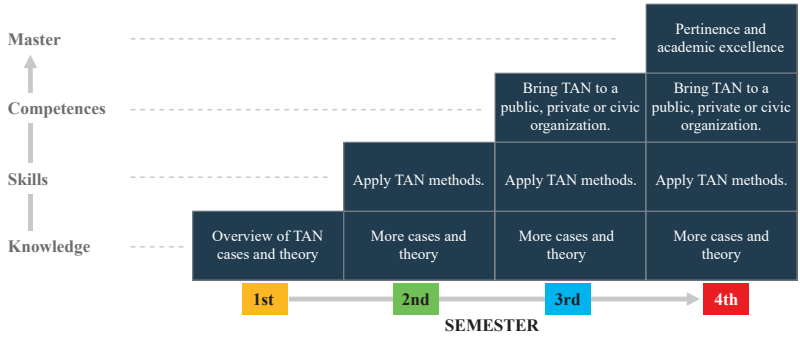

Figure 1.5. Progression of the MSc in Techno-Anthropology.

The focus of the first semester is generating a shared Techno-Anthropological knowledge base among the enrolled students by ensuring that each student has an overview of the program's central theories, methods and examples, and to form students' interdisciplinary and intercultural competences. The second semester adds a focus on applying Techno-Anthropological theories, skills and methods in order to promote responsible and sustainable technological solutions, while the third semester requires the students to re-locate themselves in professional contexts and thereby add a focus on generating Techno-Anthropological competences. A central element of the Techno-Anthropological vision is that students generate insights into the professional literature. This is done in all semester projects, which must include references to the relevant professional literature. The thesis in the fourth semester aims at academic excellence.

To acquire an idea of the effects of the revised curriculum, we can take a look at student evaluations of the first semester in 2016, the year the revised curriculum was introduced. The evaluations showed that:

- The integration of different disciplinary backgrounds in the semester projects was still lacking
- Students with a BSc degree in Techno-Anthropology continued to perceive the content of the first semester as repetitive, though

the professional Bachelor's student found the program challenging.

In 2017 a research and development project entitled "Translation of an Interdisciplinary PBL Strategy to the Formation of Interdisciplinary Competences" funded by the Strategic Education Council at Aalborg University was launched. The purpose of the project was to analyze the different formal and informal educational practices in the Master's program in Techno-Anthropology and to identify and develop a list of good practices to enact and promote inter- and transdisciplinarity in university education. This book will report on this project. It successfully addressed these two issues, as the semester evaluation of the first semester in the MSc program in Techno-Anthropology in 2019 was given a positive evaluation with no critical remarks. The project also provided input into the 2020 revisions of the study program.

1.6 Summing up

This chapter has introduced the complexities of the MSc program in Techno-Anthropology. The complexities are seen in the diversity among 1) the enrolled students in terms of different professional, disciplinary and national backgrounds, and 2) the teachers who are employed at two locations – Aalborg and Copenhagen – and at different faculties, namely the Technical Faculty of IT and Design, the Faculty of Humanities, and the Faculty of Science and Engineering. The interdisciplinary study program in Techno-Anthropology was presented through a discussion of the links between the program's competence profile and the socio-technical understanding of technology, as well as the Aalborg model of problem-based learning. The chapter also included a presentation of where Techno-Anthropology graduates typically find post-graduation work and a discussion of how the Master's program was revised in 2016 and 2020.

This presentation of the complexities of Techno-Anthropology serves as background to the project "Translation of an Interdisciplinary PBL Strategy to the Formation of Interdisciplinary Competences", which was carried out in 2017 with the purpose of exploring how a clear interdisciplinary professional profile can be supported by target

activities. This exploration was carried out by arranging activities aimed at developing students' interdisciplinary competencies.

The project activities included a literature review, an analysis of project reports, workshops with students and faculty members, and a catalogue of ideas to promote interdisciplinary education. These different parts are presented in the following chapters of this book.

In summary, all these activities point to the initial question we are addressing: "How can heterogeneity and complexities be dealt with in a transdisciplinary and interdisciplinary teaching environment such as the Master's program in Techno-Anthropology?"

CHAPTER 2:

State of the Art: Transdisciplinary Threshold Concepts

This chapter provides a literature review to support understanding of the links between PBL and inter- and transdisciplinary university study programs. It develops a knowledge and conceptual basis for analyzing and understanding the challenges of Techno-Anthropology, conducted in relation to the project "Translation of an Interdisciplinary PBL Strategy to the Formation of Interdisciplinary Competences", mentioned above in Chapter one.

With this in mind, the chapter presents the literature review that was conducted (including criteria and a systematic description of methods) and its results, culminating in a proposal for a theoretical framework. The chapter also addresses some of the practical dimensions that are related to the implementation of this framework. This is done by providing specific examples of educational activities that are believed to be consistent with the proposed theoretical framework, which was implemented in 2017 in the seventh semester of the Techno-Anthropology Masters' Program in Aalborg University Copenhagen.

2.1 Literature Review Criteria and Description

The focus of this chapter is to support the understanding of doing problem-based learning (PBL) in an interdisciplinary and transdisciplinary university teaching environment. Unless otherwise stated, PBL is used throughout this chapter in accordance with the outline in "Problem-Based Learning for Techno-Anthropologists", included in this book as Annex 1. The key words of the literature review used in accessing the relevant academic databases were 'PBL', 'university teaching', 'interdisciplinarity' and 'transdisciplinarity'. The results of the review were compiled in a small dataset, which was then

analyzed quantitatively and qualitatively. Ultimately, the results of the literature search form the basis of a suitable theoretical framework that strengthens, revitalizes, and refocuses Aalborg University's PBL approach within Techno-Anthropology.

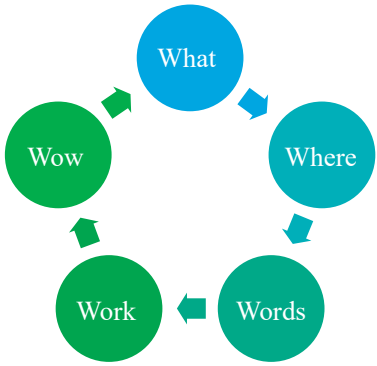

Figure 2.1 Aalborg University Library's Search Strategy: The 5 W's.

The literature search builds on a search strategy used by Aalborg University's library. The strategy has been adapted by drawing on "Success, a Structured Search Strategy: Rationale, Principles, and Implications" (Zins, 2000), and employs what it calls *The 5 'W's*: *what, where, words, work, wow* (Figure 2.1). Effectively it narrows down a broad problem to specific literature results. Additionally, a secondary analysis via wordclouds.com, an online word cloud service, is conducted as a quantitative method. This approach is meant to complement and strengthen the literature search by providing a broader perspective on the general focus of the literature corpus. Finally, a qualitative analysis focuses on an article by Maggi Savin-Baden and goes at depth into her proposed *transdisciplinary threshold concepts* (TTC).

2.1.1 Criteria

The criteria used for the literature search are as follows. The 'what', the overall problem, is formulated as "How can PBL scaffold the construction of an interdisciplinary and transdisciplinary university teaching environment?" What follows is the 'where', which in this

case is the Educational Resources Information Center (ERIC) academic database, chosen for its specific focus on educational resources and its correspondence with the 'university teaching' segment of the initial question. The third 'w' – 'words' - are three blocks of keywords: 1) 'university teaching', initially made up of the terms 'university teaching' and 'academic teaching', 2) 'PBL', made up of 'problem-based learning' and 'PBL', and 3) 'interdisciplinary and transdisciplinary', made up of 'interdisciplin*' and 'transdisiplin*' versions to cover inter-/transdisciplinarity as well. The fourth 'w' – 'work' – covers the four iterations of keyword combinations that narrowed down the number of academic texts. Lastly, 'wow' refers to the insights these four iterations produce. In a different scenario, these insights would initiate a rephrasing of the main question and the remaining four factors; in this case, however, that did not happen. Instead, we used the new keywords from the initial search results to perform a second iteration and demonstrate potential new insights and directions for analysis.

Our use of only one database needs justifying. Choosing ERIC as a database is dictated by the databases that available through Aalborg University's academic content agreements. Even though the current chapter does not claim that the present literature search is exhaustive in its results, focusing on a single database specializing in the topic being investigated is a conscious choice. At the same time, we recognize that other academic databases (i.e. *Index Copernicus* and *VET-Bib*) could also be useful. This choice both limits the scope of the literature search and provides a clearer view of ERIC's contents. Two major goals of the literature search are 1) to stay consistent with the criteria set out for it, and 2) to provide meaningful information that could help in answering the initial research question.

Table 2.1. Words table following Aalborg University Library's Search Strategy

Block 1 – University Teaching	**Block 2 – Problem Based Learning**	**Block 3 – Interdisciplinary and Transdisciplinary**
university teaching academic teaching	problem-based learning PBL	interdisciplin* transdisciplin*

2.1.2 Description

After combining the keywords in different ways, we chose the following string:

> (university teaching) AND PBL AND (interdisciplin* OR transdisciplin*)

This query resulted in 91 articles, presented as a list, which can be modified into what ProQuest (the portal through which ERIC was accessed) calls "Brief view" and "Detailed view". The Detailed view is preferred during this search, as it displays the articles' source type (i.e. *scholarly journal, report, dissertation* and *thesis*), its title, list of authors, an excerpt of the article's abstract, a *Preview* drop-down menu for the full abstract, and two links. The first link is to a full *Abstract and Details* page; the second is either a direct link to read the full text or links to external organizations, also providing the full text.

To further optimize the results of the enquiry, we applied an "Educational level" filter and chose only articles that deal with "Higher education", leaving out material that includes "Elementary Education" and "Junior High Schools", to name just a few. This filtering brought down the number of articles from 91 to 50 published between 2005 and 2020.

Two methods contribute to the analysis of the 50-article corpus. The first method is to manually extract details that identify common threads and shared topics in all 50 articles. The second method uses a third-party tool, which builds on the results of the above extraction. The extraction process manually opens each article in ERIC via the full Abstract and Details page. Then each article's authors, title, abstract, subject, and identifier/keyword(s) are pasted into a Microsoft Excel sheet. Even though ProQuest provides much more metadata, such as the article's *Publisher, Accession number*, and so on, only the relevant metadata are chosen in order to focus more clearly on the contents of the articles. The three columns for titles, abstracts and identifier/keyword(s) are then pasted into a separate Microsoft Word document for each column, and each of these three documents is then fed individually into wordclouds.com.

This third-party online service provides a basic, but sufficient method of word sorting, based on word weight and size. The website visualizes each Microsoft Word document containing the extracted paragraphs and/or words by categorizing the number of times a word is used. It then visualizes each document in a word cloud where the size of each word is affected by its weight: more mentions of the word equals a larger word-size. Another important feature of the site is the ability to sort each word from the original Microsoft Word document in two ways: alphabetically and by weight. Selecting the weight option creates a list giving the number of times each word from the aggregate document is mentioned. What this method adds to a literature search is 1) a fast and efficient way of quantitatively analyzing a large result set with tens if not hundreds of articles, and 2) quantitative insight into the most frequently used words and phrases, which can be used to build on the initial search query. This could potentially lead to new search directions and new results that would otherwise be more difficult to obtain.

2.2 Results

As previously mentioned, the literature search results in a 50-article corpus, which is uploaded to wordscloud.com for analysis. The results are two-fold. First, a quantitative analysis reveals what the aggregates of the titles, abstracts, and identifiers/keyword(s) can tell us about the general trends in the 50 articles. Second, a qualitative reading of a selected list of 10 articles informs the proposed theoretical framework.

2.2.1 Quantitative results

We employed a quantitative analysis of the 50 articles to find search words that would help us in finding additional relevant articles. The titles category from the Microsoft Word document was run through wordcloud.com, resulting in a list of 277 words. The highest word-weight in the list is 'problem-based', including 'PBL' (41), 'learning' (35 mentions) and 'education' (13). The identifier/keyword(s) category has a list of 57 words, where 'education' (96 mentions) has the highest word weight, followed by 'higher' (48), and 'postsecondary' (39). Lastly, the abstracts category is, as expected, the largest, with a

list of 2500 words. If we combine the different versions of the word 'PBL', it sits on top of the list with 269 mentions (177 for 'PBL', 47 for 'problem-based', 34 for 'problem(s)', 9 for 'problem-solving' and 2 for 'problem-oriented'). Following that come versions of learning with 172 mentions (148 for 'learning', 19 for 'e-learning(-embedded)', 1 each for 'blended-learning', 'm-learning', 'self-learning', 'student-learning', and 'u-learning'). Finally, the third term with the highest weight is students with 126 mentions.

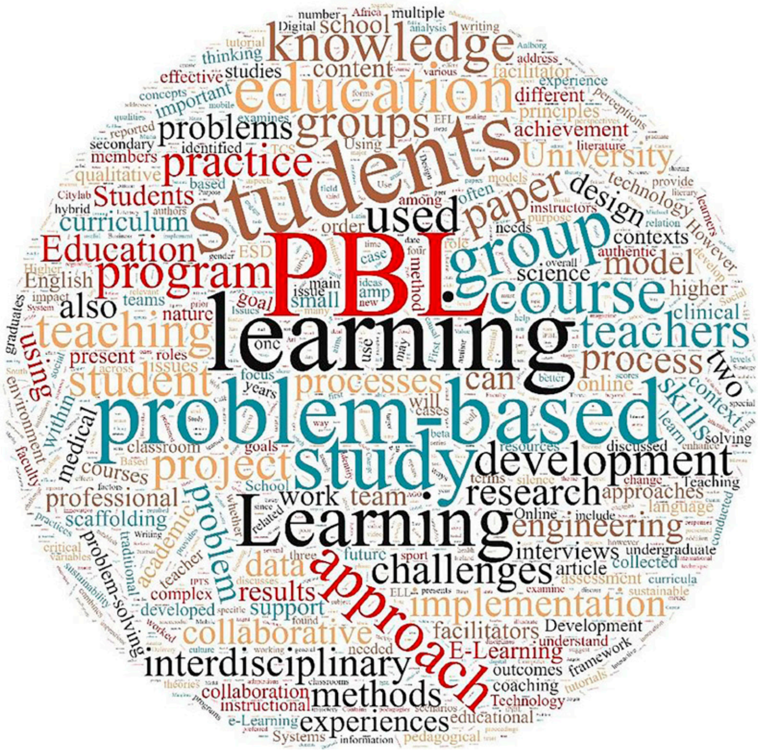

Figure 2.2. Word cloud visualization of the Abstracts category, generated by wordclouds.com.

Of these three metadata qualifiers, the abstracts are the largest set, and as such they can give us a clearer view of the topical focus of the corpus. Delving somewhat more deeply into the abstracts word cloud, we can also see keywords like 'education(al)' (63), entries with 'group'

(61 total, including 'small-group', 'grouped', 'groups', 'peer-group'), and 'approach(es)' (41) standing out.

Using the information from the quantitative analysis, we present the top 5 most used words according to their word weight in each category. This sorting is far from exhaustive, but it is used here to show what directions would be useful for further iterations of the search strategy, that is, how each of the three blocks in Table 2.2. could be improved to give more relevant results.

Table 2.2. "Categories" corresponds to three qualifiers made available through ProQuest and ERIC. "Word weight" equals number of mentions in a category dataset, processed by wordclouds.com. Words in red are identical to the initial keywords used for querying the database.

Categories	Title	Identifier/Keyword(s)	Abstracts
Word weight	41 (PBL)	96 (education)	269 (PBL + variants)
	35 (learning)	48 (higher)	172 (learning + variants)
	13 (education)	39 (postsecondary)	126 (students)
	12 (student(s))	7 (secondary)	63 (education(al))
	8 (science(s))	7 (united)	48 (study + variants)

The results of this literature search iteration show that Block 1's search words from the initial search could benefit the most by enhancing 'teaching' with 'education', and 'university' with 'postsecondary', 'higher' and 'college'. Block 2 could benefit from including different versions of 'education', as well as more specific variants of PBL, e.g. 'problem-oriented', 'problem-solving'. Block 2 might also benefit from including many different variants of 'learning', e.g. 'learning-embedded' and 'blended-learning'. The keywords from Table 2.2 that come out of the database search are mostly synonyms of the words used in the initial search sequence. We note that 'PBL' and 'problem-based learning' are often mentioned in titles and abstracts. Very few words equal the third block of search words – 'interdisciplinary' and 'transdisciplinary' – indicating that few of the identified articles deal in depth with inter- or transdisciplinarity. Most articles only mention these buzz words without engaging with them. Hence, the

search has identified a knowledge gap regarding inter- and transdisciplinary perspectives on PBL in higher education.

What, then, is new here, and what is the benefit of this kind of quantitative analysis? As a basic methodological approach, it brings in thematic perspectives and supports the reevaluation of initial ideas. The purpose of the quantitative analysis in this chapter is not to present a thoroughly exhaustive result, but to reassure ourselves that the search is on track and to stress the need for a multi-step iterative process, as well as to show how a literature search can benefit from a quantitative perspective.

Ultimately, we decided to use the 50 papers, as we did not need a larger body of work for the purposes of this chapter.

2.2.2 Qualitative results

Qualitatively analyzing results is not a trivial task. The analysis relates to the entire research process and can take inspiration from theories like hermeneutics and phenomenology. (Järvinen and Mik-Meyer, 2020). For the purposes of our project, however, we performed a thematic clustering of all 50 papers, using their abstracts as source material. We use the following criteria to look for the most relevant articles in the corpus:

1. Strong focus on PBL as a method
2. Strong focus on student engagement as process and outcome
3. Strong focus on academic interdisciplinarity/transdisciplinarity as an approach

The focus on PBL is important for the current project as it is the modus operandi of the study program in question – Techno-Anthropology – and of Aalborg University in general. Relying on and continuously striving to enhance student engagement is another focus, supported by the PBL environment, as well as student responses (cf. Chapter 4). A focus on academic inter- and transdisciplinarity as an approach is essential, as both perspectives are constitutive of the Techno-Anthropology program.

While going through the corpus of articles, we noticed two overall types of papers: understanding/reflecting and problem-solving. As all 50 articles are nuanced in their goals, approaches and insights, we cannot say that these two labels provide exhaustive descriptions of the material. What these labels provide for the purposes of the current paper is a broadly applicable lean, by which we can group the entire corpus. This grouping, then, permits a more in-depth look at how each article relates to the criteria we presented earlier. Understanding/reflecting articles generally have a lean towards highlighting insights that could bring more nuances and perspectives into how we conceptualize PBL and interdisciplinarity in a university environment. Problem-solving articles, on the other hand, have a slightly stronger focus on discussing specific approaches around the implementation and testing of methods in relation to PBL and interdisciplinarity in a university environment.

The understanding/reflecting category includes articles like "Problem Orientation in Art and Technology", in which the author Line Marie Bruun Jespersen investigates "what defines a problem […] in the field of Art and Technology, by analysing the problem formulations of the 2017 BA projects through Mogens Pahuus three types of problem orientation" (2018). as well as Liu et al.'s 2014 paper "Creating a Multimedia Enhanced Problem-Based Learning Environment for Middle School Science: Voices from the Developers", where the authors aim to "further our understandings of technology, pedagogy, and instructional theories as they relate to the application of PBL within middle school classrooms through the application of design-based research". Both articles are broadly aimed at investigating definitional questions about problems and fields as they relate to PBL learning, and they also reflect on how current understanding affects particular programs and fields.

The problem-oriented type broadly includes articles like Blackburn's "Effectiveness of eLearning in Statistics: Pictures and Stories", where the author investigates

> "(1) the effectiveness of using eLearning-embedded stories and pictures in order to improve learning outcomes for students and (2) how universities can adopt innovative approaches to

the creation of Problem-Based Learning (PBL) resources and embed them in educational technology for teaching domain-specific content, such as statistical literacy" (2015).

Other examples include "Producing an Online Undergraduate Literary Magazine: A Guide to Using Problem-Based Learning in the Writing and Publishing Classroom", in which Amy Persichetti illustrates "how a problem-based learning (PBL) course (Savery, 2006) can be used in a writing program as a vehicle for both creative and preprofessional learning" (2016). Both articles focus on specific issues – statistical literacy and learning outcomes, the adoption of innovative approaches and creative and pre-professional learning – and they provide concrete suggestions for solutions to these problems.

Going through all 50 articles, we ultimately found that 27 generally lean towards *understanding/reflecting*, while 23 are more focused on *problem-solving* approaches.

Even though most articles included some or all of the criteria we described earlier, a discussion between the authors resulted in the conviction that the article that fulfills all the formally set requirements and hence is most relevant for this study is Maggi Savin-Baden's 2016 article, "Impact of Transdisciplinary Threshold Concepts on Student Engagement in Problem-Based Learning: A Conceptual Synthesis". This was the paper that most strongly presented an inter- and transdisciplinary perspective on PBL in higher education. What follows is a presentation of the article, together with a justification for using some of its contributions to construct a meaningful theoretical framework in support of the goal of this chapter.

2.3 Outline of Maggi Savin-Baden's "Impact of Transdisciplinary Threshold Concepts on Student Engagement in Problem-Based Learning"

In her article, Savin-Baden presents the case for what she calls 'transdisciplinary threshold concepts' (TTC) and their usefulness in uni-

versity education.[1] To introduce this idea, we first need to step back and look at her use of Meyer and Land's 2006 definition of a 'threshold concept' (TC), which will allow us to explain the foundations of transdisciplinary threshold concepts. A threshold concept is defined as

> "akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress" (Meyer and Land, 2006, p. 3: quoted in Savin-Baden, 2016).

A threshold concept is thus a break, a rupture in the fabric of meta-knowledge that does not belong where it opens (as it is not part of the initial structure of conventional or traditional ways of understanding). A threshold concept accepts potentials and developments beyond what the current knowledge system can provide. Implicit in what Meyer and Land call a 'transformed way', as read through Savin-Baden's article, is a deeper kind of knowledge – theoretical as much as tactile, or practical – of the current state of understanding. We could hypothesize a deeper kind of knowledge that is involved with questions such as: Why do we understand knowledge as we do? What contributes to structuring our understanding in how we do it? What are the visible and invisible characteristics of our ways of understanding? What other types or ideals of understanding exist outside our own, which ones are desirable and why, and much more. We propose that, without these threshold concept-provoked questions, meaningful advancement within any study program would be extremely difficult, if not impossible.

Thus, a threshold concept, with its transformed way of understanding, allows for a rupture in a knowledge structure with an insightful effect. It allows for consideration on how to form foundationally, theoretically and practically strong connections within an

[1] All quotations in the remaining part of this chapter are, unless stated otherwise, taken from Maggi Savin-Baden's 2016 article "Impact of Transdisciplinary Threshold Concepts on Student Engagement in Problem-Based Learning: A Conceptual Synthesis".

academic discipline. Through these connections, qualitatively new and useful types of insights for both students and university staff are made possible, which in turn helps advance academic progress.

To strengthen this position, the article presents five key characteristics of threshold concepts:

- *Transformative*, as they change the way students view the discipline they are in.
- *Troublesome*, as they occasionally transfer knowledge that is perceived as counterintuitive, alien, or incoherent.
- *Irreversible*, as they are difficult to unlearn.
- *Integrative*, as they bring together different aspects that the student does not see as being related.
- *Bounded*, as they delineate a particular conceptual space.

These characteristics also apply to transdisciplinary threshold concepts, but they take on a slightly different meaning due to the difference between TTCs and TCs. TTCs situate TCs in a transdisciplinary context (see section 2.4.4).

Having presented the threshold concepts, Savin-Baden argues that, "while the idea of threshold concepts being located within disciplines is useful to a degree, they need to be broadened. Instead, particularly in the context of PBL, transdisciplinary threshold concepts are more helpful". Savin-Baden identifies four TTCs that are required to enhance student engagement in PBL: 1) liminality, 2) scaffolding, 3) pedagogical content (knowledge) and 4) pedagogical stance.

2.3.1 Student engagement

Before we discuss the substance of these four TTCs and their applicability to the focus of this chapter, we must outline the question of student engagement and explain some of its main characteristics, which are a key part of the bigger issue being addressed here.
To start with, we turn to Savin-Baden's definition of student engagement, described as

> "student connection with the learning context, discipline, peers, and tutors that enable transition and voicefulness in learning.

It also includes students' 'will to learn': the degree of interest and attention students show when they are learning.".

We are using this definition to highlight systemic pain points and feedback items within an academic setting. More specifically, we will use examples from our workshops with Techno-Anthropology students and faculty members at Aalborg University (cf. Chapter 3). These examples directly relate to questions concerning peers and the will to learn. In addition, we will provide a theoretical context for student engagement with specific feedback items by referring to the article's three main points and arguing the need for transdisciplinary threshold concepts. We will outline them here and illustrate corresponding feedback from student workshops carried out at Aalborg University (cf. Chapters 4 and 5).

The article argues the following three main points:

- Students who are learning through PBL are often initially unaware of PBL as a learning approach, the process of getting stuck in learning, or the notion of transdisciplinary threshold concepts.
- Recognizing common transdisciplinary threshold concepts could improve student engagement in PBL.
- Facilitators who are aware of the impact of transdisciplinary threshold concepts in PBL are more likely to be able to enhance and support student engagement."

Conversely, Techno-Anthropology Bachelor's students from AAU's Copenhagen campus report pain points emphasizing the need for the "…teacher/supervisor to recognize the need for interdisciplinary work -> be curious/embrace it". Additionally, first semester Techno-Anthropology Master's students in Copenhagen identify a difficult aspect of the Techno-Anthropology Masters' program, namely "Getting Techno-Anthropology BSc's to take advantage of other BSc students' knowledge", this being an example of peer difficulties in student engagement. Commenting on the introductory module for

newly enrolled Master's students in Techno-Anthropology, called "Interdisciplinary Knowledge Production", students noted that the class had a "weird theme", and required "little commitment since we did not actually do the projects". Additionally, teachers said that "supervision did not really improve interdisciplinarity" and that there is a need to "integrate interdisciplinarity in teaching to stimulate student interdisciplinarity. E.g. -> Interdisciplinary student case as part of lectures". A more in-depth elaboration of AAU student feedback in relation to university teaching methodologies and goals will be presented in Chapter 4.

