Using the learning by developing action model: case study in project-based computer science studies in higher education institutions.

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Using the Learning by Developing Action Model – Case Study in Project-Based Computer Science Studies in Higher Education Institutions

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Using the Learning by Developing Action Model – Case Study
in Project-Based Computer Science Studies in Higher
Education Institutions

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Abstract

Teaching methods change continuously. In the last 30 years, there has been a shift from traditional teacher-centred teaching to student-centred learning, which focuses on developing students' competence and skills and enables lifelong learning and the development of problem-solving skills. Learning by Developing (LbD) is a pedagogical model developed and used by Laurea University of Applied Sciences, where the starting point is authentically working life development and problem situations in cooperation with working life. LbD aims to produce new competencies, products, operating models and work culture. The LbD model has been developed since 2002 and is rooted in exploratory learning and Dewey's pragmatism.

This thesis aims to study the use of LbD in three higher education institutions, Laurea and Haaga-Helia in Finland and RGU in the UK. This study aims to get information about the development of computer science students' skills during the study module selected for the research, as well as their experiences with LbD as a learning method.

Surveys and interviews have been used as research methods for data collection. In action research, the purpose is to study the organisation's operating methods and look for improvements. Action research progresses in cycles, and after each cycle, reflection is made based on the research results, which provides inputs for the next cycle. The research results have been analysed using both qualitative and quantitative methods.

From all three higher education institutions, a study module in which the students were involved in implementing the client's IT project was chosen because that was the focus of the study. Data was gathered from various stakeholders in the LbD process, including staff, students and project clients.

LbD is widely used at Laurea, and information has been collected from pedagogy staff about the backgrounds of LbD and experiences of using LbD. Information has been

gathered from RGU and Haaga-Helia's pedagogy staff on whether the LbD model would also suit them as one pedagogical model. Lecturers of the study modules selected from all three higher education institutions have also participated in the study, as well as project clients who participated in these study modules. Information has been collected from lecturers and project clients through interviews. The study also aims to get information from lecturers and project clients about their experiences using LbD and its suitability for computer science studies. The studies have been carried out between the years 2019 and 2022. A critical goal of the study has also been getting information from all parties, including how they think the LbD model should be improved to work even better.

Keywords: Learning by Developing, pragmatism, computer science studies, student-centered learning, project-based learning

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Declaration

I confirm that the work contained in this PhD project report has been composed solely by myself and has not been accepted in any previous application for a degree. All sources of information have been specifically acknowledged, and all verbatim extracts are distinguished by quotation marks.

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Chapter 1:   Introduction

Teaching and learning are continuously changing, especially in higher education. The traditional teaching methods are no longer well suited to modern society