Students' reported on 1) a perceived lack of teacher recognition for interdisciplinary work, and a need for curiosity from the university staff; on 2) a deep divide between Techno-Anthropology Bachelor's and non-Techno-Anthropology Bachelor's students; 3) a lack of understanding for a basic introductory course. These feedback items seem to correspond to Savin-Baden's arguments about PBL-enrolled students, who are often unaware of PBL as a learning approach, or that interdisciplinary work could improve student engagement. The students' feedback outlines frustrations concerning the problematic functioning or non-functioning implementation of PBL. It creates a space for transdisciplinary threshold concepts, which is to be welcomed in a transdisciplinary program.

2.3.2 Transdisciplinary threshold concepts: definition and usage.

Savin-Baden defines TTC as

> "concepts which transcend disciplines and subject boundaries, but which are challenging and complex to understand, but once understood, the student experiences a transformed way of understanding, without which they would struggle to progress with the curriculum".

One point of criticism of TTC, as defined and used in Savin-Baden's article, is that no formal definition is given of transdisciplinarity as a stand-alone term. As this is the case, it is up to the reader and practitioner to interpret the term, which could lead to misunderstandings when applying the concepts. Transdisciplinarity already has multiple definitions. Some refer to a unity of knowledge that goes beyond disciplines, being simultaneously between, across and beyond

them (Piaget, 1970). Others say that, when the nature of the problem is uncertain, transdisciplinarity can determine the most relevant problems and research questions that are needed (Funtowicz and Ravetz, 1993). Utilizing the multilayered focus of Techno-Anthropology – that is, incorporating technological, social, and socio-technical understanding, among other things – we can view transdisciplinarity as a concept that is in a constant state of awareness of and engagement with the disciplines it is dealing with. This awareness activates theoretical understanding of the underlying disciplinary concepts, their history, current state and development. It also activates a practical engagement with how various disciplinary facets are enacted in a non-academic, real-life scenario. Crucially, from a Techno-Anthropological perspective, transdisciplinarity operates within the constant dynamic between the theoretical and practical imperatives, the clear goal being to have a positive effect on a real-life societal problem.

Put in a more straightforward way, transdisciplinary threshold concepts take their point of departure in threshold concepts and their characteristics, and then apply a notion of transdisciplinarity to them. What is the result, then? Savin-Baden identifies the following four TTCs in relation to student engagement with problem-based learning: 1) liminality, 2) scaffolding, 3) pedagogical content knowledge, and 4) pedagogical stance.

Liminality "tends to be characterized by a stripping away of old identities and an oscillation between states; it is a betwixt and between state, and there is a sense of being in a period of transition, and an oscillation between states and personal transformation".

Traditionally, liminality is bound to a ritual, a rite of passage between states. Savin-Baden cites Turner's ethnographic studies (1969), which use 'liminality' to address a transitional space/time, such as the initiation processes boys go through to reach manhood. Thus, in the present context, liminality embodies a threshold concept, as it lives on the borders between continuously oscillating states of engagement and disengagement (or 'stuckness') with university teaching and PBL. We find this impression presented by first-semester Master's students at so-called milestone meetings (mid-semester

evaluation meetings). This oscillation, the repetitive movement between states of knowledge and ignorance, is intertwined with the notion of personal transition in a university education setting, where students are expected to gain knowledge and develop personal skills and competences in a PBL framework. Tutors are also expected to continue adapting their own skills and competences regarding their work with their students. Thus, students and tutors are always between states of knowing and being stuck while struggling to gain knowledge. This in-between-ness energizes the oscillation, which in turn strengthens the effects of liminality.

Savin-Baden further clarifies that liminality is a transdisciplinary threshold concept in student engagement in PBL, because

> "it is a complex, often covert learning space. It is invariably a place of incoherence and confusion for students and is a threshold concept because students (and often tutors) do not realize or accept that liminality, and the processes involved in managing it, can enable students to adopt deep approaches to learning and emotional engagement with the knowledge put before them".

To sum up, a traditional educational strategy would not automatically embrace the somewhat chaotic nature of transdisciplinary threshold concepts. After all, that is why educational strategies exist – to introduce order and structure in gaining new knowledge, skills, etc. This more traditional approach, however, has played its part in limiting student engagement and sometimes actively suppressing it. Liminality, on the other hand, both offers a structured suggestion for engagement and embraces an awareness that takes personal development into account to a much higher degree.

Scaffolding refers to the distance between independent and guided problem-solving. The concept addresses situations that lead to "a consequential increase in stuckness". This stuckness arises either when the students do not understand the lecturer's plan (his/her 'map for learning'), or during a disjunction between the students' and the tutors' plan, which in Savin-Baden's words is when, "perhaps in more cases than we would wish to acknowledge, the student's

map is better than that of the lecturer". A main takeaway here is that "it would seem that tutors' need to scaffold learning is troublesome and results in student disenchantment. […] Thus, removing or minimizing scaffolding can enable tutors to improve student engagement in PBL […]."

Student engagement is directly linked to a theoretical, practical and methodological crossing of the educational/academic threshold via an approach that is aware of scaffolding concepts, recognizes them, and moves beyond them.

> "Movement over the threshold for both tutors and students relies on not over-scaffolding, but instead allowing for disjunction and threshold exploration to occur in the context of scaffolding that is pedagogically informed".

A positive view of scaffolding in this case would be that the structure it provides can be viewed as a useful starting point for student engagement. Scaffolding, however, needs to be rethought, deconstructed if necessary, re-contextualized and generally played with, but not taken as a monolithic entity whose prescriptions have to be followed unquestioningly.

Scaffolding also relates to a certain sense of distance between guided and independent problem-solving. What makes scaffolding a transdisciplinary threshold concept is that it sits between the individual and the assisted problem-solving, where differences meet and touch, and exchange. 'stuckness' and scaffolding are part of the dynamic between students' and tutors' mismatched ideas for a 'map of learning'.

Savin-Baden uses scaffolding as a transdisciplinary threshold concept and also shows what it is not. Scaffolding has a long tradition in education, its popularity within academia is high, and it is a preferred method of teaching for many tutors. It is also, as Savin-Baden argues through Kinchin, Cabot and Hay (2010), linear in its approach to student engagement; it "fails to link different knowledges together". Instead of a linear structure of teaching, there should be a more holistic, linked, networked approach, which integrates knowledges. This is why using a well-known and methodologically dubious idea

like scaffolding and transforming it into a transdisciplinary threshold concept helps to shed light on practices, that have positive impact on student engagement.

Pedagogical content knowledge "includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring to their learning of those most frequently taught topics and lessons" (Shulman, 1986, pp. 9–10, quoted in Savin-Baden, 2016).

Pedagogical content knowledge (PCK) embodies an awareness of perspectives, as well as of their teaching. To be able to bring together students from a variety of academic and practical backgrounds studying for and working productively on one issue is no small feat. The success of this kind of work relies, at least in part, on the context of PCK. This context, as the name "pedagogical content knowledge" suggests, is related to the practices and methodologies that reshape existing knowledge in a new, transdisciplinary form. By tapping into internalized background knowledge, this concept bridges taught and to-be-taught lessons by using the benefits of already assimilated lessons. Thus, PCK's transdisciplinarity is defined by it being bounded by the past, which can only be activated by interacting with new contexts, situations and knowledge. As Savin-Badin sums it up: "once tutors appreciate this they realize that knowledge, and the teaching of it has to be seen afresh."

To simplify, PCK is concerned with the re-contextualization (the pedagogy) of specific (pre)conceptual types (content) of information (knowledge). Savin-Baden writes that: "Students may have, for example, studied psychology in high school, but the use and portrayal of psychology in a medical or theology degree is reformulated to reflect the pedagogical content knowledge. The result is that knowledge for a particular discipline is taught and fashioned within it and for it, and thus it is for many students a threshold concept." What does the bridging of existing knowledge with a new academic context require? It requires an open set of questions from one field or discipline addressing and engaging another field or discipline. The specific approach of this inquiry demands a type of conceptual thinking which takes into consideration all sides from their respective

points of view. "Few students realize that in order to think like an engineer, for example, they have to see knowledge through the lens of the discipline. However, perhaps more pertinently, there is also an assumption by tutors that knowledge has to be gained in a particular way related to the pedagogy of the discipline." No one way of gaining knowledge can be facilitated through any one discipline and its learning prescriptions. This is why PCK is a transdisciplinary threshold concept that should have a positive impact on student engagement in PBL.

Pedagogical stance "depicts the way in which students see themselves as learners in particular educational environments. The choices students make within a learning situation and the particular learner history, which they bring to a learning environment both influence students' pedagogical stance." Savin-Baden sums this up further:

> "These types of pedagogical stance can be seen as transdisciplinary threshold concepts, in that they are stages through which students pass on the way to high-level deep engagement in learning. Thus they journey across multiple thresholds on their way toward reflective pedagogy".

The pedagogical stance concerns a deeper relationship between not just the student and the particular educational environment, but also the very specific actions a tutor or professor may take. This stance addresses a crucial point in any PBL effort: trust. Savin-Baden outlines both 1) the personal trust students should muster if they want to practice newly attained knowledge, skills and competences, and 2) the trust tutors and professors must exhibit towards those of their students who need guidance, which would allow them to experiment, make mistakes and ultimately be creative. One could argue that both types of trust are personal, as they relate to how secure the individuals feel about themselves. True though this may be, the larger point here concerns a methodological, pedagogical perspective on control. How much control does a student have over basic knowledge? How much control does a student have on himself or herself in applying

that knowledge? How much control does a tutor have on a student's performance and creative abilities?

Breaking this down further, Savin-Baden quotes an engineering student she interviewed, where a main issue was that, "even by buying into the academics' notion of problem-based learning he was not always enabled to develop himself and explore areas which he valued." After a first-year engineering course where this student had seen the need to develop skills addressing issues of the application of knowledge and understanding, something else had come up: "… in the fourth year, he felt angry when some tutors imposed their own strategies upon students. He believed he had not been offered the opportunities to fully develop his problem-solving capacities. He objected to these artificial disciplinary boundaries and the ways in which he had been prevented from exploring various aspects of the given problem due to the inculcation of a step-by-step approach to problem-solving by some of the staff" (Savin-Baden, 2000 p. 82). Thus, the issues of control and trust emerge as main aspects of the pedagogical stance. Being able to take on the mantle of an active learner allows a student to go through various stages of what Savin-Baden calls "high-level deep engagement in learning". The way into this kind of learning must necessarily cross a variety of thresholds. Not being denied the position of an autonomous learner, holding this ground partly means being able to invoke a transdisciplinary angle when passing over these thresholds.

In a certain type of synchronization with the second transdisciplinary threshold concept, 'scaffolding', the pedagogical stance also refers to facilitators who "later remarked on how part of the transition they had made was learning to trust the students to learn for themselves". Letting go of a particular scaffolding methodology and a set of expectations on how students should learn – how they should combine the knowledge they already posses with the new knowledge they are presented with and are expected to generate – is crucial to a successful and productive PBL approach.

2.4 Conclusion

In this chapter, we have seen that transdisciplinary threshold concepts can link PBL with inter- and transdisciplinary university education.

Having presented Maggi Savin-Baden's four transdisciplinary threshold concepts, we can reformulate the research question set out in Chapter 1: "How can transdisciplinary threshold concepts support PBL in an interdisciplinary and transdisciplinary university teaching environment such as the master's program in Techno-Anthropology?" Looking at this question from the point of view of liminality, scaffolding, pedagogical content knowledge and pedagogical stance, we argue that a satisfactory answer is inextricably linked with a creative and committed translation of the transdisciplinary threshold concepts into concrete activities with a transdisciplinary character. TTCs represent the foundation of the theoretical framework we propose in this text via 1) their use in a theoretical and/or practical PBL context, and 2) their application of key characteristics in university teaching.

We argue that our proposed framework explicitly combines TTC with 'generability'. By generability, we mean the specific applicability of TTC to all different educational and professional backgrounds that make up the Techno-Anthropology program at Aalborg University. We argue for a principle of selectively applying the four TTCs to the foundation of a study curriculum. With the help of a TTC-augmented AAU PBL model, we propose that 1) interdisciplinary and transdisciplinary university education will be characterized by higher levels of student engagement; and 2) that this engagement will have a positive impact on outreach initiatives that will see students and staff alike become even more involved with outside institutions and collaborative efforts.

CHAPTER 3:

Analysis and Comparison of Project Reports from 2014 and 2016

We are moving from the results of Chapter 2, which proposed that applying transdisciplinary threshold concepts to interdisciplinary and transdisciplinary university education will have a positive effect on student engagement and on collaboration with outside institutions, to an analysis and comparison of first-semester MSc project reports.

The overall goal of this chapter is to provide an analysis of 27 first-semester project reports for the Master's program in Techno-Anthropology at Aalborg University's Aalborg and Copenhagen campuses. Less than a third – seven reports – are from campus Copenhagen in 2014, and one from campus Aalborg in 2014. The remaining nineteen reports are from the Aalborg (six reports) and Copenhagen campuses in 2016 (thirteen reports).

The aim of comparing these 26 reports is to characterize them and assess if they are interdisciplinary or not. The operational definition of interdisciplinarity we are using is the ability to integrate "knowledge and methods from different disciplines, using a real synthesis of approaches" (Jensenius, 2012). Assessing whether the formulations of problems are interdisciplinary or not will assist us in understanding the differences brought about by the 2016 curriculum, presented in Chapter 1.

First, we provide a general outline of the current chapter. Second, we present the criteria used for the analysis, and describe how they work. Third, we analyze the two groups of reports, from 2014 and from 2016. We then use the said analysis as a baseline for how *transdisciplinary threshold concepts can be incorporated in the project reports in the 7th semester in Techno-Anthropology.* We retain this notion while presenting the four criteria used to analyze the Master's students' project reports. After presenting each criterion, we systematically come back to this notion of "What else is missing?". We ask the

question "How can university education use transdisciplinary threshold concepts to illuminate theoretical, methodological and pedagogical approaches, which strengthen the systematic integration of knowledge and practices from different disciplines?" Then we answer it by applying the transdisciplinary threshold concepts to the insights gained from analyzing the reports. Lastly, we conclude that the comparative analysis supports the implementation of transdisciplinary threshold concepts as a guiding principle for curriculum design in Techno-Anthropology.

3.1 Description of Analysis Criteria

The main goal of analyzing the students' project reports is to assess their interdisciplinarity. To analyze the first-semester project reports submitted by the Techno-Anthropology Master's students in the Aalborg and Copenhagen campuses for autumn 2014 and autumn 2016, we need to provide a set of criteria that are relevant to the task. We perform this analysis to assess whether or not the submitted project reports are interdisciplinary in conformity with the operational definition of interdisciplinarity we use. This means that the projects have to integrate "knowledge and methods from different disciplines, using a real synthesis of approaches" (Jensenius, 2012). To perform the assessment, we have chosen to focus on four criteria: 1. Problem formulations, 2. Project report methods, 3. Project report theories, and 4. Group composition, as the criteria for analysis. To explain our choice, we provide the following reasoning:

The problem formulations are good indicators of the particular focus in a project report. If the problem formulation uses its focus only to consider one type of perspective, only one conceptual and methodological standpoint, and if it does not acknowledge and incorporate perspectives from various disciplines, then it is unlikely that this problem formulation will allow an in-depth interdisciplinary perspective on a socio-technical issue. We consider a problem formulation to be interdisciplinary if it displays this acknowledgement and uses more than one conceptual, methodological and/or disciplinary perspective.

The project report methods represent the students' ability to enact their conceptualization in a specific environment. Therefore, we

consider methods that combine theoretical approaches from multiple disciplines – taught in the Master's program, as well as in other disciplines the students may be familiar with – to be interdisciplinary.

The project report theories are likewise a clear indicator of whether the students are integrating knowledge from a theory taught in the Techno-Anthropology program with another theory by means of a synthesis. We consider the students' ability to conceptualize this synthesis to be an important criterion for interdisciplinarity.

Group composition is an important criterion for interdisciplinarity on a very practical and social level that is specific to the Master's program in Techno-Anthropology. It is critical to facilitate and observe how students are grouped and work together due to the diverse academic and social character of the program. For example, academic diversity is exemplified by grouping students with a professional background (nursing, midwifery, etc.) with students of the social sciences and humanities (anthropology, sociology, etc.), engineering (chemical, electrical, etc.), or with Techno-Anthropology Bachelors. Another example is linguistic and cultural, as seen in the mixing of Danish students with international students. The logistics behind this work process are essential for establishing an interdisciplinary environment and producing an interdisciplinary semester project.

3.2 Comparative Analysis of Project Reports from 2014 and 2016

As already discussed, the problem formulations are an important factor in assessing whether the semester projects are interdisciplinary or not. Therefore, the concept of a problem is an important one, as it is foundational in forming the students' perception of the types of issues their expertise will be used with. Because Techno-Anthropology deals with various types of issues, e.g. wicked problems, this concept has to be broad in scope, but also narrow in its ability to focus on relevant types of problems.

We have analyzed students' reports on the first semester of the MSc program in Techno-Anthropology submitted in 2014 and 2016 to acquire an idea of how these were formulated and changed when the curriculum was revised.

3.2.1 Different categories of problem formulations

Of the 27 reports, two general thematic categories emerge, namely 'solution-oriented' and 'exploratory'. The solution-oriented category generally refers to problem formulations from the Aalborg campus, and is visible in problem formulations under the original 2011 study plan, but not exclusively. The exploratory category refers to problem formulations created under the 2016 study plan and is generally evident in problem formulations from the Copenhagen campus in 2016, again not exclusively. In calling these six problem formulations 'solution-oriented', we do not mean that each one has the explicit goal of producing a specific solution to a specific problem. That is not the case, as students combine their freedom to choose their own points of view regarding an issue with their unique educational backgrounds. We see all 27 problem formulations as occurring on a spectrum between solutions and exploration, and we have divided them based on how much they lean toward either of these two sides. Therefore, all problem formulations to some extent explore the issue they are interested in and are attempting to provide a solution, with a few exceptions. After discussing both categories, we group them by campus and provide general conclusions.

Now, a general overview of the categories of problem formulations:

The *solution-oriented* category refers to 8 problem formulations: 2 in Copenhagen - 1 in 2014 and 1 in 2016, 1 in Aalborg in 2014, and 5 in Aalborg in 2016. The *exploratory* category refers to 19 project problem formulations: 7 in Copenhagen in 2014, 11 in Copenhagen in 2016, and 1 in Aalborg in 2016.

3.2.2 Solution-oriented category

This category is characterized by a majority of *how* questions (4 out of 8), which aim at conceptualizing a solution for an identified problem, as can be seen in Table 3.1 below.

Table 3.1. Solution-oriented category of problem formulations from the Copenhagen and Aalborg campuses, 2014 (marked in yellow) and 2016 (marked in green).

Campus Copenhagen
2014: From a phronetic point of view, what could be the ethical and responsible way to handle the current Ebola Virus outbreak in West Africa by focusing on good clinical care and isolation as a technology, as opposed to doing medical trials with non-tested medical intervention in an outbreak of this size?
2016: 1. How can the approach applied in the LEO Innovation Lab contribute to better treatment and an elevated quality of life for people with psoriasis? Which market tendencies have pushed LEO Pharma into to this novel strategy, what do they gain from it, and what are the potential pitfalls in this approach?
Campus Aalborg
2014: 1. How can the process of installing video systems in ambulances benefit from insights from the ambulance crew?
2016: 2. Which values can be incorporated into the design of a solution for automated venipuncture in order to create a sense of safety and security for the patient?
2016: 3. With an offset in the current use of PARO as part of dementia treatment in Danish nursing homes, how could an evaluation of the design and use of PARO provide guidelines towards future therapies for dementia?
2016: 4. How can experiences from the adverse event reporting system be used to empower the evaluation of welfare technologies on an organizational level at the Lundbye centre?
2016: 5. Why do people miss their appointments at the AUH, and can we, using this knowledge, contribute to a solution to the problem?
2016: How are dilemmas of a private and sensitive character in patient portals dealt with and processed in Denmark and internationally? Sub-questions: 1. How are decisions concerning the intentional withholding of test results, parents' access to childrens' EHR and patients blocking of information within the EHR decided? 2. What is the Ethical Council's involvement in these dilemmas? 3. How are the three functionalities dealt with internationally?

In the Aalborg campus in 2016, most of the problem formulations consist of two parts, one being an exploratory question of what or how something is, the other being about how this knowledge can be mobilized to create a solution. Examples of this composition are given in the blue areas marking the exploratory part, and the green areas marking the solutions-oriented part:

"Why do people miss their appointments at the AUH, and can we, using this knowledge, contribute to a solution to the problem?"

"With an offset in the current use of PARO as part of dementia treatment in Danish nursing homes, how could an evaluation of the

design and use of PARO give guidelines towards future therapies for dementia?"

"Which values can be incorporated into the design of a solution for automated venipuncture in order to create a sense of safety and security for the patient?"

What is evident in these three examples of problem statements from Aalborg is the significant solution-oriented approach that seeks knowledge for the sake of change and the ability to affect the researched field in a positive direction.

3.2.3 Exploratory category

We identified 22 explanatory problem formulations in the batch of analyzed reports (Table 3.2) 6 and 12 respectively from 2014 (marked in yellow) and 2016 (marked in green) in Copenhagen. In Aalborg we found one explorative problem formulation in the 2016 reports.

Table 3.2: 22 explanatory problem formulations in the batch of analyzed reports.

Campus Aalborg
2016: What are the drivers and barriers of implementing a niche renewable energy technology, and how do social and technological networks affect the implementation? (Understanding how actors influence technology)
Campus Copenhagen
2014: When tele-monitoring technologies are introduced in health care, what are the implications the increased distance between the doctor and the patient on the matter of power and responsibility? (Understanding unintended challenges / implications)
2014: How can the increased use of remote monitoring of ICD devices navigate the potential conflict between the ethics of good practice and the sociopolitical tendency toward the responsibilization of the individual? (Understanding unintended challenges / implications)
2014: An exploration of the responsibilities of development practitioners working in the context of water and sanitation projects in rural Bangladesh (Understanding expert cultures / expert responsibilities)
2014: What are the facets of the debate on MRSA CC398 portrayed in the Danish media, and how are the various standpoints and solutions described in relation to expert groups and interest organizations? Is this a desirable development? (Understanding stakeholder disagreement)
2014: How does self-quantification affect knowledge production, and will it affect users' autonomy? (Understanding unintended challenges / implications)

2014: Which challenges does the Google Car present in moral decision-making when functioning as a fully autonomous vehicle? And in what sense does this technology influence new human-technology relationships. (Understanding unintended challenges / implications)
2016: How do different institutions conceptualize drones, and how do they imagine the potential for drone technology? (Understanding stakeholder disagreement)
2016: How has collaboration between data scientists and the Copenhagen Culture & Leisure Department VKV evolved? By examining the practice, we will explore which alliances were created between the different actors. This report will try and help libraries with the questions they need to ask themselves, working with outside consultancies in the future. Problems to be addressed: 1. What happens when a new technology, digital methods, is introduced to the Copenhagen Culture & Leisure Department VKV? 2. How is diversity like bias and validity represented in the social data? How was the Copenhagen Cultural Map created using social data? 3. How can the libraries use these maps when forming a social media strategy? What is required when creating a strategy using social data? (Understanding how actors influence technology)
2016: How can the different drivers and barriers identified in the organizations of CPH Fab Lab Valby, Labitat and Underbroen contribute to the assessment of these workshop spaces in their technology domain with the goal of classifying essential workings? (Understanding technical expert culture)
2016: Thus, we have chosen to write an analytical project that investigates how both Blockchain technology and the EU regulatory framework address these variable perceptions of 'trust' and the issues associated with it. (Understanding technology institutions: legislation)
2016: We wish to analyze the different perceptions of the CRISPR phenomenon. Following this, we will map the ethical debates on CRISPR used on humans that have unfolded so far and investigate the relationship between the CRISPR phenomenon and the ethical debate. (Understanding stakeholder disagreement).
2016: How has the implementation of SP affected the workflow at AKM, Gentofte hospital? (Understanding unintended challenges / implications)
2016: How do physiotherapists review the Health Platform's initial implementation process, how has the technical change affected their daily work routines, and which elements regarding education, practical implementation and the level of information passed to the micro-level might have to be altered to improve the implementation process concerning the physiotherapists? (Understanding unintended challenges / implications)
2016: Examined through a Techno-Anthropological understanding of technology, what technology assessment is produced when working with the VTV model? (Understanding technology institutions: assessment)
2016: How does the social construction of urban cyclists' practices influence the use of Hövding, and what are the safety perspectives and the practice-related challenges that are preventing the stabilization of the technology? (Understanding technology use)
2016: How has Smart Floor technology affected the relevant social groups at the Frydenholm nursing home? (Understanding unintended challenges / implications)

2016: What is hypothyroidism, and how is it enacted through methods of diagnosis and treatment? Sub-questions: How do actors diagnose hypothyroidism? How do actors treat hypothyroidism? (Understanding stakeholder disagreement).
2016: How is the behavior of drivers or users influenced by technologies implemented in semi- and fully autonomous vehicles? What are the limitations of autonomous vehicles today, and how does that influence the trust of users throughout the transition to fully-autonomous vehicles? How will the introduction of semi- and fully autonomous vehicles influence social interactions in traffic? How do the data collected by autonomous vehicles influence users, as well as other road users interacting with autonomous vehicles? (Understanding unintended challenges / implications)
2016: What are the drivers of and barriers to implementing a niche-renewable energy technology, and how do social and technological networks affect implementation? (Understanding how actors influence technology)

The following two examples of exploratory problem formulations illustrate how they are usually constructed.
"This project will explore how a collaboration between data scientists and the Copenhagen Culture & Leisure Department VKV evolved. By examining the practice, we will explore which alliances were created between the different actors. The aim of this report is to help libraries decide what questions they need to ask themselves, working with outsides consultancies in the future. Problems to be addressed:

- What happens when a new technology, digital methods, is introduced to the Copenhagen Culture & Leisure Department VKV?
- How is diversity like bias and validity represented in the social data?
- How was the Copenhagen Cultural Map created using social data?
- How can the libraries use these maps when drawing up a social media strategy?
- What is required when creating a strategy using social data?" // Copenhagen campus

"How are dilemmas of a private and sensitive nature in patient portals dealt with and processed in Denmark and internationally?

Sub-questions:

- How are decisions concerning the intentional withholding of test results, parents' access to children's EHR and patients blocking of information within the EHR decided?
- What is the Ethical Council's involvement in these dilemmas?
- How are the three functionalities dealt with internationally?" // Aalborg campus

Both examples use a broad, open perspective to understand their topic of interest. In the first example, the problem formulation asks what does the collaboration between data scientists and the Copenhagen Culture & Leisure Department entail in terms of structure, practice and strategy, thus gathering a rich set of data to provide a deeper understanding of the processes of interest. In the second example, the problem formulation asks what is the practice of collecting and using private and sensitive medical information in both Denmark and internationally, with a focus on multi-stakeholder involvement (patients and administrative staff; parents and children). Both problem formulations display an open, exploratory interest in a socio-technical issue, and more specifically they attempt to involve different social groups, such as data scientists, administrative staff, patients, parents and children, to gain a better understanding of these groups' unique experiences within a socio-technical configuration.

We categorized all 19 explorative problem formulations in accordance with what they wish to understand regarding technologies, and found six issues (Table 3.3).

Table 3.3. Six issues with explorative problem formulations

Issue to understand	Number of problem formulations
Unintended technological challenges or implications	8
Stakeholder disagreement	3
Actors' influence on technology	3
Technical experts' cultures and responsibilities	2
Technology institutions	2
Technology use	1

3.2.4 Campus-specific conclusions: Aalborg

The papers from Aalborg divide into two differing camps when it comes to formulating a conclusion. One camp delivered a longer conclusion, consisting of not just the answer to the problem formulation, but also describing how these answers were gathered. These conclusions reflected on methods, though their reflections on the limitations of their studies seem to have made this camp afraid of concluding anything.

> "From these age-based relevant social groups, we learned that patients tend to blame other patients, as they believe that the reasons why missed appointments occur are due to forgetfulness, ignorance, laziness, etc. These predictions are, however, difficult to confirm, since it would require reaching an incredibly large number of patients. Therefore, we are not able to give a concrete answer to this rather complex question. Our study was primarily based on our thoughts, which were obtained through knowledge production based on ethnographic methods. While ethnographic methods are scientifically approved tools for gathering knowledge, their reproducibility can be considered vague. Furthermore, as we depended solely upon Content Analysis for analyzing the results of our data inquiries, one might question whether our own thoughts have interfered with and thereby affected the analysis. We can therefore conclude that the knowledge we have produced in this study cannot contribute to a solution to the problem of missed appointments,

but we have gained some insight into what a further study would require to be able to contribute a solution to the problem."

This paragraph merely concludes that the students have no answer to their problem statement due to a lack of time or of relevant methods. Furthermore, it concludes that their study cannot be replicated, thus questioning the academic value of the report. The nature of the arguments in this conclusion points to a lack of reflections on techno-anthropological methods and their strengths.

In the other camp, the papers answered their problem statement more directly. These conclusions are more closely aligned with the problem statement, and they are shorter in composition.

"Now, to try and answer the problem statement; what are the drivers of and barriers to implementing a niche renewable energy technology, and how do social and technological networks affect their implementation? The main objective for a successful implementation of the CSP plant in the housing project in Solbjerg is to challenge competitive actants in the existing network and make its activities fit easily with all the other actants."

This example illustrates how the key point in their findings is mentioned first as the overall answer to the problem statement. The answer is direct and completely aligned with the problem formulation.

3.2.5 Campus-specific conclusions: Copenhagen

The problem formulations from the Copenhagen campus showed a lack of elaboration regarding which problems were treated, and this was evident in the conclusions. A problem formulation about drone technology, which did not specify what problem was in focus, the intended application of the technology, or which institutions were involved, serves as an example:

"How do different institutions conceptualize drones, and how do they imagine the potential for drone technology?"

The conclusion of the report sums up what has been done throughout the project:

"Throughout our project, we have highlighted the different socio-technical imaginations on different levels, starting from

> the EU Commission, and then working towards the Danish understanding and imaginations of drone technology."

From there the group goes on to specify it findings regarding how these institutions imagine the potential of this technology. However, the conclusion does not answer any problems or describe what the group has learned. Other conclusions that also did not address their problem tend to focus more on what has been done, instead of what knowledge has been produced e.g.:

> "At that point, we were both able to discover changes in old practices, as well as the introduction of completely new practices, which arose from the fact that the floors were a completely new introduction with no former technological equivalent. Still following practice theory analysis, we were then able to break down the components making up the Smart Floor and analyze how each component affected the different social groups."

Nothing in this conclusion reveals the group's actual findings, as opposed to merely producing an introduction to their findings. To figure out what knowledge the group gained from their study, one must turn to their entire analysis. In general, the problem statements are answered in the conclusions, but regarding some of the specifics, there is less information as to what the findings were and how they contribute to solving the problem. This shows the importance of a well-formulated problem formulation when writing the conclusion.

3.2.6 What is Missing: Interdisciplinarity?

When we described the criteria for the analysis of problem formulations, we said that what the problem formulations themselves include is a good indicator of whether they are interdisciplinary or not. Judging by the presented categories – solution-oriented and exploratory – as well as the campus-specific conclusions, we can say that there is no overall coherent and intentional focus on interdisciplinarity to be observed in the problem formulations. There are multiple instances where different perspectives and expertise are taken into account [i.e.

institutional perspective in "How do different institutions conceptualize drones, and how do they imagine the potential for drone technology?"; or market perspective in "How can the approach utilized in LEO Innovation Lab contribute to better treatment and an elevated quality of life for people with psoriasis? **Which market tendencies** have pushed LEO Pharma into to this novel strategy, what do they gain from it, and what are the potential pitfalls in this approach?" (bold added)]. However, these instances only show a sporadic and patchy awareness of other disciplines and do not appear to employ a systematic integration of knowledge and methods from different disciplines through a synthesis of approaches. Therefore, we can conclude that interdisciplinarity is missing from the 2014 and 2016 problem formulations, which leads us to our recurring question:

> "How can university education use transdisciplinary threshold concepts to illuminate the theoretical, methodological and pedagogical approaches that strengthen the systematic integration of knowledge and practices from different disciplines?"

In the case of the problem formulations in the 2014 and 2016 reports, we have gained a specific insight: overall, the problem formulations display only sporadic and patchy awareness of other disciplines. To make use of this insight, we can apply the transdisciplinary threshold concepts presented in Chapter 2. First, we can understand what makes the systematic recognition, understanding and use of diverse concepts easy or difficult for students (inspired by 'pedagogical content knowledge'). Second, we recognize that the students see themselves as learners in a particular educational environment (inspired by the 'pedagogical stance'), and we adjust advice regarding problem formulations accordingly. For example, students with engineering backgrounds might tend to see themselves as needing much more detailed instruction in how to approach an interdisciplinary Techno-Anthropological problem formulation, whereas students with an anthropological background might think they know exactly what needs to be done. Third, after making this explicit adjustment regarding the students' previous educational backgrounds and the curriculum requirements for Techno-Anthropology, we facilitate a sustained and

visible oscillation between their previous educational and personal identities and their new ones as part of the Techno-Anthropology program (inspired by 'liminality'). This effort can be supported by a variety of activities (see Chapter 6). Finally, we guide this shared process of learning with a visible sense of learning structuring that decreases over time. The need to have a structured learning process from the outset takes into account the diverse educational backgrounds of the students and introduces a specific structure for acquiring knowledge, skills and competences (inspired by 'scaffolding'). This whole process must be presented as a transparent and collaborative effort from the start of the learning process.

3.3 Project Report Methods

The second criterion for analysis of the 2014 and 2016 project reports concerns methods. As we stated previously, the project report methods represent the students' ability to interact with a particular set of problems in a specific environment. Therefore, we consider methods that combine approaches from multiple disciplines – taught in the Master's program, as well as other disciplines the students may be familiar with – to be interdisciplinary.

A general point is that quantity alone does not add up to quality: i.e. using more methods does not necessarily mean that the report will turn out to be interdisciplinary. Conversely, by definition, using only one method or one type of method cannot provide interdisciplinary exposure and experience to the students and their reports. Grouped by year, here are the methods used in 2014 and 2016.

3.3.1 Copenhagen Campus, 2014

In the 2014 project reports from Copenhagen, the literature search is undoubtedly the main method used. This result falls within our expectations, because in Techno-Anthropology the literature search is seen as a strong interdisciplinary tool. Starting in their first semester of the Master's program, students are tasked with gaining the ability to develop fluency in reading and understanding academic texts in different fields. That is why the literature search is developed and taught as an interdisciplinary method.

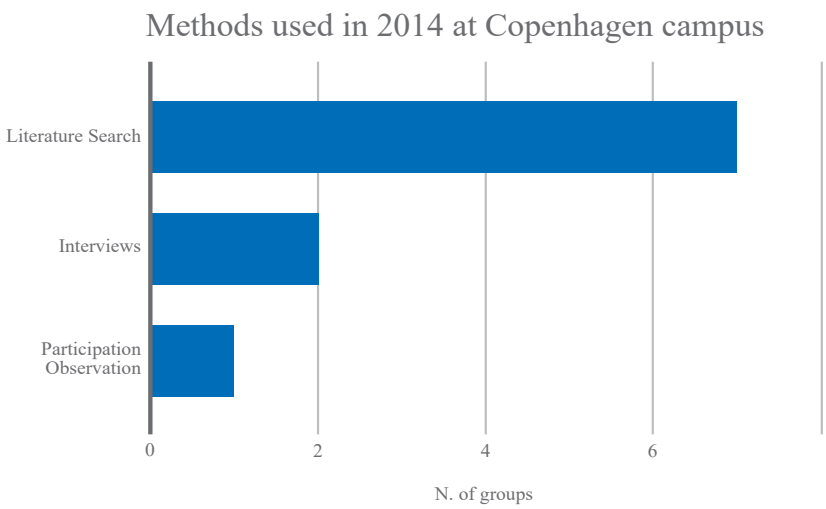

Figure 3.1. Methods used in project reports in 2014 on Copenhagen campus, overlaid on number of student groups.

However, few groups include their literature search procedure as part of their methods description. As the graph shows, most reports consider their projects from a literature-derived theoretical perspective. The lack of fieldwork alone, which would be used as basis for project reports and would necessitate the use of different methods, does not automatically mean that the methods used are not interdisciplinary. The literature search, being the main method, could be used to combine sources from different disciplines to craft a new method that was applicable to the groups' respective project. What can be said, however, is that, by not making use of more methods, the quality of the potential interdisciplinary character of a literature search is bound to suffer. There is no description available of the particular use of these methods in 2014.

3.3.2 Copenhagen campus and Aalborg campus, 2016. Methods: what and how.

In 2016, after the revised study plan, we see different results, mainly due to a stronger focus on establishing the literature search as a more

visible method. Before visualizing the change, we first present what methods were used and how.

Copenhagen: description of methods

Copenhagen: interviews

The students describe all conducted interviews as semi-structured interviews. The main reason for this is an exploratory approach, in which the groups seek to keep the conversations around specific themes, while still leaving room for their interviewees to contribute with new subjects:

> "In short, our main objective with the semi-structured interviews was to keep an open atmosphere between the informant and the interviewers. This is important to our research since it helps to create an open dialogue where collaboration between the actors is met, and it will also let us perform our research through a critical ethnographic point of view."

A short and precise description is given of why this approach was selected. Every paper reflects upon why the group uses this method. However, there are no reflections on the limitations of the approach. This can have a negative impact on the student's ability to engage in a reflective use of diverse methods.

Copenhagen: observation

Roughly half the groups did observations in different ways: examples are found of both participant observation and passive observation where there are no direct interactions with the observed.

Copenhagen: literature search

Literature searches are used in most reports, but often information on how they were conducted was not provided.

> "In the initial phase we used the existing literature to search broadly: looking at videos and TedTalks, mainstream media,

scientific articles and their results to open up the field and to gain an understanding of what the field contained, what was at stake and what would be relevant cases or problems for a Techno-Anthropologist to look at."

This group explains a little about what media they used in their literature search, and they explain that it is grounded in the existing literature, but not what that literature is and how they found it.

Copenhagen: use of methods

After presenting what methods were used, we visualize their use in Copenhagen in Figure 3.2:

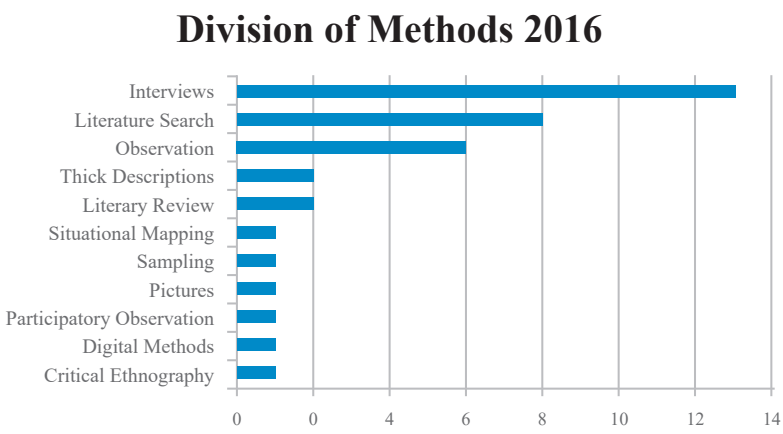

Figure 3.2. methods used in project reports in 2016 on Copenhagen campus, overlaid on number of student groups.

The initial impression is of the dominance of interviews as the preferred method, followed by a literature search: both keep their lead from 2014, but switch places. Overall, interviews, literature searches and observations are the three most frequently used methods. All groups conducted interviews, and of the thirteen groups, eight specified that they used a literature search, while seven groups used observation, participant observation, or critical ethnography. All groups used at least two of the above three methods. Furthermore, two groups made use of thick descriptions, and one made use of the

following methods: textual analysis, case analysis, pictures, and situational mapping.

Copenhagen: strengths and limitations of the methods

The reports lean strongly towards qualitative research as a preferred choice for their projects. Many reflect on the strengths of qualitative research. As with using the literature search in 2014, however, the reports do not visibly reflect on the drawbacks of their method of choice.

> "Our project focuses on how technology impacts the workflow of the healthcare professionals. To get an understanding and insight on this, our method is based on qualitative research. We chose a qualitative method because of its qualifications to answer our problem formulation. Qualitative research aims to interpret, understand and explore nuances and get a deeper understanding of phenomena of different attitudes."

The group does not show that they are aware of the weaknesses of their method of choice, and they seem to take it for granted that qualitative methods bring nothing but positives. Another group relies on theory to explain the choice of qualitative methods without making a specific case for their use in their particular project:

> "These are the initial findings and observations one does, but following Geertz' logic, all actions have underlying meanings, and these meanings can only be understood through the application of qualitative methods."

Another example shows a group explaining what their methods are, but only offering superficial reasoning for their use:

> "To gather empirical data about the field of AVs, interviews were conducted with experts in the fields of big data & machine learning, ethics and autonomous driving on a societal level. The interviews were conducted in a semi-structured manner to support the exploratory approach of our project. A semi-struc-

tured interview is open-ended, yet it follows a list of topics and a certain script – the interview guide."

Furthermore, we have not seen any reflections on the use of methods, how their enactment in the project changed the students' perceptions and minds, and so on. The absence of any reflections appears to undercut the depth to which students can go analytically with a set of methods.

Aalborg: description of methods

Aalborg: interviews

The interviews were all conducted as semi-structured interviews; however, a few groups took advantage of the situation to do some observation and to be given a tour of the location facilitating the interview.

Aalborg: workshops

The workshops seemed planned and included reflections on icebreakers, and on how to create an inclusive setting that also leaves room for less dominant personalities.

> "The very first activity for engaging the participant is an icebreaker exercise that starts by a presentation of ourselves, followed by the participants giving a presentation of themselves. The participants were asked to sit at the 'discussion' table and give their names, age and occupation."

To set some time apart in the beginning to let everybody introduce themselves seems to be an active choice to let the participants feel more comfortable with each other. Even though the workshops seem very reflective, they are not based on any literature, which is interesting, as we then do not know if the facilitation is based on personal experience or actual literature, or maybe even their courses for the semester.

Aalborg: use of methods

The breakdown of the methods used on Aalborg campus shows us the following (Figure 3.3):

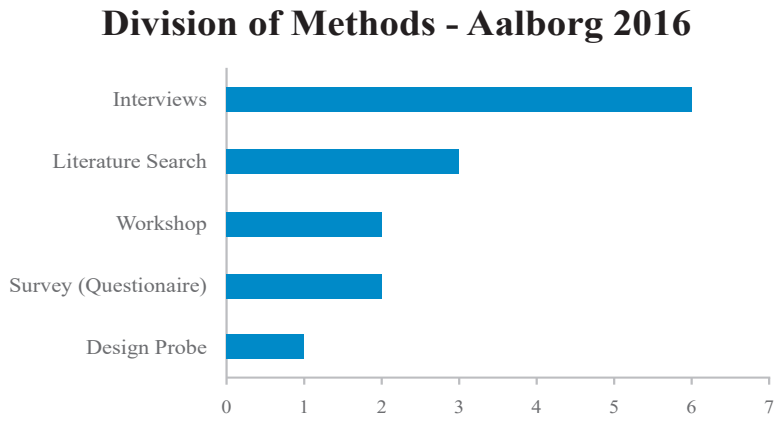

Figure 3.3 Detailed view of methods used in project reports in 2016 on Aalborg campus, overlaid on number of student groups.

- Interviews represent semi-structured and structured interviews.
- More hands-on methods, i.e. workshops, questionnaires and a design probe, appear in Aalborg, but are absent in Copenhagen.
- 'Literature' means both a literature search and literature reviews.

It seems that multiple groups had difficulties in conducting an observation study, which is why they used other methods to gather empirical data, i.e. workshops, questionnaires and a design probe. Most groups reflect on the strengths and shortcomings of their chosen methods:

> "We are aware that open questions within this survey do not give us an in-depth view of the subject as if we had conducted qualitative interviews. Nevertheless we believe that these answers will provide us with the information and facts we seek, which will make us capable of making a comparison of

the countries both from a Danish perspective and also internationally."

This reflection shows an evaluation of methods with a view to deciding which one might be the most fitting for the specific project, and which one might help answer their problem statement.

3.3.3 What's Missing: Interdisciplinarity?

As with the problem formulations, what we observe with the employed methods is their patchy use and an absence of coherent efforts to use methods systematically in an interdisciplinary manner. What is also visible is a reliance on methods that are traditionally associated with the social sciences, i.e. interviews and observations. This in itself is not problematic, as both the 2011 and 2016 study plans deal with more technical methods in the next semester. However, due to the diversity of students in the program, this lack of methods from fields outside anthropology, sociology, etc., may have a negative effect on students from fields such as engineering and computer science, for example. Because the students in neither campuses in 2014 and 2016 used mixed methods in a systematic way, we conclude that the use of interdisciplinary methods is indeed lacking and needs to be addressed. A specific step we consider essential is to increase the visibility of the literature search as an interdisciplinary method. It should serve as a theoretical and methodological foundation for the Master's students, as for them it is a familiar approach that can offer meaningful theoretical, methodological and pedagogical results.

To sum up, when reviewing the project report methods from 2014 and 2016, we gain two general insights:

- A reliance on methods associated with the social sciences and humanities.

- A lack of interdisciplinarity, due to the patchy use of methods and the lack of a coherent effort to use them in a complementary manner

After highlighting another lack of interdisciplinarity, we once again ask: "How can university education use transdisciplinary threshold concepts to illuminate theoretical, methodological and pedagogical approaches that strengthen the systematic integration of knowledge and practices from different disciplines?"

To answer this question, we will apply the transdisciplinary threshold concepts presented in Chapter 2 to the insights we have acquired.

If we first look at the insights, we can see that they share a lack of direction: either incoherently using methods presented in the Techno-Anthropology program, or falling back on using familiar methods from their educational past. To address this, we can refer to Savin-Baden, who explicitly writes about 'liminality': "It is invariably a place of incoherence and confusion for students and is a threshold concept because students (and often tutors) do not realize or accept that liminality, and the processes involved in managing it, can enable students to adopt deep approaches to learning and emotional engagement with the knowledge put before them" (Savin-Baden, 2016: 7). Thus a liminal approach would embrace the natural incoherence of using methods offering methodological exercises, and then offering coherence (using the 'oscillation between states' Savin-Baden writes about) through a proposed methodological approach, for example, via exemplary Techno-Anthropological projects. This second part, where methodological coherence is offered, can be strengthened by using a 'scaffolding' approach, which resonates with our proposal from Section 3.1.2. This means that structure is introduced as a methodico-pedagogical tool that simultaneously assists students in their projects and helps socialize them by leveling the playfield (not favoring students with a BSc in Techno-Anthropology over other students). We have therefore deployed a combination of 'liminality' and 'scaffolding' to address the patchy use of methods.

The second insight we mentioned previously is that students rely too much on methods traditionally associated with the social sciences and humanities, i.e. interviews and observations. This, in and of itself, is not a problem that has to be "fixed" by mechanically suffocating these methods with something that is familiar to students with engineering backgrounds, for example. It does, however, indicate a

need to understand what makes these methods easy for some and difficult for others, which is where Savin-Baden's 'pedagogical content knowledge' can help us. When we have a grasp of the reasons underlying this situation (for example, that students with engineering backgrounds generally tend to expect step-by-step guides or textbooks with diagrams, and that students with backgrounds in social science may feel too cozy simply reusing a method without questioning its validity), we can problematize it. We can understand the students' comfort limits, and with that knowledge adjust the amount of trust teachers will have in them to complete their tasks. In doing this, we will have engaged the 'pedagogical stance' concept, which situates students as learners in a particular learning environ–ment. This whole process should not be viewed as an algorithm that automatically solves problems, but as a specific suggestion to a specific problem, a suggestion that is meant to inspire teachers to address the particular problems they are facing in an interdisciplinary university environment. This process is also something that should be discussed in the open with all participating parties – students, teachers, administrative staff to varying degrees (where it makes sense) so it can be shared and can assist in delivering greater levels of student engagement in the learning environment.

3.4 Project Report Theories

The third criterion for analyzing the project reports is their use of theory. How theory is chosen and used in the reports indicates whether the students are integrating knowledge from a theory taught in the Techno-Anthropology program with another theory through a synthesis. As previously stated, we consider the students' ability to conceptualize this synthesis to be an important criterion for interdisciplinarity.

Due to a lack of comprehensive data from 2014, only one major insight about the theories used is available. Whereas a wide range of theories are represented in the reports, one scholar is evident in all of them: Bent Flyvbjerg. His thinking on the concept of 'phronesis' is applied by all the students to show how to assess ethical dilemmas. Data for the other theories that were used is lacking, meaning that this segment of the analysis is incomplete.

On the Copenhagen campus, eighteen theories are recorded as being used, as visualized in Figure 3.4:

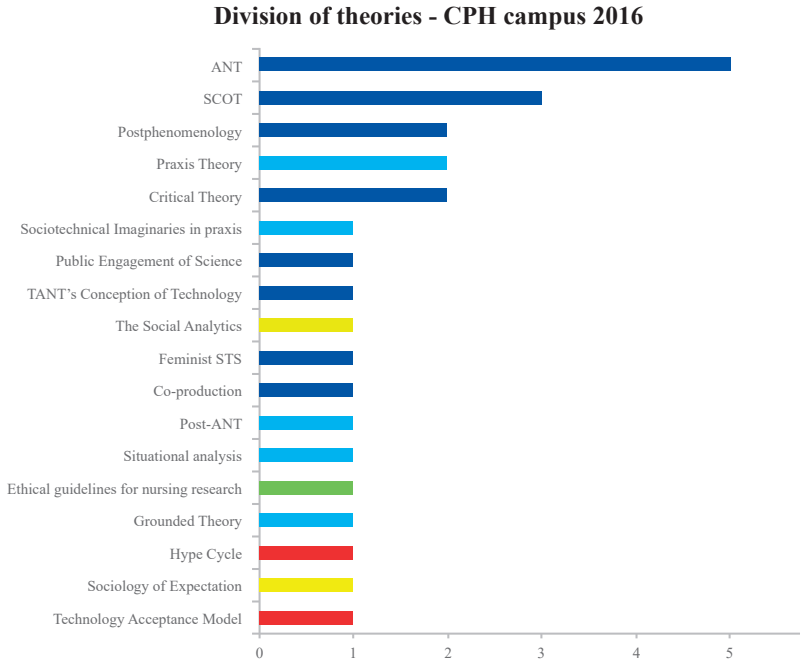

Figure 3.4.Ttheories used in project reports in 2016 on Copenhagen campus, overlaid on number of student groups.

- Dark blue colors indicate theories taught in the course on "Techno-Anthropological Problems and Theories".
- Light blue indicates the theories that were taught on the Techno-Anthropology Bachelor's program.
- Green represents theories from the healthcare area.
- Dark red represents technology or innovation related theories.
- Yellow represents social theories.

All groups except for one have used one or two theories, the exceptional group used four theories. All groups have used at least one of the six main theories presented in the course on "Techno-Anthropo-

logical Problems and Theories", and the majority of the applied theories are taught on the Bachelor's or Master's program in Techno-Anthropology. With Actor-Network Theory, Social Construction of Technology, Post-phenomenology and Critical Theory being the most used theories. Most of these theories have also been taught in the Bachelor's program in Techno-Anthropology.

On the Aalborg campus in 2016, eight theories were recorded as having been used. The diagram below shows the different theories used by the groups on the Aalborg campus. The color-coding is the same as with the Copenhagen campus, where dark blue indicates the theories taught in the semester course and dark red indicates technological or innovation theories.

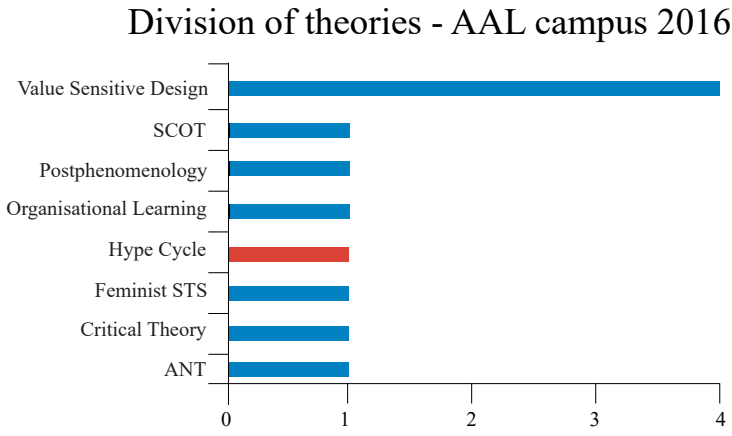

Figure 3.5. Theories used in project reports in 2016 at campus Aalborg, overlaid on number of student groups.

As with the Copenhagen campus, the most frequently used theories on the Aalborg campus are those taught on the main Techno-Anthropological course, which also have been introduced at the Bachelor's program.

3.4.1 *What's Missing: Interdisciplinarity? Proposing a further diversified use of theory.*

The use of theory shows strong links to the Bachelor's program in Techno-Anthropology, just like the problem formulations and methods already discussed. Using additional theoretical perspectives is exceptional, exemplified mainly by the Copenhagen group, which uses only few new theories. In respect of 2014, the main insight from the available data is that all the groups are relying on 'phronesis', Bent Flyvbjerg's concept, while different theoretical perspectives are missing. This means that a lack of interdisciplinarity is characteristic of the theories used in the project reports in 2014 and 2016, and that the students are not creatively synthesizing the theories they already know with those that are new to them. This is visible in the graphs, which show the recorded use of theories on both campuses as clustered around one or two familiar theories. Even though the students are taught a variety of theories, they do not seem to integrate them with their existing knowledge. When students coming to the program from outside Aalborg University come with unique theoretical perspectives, they rarely use them, if at all.

This observation prompts a suggestion for a shift in the teaching of theories and the structure of courses. Students new to Aalborg University should be invited and encouraged to share their unique theoretical knowledge with everyone. At the same time, they should familiarize themselves with the theories taught in the Master's program. As previously described in Chapter 2, theories that are new to both students with a Bachelor's degree in Techno-Anthropology and studies with Bachelor degrees from other universities are needed. We conclude that the material presented in 2014 and 2016 reinforces the need for theoretical diversification.

At this point, we will propose a general framework for how to apply the transdisciplinary threshold concepts to the main insights presented in the theoretical section of this chapter. To do this, we begin with our main question: How can university education use transdisciplinary threshold concepts to illuminate theoretical, methodological and pedagogical approaches that strengthen the systematic integration of knowledge and practices from different disciplines?

The main insights gained from the data on theory use are:

- Students mostly use theories presented already at the Bachelor's program in Techno-Anthropology
- Using more than one theory is the exception, not the rule
- Students who are new to Aalborg University rarely if ever use the theories they bring with them from elsewhere

To begin addressing these insights, we can first turn to 'liminality' and look for strategies that help strip former Techno-Anthropology students of their identity as Bachelor's students, and students with a deep understanding of the meaning of theories. The purpose here is to allow a new type of curiosity to emerge around what it means to understand and engage with theoretical material on the Master's level. This brings us to our second point, where we can address the students' preferences for mostly utilizing one theory (something they are familiar with) and rarely engaging with other theories. We can gain inspiration from the 'pedagogic content knowledge' concept, which will allow us to explore what makes familiar theories preferable (easy?) to unfamiliar theories (difficult?). Then a revised approach is needed to structuring how teachers presented and convey theories to different groups of students. This can be done with an assessment of the distance between the independent and adult-guided problem-solving visible in the 'scaffolding' concept. This scaffolding concept can also address the problem of how students new to Aalborg University rarely use the theories they are already familiar with in a new context by engaging the fourth concept, 'pedagogical stance'. This means exploring and then taking into consideration how students see themselves as learners in a particular educational environment, and then activate the theories they are familiar with in a new context. This whole process must be initiated in a clear way that the students generally understand and are aware of.

3.5 Group Composition

The fourth and final criterion we use to analyze the project reports is group composition. First, we need to state explicitly what we mean

by group composition, and why we consider it significant in project report analysis.

Group composition is a diversity metric that shows the number and types of different academic backgrounds represented by the students in a study group.

So why do we consider group composition a criterion for project reports? As groups are defined by very specific and individual traits, to answer this question we have to zoom out a little bit. We perceive the entire Techno-Anthropology Master's program to be an endeavor that strives to transgress boundaries – academic, disciplinary, and so on. This shared notion of what the program *is generally supposed to be doing* necessitates a diverse student body that brings with itself a rich variety of theoretical and methodological viewpoints that are not intuitively compatible with each other. Master's students need to communicate as clearly, efficiently and engagingly among themselves as possible. To achieve this level of academic communication, the Master's program should be using theories and methods to expand current understandings of socio-technical issues. These theories and methods can come from the core curriculum. New students can also introduce these theories from programs outside of Techno-Anthropology. Again, why do we consider group composition a criterion for project reports? Because how students interact and work together, how they use their existing knowledge and develop new ideas, is crucial for the quality of their academic results.

There are a few requirements for the first semester of the Master's program relevant to this section, which we will list here:

- First, a state-of-the-art literature review. Having meaningful academic collaboration requires a shared vocabulary (theoretical and methodological), which is why all students in the first semester of the Master's program are required to do state-of-the-art literature reviews. These reviews allow them to identify literature from different disciplines. Making these reviews is a new requirement for the program that is not present on the Bachelor's course.

- Second, mixed groups of students, for example, pairing students with an engineering background with students with a medical degree and students with a BSc in Techno-Anthropology.

The students need to be aware of different types of academic and practical problems. How students are grouped together therefore plays an important role in their academic development. How they are grouped also greatly affects the set-up and development of their project reports. If the students have only worked with one or two types of problems prior to starting the program, in their project report they are encouraged to work with a new problem formulation, a new theory, a new method.

An important and somewhat obvious note to be made here is that simply putting students from diverse academic backgrounds in the same group does not automatically result in interdisciplinary collaboration. On the contrary, if a study plan does not consider these diverse academic collaborations seriously through policies, courses and ongoing support, then these study groups are likely to suffer from negative effects, e.g. personal and academic disengagement, the lack of a shared operational language, opposing goals, etc. Considering how to combine academic backgrounds in a study group is an important point, especially at Aalborg University, as the institution relies heavily on Problem-Based Learning (PBL), a method that functions mainly through collaborative group work.

Another point regarding group composition it that it is an extremely personal process – how specific individuals react to a new academic environment, as well as to a new personal environment, given that students come from other disciplines and universities, as well as from different countries and cultures. Internationalization in higher education, intercultural communication and learning, and other fields exist where considerable research provides deeper insights regarding these issues (Tange 2010, 2012). However, as we are not producing this kind of work, we are acknowledging its relevance here and are stressing the fact that, alongside the educational, academic and policy-influenced effects on how student groups perform, we consider the deep effects of personal and individual perceptions regarding group work.

This brings us to the main question we will answer in this section: how does group composition contribute to the project reports in the 2014 and 2016 datasets from the Aalborg and Copenhagen campuses at Aalborg University?

To answer this question, we will describe how Master's students from Aalborg and Copenhagen in 2014 and 2016 were grouped and worked together. We will describe how group formation is related to PBL principles, the influence on project reports of the number of students and how they make up a group, the explicit use of diverse backgrounds, and the role of language. Finally, we end this section with a proposal for how group composition can be improved in the future.

The group formation process in 2014 and 2016 was aligned with the PBL principles taught at Aalborg University, where knowledge, skills and competences are encouraged to be developed within a group and with a joint group effort. Master's students with a BSc in Techno-Anthropology have already had a PBL class and are therefore familiar with these ideas. Master's students with a different BSc, however, go through a mandatory PBL class. The main purpose is to introduce new students to PBL principles, as seen in AAU, and to encourage learning from each other.

The groups are formed on the basis of their academic background, putting students with different forms of expertise to work on the same project.

Three data points are available to answer this question: first, the number and group compositions for 2014 in Copenhagen and 2016 in Aalborg and Copenhagen; second, the expression of backgrounds, i.e. if the students used their diverse academic backgrounds in the project report or not; and third, some effects of an English-language program in a Danish university.

Number of Techno-Anthropology and non-Techno-Anthropology Bachelor students and make-up of groups, Copenhagen 2014, Copenhagen 2016, Aalborg 2016

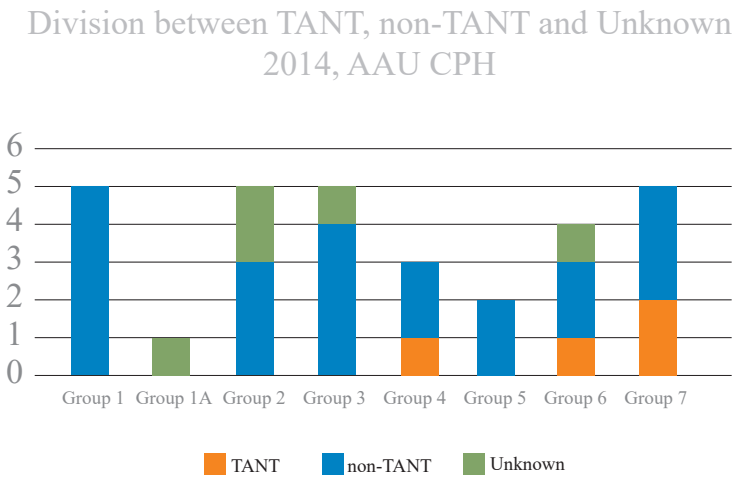

Figure 3.6. Number of students and group division in the Master's program at Copenhagen campus, 2014.

Thirty students are recorded in 2014 at the Copenhagen campus, spread out in seven groups. Their distribution is mixed, with four Techno-Anthropology BSc students (TANT) split into three of the seven groups (Figure 3.6). There are five groups entirely made up of students with a BSc other than Techno-Anthropology (non-TANT).

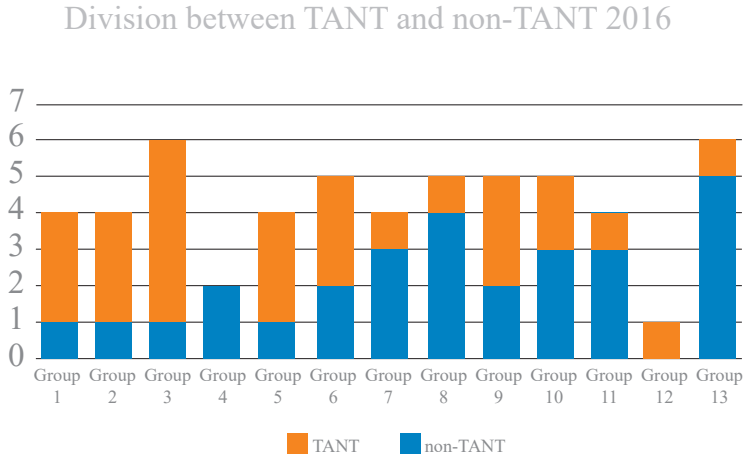

Figure 3.7. Number of students and group division in the Master's program at Copenhagen campus, 2016.

The 2016 graph (Figure 3.8) shows a similar picture: 56 students in 13 groups, where six groups have a majority of students with a BSc in Techno-Anthropology and six have a majority of students with a different BSc. This time students with a BSc in Techno-Anthropology (27 out of 56) are much more clustered in the groups they join. There are only three groups dominated by students with a BSc different from Techno-Anthropology, and one group made up entirely of students with a degree different from a Techno-Anthropology BSc.

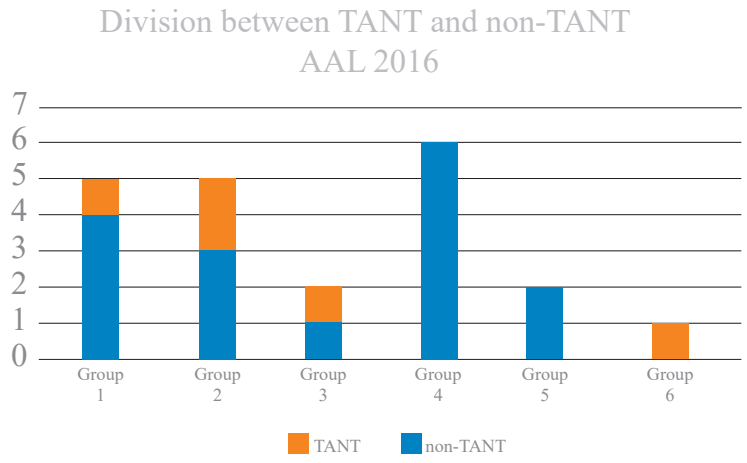

Figure 3.8: Number of students and group division in the Master's program at Aalborg campus, 2016.

At Aalborg campus in 2016, we observe a familiar situation with a total of 21 students spread out in six groups. Of these, five students with a BSc in Techno-Anthropology are present in four groups, and two groups are made up entirely of students with a BSc other than in Techno-Anthropology.

Expression of backgrounds

Now that we have seen the number and distribution of students in student groups, we go a step further by factoring in the students' educational backgrounds. We show how this background is distributed among the groups, what technologies the projects have focused on, whether the topics were relevant to the students with a different

BSc degree than Techno-Anthropology, and whether their educational background influenced the reports. Note: we do not have these data for the Copenhagen campus in 2014.

Copenhagen Campus 2016

Table 3.4. Campus Copenhagen 2016, student group number, type of technology the project deals with, group-specific educational backgrounds.

Group	Technology	Educational backgrounds
Group 1	Civilian drones	3x Techno-Anthropology, 1x Economics and International Development
Group 2	Digital methods	3x Techno-Anthropology, 1x Advertising and Marketing
Group 3	FabLab	5x Techno-Anthropology, 1x Art & Technology
Group 4	Blockchain	1x Electrical and Electronics Engineering, 1x Arts & Culture
Group 5	Psoriasis app	3x Techno-Anthropology, 1x Radiography
Group 6	CRISPR	3x Techno-Anthropology, 1x Midwife, 1x BSc of Technology Management and Marine Engineering
Group 7	Health Platform	1x Techno-Anthropology, 2x Radiography, 1x Biomedical Laboratory Science
Group 8	Health Platform	1x Techno-Anthropology, 2x Physiotherapy, 1x Nurse, 1x Radiography
Group 9	VelfærdsTeknologiVurdering	3x Techno-Anthropology, 1 Radiography, 1x Sociology
Group 10	Hövding (Helmet)	2x Techno-Anthropology, 1x Radiography, 1x Bioanalysis, 1x Architecture, 1x Social work
Group 11	Smart floor	1x Techno-Anthropology, 1x Market and Management Anthropology, 1x Social and Cultural Anthropology, v1x BSc of Social Science
Group 12	Hypothyroidism	1x Techno-Anthropology
Group 13	Autonomous cars	1x Techno-Anthropology, 1x International and European Law, 1x Digital Concept Development - Design Technologist, 1x International Business and Engineering, 1x BSc in Performance Design and Geography, 1x Market and Management Anthropology

The first thing we see in Copenhagen is the large number of educational backgrounds: there are a total of 24 Bachelor's degrees in Table 4. The biggest group by far is Techno-Anthropology with 27 students,

spread out in 12 of the 13 groups. We also notice a large clustering of 17 BSc's in Techno-Anthropology (TANT) in just 5 groups. There are also 6 students with a background in Radiography and 2 with a background in Physiotherapy. These three backgrounds make up 62.5% of the entire class (35 out of 56 students). The radiographers are spread out evenly among the groups, except 2 Radiography BSc's in Group 7, and both physiotherapists are in Group 8. This table can only provide educational background information relevant to the project reports when it is combined with the next table:

Table 3.5 Copenhagen campus 2016, student groups, topic relevance to students with a BSc different from Techno-Anthropology, and an indicator of whether these students' educational backgrounds have influenced the project report.

Group number	Topic relevant to non-TANTs	Paper clearly influenced by non-TANTs
Group 1	Relevant to the Economics and International Development background	Yes
Group 2	Relevant to the Advertising and Marketing background to some extent	Yes
Group 3	Relevant to the Art and Technology background	No
Group 4	Mainly relevant for the Electrical and Electronics Engineering background	No
Group 5	Relevant to the radiography background to some extent	No
Group 6	Can be relevant to the midwife background	No
Group 7	Relevant to the different health care backgrounds in the group	No
Group 8	Relevant to the different health care backgrounds in the group	No
Group 9	Less relevant to the backgrounds	No
Group 10	Less relevant to the backgrounds	No
Group 11	Less relevant to the backgrounds	Yes
Group 12	Group consists of only TANT backgrounds	No
Group 13	Relevant to most of the different backgrounds	Yes

What we see in Table 3.5 is that in 3 of the 13 groups the topic was not relevant to the educational backgrounds of those students with a BSc different from Techno-Anthropology (non-TANT). In Groups 4, 5, and 6, we also see that the topic is relevant to only one such student, making it less relevant for the other 2 students (in Groups 5 and 6) with a BSc other than in Techno-Anthropology. The table also shows us that in 6 out of the 13 groups, the topic is relevant for these students, whereas in 3 groups (10, 11, 12) it is less relevant for them. The other important factor in the table is the last row, which shows whether the project has been clearly influenced by students with a BSc other than in Techno-Anthropology. This is an interesting indicator, as it shows us that in 6 of the 13 groups (Groups 1, 2, 3, 5, 6 and 9), non-TANT students are in the minority, and that, of these 6, only 2 project reports were influenced by the non-TANT students. There are a number of possible reasons for this, for example, that the TANT students from Groups 3, 5, 6 and 9 assumed leadership of the group and steered the project in a direction where the non-TANT students' educational backgrounds cannot be used. Additionally, the non-TANT students in these groups could all have decided that their backgrounds cannot help, or simply refused to use their previous experiences. Regardless of the specific reasons, the important result for our analysis is that a majority of the students with a BSc different from Techno-Anthropology have not clearly demonstrated their academic experience and educational background in their project report; that is, they have not built on what they already know in the context of Techno-Anthropology. The students with a BSc in Techno-Anthropology, on the other hand, are thought of as advancing their existing educational background, as the MSc program builds on the BSc and expands its theoretical, methodological and practical horizons. Finally, we see that 9 out of 13 groups' projects were not clearly influenced by non-TANT educational backgrounds.

Table 3.6. Aalborg campus 2016, student group number, type of technology the project deals with, group-specific educational backgrounds.

Group number	Technology	Educational backgrounds
Group 1	Social therapeutic robot	1x Physiotherapist, 1 Techno-Anthropology, 1x Bioanalyst, 1x Radiographer, 1x Electrical and Electronics Engineering
Group 2	Welfare technology assessment	1x Medialogy, 2x Techno-Anthropology, 1x Art and Technology, 1x Radiographer
Group 3	Technology for automated venipuncture	1x Humanistic Informatics, 1x Techno-Anthropology
Group 4	Electronic heatlh records	1x Humanistic Informatics, 1x Bioanalyst, 1x Physiotherapist, 1x Anthropology, 1x Social Sciences, 1x Humanities
Group 5	Missed appointments in the healthcare sector	1x Humanistic Informatics, 1x Bioanalyst
Group 6	Solar power	1x Techno-Anthropology

At Aalborg campus in 2016, we can see 13 total educational backgrounds, represented by 21 students in 6 groups. Similar to the Copenhagen campus, the most represented educational background is Techno-Anthropology, with 5 students in 4 groups. The next most represented background is Bioanalysts (3 students), followed by Radiography and Humanistic Informatics, both with 2 students. The other 9 educational backgrounds have one representative each. To acquire a better understanding of the project report approach and its effects on the student groups, we have to look at the next table:

Table 3.7. Aalborg campus 2016, student groups, topic relevance to students with a BSc different from Techno-Anthropology, and an indicator of whether these students' educational backgrounds have influenced the project report.

Group number	Topic relevant to non-TANTs	Paper clearly influenced by non-TANTs
Group 1	Relevant to the engineering background, and maybe the physiotherapist	No
Group 2	Not directly relevant to any of the backgrounds, but indirectly could be relevant to both the medialogist and radiographer	Yes
Group 3	Not directly relevant	No
Group 4	Relevant to most of the backgrounds in different ways	Yes
Group 5	In different ways the topic is relevant to both backgrounds	Yes
Group 6	No non-TANT backgrounds in the group	No non-TANT backgrounds in the group

Table 3.7 shows that, in 2 of the 6 groups, the topic of the project report was not directly relevant to the students with a BSc other than in Techno-Anthropology. There is also one group entirely made up of TANT educational backgrounds, and for the 3 remaining groups, the topic was relevant to the existing educational background. The most interesting thing revealed by Table 3.7, however, is that, in a class dominated by students with a BSc different from Techno-Anthropology – 4 out of 6 student groups have majority non-TANT students, and 1 group has parity – most project reports (4 out of 6) are influenced by these students' educational backgrounds. Only the project report from Group 1 (made up of 5 people, 4 of whom have a background different from Techno-Anthropology) is not clearly influenced by these 4 students' educational backgrounds. Again, different possibilities exist – the student with a BSc in Techno-Anthropology could have steered the project in a direction where the other students' backgrounds could not be used, or the non-TANT students decided to do something completely new, etc. Regardless, the fact is that the students' existing experience was not utilized in

Group 1. However, as this is an outlier in the 2016 Aalborg sample, we can conclude that all the other groups with non-TANT students see their project reports as clearly being influenced by these students.

The role of language

The Master's program in Techno-Anthropology is an English-language program with formal requirements: minimum IELTS score of 6.5, internet-based TOEFL score of 88, certificate in Advanced English or the Cambridge Certificate of Proficiency. However, with no hard data (e.g. questionnaires, specific observations, etc.) to use for the reports regarding the Copenhagen campus in 2014 and 2016 or the Aalborg campus in 2016, we are simply highlighting the importance language plays in an interdisciplinary academic environment. We also call attention to the social effects of English as a second language in a Danish university context, where the majority of students and staff are native Danish speakers, where the minority – almost exclusively made up of students – are English speakers, and where English is rafrely a native tongue. A separate study is required to delve more deeply into the social complexities and academic consequences of this division. We are marking it here to acknowledge that it plays a role in the group compositions observed in the 2014 and 2016 project reports.

3.5.1 What's Missing: Interdisciplinarity? Proposing how to account for group composition.

In the beginning of this section, we asked how to account for group composition in the project reports from the Copenhagen campus in 2014 and the Copenhagen and Aalborg campuses in 2016? We then presented the following insights from how the groups were formed and how they influenced the project reports:

- The student groups in 2014 and 2016 are mixed, i.e. are made up of students with diverse educational backgrounds
- The students with a BSc other than in Techno-Anthropology demonstrate an ability to understand theories from the Techno-Anthropology curriculum and to work on a techno-anthro-

pological project. However, they almost never demonstrate that they can incorporate their previous academic backgrounds into the same project.

- Language and cultural specifics, i.e. international education in a Danish context, needs to be further examined in Techno-Anthropology.

Summarizing these insights, we observe that there is room for additional efforts to increase theoretical and methodological exchanges between students with different backgrounds. We should also point out that such exchanges should be structurally supported by teaching activities that specifically address the identified insights. This leads us to our recurring question:

> "How can university education use transdisciplinary threshold concepts to illuminate the theoretical, methodological and pedagogical approaches that strengthen the systematic integration of knowledge and practices from different disciplines?"

Addressing this question in the group composition segment requires a greater focus not just on what students read and write, but also on how they interact with each other, as well as with the teaching and administrative staff and the university as a whole. First, when we consider how students are placed in groups with mixed educational backgrounds and relate that to the results from the previous three criteria (problem formulations, project report methods, project report theories), we propose a stronger focus on activities inspired by 'liminality' and 'pedagogical stance'. The students should not just be put into groups randomly for the sake of being with someone from a different field. The teaching staff should consider the students' educational backgrounds and combine it with how the students see themselves as learners. This should be presented when the staff sets out arguments in favor of interdisciplinary groups. The students must see the purposes and benefits of studying and working with someone whose background (educational and personal) they know close to nothing about.

Secondly, when students with a BSc other than in Techno-Anthropology come to the Master's program, the teaching staff should consider how to invite someone new to summarize and share the most interesting, relevant and practical insights from their own background. One way to do this is to acknowledge that the students see themselves as different types of learners and to trust them to influence the overall theoretical and methodological structure of the semester with specific and relevant inputs from their own backgrounds ('pedagogical stance'). To know exactly where and how to do this, the teaching staff can ask what was difficult and what was easy in the students' Bachelor's degree and engage with the results ('pedagogical content knowledge').

Thirdly, an awareness of and a sensitivity for the students' different cultural backgrounds and linguistic abilities is paramount in inspiring the class to be engaged in the learning process. It is important to recognize the potential power of 'liminality' in the early stages of the program, as this represents a 'complex, covert learning space' (Savin-Baden, 2016:7) where both students and teachers can easily fail to see how stripping away old identities and oscillating between states of knowing and not-knowing can deepen the learning experience and emotional engagement with the knowledge. Examples of specific activities that address these issues are presented in Chapter 6.

3.6 Conclusion

In the beginning of this chapter, we set out to analyze and compare 27 student reports from Copenhagen campus in 2014 and the Aalborg and Copenhagen campuses in 2016 to determine whether they are interdisciplinary or not. After going through the data from 2014 and 2016 on how Techno-Anthropology Masters' students influence their project reports, we turn back to answer that initial question. There are a few insights we can point out, drawn from the presented data:

- In the problem formulations section, we saw that the project reports generally fell into either a solution-oriented category

or an exploratory category. There was no observable effort to construct interdisciplinary problem formulations.

- In the project report methods' section, we observed that, even though different methods were used on both campuses, no systematic effort to achieve interdisciplinarity was evident.
- In the project report theories' section, we see that theories taught in the Bachelor's program in Techno-Anthropology are used heavily in the first semester Master's project reports and that few other theories are employed. Students are not creatively synthesizing the theories they are aware of with new ones.
- In the group composition section, we see that the number of Master's students with a BSc in Techno-Anthropology has a disproportionate influence on the project reports: on the Copenhagen campus in 2016, out of 13 project reports, only 4 were clearly influenced by the non-TANT students' previous educational backgrounds, and 9 were not. On the Aalborg campus in 2016, 3 projects out of 6 were clearly influenced by non-TANT students.
- As an English language program with a majority of non-Danish students immersed in what is a Danish context, English and Danish both have an important role in the Master's program in Techno-Anthropology. Their effects on the project reports have not been calculated precisely.

The project reports from 2014 and 2016 from the Aalborg and Copenhagen campuses present a highly diverse academic environment. As with any complex configuration, this one requires an in-depth and long-term commitment from both teaching staff and students. The teaching staff can focus on stimulating interdisciplinary exchanges between the students via exercises that engage the non-TANT students' educational backgrounds and re-contextualize them in the Techno-Anthropology curriculum with a focus on theory and methodology. Teachers can also benefit from an acknowledgement of a diverse linguistic and cultural environment. They can use the students' flexibility (evidenced by high project relevance among students with a BSc other than in Techno-Anthropology) to 1) suggest projects where

expertise from both TANT and non-TANT students is essential; 2) require an in-depth literature search specifically aimed at increasing the students' ability to cooperate academically (as discussed in *3.3. Project Report Methods*); and 3) use the proposed transdisciplinary threshold concepts as specific tools for student engagement.

CHAPTER 4

Workshops as a Means for Revision and Reflection in Interdisciplinary Study Programs

In 2017, three workshops were conducted in connection with the Techno-Anthropology (TAN) study program. The goal of the workshops was *to support and develop Techno-Anthropological study in relation to interdisciplinary competencies*. The key question thus becomes: "How do we as teachers and students develop and support interdisciplinary competencies in the study of Techno-Anthropology?" The workshops were designed for evaluation and idea development to provide space, tools and results with a view to revising and reflecting on the interdisciplinary study program in TAN. Thus, the aim of the current chapter is to present the results from two sets of workshops conducted for students in Copenhagen in May 2017 and teachers from Aalborg and Copenhagen on two different days in June 2017.

As described in Chapter 1, TAN is a study program that exists in the intersection between engineering, social science and humanities in its combination of understanding both technology and the social and ethical aspects of human practice. This combination of perspectives marks it as an interdisciplinary field where researchers from different research traditions meet. In this meeting between disciplines, there is a need to support and co-create shared understandings of the basis and aims of the study program. The workshops presented below are framed to facilitate this process through the co-creation of the evaluation and development of ideas to improve the study program. The reason for this dual approach is to provide a basis for understanding between teachers from different disciplines, as well as for self-reflection. The creative process of the co-creation of ideas makes it possible to create shared horizons or understandings of how to move forward.

The framework for the workshops was based on the core methods of TAN, namely participatory methods and action research. It is a case of 'taking your own medicine', i.e. trying to create shared spaces in which to develop the study program.

4.1 Background and purpose of workshops

As mentioned in the previous chapters, interdisciplinary study programs are complex because researchers from multiple fields join in teaching students with different bachelor's backgrounds and thereby strive to bridge between different types of methods and theories in the understanding of technology (seen as socio-technical problems). In such contexts, there is an increased need to develop a basis for negotiating and discussing shared understandings and learning goals for and with both students and teachers.

As an interdisciplinary study program, the mixture of different fields of research and practices provides the program with both its strengths and challenges. Teachers from different backgrounds come to the study with different perspectives on what it means to be a professional, and even on what constitutes scientifically valid knowledge (including but not limited to engineering, anthropology, philosophy, science and technology studies, participatory design, energy technology and others). Additionally, students in the Master's program have different perspectives on how professionalism is based in interests and competencies developed in different Bachelor's programs. As mentioned in Chapter 1, the students come from both the TAN Bachelor's degree, interdisciplinary Bachelor's degrees (like Art and Technology, Communication and Digital Media, and Humanistic Technology), BSc degrees in Social Sciences or the Humanities (like Anthropology, Market and Management Anthropology, Sociology, Psychology), health professional Bachelor's degrees (like Radiographer, Nurse, Bioanalyst, Midwife, Occupational Therapy, Physiotherapy) and Bachelor's degrees in engineering or natural sciences.

Because there are differences in world views in play among both teachers and students, it is important to have a continuous dialogue of what being an interdisciplinary professional within TAN really means. What are the core competencies, and what are the understandings of key methods and theories? It is important internally for

teachers and students to develop shared identities that aid engagement and student retention, and important externally in order to provide a competence profile for employment after the students have graduated.

There is also a need for constructive and creative communication in a socio-academic setting within an interdisciplinary program. Problematizing and engaging in this kind of dialogue supports students in being more attractive candidates for collaboration and work after they graduate. This complex task of developing shared and intersecting understandings and world views is a constant work in progress. As mentioned in Chapter 1, and as will be further elaborated in Chapter 5, a multitude of activities have been and are being used to achieve this in the TAN study program. In this context workshops have the dual role of generating dialogue and new ideas for the study program improvement in both the teachers and students' groups.

4.1.1 Why use workshops?

In TAN, among the core study methods for acquiring shared understandings between people with multiple rationalities, professions, interests etc. are participatory design, action research and related change-oriented methods (Kanstrup and Bertelsen, 2011, 2013; Thorsen and Børsen, 2018). Methods within this field focus on many different spheres of change involving different actors, like users, designers, experts, and researchers. Different approaches have different foci. Action research has a focus on generating knowledge within change processes, future workshops focus on imagining futures with central or vulnerable actors, and participatory design is used in areas from policy and developmental work to technology and information systems design. The focus of participatory design is on involving central actors in the generation of new organizations, services, and technologies. In this case we use 'User Innovation Management' (UIM) as a framework within participatory design (PD). As its name indicates, UIM provides tools and methods for involving users in innovation processes. In this case, the innovative process involves rethinking and improving a study program.

Developing the workshops was inspired by key insights from both action research and PD. Action research has a focus on participation in change processes, as does PD. Here the traditional sociological study of a field is flipped to studying with the field. This represents an alternative approach to how ideas can be generated with a focus on engagement and change. Here workshops are used as a basis for cooperation, discussion and developing shared understandings of interdisciplinarity, evaluations of the study program, and ideas for new initiatives for the program.

4.2 Workshop Methodology based on UIM: Co-operation, Context, and Concept

The workshops provide the scene for an innovative process, as we expand our understanding of the study program in order to improve it. User Innovation Management (UIM) (Kanstrup and Bertelsen, 2011) can assist in the innovation process, as it is a framework for collaborative innovation. It uses an iterative approach to provide a learning process that places users at the center.
The UIM process has six phases divided into three parts:

Cooperation involves the phases of
1. selecting and
2. planning

Context involves the phases
3. insight and
4. vision; and finally

Concept involves
5. sketching and
6. presenting.

All of these phases are described in more detail below.

Cooperation: Selecting and Planning is about framing the involvement of the relevant users. Who do we need to involve to represent the relevant innovation actors? This involves selecting the participants and planning the process. In this process, different constellations of participants were considered. First, we considered only inviting study

coordinators. However, this would limit the ideas and possibility of using the workshop to acquire shared dialogues and understandings. Therefore, we decided that all teachers and Master's students should be invited to participate in the process.

After selecting the user groups, we needed to plan the engagement. We chose the workshop format, as this was a way to ensure the dual purpose of dialogue and ideas for improvement. We used the "tune in, focus and check out" workshop method: tuning in by discussing interdisciplinarity, focusing through assessment and ideas for improvements to the study program, and checking out by rating ideas.

Context: Insight and Vision is a matter of understanding the present and framing the future. It is concerned to acquire insights into what types of knowledge you need to access, and in our case, what kinds of learning and dialogue we wanted as an output of our engagement with the teachers and students, on the basis of which a vision for the future and possible changes are identified.

We chose to structure the workshops (described in more detail below) first as an assessment of current activities ('Insight'): What are the challenges and positive initiatives? This forces the participants to consider what the current situation is. On the basis of this insight, we used an idea-generating session as a means of gaining new perspectives ('Vision') on how to support interdisciplinarity and retention in the Master's study program.

Concept: Sketching and Presenting concerns visualizing and considering how best to disseminate the results of the UIM process. The different phases address the verbalization, illustration and design of shared ideas, needs and requirements, that is, the process whereby raw ideas are molded together under the pressure of mutual, as-equal-as-possible visions by participants who share similar goals (i.e. student engagement, academic excellence, meaningful research and education, etc.). In UIM this entails going from vision to action in the participatory process. Here you need to consider how to use the insights you have acquired in the participatory process. We chose to incorporate sketching in the workshop, where the teachers used the insights drawn from discussing the challenges, positives and new

ideas by rating the most important ideas to be addressed. The outputs of the study were used in later meetings and implemented in initiatives to improve study activities and the 2020 curriculum, as described in Chapter 5.

4.2.1 The Workshop Participants

In order to have as many participants as possible, we placed the workshops on the agenda of an annual teachers' meeting for all teachers of TAN, one in Copenhagen and one in Aalborg. We chose a teachers' meeting, as this was a gathering where all the teachers met. By doing this, we did not need to invite the teachers and also ensured a high level of attendance.

For the students, there was no suitable time or event at all the Master's students would be present. In Copenhagen we invited all the students and fixed the workshop to come after a lecture in the seventh semester in the Master's in Copenhagen. That, of course, had an impact on attendance and on who attended. Only a few students did so, namely those with an interest in giving feedback. Therefore, the students who did participate were very active in providing feedback and ideas for improving the study program. However, this left out some important voices on students' perspectives.

Regarding the workshop for students in Aalborg, we were too late in the semester to coordinate the meetings in relation to teaching, and consequently no student from Aalborg found the time to attend the workshop.

The focus of the workshops was on improving the Master's program. However, some teachers at the teachers' workshops only taught on the Bachelor's course, and at the students' workshop some students from the Bachelor program who were interested in the topic of the workshop were allowed to join in.

There were 12-16 teachers present at each teachers' workshop in Aalborg and Copenhagen and 10-15 students present at the workshop in Copenhagen. They were divided into 2-3 groups of 5-6 participants. The reason for the approximate numbers is that some teachers and students arrived late, and a few participants left before the workshops were finished. The students were divided into a Master's and a mixed group, and the teachers in both Aalborg and Copenhagen were divided

into three groups, one for teachers primarily associated with the Master's, one for teachers primarily in the Bachelor's program, and one mixed group with teachers associated with either the Master's or the Bachelor's or both.

4.2.2 The Workshop Design

The workshops conducted an open discussion of interdisciplinarity in the program, with three evaluation phases and three idea development phases. The following is an overview of the program of the **Evaluation and idea development** workshop:

1. Open discussion of interdisciplinarity in the study program
2. Evaluation of the current program:
    a) Evaluative reflection and discussion of the challenges and positive aspects of the current study program
    b) Identifying the most important and urgent challenges, and prioritizing critical initiatives for implementation
3. Idea generation:
    a) Group discussion on new ideas based on the output of the evaluation
    b) The groups present their key ideas
4. Prioritization

The workshop design is described in more detail below. Each phase of the workshop was accompanied by slides with a description of the activities. The first slide (Figure 4.1) gave the title of the project. The workshop facilitator gave a short introduction to the project and the purpose of the workshop.

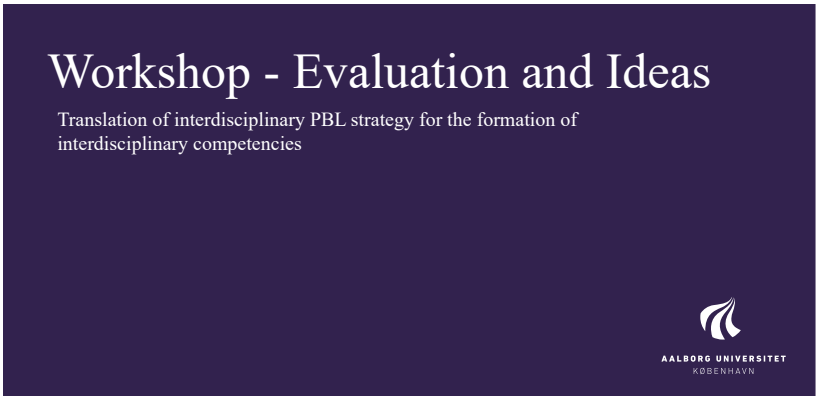

Figure 4.1. Workshop slide 1: introduction slide

The Discussion Phase: Tuning In

In the open discussion of interdisciplinarity in the study program, everyone joined in a discussion on how interdisciplinarity is or is not expressed or integrated into the study program. The participants were guided by a slide (Figure 4.2) containing as a discussion point "What are the inter/cross disciplinary competencies and skills of TAN?"

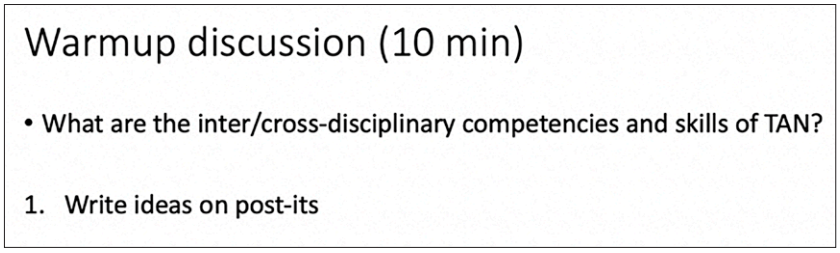

Figure 4.2. Workshop slide 2: Open discussion of interdisciplinarity in the study program.

The participants were also urged to write their ideas and thoughts in post-its and place them on an A3 poster. However only some groups found the time in the discussion to do this (An example can be seen in Figure 4.3 (in Danish)). These groups found the discussion more interesting and would have liked more time to discuss with colleagues they didn't see very often.

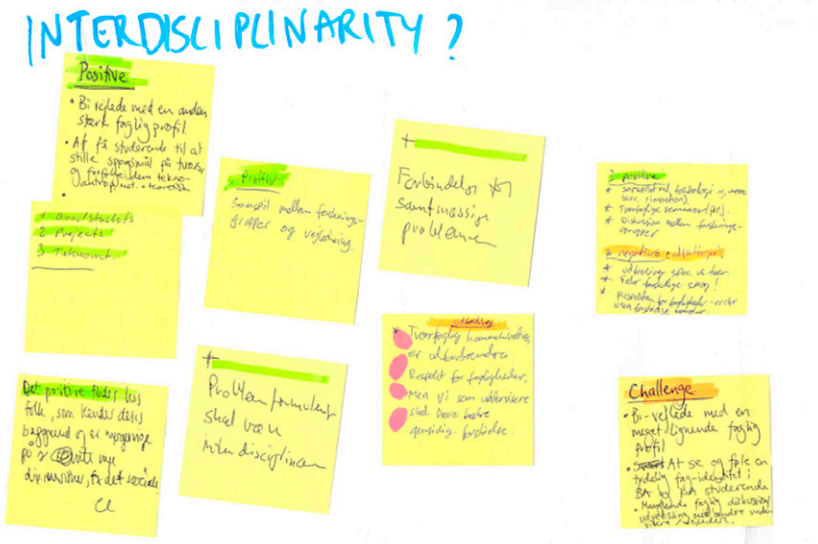

Figure 4.3: Poster from interdisciplinary discussion at the teachers' workshop in Aalborg (in Danish).

The Evaluation Phase: Focusing

The purpose of the evaluation phase was to have the participants consider and reflect on the existing initiatives and challenges of the study program, primarily in relation to interdisciplinarity.

In the first session, the participants were asked to individually consider the positive experiences, initiatives and challenges of supporting inter/cross disciplinary competencies in the study program of TAN (see slide: Figure 4.4).

Evaluation 1 (5 min)

- Individual session
  - Write on post-its: three positive experiences/initiatives and three challenges for teachers/students in relation to supporting inter/cross-disciplinary competencies.

Figure 4.4. Workshop slide 3: Evaluation slide 1: Positive experiences and challenges.

In the second part of the evaluation, the participants were asked to reflect on the challenges and ideas that were found in the individual session and to put their thoughts on orange for negative and green for positive thoughts and ideas (see Figure 4.5).

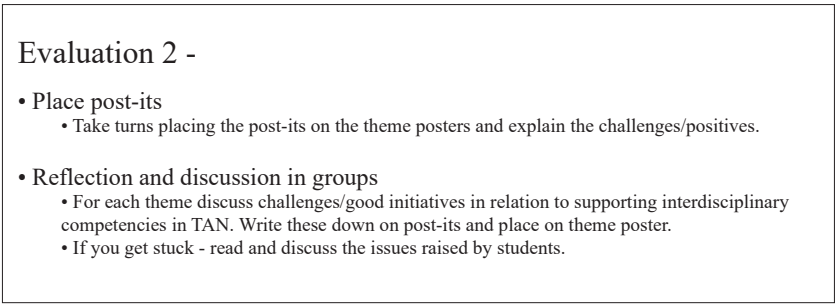

Figure 4.5. Workshop slide 4: Evaluation of positive and negative practices.

Here the groups were introduced to five A3 posters showing the categories that were used throughout the workshop.

- P0 – an introductory project phase of one month at the beginning of the 1st semester of the Master's
- courses
- project work and supervision
- social environment; and
- other.

At least one challenge, problem and/or good initiative within these categories had to be mentioned.

The previous semester evaluations were made available for reading and discussion if participants needed ideas about challenges in the study program.

Figure 4.6. Output from the Master's groups at the teachers' workshop in Aalborg (blue "Other" header) and Copenhagen (Purple "Projects/Supervision" header).

The participants were encouraged not to enter into arguments about what was being proposed. The participants wrote their ideas on post-it notes and placed them on the posters (see Figure 4.6). This section was supposed to continue until there were no more ideas from the participants, though in the event the facilitators had to break up the discussions due to a lack of time. Again many groups expressed the need for further discussions.

Evaluation 3

- Individually mark the three most important/urgent challenges in relation to supporting cross/inter-disciplinary competencies with the pink marker
- Mark 3 challenges each

Figure 4.7. Workshop slide 5: Evaluation of challenges.

Lastly the groups identified the most important and urgent challenges, prioritizing which challenges needed initiatives for improvement and marking the most important and urgent ones (see slide in Figure 4.7).

Each participant had three "dots" that represented the key challenges of the study program, which they could distribute on the A3

posters containing evaluative statements about the study program (see Figure 4.8).

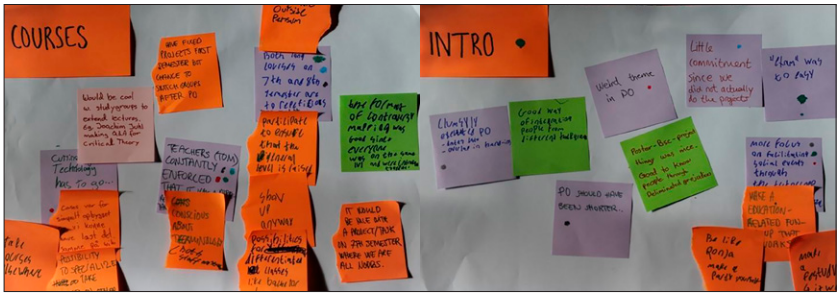

Figure 4.8. Output from the Master's group at the student's workshop in Copenhagen.

The idea generation phase: Focusing and Checking out

The idea generation phase was conducted similarly to the first evaluation part of the workshop. Here the same categories and the input from the previous sessions on the A3 posters were made available. First the groups were encouraged to think individually about improving interdisciplinary competencies in TAN (see slide in Figure 4.9).

Idea development 1 (5 min)

- Individual session
  - Write on post-its: three ideas for improving interdisciplinary competencies in the TAN study and study environment.
- Place post-its
  - Take turns placing the post-its on the theme posters and explain the idea.

Figure 4.9. Workshop slide 6: Idea slide 1: Individual reflection on improving interdisciplinary competencies in TAN.

The next step was an *Open session* (see slide in Figure 4.10). Each group presented their key ideas to the other groups. The focus was two-fold: 1) how is interdisciplinarity (professional background) expressed; and 2) what has and has not worked in study design and

the social environment. In practice this session was integrated with the last session prioritizing the ideas, as again time was running short.

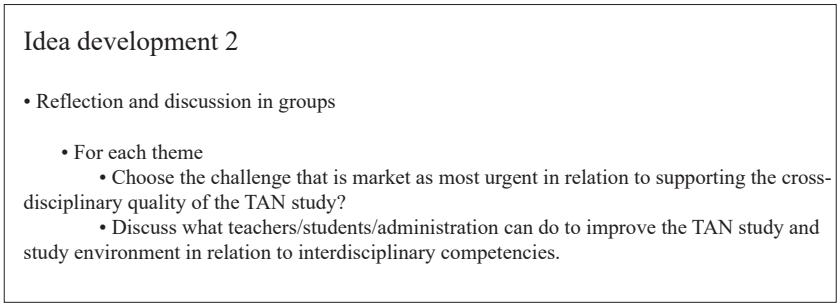

Figure 4.10. Workshop slide 7: Group reflections.

The last "checking out" stage was *Prioritization* (see slide in Figure 4.11). Each member of the group had to distribute three marks on the ideas and challenges they found to be most urgent or important to address. The purpose was to provide the Study Board with an overview of challenges, problems and solutions that deserve to be addressed in the future.

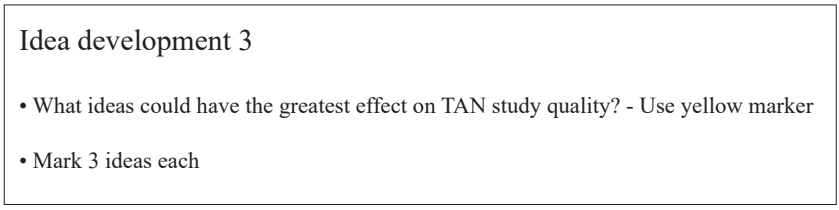

Figure 4.11. Workshop slide 8: Prioritizing ideas.

Challenges of the workshop process

A range of challenges emerged in conducting the workshops. Below some of the key issues of doing workshops for study program revision at an interdisciplinary study program are presented.

At the teachers' workshops in both Aalborg and Copenhagen, one group went off track. The "off track" groups did not used the concept set up by the workshop. The participants in these groups got caught up in the discussions and only generated a list of unstructured ideas and inspirations. This can be seen as an inherent challenge of

working with creative people that is hard to avoid. When working with people who have a lot to say, you either need a strong facilitator or must accept the chaos. Here there is a conflict between two possible processes and learning outcomes of the workshops: one is the expected production of a list of ideas, while the other is the learning and community building between teachers on the same program who do not meet very often. The benefit of the chaos is that the participants acquired a feeling of being empowered in the process and of being able to challenge the boundaries. Here you have to consider what is the most important outcome.

The social environment category was criticized by some teachers and was not seen as a central area of improvements from the teachers' perspective. Either there is a need to explain this category, or you can consider other ways of addressing the context of the students in the study program.

How to communicate an uncertain description of a problem, and how to invite students to claim partial ownership of their own study? Not as many students as expected joined the workshop. Those who did had something to say, and a few were asked to speak personally by a student representative. The students did not see the workshop as particularly important, and only twelve to fifteen attended; some came and left during the workshop. In order to improve attendance, a thorough plan of the workshop needs to be co-created and made clearly available to prospective participants prior to the event, e.g. at the beginning of the semester. Clearer communication about the purpose, format, outcome and requirements for the workshop will encourage both teachers and students to join in, as well as placing the workshop in relation to already scheduled activities of teaching or meetings.

During both the evaluation and idea phase of the workshop, discussion by some groups had to be ended prematurely. This challenge can either be seen as inherent in any creative process, as you cannot discuss forever, or else the workshop could be extended for a longer time period.

There are no doubt other challenges to be faced when preparing and facilitating workshops for colleagues in an interdisciplinary study program. The most important result of this process was the deep

professional dialogues and the inspiration and new ideas gained through the process, described below.

4.3 Workshop Results

The results of the workshops are many and diverse. Here we will present the main themes that were addressed in the workshops and point out some of the key ideas that were prioritized by the participants during the workshops.

4.3.1 Presentation of key ideas

As already mentioned, the workshop was structured in order to provide a broad base for inspiration on all areas of the study program. This was done by providing categories in the key elements: social environment, intro P0 class, projects/supervision, courses and other.

The analysis of data from the workshops was conducted by three researchers (the authors of this book). It consisted in: 1) transcribing the posters and post-it notes from the workshops; 2) eliciting themes in the data and categorizing them in an excel file, followed by a second iteration of analysis condensing these themes into five areas of engagement; and 3) preparing the presentation of the results with key ideas for the project report and for future teachers' meetings in the study program.

In the following, the resulting five areas for possible action for analysis are presented and described in detail. Then the key challenges and ideas from the workshops elicited from the students and teachers are presented.

Five core areas of possibilities for action within the study program were found:

1. Interdisciplinarity. gaining insight into collaboration through in-depth (quick and proper) domain knowledge and into how different domains talk to each other to produce new knowledge (including insights from the themes of bridging gaps, new stuff, changes of discourse, collaboration format, definition of technology domain).

2. Technical perspectives. More knowledge about the specific functions of technologies within specific domains (including insights from the themes of bridging gaps, changes of discourse, defining the technology domain, and excursions and cooperation with companies).

3. Study forms. The form of teaching (using posters, video, etc.), the aspiration (higher levels of academic excellence, etc.), creating a new space where new and old students in the program are on equal footing (including insights from the themes of understanding academic readings, conducting broad theoretical overviews, bridging gaps, new stuff, changes of discourse, collaboration format, planning format, excursions and cooperation with companies, and physical environment).

4. Social/intercultural. The need to support the integration of students from different Bachelor's programs, domains and countries (including insights from the themes of bridging gaps, changes of discourse, collaboration formats, excursions and cooperation with companies, and the social and physical environments).

5. Employability and professional profiles. Teachers and students want more examples of possible jobs when you graduate from the program (including insights from the themes of conducting broad theoretical overviews, bridging gaps, collaboration formats, and excursions and cooperation with companies).

The workshops provided the basis for a wide range of criticisms and ideas for the revision of the study program, as well as study didactics. The students and teachers identified and marked a range of challenges and ideas in workshops that were especially important. Below a selection of these ideas are presented in relation to the five areas for action presented above.

Below, the challenges and ideas relating to interdisciplinarity, employability and professional profile, technical and domain perspectives, study forms and social activities are presented. The challenges and ideas are presented in tables in which the challenges are

labeled with a C# and the ideas are labeled with an I#, where # signifies a number.

Challenges of and idea for an interdisciplinary study program

Within the theme of interdisciplinarity, the workshop supported an initial discussion of the term in the context of TAN. These discussions were further elaborated in the evaluations and idea-development workshops.

The students in Copenhagen had a range of reflections on what interdisciplinarity means within the TAN study program (Table 4.1), whereas the discussion in the teachers' group was more related to theoretical understandings of the concept of interdisciplinarity and was merged into the following workshop sessions (Table 4.2). The students generally express an understanding of interdisciplinary competencies in TAN as an understanding of different cultures or practices and of the ability to bridge between different cultures.

Table 4.1. Students reflections on interdisciplinarity in TAN.

Students understanding of interdisciplinarity	Workshop poster
Being able to bridge different levels of practical, engineering, leadership and other skills. Dissemination and communication between stakeholders.	Interdisciplinary, Students, CPH
Interdisciplinarity means being able to lead and semi-understand publications from different disciplines. Provides a wide theoretical foundation for understanding problems from many angles.	Interdisciplinary, Students, CPH
We learn to identify different expert cultures and act accordingly. Ethnographic experience of different types of expert culture.	Interdisciplinary, Students, CPH
The program challenges one's world view when meeting Bachelor's students from different backgrounds. You have to defend what you took for granted.	Interdisciplinary, Students, CPH

When analyzing the challenges (labelled C1-C7) and ideas (labelled I1-I8) of the interdisciplinary study program in TAN (Table 4.3), three main issues surface. Firstly, there is a transdisciplinary concern for what has already been covered in Chapter 1, namely the diversity of

teachers and student groups (C1-C4, I1-I5). This causes challenges to bureaucratic structures, pipeline thinking and an increased need for communication and disciplinary discussions. This is a key point for students, but mostly for teachers. Interdisciplinary study programs foster bureaucratic challenges in respect of teaching and coordination. The coordination work is expanded when planning and managing a study program across different faculties, disciplines, languages and campuses.

Another challenge that is raised is that of the terminology used to address the difference in disciplines between teachers, but in the Master's program more specifically between TAN and non-TAN students (C5, I6). Providing a good work and study environment for teachers and students requires respect and understanding between disciplines and world views (C6-C7, I7-I8).

One idea that relates to the challenge of the Master's students' different Bachelor's backgrounds is having the students on the Master's courses in technical study programs serve as experts in projects: "collaborate with group members in specific areas, where they are experts, and use their knowledge (e.g. health-care project with nursing students)". Another idea was to cooperate with other study programs.

Summing up, both students and teachers emphasized the need to gain insights into collaboration and how different domains must talk to each other to produce new knowledge. The students acknowledged the importance of being mindful of the vocabulary used to distinguish between students with different Bachelor's degrees. Additionally, they emphasized the way the study challenges the different world views between of different professions. This aligns nicely with the teacher's emphasis on the competence of the study program in having a language in which to understand different 'worlds'. The teachers also focused on the need for mixed groups at the master's level as a basis for supporting these competencies.

Table 4.2 Challenges and ideas of an interdisciplinary study program.

No.	Challenges of an interdisciplinary study program	
C1	De-bureaucratization in a study program between different research groups, departments and faculties	P0, Teachers, AAL
C2	Address pipeline thinking, i.e. the lack of communication and shared understanding between different semesters, courses and faculties	Courses, Teachers, AAL
C3	Challenge of the difference in competence in a heterogeneous project supervisor group	Courses, Students, CPH
C4	Not enough resources for discussions about scientific research within the teachers' group	Other, Teachers, CPH
C5	Teachers constantly enforced the differences between students from the TAN Bachelor's "TANs" and those from other Bachelor's backgrounds "non-TANs"	Courses, Students, CPH
C6	Prejudices about/between anthropology and science	Courses, Teachers, CPH
C7	Students speaking different languages between both domains and different countries	
No.	**Ideas for an interdisciplinary study program**	
I1	Giving the students a language in which to understand different "worlds"	Other, Teachers, CPH
I2	Interdisciplinary student groups are both a challenge and opportunity. The different backgrounds can be used as the basis for initiating interdisciplinary understanding and discourse.	Project/ Supervision, Teachers, AAL
I3	Showcases of messy science and cross/ interdisciplinary research	Other, Teachers, AAL
I4	Combination of TAN Bachelors, profession Bachelors and other Bachelors from AAL University	Other, Teachers, AAL
I5	Providing tools for handling the challenges in interdisciplinary communication. Respect for other disciplines and gaining mutual understanding	Inter-disciplinarity, Teachers, AAL
I6	Teachers should be more conscious about terminology used in classes, e.g. "TAN", "non-TAN"	Inter-disciplinarity, Students, CPH
I7	Respecting the different disciplines in the study program and seeing the value of different domains of knowledge	Other, Teachers, AAL
I8	Promoting humility in approaching the TAN identity in relation to other professions and domains	Other, Teachers, CPH

Challenges and ideas for employability and professional profiles in an interdisciplinary study program

A central topic for the university, as well as the workshops, is employability in the sense of gaining a clear view of the professional profile and possible areas of work associated with TAN. The main concern with regard to employability addressed at the workshops was a need to provide a connection between being a professional and being a techno-anthropologist (C8). "Techno-anthropologist" is not just an academic title but a means of employment. There are many ideas for improving the connections in the study program. Working actively with student self-perceptions is one idea for more explicit conversations with the students about career paths during the Master's program (I9, I11). More interactions with potential employers are also mentioned (I11, I13, I14). Possibilities like the excursions mentioned under social activities (below) could also be added to this list (I25).

Table 4.3. Challenges and ideas of employability and professional profiles in an interdisciplinary study program.

No.	**Challenges of employability and professional profiles**	
C8	Need for a connection between profession and identity as a techno-anthropologist	Other
No.	**Ideas for employability and professional profiles**	
I9	To work with their DNA, the students have to understand that the strength in education lies in the way they approach challenges	Other, Teachers, CPH
I10	A better range of subjects In the first semester of the Master's, where the subjects are framed more as a specialization	Courses
I11	More presentations by people working with TAN skills to act as an example of the usage of skills; role models	Social, Teachers, CPH
I12	Student Development Talks in the first semester of the Master's, where the Master's students are provided with personal feedback on their demands for competence profiles	Courses, Teachers, AAL
I13	Events with potential employers	P0, Teachers, AAL
I14	Focus on employability and internships	Other, Teachers, CPH

These challenges are addressed via testimonials from graduates on the program's website, as well as company visits. Additional information is provided in Chapter 5.

Technical or domain perspectives in an interdisciplinary study program

As mentioned above, there is a debate in the study program of the role specific disciplines need to play in education in order to provide the student with a sound basis of technical knowledge (C9-C10). There also was an emphasis on gaining access to and understanding other domains (C11-C13). The task of providing the basis for integrating technical domains into an interdisciplinary study program can be addressed in many different ways, but fundamentally the dialogue about this challenge between teachers and students remains a focal point in any interdisciplinary study program (I15). However, some teachers from the technical domain are advocating mono-technical progression, instead of giving the students free range in relation to the choice of a technical domain (I16).

Table 4.4. Challenges and ideas from technical or domain perspectives in an interdisciplinary study program.

No.	Challenges of technical or domain perspectives	
C9	The balance between providing specialization and interdisciplinary in a Master's program.	Other, Teachers, AAL
C10	How can technology become something more than a subject field that is integrated into Techno-Anthropology?	Other, Teachers, AAL
C11	The technology domain is too vaguely defined	Projects, Students, CPH
C12	Not enough knowledge about technology practices because the students aren't from one department (food studies, urban planning)	Other, Teachers, CPH
C13	The students are not forced to have direct interactions with the development and use of specific technologies	Courses, Teachers, AAL
No.	**Ideas for technical or domain perspectives**	
I15	Support technical knowledge through interaction with professionals and literature study. Support the students in gaining knowledge and understanding of the correct technical terms	Project/ Supervision, Teachers, CPH
I16	Having clearer mono-technical progress	Courses, Teachers, AAL

Types of study forms in an interdisciplinary study program

Many of the ideas and challenges that emerged from the workshops were provided in this category, ranging from the need to improve the existing study activities to challenges and ideas for supporting and improving content and processes (C14-C18, I17-I22). A few challenges are worth mentioning. Firstly, there is the perceived repetition of literature and theories for students with a Bachelor's in TAN (C14-C15). Secondly, there is the challenge of introducing socio-technical theories to new TAN students (I17, I20-I22). Here the option of using students as ambassadors for different TAN theories in the teaching is worth mentioning. Thirdly, there is the need, addressed by teachers in both Aalborg and Copenhagen, for improved academic competencies, e.g. reading and writing skills (C17).

In summary, the teachers and students identified a need to support the cohesion of the study program both in relation to connections between students from different domains, and within the teacher's group. Additionally, both teachers and students emphasized the need to develop the skills of writing academic texts in the Master's program.

Table 4.5. Challenges and ideas of types of study forms in an interdisciplinary study program

No.	**Challenges of different types of study**	
C14	Repetition in multiple courses In the seventh and eight semesters	Courses, Students, CPH
C15	Challenges in P0. Themes, planning, motivation	P0, Students, CPH
C16	Students want access to electives from other studies	Courses, Students, CPH
C17	Students need to know how to understand academic challenges and how to craft a solid academic project.	Project, Other, Teachers, CPH and AAL
C18	Need for better support in knowledge-sharing	Other, Teachers, CPH
No.	**Ideas for types of study**	
I17	To support interdisciplinarity, more tuition and texts on earlier semesters (PBL/STS courses) are needed.	Courses, Teachers, CPH
I18	Teachers/project supervisors need to acknowledge the need for interdisciplinarity work. Foster being curious.	Other, Teachers, CPH

I19	Teachers should refer back to what has been taught prior to their own class. Create a connection in the teaching.	Courses, Teachers, AAL
I20	Use Techno-Anthropology Bachelor's students actively in the teaching of socio-technical theories and methods, e.g. by describing the use of the theories and methods they used in their Bachelor's projects.	Courses, Students, CPH
I21	Introduction of theories and methods to students from other Bachelor's programs before the start of the first	Courses, Students, CPH
I22	A presentation of a good or exemplary project by MSc. students	P0, Teachers, AAL

Social activity in an interdisciplinary study program

The social aspects were mostly addressed by the students (C19-C20). Some teachers did not understand why they had to deal with the social aspects of the study program in the workshop. Teachers in Copenhagen and Aalborg find that integrating Bachelor's students from different study backgrounds and from different countries is a challenge, as mentioned above (I2, I4). However, the teachers did not directly address this challenge in relation to activities that were social. The students especially emphasized the social environment. Here field trips were also mentioned, along with having spaces available that were fit for socializing (I23-I25).

Table 4.6. Challenges and ideas for social activity in an interdisciplinary study program.

No.	**Challenges of social activity**	
C19	The need for a greater focus on facilitating social events, e.g. through the tutor corp. This has to be funded and prioritized by the university	P0, Students, CPH
C20	There was a lack of social connections across project groups.	P0, Students, CPH
No.	**Ideas for social activity**	
I23	Social gathering at the beginning of the Master's course	P0, Students, CPH
I24	Techno-Anthropological Friday bar	Social, Students, CPH
I25	Field trips to blend better (socially and in class), and also to visist places where students might find employment	Social, Students, CPH

The workshops provided two main outputs. One output is the many challenges and ideas to be addressed by the study council, coordi-

nator, teachers and students in the study program. The other is the dialogue between colleagues, which provided the basis for a better understanding of the interdisciplinary program among teachers, some of whom use a single discipline in their research fields. This, however, is an ongoing challenge, and workshops or other forms of facilitated dialogue can be seen as a basis for this type of study program in order to provide the best conditions for it to develop and thrive.

4.4 Conclusion: Methods, Challenges, and Results

Holding workshops in connection with interdisciplinary study programs can provide value in relation to both the evaluative output and the ideas generated in the process. The co-creation process also provides the basis for developing shared understandings that can support more collaborations in the groups of teachers and students. Workshops can be an alternative to more traditional forms of evaluation and can change process meetings where students and faculty have traditionally discussed the challenges and opportunities for the development of a study program in the forum of the study council. Therefore, workshops can be an excellent method if you want or need to develop interdisciplinary study programs, courses etc.

In the process of conducting these workshops, some challenges emerged with regard to the process. Therefore this chapter ends with a range of considerations that can or should be addressed when designing workshops for study revision and/or dialogue:

Summary of key insights:

- Have the activity integrated into existing and core activities for all students and faculty
- Possibly have a facilitator who is not part of the teaching group (i.e. an outsider) to avoid political agendas and misunderstandings concerning the aim of having mixed groups in the workshop
- Make sure to take into account the mix of each workshop group so that all feel they have a voice in the discussion

- Make the activities simple and have a visual cue to keep people on track
- Have the groups formulate the key ideas as action steps (what do we need to do to achieve this?)
- Have facilitators who can moderate the discussion OR focus on having discussions instead of reviewing results in the workshops.
- Adjust ideas to new circumstances and use them to engage new staff in the ongoing discussion about the interdisciplinary study program (consider how ideas can be made understandable to "outsiders" and new members
- Conduct a workshop every Second year to keep considering and continue to keep good ideas in focus, even though there has not been the time to implement this

In summary, workshops are an efficient way of addressing the multiple challenges involved in revising in study programs, and also in retaining a strong dialogue about what constitutes being a professional within a study program for both students and teachers. The ideas and challenges of this chapter were used as an inspiration for the initiatives presented in Chapter 5.

CHAPTER 5:

Thirteen Implemented Initiatives for the Engagement of Students with Diverse Academic Backgrounds

This chapter presents thirteen initiatives aimed at strengthening student engagement in the 7th semester in the Techno-Anthropology Master's Program in Aalborg University's Copenhagen campus. Following a series of feedback sessions with staff and students, as well as the workshops described in Chapter 4, an initial list of initiatives was compiled for implementation. They are unified by a hands-on approach with a focus on knowledge of theory gained via a literature search, as well as practical exercises that support analytical skills. The initiatives described here were implemented over a three-year period and include poster presentations, film discussions, food events, academic reading seminars, analysis of cases, literature searches, updated language use, a company visit, PBL classes for everyone, a refocus on topical theories, domain theories and exemplary cases, and a pedagogical focus on new texts from 2017. Additionally, participation in the annual Techfestival in Copenhagen was officially introduced in 2019, and an online introductory course was initiated in 2020. We conclude the chapter with a summarizing discussion on the relation of ideas to the transdisciplinary threshold concepts presented in Chapter 2. The reader can find inspiration and use these initiatives to promote interdisciplinarity and transdisciplinarity, as well as to manage complexity in academic programs.

5.1 PBL for everyone

At the Technical Faculty of IT and Design at Aalborg University, all Master's students who have not completed their Bachelor's degree at Aalborg University (AAU) must take a mandatory class in Problem-Based Learning (PBL). This structuring of students has not had the best effects on the social and academic environments. What is more, since a considerable number of Master's students who have

not completed their Bachelor's degree at AAU are not Danes, this mandatory class may serve to exacerbate the potential division between Danish students with an AAU BSc and foreign students without an AAU BSc.

This has been one of the main arguments in rethinking the way PBL principles in the AAU tradition, like *knowledge, skills* and *competences*, are offered to new Master's students. In 2017, the Study Board for Techno-Anthropology, Sustainable Design and Integrated Food Studies initiated a revision of the PBL class, which resulted in the plan being overhauled. One of the main suggestions in the revised plan is to integrate the principles of PBL into classes and semester projects with the support of the semester coordinators and teachers. The goal is to incentivize students who have completed their Bachelor's degree in AAU to see PBL in a new perspective – now as Master's students – in order to 1) refresh their understanding of PBL, and 2) involve them with students new to AAU both academically and socially. A proposition like this requires much better communication between the administration, teachers, semester coordinators and students. In other words, a more coherent, transparent and bold approach is needed to practicing PBL.

5.2 Poster presentation

In the first week of the program, every student is required to prepare a physical poster on which to present their Bachelor's thesis project. The idea behind the exercise is to foster both 1) academic understanding, by exchanging ideas successfully developed from completed projects, and 2) a collaborative social spirit, as the students were expected to discuss their projects. The logistics of the presentation were purposefully designed to get the students to know each other. Printing the posters turned out to be problematic for some students, as they were not yet familiar with using the devices on campus or had not yet had their student cards activated, which they needed for printing. These kinds of difficulties forced the students to help each other.

As part of the poster session, the authors presented their own academic poster of their current research, highlighted useful practic-

es (design, reflection, etc.) and invited the students to assess each poster and suggest improvements.

The presentations were supposed to last for five minutes per person. The students were divided into three clusters of fourteen individuals. Inspired by a previous positive experience with this type of exercise, a rotational principle was adopted for the presentations. This meant that members of the three clusters were presenting simultaneously, while the remaining students were encouraged to move within a relatively small space around the different presentation areas, listen to what they thought was interesting, and eventually have discussions with people whose projects they felt inspired by. An expected and somewhat natural effect of this kind of approach is a sense of chaos, which had to be carefully controlled by a team of associate professors and a research assistant, timing the presentations and encouraging the students to be as communicative as possible.

Figure 5.1. Two student groups listening to two simultaneous poster presentations of their colleagues' Bachelor's thesis projects, September 2017.

The chaos element played an important role, as its goal was to inspire, challenge, invite and inform students who did not know each other. Even though the format had been carefully prepared in advance, its execution was reliant on surprises. How would the students present their BSc projects? We offered a categorization of problem statements

as exploratory or solution-oriented to the students when presenting their projects (cf. Chapter 3). To what extent would they be engaging in the rest of the pilot project class? Will comments on the presentations grow into discussions or maybe debates? How will this affect the atmosphere of the presentation? This shows that executing an open format presentation like this one is not an easy task to put into motion and manage. Thus, a great deal of importance lies in the planning phase of the exercise, i.e., logistics like choosing an appropriate physical space which is large enough to fit everyone comfortably, but not too large, so students are naturally nudged to discuss things.

Additionally, a critical aspect of this kind of event is its positioning in a broader context that is understandable to students. Why is this poster presentation happening? What are its goals? Is it part of a larger set of events? If so, why are they happening? As this was the first practical exercise for the 7th semester Master's students in Techno-Anthropology, it was very important to keep stressing the underlying reasons for it. This can never be done perfectly, but an attentive approach that takes into account students' and teachers' feedback will result in an open forum where ideas can be more easily exchanged.

5.3 Film discussions

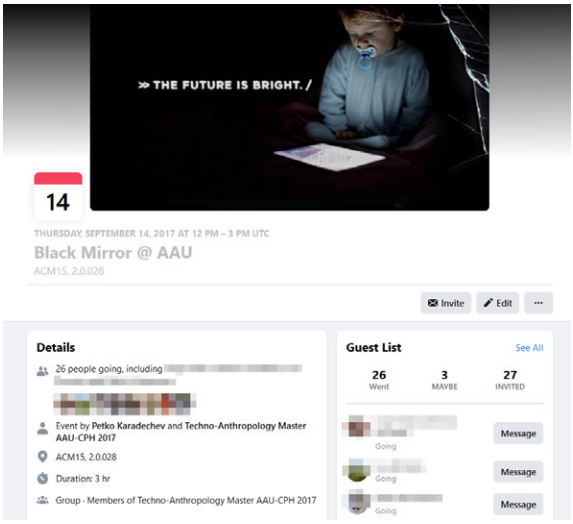

Figure 5.2. Screenshot from the Facebook event holding the first film discussion for the 7th semester Techno-Anthropology Master's students in AAU's Copenhagen campus, September 2017.

During the semester's second week, the Master's students were offered the opportunity to participate in a film screening and discussion. The idea was to test whether a critical mass of people would accumulate and create a movie club with a focus on various types of film – fiction, documentary, etc. – which are relevant to the study program. The goal of the film discussions was to build on the positive aspects of the poster presentation exercise: e.g. students were encouraged to spend time together and to discuss the relevant materials. Furthermore, the proposed movies and TV episodes were selected so discussions could naturally revolve around topics and themes that were part of the current semester. For example, "The Entire History of You", an episode from the UK edition of the Black Mirror TV series, served to start a discussion on values and ethics in relation to technology.

Choosing popular TV shows and movies as a format for the discussion of relevant issues related to the core competences of the study program stimulates students to be engaged in more ways. The theoretical and practical knowledge they gain through the traditional study program finds new outlets for experimentation in these kinds of activities, and the artistic quality of a video medium demands interpretations in a way that text-based exercises cannot. For first-year Master's students, most of whom are not from Aalborg University's BSc programs and often come from outside of Denmark, this kind of activity demands a degree of theoretical and social creativity that may be unfamiliar to them. It requires students to make connections between a culturally relevant trigger, an artistic expression, a visual product, an array of academic theories and their own personal academic experience. Additionally, this activity actively invites students to present the results of these complex connections to a diverse group of people whom they do not know and with whom they need to find and/or create a new language of communication.

Critically, and in respect of a more methodological point, this activity depends on well-chosen materials. No TV shows or movies will be praised by all students. However, a top-down approach where the teacher tells the students what they will watch and discuss, even if it is the most relevant title, will not work. Choosing the material is an integral part of the whole experience and must be shared by everyone.

Choosing is a collaborative experience; it is intimate, especially in a digital age where a sizable portion of the content available to audiences is tailored to personal profiles. This must be dealt with by giving options to students and also accepting options from them, the key focus being on fostering an inviting atmosphere. Bland movies and TV shows make for a bland experience, and bland experiences are seldom where innovative ideas occur, especially among first-year Master's students. Thus, a balancing act is needed when choosing appropriate material for the circumstances (time, knowledge, etc.). Just like the poster presentation, this must also be presented as part of a larger effort to offer students with common ground on which to meet, an alternative to previous study structures and plans that did not have these ideas in mind. This was the ethos driving the film discussions offered to 7th semester Master's students in Techno-Anthropology.

5.4 Food events

An interesting offshoot of the opportunity provided by film discussions was that students volunteered to bring snacks and prepared homemade food for the event. This initiative thus developed into an organized event.

Figure 5.3. Seventh semester Techno-Anthropology Master's Students participating in a food event, September 2017.

Students were encouraged to cook and share meals with their classmates. Even though the campus has several cantinas available for students and staff, and even though the Opening Day on 1 September offers various kinds of meals, there is still a strong need for social events, at least initially in the study process. It is highly beneficial to support and encourage events where students are introduced to each other not only through their academic interests or their identities as Bachelor's or Master's students, but through their personal interests and skills. When an educational institution recognizes this side of its students' lives as influencing how they develop their academic skills, it signals that they are expected to do more than just fulfill the formal requirements and pass tests.

Cooking, just like choosing a movie or a TV show, is a very personal activity, while eating is usually very social. This mixture of personally invested time and socially shared experiences has the potential to bring people closer together and even to offer new avenues for ideas to materialize.

5.5 Literature search

As part of the introductory class, "Interdisciplinary Knowledge Production", the 7th semester Master's students were introduced to a literature search. This included: 1) a class on literature search strategies and tools, carried out by an Aalborg University Library representative; and 2) a major part of the mock project the students had to complete for the introductory class.

The lecture presented the students with an overview of the databases that were available through Aalborg University's website, as well as with definitions of search terms and strategies for how to conduct a structured literature search. *The 5 W's,* used in Chapter 2, were also introduced to the students.

Additionally, a literature search was made an official priority as part of the introductory class. Students were given a three-week period in which they had to outline the framework of a semester project. Their main tool for constructing, reflecting on and readjusting this framework was a literature search. This was meant to serve as a building block for their future studies on a broader scale, and

more immediately, to prepare them for their first upcoming semester project in the "Techno-Anthropological Problems & Theories" class.

5.6 Updated language

A persistent criticism of the Master's program has been the implicit distinction between students who have completed the Techno-Anthropology Bachelor's program and those who have not. Quickly abbreviated by many as "TAN and non-TAN" (cf. Chapter 4), this way of addressing students was perceived to perpetuate a spirit of division rather than unification, which might have a corrosive effect on the social and academic environment. This is documented in project reports from 2014 and 2016, presented here in Chapter 3. Addressing this issue practically does not require much effort: in the first class with the Master's students, they were divided into groups according to the overall framework of their Bachelor's studies, i.e. *technological BSc, social science BSc,* or *mixed BSc*, which set the stage for a different kind of dialogue between the students, one that avoided the opposition between "TAN" and "non-TAN". The more difficult part of this idea is behavioral: first, it is to be recognized by everyone involved in the program, both students and teachers. Secondly, and most importantly, it exists as a task for the teachers, who have classes mainly with Danish students in the Bachelor's program. When these students sign up for the Master's program, they are almost naturally labeled "TAN" students, whereas the newcomers, who are most often not Danish, receive the "non-TAN" label. What was originally just an idea was implemented practically in the 7th semester in 2017.

5.7 New texts

In line with the theoretical refocus described previously, teachers in the program are instructed to use mostly good examples of recent academic and scientific texts. A push for this kind of refocus would serve at least three main points:

1) Relevant discussions. New texts in topical and domain theories would have to address recent, current or future debates, thus familiarizing the students with the state-of-the-art scientific conversations they should be conversant with.

2) More current examples where techno-anthropological perspectives could be useful. New texts could also present examples that are more familiar to the new students, and offer them a new perspective on questions they are passionate about or genuinely interested in, thus incentivizing them to address these questions from a techno-anthropological stance.

3) Address academic concerns from Techno-Anthropology students with a Bachelor's degree in that subject. A recurring point of criticism of the Master's program from the students with Bachelor's degrees in Techno-Anthropology is that the academic content on offer is very similar to what they have been taught for the past three years at the Bachelor's program in Techno-Anthropology. This is cited as a reason for their lower levels of engagement in the academic process and their lower levels of interest in social events and discussion groups with students from different backgrounds, as the Bachelor's students with a background in Techno-Anthropology generally express a feeling of already having been familiarized with the general theories. Using new texts would address this issue and offer another source of engagement with the course.

5.8 Academic reading seminar

An extra-curriculum seminar entitled *Academic reading* was introduced for the 7th semester Master's students in October 2017. In more recent years the seminar has been integrated into the TAPT course. The need for this seminar is based on students' feedback from previous semesters. Specifically, the seminar addresses requests for an academic exercise that would focus on basic academic skills, i.e. reading and understanding complex academic texts. A future seminar on academic writing is under consideration. The seminar is meant to offer a shared platform for students from diverse backgrounds who are not familiar with each other's academic strengths and weaknesses. This begs the question: why a seminar on reading?

As most of the knowledge for first-year students is traditionally structured around texts and theories, it is critical that they are given guidelines – ones that could be used, but also misused, altered, ignored – for using these texts and theories. Reading is deceptively simple

– one just reads. However, when non-native English speakers with diverse academic and practical experience are taken into account, the task suddenly become a lot less straightforward. Reading is also a very private activity, We rarely read aloud to each other, especially in an academic environment in which the nature of the texts requires a more focused, isolating approach. This practice could have a negative effect on student engagement if they are not offered an outlet, one outside their student groups, where the reading of texts itself is problematized, deconstructed, and reconstructed again. Thus, the Academic Reading seminar is set up in a way that supports Aalborg University's PBL model and its focus on personal responsibility and autonomy. At the same time, it discusses basic academic terms in class and requires students to exercise together by sharing a toolbox.

Ultimately, the goal of the seminar is to assist new Master's students in Techno-Anthropology develop useful practices when reading, understanding, and activating academic and scientific texts. To "activate" in this context means:

- to deconstruct texts so that their central points become clear
- to identify the theoretical context within which the texts are situated, in order to expand theoretical horizons
- to apply and use some of these points practically in light of the reader's specific requirements

Additionally, the seminar has three goals: 1) to focus on efficiency in reading; 2) to understand scientific and academic texts; and 3) to create a *best practices* document, based on practical experience, from which others can benefit in the future. Initially, the scope of the seminar's content was to include texts from the introductory "Techno-Anthropological Problems and Theories" class, as well as non-academic texts (including fictional literature for illustrative points). Due to time constraints, and as a response to student feedback, the non-academic texts were not used. Instead, only texts from the introductory class were used. In practice the seminar acted as a support class where students could go much more deeply into texts for which there was usually not enough time for discussion in class.

The actual methodology is intentionally kept as simple as possible. This means a simple structure, simple exercises, and discussions. Specifically, the class focuses on three main types of exercise: reading, descriptive, and analytical. The reading exercise involves an excerpt from a paper the students are required to read, usually of around 500 words. They are given a link to a private, shared Google Document containing the text, which they are invited to read out loud. The purpose of reading aloud is to involve them in using a basic pedagogical method and to present the students with a familiar type of exercise, something most of them have shared regardless of their age, experience, or country of origin. It must not be overdone, as not everyone feels comfortable reading in front of others, especially in a language that is not their mother tongue.

Taking all of this into account, the descriptive exercise requires the students to look for so-called "activating words" in the text. These "activating words" are a spin on "primary words", as used in a guide for effective reading issued by the University of Bradford's School of Management (Effective Learning Service, no date, p. 14).[2] This guide is aimed to encourage a very specific managerial perspective. It was chosen for two reasons: 1) its simplicity; and 2) as a text whose structure could be broken up and played with in a new context. The activating words are words or phrases the students consider illuminate important points in the text. To stress them even further, the students are asked to highlight the activating words or phrases and briefly describe what makes them illuminating, as seen in Figure 1.

[2] Effective Learning Service (no date). *Six Steps to Effective Reading*, Bradford University, Faculty of Management and Law. School of Management.

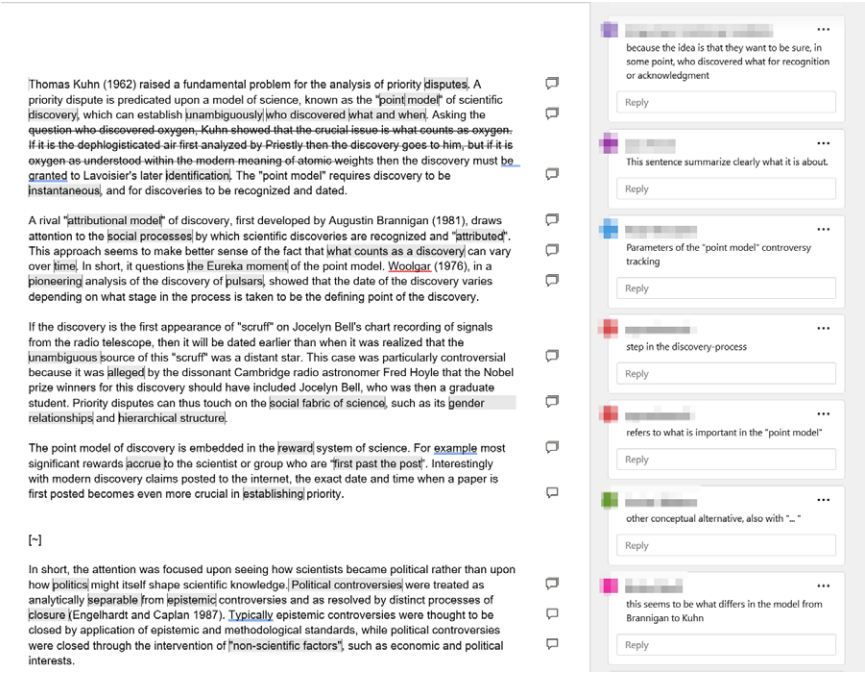

Figure 5.4. A screenshot from a shared document on Trevor Pinch's "Scientific Controversies" for the International Encyclopedia of Social and Behavioral Studies, part of the Techno-Anthropological Problems and Theories class. Students are identifying, highlighting and discussing so-called 'activating words' in the text.

When this is done, the third exercise, which is analytical in type, starts the discussion part of the seminar. The students are invited to comment on every highlighted word or phrase and to share their perspective on why they agree or disagree with the person highlighting the word. The purpose of the analytical exercise is twofold. First, it asks the students to understand (to a degree) the writing process behind an academic or scientific article. As a thorough critique requires high levels of empathy and analytical skills, this understanding is helpful when introducing new students to an unfamiliar type of academic expression. Second, it requires them to take sides and argue why some ideas are illuminating and others are not, and what new ideas

would make more sense in the context. The exercise is meant to be creative and provocative, yet simple.

The class was an independent initiative and therefore did not manage to reach every 7th semester Master's student. However, around a third of the students participated during the class while it was running (around fifteen people) and expressed agreement with the idea behind the class. A more structured approach to this initiative would benefit larger portions of the students and have a longer lasting positive effect on their understanding of academic and scientific texts, which is so fundamental to many courses in a university setting.

5.9 Case reports for the Techno-Anthropological Problems & Theories class

As part of the *Techno-Anthropological Problems & Theories* class, Master's students are required to perform a two-fold analysis on a predefined case, outlined by the teachers. Successfully completing this analytical exercise allowed the students to go on to the course's final oral examination. The main aim of the exercise is to strengthen the students' understanding of the presented domain theories (Social Construction of Technology, Actor-Network Theory, Post-phenomenology, Critical Theory of Technology, Feminist STS, and Co-production) as viable analytical tools. The exercise varies from year to year. One of the exercises issued in 2018 is analyzed in (Børsen, 2020).

Another exercise, from 2017, is discussed here. The first part of the exercise focused on theoretical comparison. Students were asked to choose two out of the six main theories and compare them in relation to five questions, highlighting the similarities and differences between the two theories for each question:

1. What are the kinds of "object" or "process" that the theories analyze?
2. What are the elements, steps and key questions that the analyses are concerned with?
3. How would you describe the nature of the kinds of conclusions, descriptions, observations, results and criticisms that come from these theories and their analytical approaches?

4. What are the explicit or implied notions of technology in the theories?
5. What is the role of power, politics, and/or interests in the theories?

The format of the comparison was a paper with a 1500-word limit, to be written within ten days. Students were expected to address each question systematically and demonstrate good understanding of the theories they have chosen.

The second part of the exercise used a specific case study as a starting point, together a set of analytical questions, which were meant as a guideline or a recipe that students are recommended to follow. The specific case concerned a "play pump" aimed mainly at children in Africa. They would have to rotate the pump's wheel to extract water in the form of a game.

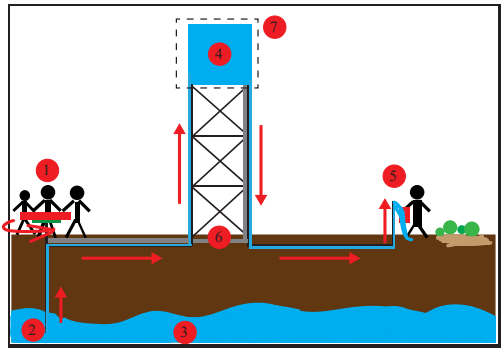

Figure 5.5. Schematic representation of the Play Pump case for 7th semester Techno-Anthropology Master students, September 2017.

Materials about this case were collected by Larry Bucciarelli and Anders Buch for a course in Science and Technology Studies taught at the Massachusetts Institute of Technology. They were repurposed for the "Techno-Anthropological Problems and Theories" class for the 7th semester course. The students had to use the following analytical questions related to the six main theories presented in the class:

Social Construction of Technology
Choose a relevant technology from this case and document its openness to different interpretations. Identify the relevant social groups that engage with the technology and describe if and how any controversy in relation to this technology is brought to closure by the groups. Finally, try to relate the closure mechanisms to broader political and social structures in society.

Actor-Network Theory
Choose a key actor in the case and follow the series of translations through which this actor attempts to mobilize the allies the actor needs to build a solid statement, organization, project or device.

Critical Theory of Technology
Determine and describe if and how the case's dominant socio-technical configuration neglects the interests of a vulnerable group, e.g. children, the poor, patients, employees, lay people, or future generations (social code). Discuss the barriers to and possibilities for transforming its socio-technical configuration (i.e. the social and/or the technical code) so that it accommodates the interests of this group.

Post-phenomenology
Choose a relevant technology for the case in which emergency and complexity are at stake, describe and analyze the human-technology-world relations involved, and discuss how the concepts of multi-stability and technological intentionality can transform human practices.

Feminist STS
Choose a technology described in the case and analyze it through the notion of phenomena developed in agential realism. What is the technology's genealogy? How does the technology emerge through the entangling of materials and discourses? How does it enable inclusions and exclusions? In the latest version of the course, Feminist STS has been replaced by Multiplicity Theories.

Co-Production
Starting from a technology or a specific course of action found in the case, describe and characterize the knowledge domain(s) and the normative aspects (values, priorities, politics, sensitivities, etc.) that are involved, and how they relate to and affect each other?

After familiarizing themselves with the materials regarding the play pump and going through the analytical questions, the students had to write a short paper and give a brief presentation. The paper had a 1500-word limit and the goal of summarizing the key points of the selected theories, which they had to apply succinctly to the specific case of the play pump. The presentation had to last no more than ten minutes and use a maximum of five PowerPoint slides. The goal of the restriction was to channel the students' creativity and demand a concise, to-the-point analysis of the specific case, drawing on, but not restricted to, the suggested analytical questions. The students had twelve days to prepare the 1500-word paper and two days to prepare a brief presentation.

5.10 Theoretical refocus

As previously stated, the *Techno-Anthropological Problems and Theories* class focuses on six main theories: Social Construction of Technology, Actor-Network Theory, Post-phenomenology, Critical Theory of Technology, Feminist STS, and Co-production, which we call *domain theories*.

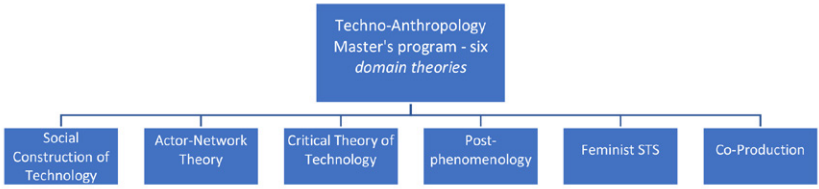

Figure 5.6. Old model of theoretical focus: one program, six domain theories

This theoretical focus has tended to encourage the notion among the students that these six theories are the only techno-anthropological theories. This is, of course, not the case. The Master's program is structured in a way, so as to which provide a robust theoretical

framework, but robustness does not mean rigidity. Any theoretical framework that strives to achieve a redefinition of interdisciplinarity benefits from academic support from four departments (Department of Planning, Department of Learning and Philosophy, Department of Energy Technology, and Department of Chemistry and Bioscience), and that serves students with backgrounds as diverse as Radiology, Cultural Studies and Business Management, cannot be rigid and fixed. Therefore, a meaningful refocus on the presentation of foundational theoretical materials is needed. The purpose of this theoretical refocus is to add *topical theories* and *exemplary Techno-Anthropological examples*, as well as highlight their importance to the Master's program. In addition to the six theories mentioned previously, these two new approaches are presented below.

Firstly, topical theories, by which we mean theories native to the specific fields from which students come, such as health care or engineering, are to be emphasized more prominently and in a more structured way in the program's curriculum. Secondly, good Techno-Anthropological examples, where known and/or unknown theories are used in an illuminating way that activates inter- and transdisciplinary approaches and methods will also be presented to the students. By performing this refocusing effort, the program will have shifted from a single focus on six theories to a similarly structured triple focus on a much richer set of theories, offering more options to students and their teachers and supervisors to explore, investigate, and use theories in their semester projects.

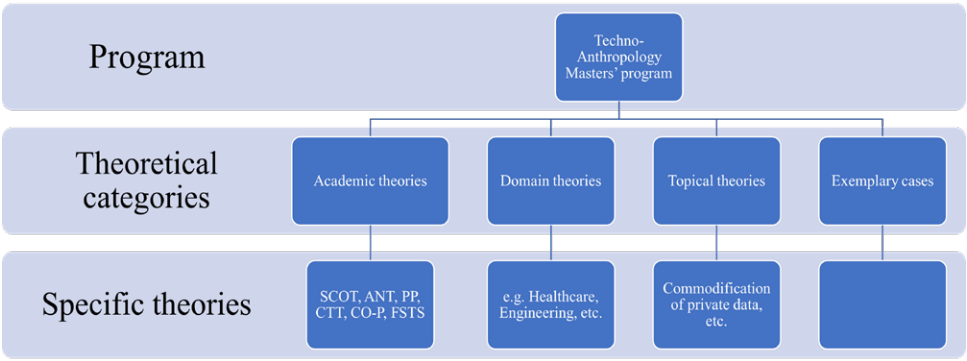

Figure 5.7. New model of theoretical focus: double-layered theoretical focus.

5.11 Company visits

Another independent initiative offered to the 7th semester Master's students was a visit to a company that is developing and producing products that are relevant to the interdisciplinary frame of the semester. A correspondence with the Danish software company iMotions was started as early as September 2017, with a general focus on introducing Techno-Anthropology Master's students to the company's research-oriented software suite, which includes facial coding, galvanic skin response, eye-tracking and more. iMotions collaborates with MIT, Stanford University, the Harvard Medical School, BMW, Honda, and GM, among others. A broad portfolio such as this was thought to indicate a scientific interdisciplinary approach that the Master's students would find useful and inspiring.

A proper logistical organization for both the company and the semester classes, which could have been affected by a hastily arranged company visit, actually required some time to arrange. However, on 23 March 2018, thirteen Master students went to iMotions' Copenhagen headquarters for a technological demonstration and a discussion session with project and product managers, software developers, and support staff. Dr Elvira Fischer, the company's Lead Product Specialist, gave an overview of the software solutions the company had developed, repacked and were providing. After that, she used a support staff member as a volunteer to demonstrate eye-tracking and

galvanic skin response tools to the Master's students. The presentation lasted one hour, after which students were invited to drinks and snacks and an informal discussion with company staff, where they were encouraged to ask general questions about the company's operations – their software development processes, their networks of educational and business institutions, etc. – as well as specific questions about semester projects.

Figure 5.8. Dr Elvira Fischer, Director, Global PS & Support at iMotions A/S, demonstrates galvanic skin response and eye tracking tools as part of the company's software suite, October 2017.

A main goal of this event was to introduce Master's students to a business environment in which their studies could be put to good use to identify institutional characteristics. They could then be provoked to draw on their theoretical and fieldwork experience, as well as witness a practical application for their skills. After the event, students were asked to fill in an online form asking for their main takeaways from the visit. One student's response was "That an academic education actually makes sense in practice. And that companies like this don't know that they need us."

5.12 Techfestival 2019

In 2017 an internet entrepreneur, Thomas Madsen-Mygdal, and a team of collaborators launched the first Techfestival, an event where technology experts, public officials, entrepreneurs, and anyone else can participate in over two hundred events where the role of technology in different societies is being reexamined. That same year, Techno-Anthropology Bachelor's and Master's students naturally started gravitating towards the Techfestival to volunteer and participate in workshops and other events. After a preliminary official participation in the 2018s Techfestival and eight months of collaboration, in 2019 all new Master's students in Techno-Anthropology joined the festival in an organized manner that was integrated into the semester's structure.

To make this happen, a collaborative relationship was established between two of the authors – Tom Børsen and Petko Karadechev – and the Techfestival's founder Thomas Madsen-Mygdal, together with the former festival director, Marie Louise Gørvild. After a series of negotiations and two pre-festival workshops held in April and May 2019, an updated semester description for 2019 included a two-day field trip to the Techfestival in Copenhagen, where all new Master's students would volunteer and/or participate in different events.

The purpose of the collaboration is two-fold: first, to offer 7th semester Master's students direct contact with entrepreneurs, policy-makers, municipal officials and other Techfestival participants who are engaging with socio-technical issues directly. These first-hand experiences are utilized in the program as foundations for the P0 and semester projects. Second, by directing the students' attention to the Techfestival, volunteering for opportunities not only helps them, it also allows the Techfestival run as well, as it is entirely driven by volunteers.

Besides basic coordination via email and telephone, the most important part of organizing collaboration with the Techfestival was participating in workshops and events.

Figure 5.9. Former Techfestival Director Marie Louise Gørvild and Techfestival founder Thomas Madsen-Mygdal at a co-creator workshop, April 2019.

Two co-creator events in April and May 2019 provided the general framework for the events, which identified a space in which Techno-Anthropology Master's students could participate. They could either join events as participants or volunteer to provide technical and logistic support to presenters.

As the Techfestival has an entry fee, all new students were told before their studies started that they could become a volunteer and attend the Techfestival for free, or they could pay the fee and ask for reimbursement later. Additionally, any student who was a member of the Danish Society of Engineers was exempt from the fee. All students were informed of the different options for participation. A specific focus was placed on how their engagement with the Techfestival can be used as project materials for the upcoming semester.

To engage the students further, Nina Rasmussen, a crew manager for the Techfestival, joined the start of the Master's program in its first semester in September 2019 to describe the opportunities for volunteering to the students and answer practical questions. Additional guidance and sessions on academic expectations were carried out to provide as much practical information to the students as possible before they got to the Techfestival.

These academic expectations included finding an issue, theme or speaker at the Techfestival for use in the students' projects. More specifically, they would have to perform a rigorous academic literature search and review for their topic of choice, to inform their choice of a socio-technical research question for their semester project. All students were also asked to read parts of Maggi Savi-Baden's text on transdisciplinary threshold concepts (TTC) presented in Chapter 2 and reflect on what their individual TTCs would be. Different academic backgrounds were taken into account: thus students with a BSc from a medical field were instructed to use their previous expertise and write a diagnosis of a socio-technical issue they could identify at the Techfestival; students with an engineering degree were asked to write up a specification sheet for a socio-technical issue; and students with a social science degree were asked to write a field diary while at the Techfestival. These three requests did not proved to be as useful as hoped, and their use will be revised for future events.

Figure 5.10. Techno-Anthropology Master's students attend a workshop on the Ethics of Automated-Decision Making at the Techfestival, September 2019.

After the Techfestival (Børsen, Karadechev, Cardeno, 2020), a full-day reflection session was carried out in class with a focus on different lessons learned at the event. A refresher presentation on the transdisciplinary threshold concepts invited students to share their indi-

vidual experiences and reflections on the Techfestival. One of the main responses was the positive attitude to the diversity of topics and the cases they could participate in, and the different speakers and volunteers they could talk to and use as inspiration for their first projects. The proximity to many different initiatives at the event was seen as stimulating and motivating. On the other hand, this large diversity made a few students feel that more in-depth discussions were missing.

Ultimately, the collaboration with the Techfestival proved to be academically stimulating and socially engaging. It also turned out to be a useful method of helping new Master's students in Techno-Anthropology to see real-life examples of socio-technical issues and to engage with them practically from the first week of the program. The long-term effects of this approach will be observed and analyzed better later in deciding the academic and professional development of this particular class.

5.13 Online introductory course

In late May 2019, the authors took their first steps in conceptualizing and implementing an online introductory course for prospective Techno-Anthropology Master's students with the support of the Department of Planning at Aalborg University in Copenhagen. Initial drafts of the course highlight key concepts and themes that need to be included in the course, e.g. a socio-technical understanding of technology and of the role of professional domains in Techno-Anthropology.

The idea was further developed and practically carried out by Jorge Ivan Contreras Cardeño, a graduate of the Techno-Anthropology Master's program, who was in the first class of Master's students to experience the initiatives described in this chapter. Jorge was employed as a Research Assistant and one of his tasks was to develope the thematic content of the online introductory course, and to produce, film and edit the course's video content.

The online introductory course is made up of short educational videos, where five professors and associate professors from the Techno-Anthropology program introduce key concepts and material to prospective Master's students. This knowledge is further reit-

erated and tested in an online test form accessible on Aalborg University's Moodle platform.

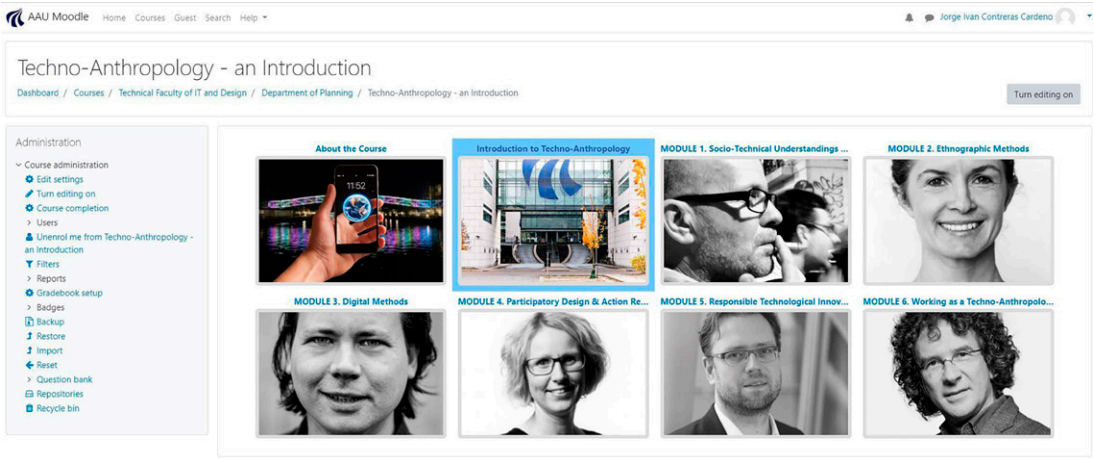

Figure 5.11. Screenshot from the Moodle page of the online introductory course showing all course modules and the professors and associate professors who teach them, July 2020.

5.13.1 Goals and structure

There are three main goals of these educational videos. First, to help new Master's students who do not hold a Bachelor's degree in Techno-Anthropology to get an equal start at the program with former Techno-Anthropology Bachelor's students. Additionally, former Bachelor's students have identified theoretical and methodological repetition as a problem for them specifically: that is, they are presented with very little or no new knowledge in the first semester of the Master's program. The online course addresses this issue by empowering teachers to create new content for an online format. This new content ensures that both students with and without a Bachelor's degree in Techno-Anthropology start the Master's program with a shared set of concepts and ideas.

Second, the course content can be used as material for a flipped approach, where the videos aimed at prospective Master's students are provided as learning materials to current Bachelor's students. This allows teachers to use the video material in their classes with

Bachelor's students and also to ensure that the Bachelor's students who move to the Master's program will not experience the same disconnect reported by previous students.

Third, the online course helps strengthen the collaboration between the Aalborg and Copenhagen branches of the Techno-Anthropology program, giving them both a shared platform from which to send a much more unified message to prospective Master's students.

The Moodle tests that go with the videos are a tool to ensure that the students are following the exercises in the videos. The tests support three goals: 1) shared understanding of the concepts and ideas presented in videos: e.g. the exams are prerequisites for the following modules, meaning that all students need to pass the exam to go on to the next module. This means that all students will be on equal footing regarding the course's key concepts; 2) guidance, e.g. the tests walk students through the introductory topics with examples and exercises; and 3) promoting reflections on the literature used in the course, e.g. the reference list and exercises in the test invite students to reflect on the theoretical content of the introductory part of the course.

5.13.2 Process and methods

The process of making the educational videos includes plans for the structure of the course, its content and goals. Presenting professors help with the structure of the course. The main structural questions addressed include the reason for the specific content (e.g. *why* it is important to have a socio-technical understanding of technology), as well as the specific modules of the course. Important themes the course addresses include a) how to prepare the students to work in AAU productively, b) what structures of thinking exist in the university, c) tools, theories and methods used in the program, and d) specific examples of how this knowledge and these tools can be used in an academic environment. Finally, at the end of the course, students see short videos illustrating the work Techno-Anthropology Master's students can go on to after graduation.

The Head of the Study Board for Techno-Anthropology decides which teachers to invite as presenters and how to group them for each learning module. Jorge contacts the teachers and works with

them in specifying what content is relevant for the course and helps them with technical questions (e.g. using presentations or teleprompters) as well as questions of performance (e.g. how to act in front of a camera). It is important that the presenting teachers feel they are in a familiar environment so they can adapt their existing lectures or PowerPoint presentations to convey the importance of the material to the students in the best way possible. Teachers can read their materials or present it via a teleprompter, and the final videos alternate between the two approaches.

The filming process itself is carried out using three different lights, two cameras (for a-roll and b-roll footage), a teleprompter, a green screen, and two microphones (clip mic and shotgun mic). Video-editing is handled in DaVinci Resolve, where footage and audio are mixed, and illustrations (text, GIFs, etc.) can be added and put together to produce a clear narrative. The video content is adjusted to the professors' slides, and GIFs are used to illustrate specific points. At all times, the content and performance are related to the video's audiences. Typically between twenty and thirty years old, prospective students are best approached with engaging, fun and succinct narratives. Finding the right clips from the professors' presentations and visualizations and using them to craft a narrative that will address the students' expectations is a difficult but important process that takes a lot of time.

Once the narrative is completed, the videos are included in a test format on AAU's Moodle platform. The test consists of videos, followed by an exercise on key points from the clips, or reference to specific reading material. The videos can also be followed by a short paragraph from a text that will guide the students thematically to the next video and leave them in a place of reflection. Leaving the mental space for breaks and thinking is critical for structuring the Moodle test, so all videos and questions have to be spaced with this idea in mind.

In other words, not only is the content of the online course important, its structure is also extremely relevant. New students taking the course follow a predefined path and cannot skip any modules. This allows a coherent message to be communicated to everyone, ensuring as far as possible a shared understanding of the program's

critical ideas, like a socio-technical understanding of technology. If these fundamental ideas are not communicated clearly in the beginning in a manner that everyone can follow, students tend to become disengaged and confused. But offering a red thread throughout the course and the program in the form of key concepts allows both students and professors to build on the fundamental content and apply it to real-world cases more quickly.

5.13.3 Implementation

The online introductory course conducted a test run with three former Bachelor's students in Techno-Anthropology. The students report an increased understanding of the key concepts presented by the teachers concerning the socio-technical understanding of technology in Techno-Anthropology. This feedback that was used to assist with the practical implementation of the course.

The course is now fully available for applicants to the Master's program in Techno-Anthropology. (Cardeno and Børsen, 2021). Students who pass the course increase their chances of admission to the Master's program.

5.14 Discussion

The ideas presented in this chapter are meant to be related to the transdisciplinary threshold concepts (TCCs), which serve as a general theoretical framework. An obvious question arises: *What relates these ideas to the transdisciplinary threshold concepts*? We will provide a brief answer by grouping the thirteen categories of the implemented and proposed ideas for student engagement.

PBL for everyone and New texts mostly deal with the breaking and restructuring of scaffolding, and with liminality. The re-contextualization of knowledge (in the form of a PBL class, and a proposed focus on new texts) affects those students who received their Bachelor's degrees from Aalborg University in a particularly demanding way. They are not only asked to follow a specific mode of understanding (like the other Master's students) that points to 'scaffolding', but in a certain sense to reinvent themselves, which relates to 'liminality' and the stripping away of old identities.

The poster presentation exercise asked students to present their Bachelor's projects to their colleagues, whom they have only met a few times beforehand, and to communicate effectively how their projects relate to Techno-Anthropology. This requirement to oscillate between states of familiarity and unfamiliarity can be seen as offering a "complex, often covert learning space" (Savin-Baden, 2016) related to the concept of 'liminality'. Moreover, this usage of a previous achievement in a new context should also be interpreted as a "stripping away of old identities" (ibid.), where the students are required to use their Bachelor's projects as tools for entering a 'liminal state' in which they acquire new skills as Techno-Anthropologists.

Film discussion, Updated language and Theoretical refocus all share a major characteristic: students (and teachers) see themselves as "learners in a particular educational environment" (ibid.) through an unfamiliar type of exercise. That exercise could aid in acquiring academic knowledge through the generally under-used method of watching and discussing science fiction movies, for example ('pedagogical content knowledge'), or else by repositioning themselves as a particular *type* of student by means of the labels they use for themselves and that others use for them. Additionally, students can see themselves as learners by refocusing the types of theories they read and the new types of mental horizons they find themselves in, thus repositioning their identities accordingly ('liminality').

Food events also suggest a certain rite of passage, though perhaps to a less obvious degree, thus being related to 'liminality', but with a more social effect. Crossing a specific line of closeness with the whole class as part of the study program, and not just with an inevitably small number of future friends, or as part of an official event is a characteristic of the food events that visibly affect student engagement in a positive way ('pedagogical stance').

The Academic reading seminar, Case analysis, literature search, and Company visit all share the characteristics not just of 'liminality' (via the "complex, often covert learning space" they create and operate in), but also of scaffolding. All four ideas require students to balance the *"distance between the actual developmental level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration*

with more capable peers" (i.e. 'scaffolding'). What this means is that the learning structure provided to the Master's students requires them to act on the spectrum of *independent/adult-guided* problem-solving. The students had to follow one possible path – the individual interpretation of the question: *How much help will I need to accomplish this task, if any?* Additionally, all four activities refer to the core characteristic of pedagogical content knowledge, namely

> "understanding […] what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring to their learning of those most frequently taught topics and lessons" (ibid.).

The students were confronted with their own (pre)conceptions when labeling one word or another as "active" in the academic reading class. Similarly, when they took a stance in analyzing the Play Pump case through Actor-Network Theory, they disregarded the Critical Theory of Technology angle. They also had to grapple with what makes a topic easy or difficult while processing the new information about galvanic skin response and eye-tracking during the visit to iMotions' headquarters, so that they could ask critical questions and position themselves as Techno-Anthropologists and as active participants in the discussion. This kind of understanding was also leveraged during the literature search, where the Master's students had to uncover the distinction between a good and bad literature search. The online introductory course offered students a particular scaffolding vision of Techno-Anthropology, presented by Associate, Honorary and Full Professors teaching in the program. The students were led not only thematically, but also mechanically, since they were not able to jump between different course modules: they can only follow a linear progression from the start to the end of the course. This experience also presented them with a specific way of seeing themselves as a type of learner ('pedagogical stance') who progresses in the Techno-Anthropology program, moving between their Bachelor's experience to the new ideas and information they will encounter throughout their Master's studies ('liminality'). Finally, the 2019 Techfestival, coming in the first ten days of the program, engaged

the students outside the campus with very specific ideas of how to be active in a social environment. These ideas were offered through a particular scaffolding approach that required students to see themselves as volunteers, participants, actants, and students with specific expertise drawn from their earlier Bachelor's degrees. Thus, scaffolding flowed into a particular pedagogical stance. The early experience at the Techfestival marked a particular rite of passage, where the students moved from being the more or less passive recipients of guidelines and information to become active participants and agents ('liminality').

Table 5.1. Linking interdisciplinary teaching activities to transdisciplinary threshold concepts

Liminality	**Scaffolding**	**Pedagogical Content Knowledge**	**Pedagogical Stance**
PBL for everyone	PBL for everyone	Literature search	Food event
Poster presentation	Film discussion	Film discussion	Updated language
Film discussion	Case reports for the...	New texts	Company visit
Food event	Online introductory course	Academic reading seminar	Online introductory course
New texts	Techfestival 2019	Theoretical refocus	Techfestival 2019
Online introductory course			

CHAPTER 6

Conclusion

What the student and teacher feedback broadly seem to suggest is that there is a lack of uniformity in the implementation of problem-based learning methods in the Techno-Anthropology program. As evidenced by the attempt to boost a more social type of learning environment, coupled with activities in are in agreement with the transdisciplinary threshold concepts (TTCs), there is a greater chance of boosting student engagement in a lasting way. What this chapter suggests is the need for focused work on educational action points to support this. These action points should address 1) the foundational study requirements for the Techno-Anthropology program, 2) the social relevance of 21st-century university education, and 3) the aspirational potential of 21st-century university education. Moreover, if possible all three should be fused with activities that incorporate all four transdisciplinary threshold concepts.

As evidenced by the feedback from both students and teachers reported in Chapter 4, there is a need to incorporate the ideas and practices associated with TTCs in teachers' practices. This kind of implementation, however, requires time before the said ideas can be reified in everyday teaching practices, which necessitates a continuous emphasis on TTC-inspired ideas. The previously mentioned action points could form the basis for a progression plan with the following structure:

- Reinterpreting the requirements for the semester's work:
  - Addressing the Techno-Anthropology program's study requirements through reinterpretation based on TTC-inspired practices. Making liminality, scaffolding, pedagogical content knowledge and pedagogical stance visible as viable foundation points for strengthened and reimagined

former study practices, as well as for new activities that would invite interdisciplinary work.

- Utilizing PBL's focus on real-world issues:
  - Increased focus on the social relevance of 21st-century education; offering theoretical and methodological tools aimed at solving present and future issues with social impacts; and welcoming and expecting student engagement oriented towards positive social outcomes.

- Pedagogical imagination:
  - Activating more connections between the different departments that make up the Techno-Anthropology program with a focus on the aspirational potential of 21st-century education. Working towards an aspirational culture in which teachers invite students not only to fulfill the study requirements, but also to bring in real-life examples and experiences in the form of semester projects that deal with emerging socio-technical trends and issues. Using these to fuel the continuous recalibration of the study requirements against impactful and previously unknown issues.

A main conclusion is that TTC-inspired ideas and practices are currently not fully embedded in teachers' and students' daily work in the university. According to students' feedback, an important way of working towards that goal must include better planning and scaffolding on the part of the teachers and university administration. This approach is in line with a desire to utilize the usefulness of transdisciplinary threshold concepts and is partly visible in a set of activities undertaken during the 7th semester of the 2017 intake of Techno-Anthropology Master's students (i.e., focuses on literature searches, academic reading seminars, company visit, etc.). Additional work in introducing and strengthening TTC-inspired practices throughout the program is planned for the upcoming semesters. Its results and effects remain to be recorded and evaluated.

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APPENDIX

Problem-based and project-oriented learning (PBL) for

Techno-Anthropology Master's students and teachers

Study Board for Techno-Anthropology
Lone Stub Petersen, Associate Professor, Department of Planning, Aalborg University
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Preface

In this guide, the basic concepts and approaches to problem-based and project-oriented learning (PBL) in AAU will be presented and related to the field of Techno-Anthropology. The guide is aimed at students who want either an introduction to or refresher on core concepts and processes in relation to AAU's PBL model.

This manual is not a textbook or theory book, so for more complete knowledge on problem-based projects, please refer to the bibliography.

This manual has been developed by Lone Stub Petersen, with the support of colleagues from the Department of Planning.

Problem-based project-organized learning for Techno-Anthropology

What is a problem?

A problem-based project is rooted in a state of wonder. However, in order to characterize the state of wonder as a problem, there must be an opportunity for either theoretical or knowledge-related exploration in relevant disciplines. There must be a basis for finding out something new about the conditions of the problem field. In addition, the problem must be authentic, i.e. have relevance outside the university. An example of a non-problem is "Can we get students to use iPads in elementary school" because this problem is a practical problem which does not entail exploring or reflecting on either the process or the product. However, this problem can be transformed into an authentic problem, before example: "What conditions apply to the introduction of tablets for education in elementary school, what purpose does this implementation serve, and what benefit can be gained in the educational setting?" An authentic scientific problem not only asks for a solution, it seeks understanding, explanation and guidelines by which we can develop and evaluate solutions.

In techno-anthropological projects the problem area often relates to what are called wicked problems. The hallmark of wicked problems is that they are complex and controversial, i.e. problems where there is no consensus on the definition of what the problem is and what characterizes a good solution for the problem area. Attempts to solve a part of the problem is most likely to create new problems. There are also often focuses on responsibility, ethics and sustainability. It is in such complex and controversial socio-technical cross fields that Techno-Anthropologists should be able to act.

What is project work?

Project organization provides a basis for problem-based learning at Aalborg University. Throughout the process, through problem formulation, analysis and exploration, the students work towards a tangible result. The result may be knowledge that expands the understanding of a problem or possible solutions to the problem, and it may also contain sketches and prototypes for a finished solution. The project is given direction through the formulation of problems, which will change during the learning process in relation to the results of the theoretical and empirical study. The project work organizes the study and learning process as a project with start and end dates, milestones etc.

What is a project group?

The project group manages and implements the problem-based project. This provides a high degree of freedom and responsibility for their own learning process. Through the project work, the students learn to handle collaboration, share knowledge, engage in collective decision-making processes and a division of labor, and develop skills in critical feedback, time management, tasks, decision-making, making evaluations etc. These are all skills that are central to participation in and the management of projects on the other side of the university's walls.

The project process and the types of projects

The purpose of the problem-based project work is to explore a given problem involving relevant methods and theories. The project is an iterative (repeating) exploration process where both theories, methodologies, and understanding of the problem change along the way. The following project model should therefore not be understood as a fixed template, but as a flexible model to be adapted to each project.

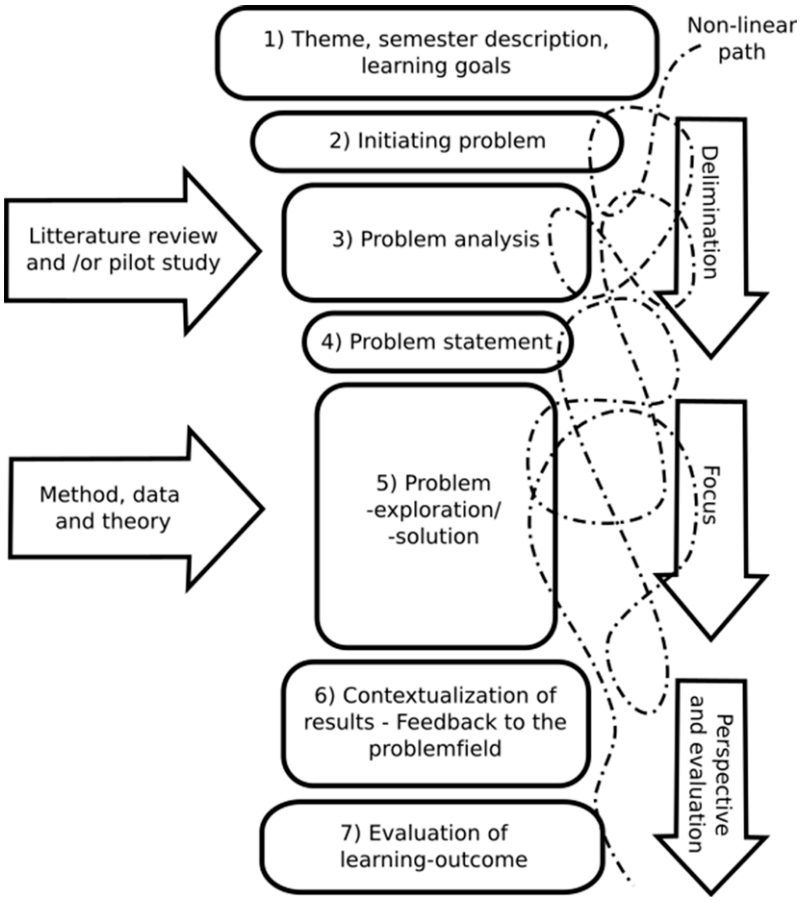

Figure 1. The problem-based learning project (adopted from Holgaard, et al. 2016, Holgaard 2014).

As already mentioned, Techno-Anthropology engages in bridging different disciplines and understandings. Thus the generic model takes different forms depending on the type of problem formulation that has been developed. That is, the project can be directed towards analysing and/or assessment, or towards action and/or change within a problem field. That is not to say that the analytical projects cannot point out ideas for change or that the oriented actions and changes do not contain elements of analysis.

Techno-Anthropological projects are situated in an interdisciplinary borderland between the humanities, social sciences, engineering and natural sciences. In this borderland, projects will necessarily have to deal with different knowledge domains, theoretical and methodological perspectives, and therefore also different problem-based ways of working. Therefore, different examples are provided below in relation to projects focused on understanding and assessing problems and solution-oriented projects in technological design and development. As the field and study of Techno-Anthropology has this dual focus, students must develop skills in relation to understanding technology in practice, participating in interventions, and developing solutions.

Projects oriented towards understanding/assessment

In investigative projects, a deeper understanding of a problem (a wicked problem) is sought through the use of ethnographic methods, technology assessment methods, and / or socio-technical analysis. This understanding of a given problem may form the basis for decision-making or assessment within the problem area. By developing technical skills, this type of project can also form the basis for assessing the technological possibilities and limitations involved in problem-solving.

Projects oriented towards action/change

In a change-oriented project, the aim is understanding and make changes within socio-technical settings related to challenges or problems that have already been identified. Here ethnographic methods, socio-technical analysis, participatory methods, action research, and understanding the technical possibilities are used. In the analysis of problems, ethnographic methods form the basis for the acquisition of contextual knowledge as input to the understanding of the problem area and thereby also form the basis of a relevant design / development process. Technical skills are applied as background knowledge that allows a consideration of the change or design possibilities and limitations. Participatory methods and action research can be used in the design and development of proposals for solutions.

In the following, each step in the project model is described and exemplified. The descriptions and examples focus on problem identification and analysis because it is this which generally creates the greatest uncertainty for the students.

Seven steps in problem-based learning and projects

The following steps are based on the PBL model set out in Figure 1. Projects will vary and be designed in different ways in relation to the chosen problem area, the project learning objectives and the chosen methods and theories. What is common to them will be that one must understand the problem area through a problem analysis to arrive at a solid research problem. In the following, each step will be briefly described, and different examples will be provided in relation to analytically and change-oriented projects.

Step 1. Theme framework, semester descriptions, and learning objectives: relating to the theme, mapping of the problem area, and conceptualization

The first step for a project group will be to relate to the project theme described in the curriculum and the semester description. This is done by considering project proposals from supervisors or relating one's own interests and ideas for relevant problem areas to the project's theme. In addition, the project group should reflect on the framework provided for the project in the curriculum, such as demands for fieldwork or user involvement. This can be done by creating a "concept map" of essential ideas, concepts, and perspectives within the theme in addition to the constraints of the project's learning goals. Based on this, the group agrees on a problem area they want to work within. In Techno-Anthropological projects the problem area will often by that of wicked problems.

In order to understand what is at stake within the problem area, the project group can use different methods. One can, for example, use the 5W1H-method by asking:

- What constitutes relevant problems within the project framework?

- Why is it relevant?
- Who are the relevant actors?
- Where do problems within the project framework emerge?
- When do interesting problems occur? and
- How are problems solved?

This initial brainstorming provides a picture of the project group's preconceptions in relation to a given problem area and thus a background to considering what (authentic) problems the group finds interesting and relevant enough to make them the starting point for further investigation.

Example Step 1:
Semester - Project learning:
Understanding-oriented: 1. Semester: Technological Transformations. Students must apply Techno-Anthropological theories and methods to gain insights into key processes of technological transformation and to identify drivers of and barriers to responsible socio-technical innovation.

Change-oriented: 2. semester: Technological processes and design. Students must improve or engage in the development or evaluation of an innovation process for the design of a technology or a specific technical product.

After the initial brainstorming (based on the concept map and the limitations of the curriculum), the group decides to focus on technological support for the elderly in nursing homes. They explore the problem area based on the 5W1H-model (what, who, why, when, where and how).

The projects for the different semesters have different foci. The 1st-semester projects focus on students acquiring a shared Techno-Anthropological knowledge base (knowledge about theories, methods, cases, professional literature). The 2nd-semester project is oriented

towards applying and combining these elements, while the 3rd semester supports students' competences in bringing Techno-Anthropology into the field of future employers. These different foci must be addressed in the initial project phases.

Step 2. Initiating the problem: characterize and identify the problems in the problem area

On the basis of the first step, the project group will have developed a shared preconception of the problem area that can be used to select a potentially authentic and academically relevant initiating problem. Although it is not always easy to agree on the direction of a project, the group can use techniques like a decision-making matrix.

Example of step 2:
From the shared preconceptions and conceptualizations, the group decides on the following initiating problem:
Understanding-oriented: How do nursing homes deal with the potential dilemma between care and technology use?
Change oriented: Can elderly inmates of nursing homes be given better care through the use of new care technologies?

Step 3. Problem analysis: analysis of the problem area

The first two steps are based on the students' own presuppositions and any framework suggested by the supervisors, but in order to determine whether the initiating problem is actually a new, authentic and relevant problem, the group must make a preliminary study of the problem area. The group applies relevant theories and methods to increase the understanding of the problem and/or possible solutions within the problem area.

Here one can again use the 5W1H model as inspiration for clarifying questions such as:

- What (specifies and conceptualizes the problem area)?
    - Identify and define the socio-technical concepts related to the problem area (Thesaurus)

    - Concepts related to the technological perspective (the technology and/or processes it is a part of)
    - Concepts related to the humanistic perspective (the technology and/cultures it is a part of)
  - What is the state of the art (latest research in the field,– i.e. systematic literature search?
    - How does this project bridge a knowledge gap / bring forward new knowledge?

- Who (buyers, operators, users)?
  - For whom is it a problem, who has an interest in it (who is affected, who has power, who has legitimacy)?

- Why (justify problem field's social relevance)?
  - Why is the issue relevant for a techno-anthropologist to study?

- When (in what situations and under what circumstances does the problem occur)?
  - Historical and timing.

- Where (location / location of the problem)?
  - Describe situations, processes and conditions where the problem occurs. This should be done from both a technical and a humanistic perspective.

- How (How does the problem appear)?
  - Existing and state of the art technological and social/organizational solutions.

Example of Step 3:
Preparation of the pilot-study design (literature review and small empirical study) and analysis of the resulting data.

The understanding-oriented project will focus on problem analysis to support the conclusion that there is a new and authentic problem for which there is a need for further investigation and clarification of the socio-technical context.

In a change-oriented project, the problem analysis indicates the situations, actors and issues that it is relevant to support with interventionist and/or solution-oriented initiatives.

Step 4. Problem statement: delineate and argue for an authentic problem

The problem analysis forms the basis for the problem formulation that is the guiding research question for the project.

Example of Step 4:

On the basis of the problem analysis, the project group defines the problem formulation. The problem analysis may, for example, indicate that there is a problem with understanding.

Understanding-oriented. Delimitation: Describe the relevant study field on the basis of the problem analysis.

Research questions: What challenges arise when caregivers use assistive technologies in the retirement home? What are the challenges of care practices and the use of assistive technology?

Change-oriented. Delimitation: Describe the relevant study field on the basis of the problem analysis.

Research question/problem formulation: how can assistive technologies supporting care practices in a retirement home be designed while taking the sustainability and ethical factors into account?

Step 5. Problem exploration/solution: study design and results

Problem exploration/solution is the central and most comprehensive part of the project, that in which the investigation or intervention design is drawn up and executed. Methods and plans for fieldwork or interventions are prepared at this stage. These plans are implemented, and the results are analysed on the basis of the relevant methodological and theoretical principles and perspectives.

Examples of questions:

- Methodology and study design: which examination or intervention design is necessary to answer the problem?

- Analysis: what are the relevant theoretical perspectives and models in relation to the analysis or solution design?

- Evaluation of results: how can the results be evaluated in relation to the problem formulation?

Example of Step 5:
Understanding-oriented project. An appropriate study design is made on the basis of the problem analysis. The group uses ethnographic methods and socio-technical analysis in order to understand the problem, e.g. through participant observation in nursing homes with a focus on the use of technology in care, interviews with key actors and insights into technology's function and use.

Change-oriented project. An appropriate intervention-study design is made on the basis of the problem analysis. The group uses participatory or intervention methods, as well as socio-technical analysis and knowledge of technical possibilities, in order to find solutions to the identified problems. This can be done by, e.g., using interventionist and participatory approaches to develop and test different design proposals (prototypes, sketches).

Step 6. Contextualization of results: feedback on the problem area

Through its problem-based project, the project group aims at either a deeper understanding of or proposals for solutions to the problem they have studied. These results are discussed, contextualized and disseminated to relevant stakeholders in the problem area.

Questions that can be addressed are:

- Does the study answer the problem formulation?

- What other perspectives could have been relevant?

- What could / should we have done differently?

- What value has the project added to the problem area?

- What are the future challenges within the problem area?

Example of step 6:
Understanding-oriented project. Ideas and feedback for future retirement homes, helping them deal with existing issues around the use of technology in care practices.

Change-oriented project. Provide input in relation to opportunities and constraints for future solutions. Providing reflections on the place of sustainability and ethics in the design.

Step 7. Evaluation: reporting and reflections on the process

The final report is drafted in light of the problem-based project work. Proposed elements of a report:

- Introduction and initiating problem. General description of the problem area and its relevance leading up to the formulation of the initiating problem.

- Problem Analysis. Description and analysis of the problem area. Contextual analysis of stakeholders, technologies, sites etc.

- Problem delimitation and formulation. Based on the problem analysis, a delimitation is made in the problem area. The final problem formulation is drawn up.

- Problem exploration/solution:

    - Theory. Arguments for choice of and descriptions of theories informing the problem formulation and its exploration and solution.

    - Methods. Argument and description of methods chosen to answer the problem formulation

- Presentation and analysis. Presentation and analysis of the empirical material or intervention. In the understanding-oriented project, this may include a description and analysis of fieldwork through socio-technical perspectives. In the solution-oriented project, this may include a presentation of the interventionist initiatives (e.g. workshops, prototyping, testing) and a socio-technical analysis of the results.

- Discussion and conclusion. Assessment of whether the results answer the problem formulation. Discussion of the results and what value they provide in the problem area. Consideration of future challenges in the problem area. How do the project's results relate to other cases and to existing knowledge?

In addition, the project team should evaluate their own learning process and their performance in relation to the learning objectives, as well as reflect on possible future improvements.

Overview and characterisation of the different Master's semester projects

Project / Semester	Description	Research methods enacted by students
P0: Interdisciplinary knowledge production 1st semester	Practical experience with collaborative group work that involves international and multiple disciplinary backgrounds.	Literature review *and* PBL
P1: Technological Transformations 1st semester	Apply Techno-Anthropological theories and methods to gain insights into key processes of technological transformation and to identify drivers of and barriers to responsible socio-technical innovation.	Revised literature review, two interviews with different stakeholders *and* half a day's observations analysis of websites, SoMe posts OR video clips.
P2: Technological processes and design 2nd semester	Improve or engage in the development or evaluation of an innovation process for design of a technology or a specific technical product.	In depths use of intervention-oriented OR ethnographic methods.
P3: Professional development 3rd semester	Acquire practical experience in solving advanced Techno-Anthropological challenges in a professional context.	Action research, participatory research OR ethnographic fieldwork
P4: Master's thesis 4th semester	Carry out a Techno-Anthropological research project following good academic and professional practice that directly or in-directly contributes to the development of robust and socially responsible solutions to societal challenges.	Own choice

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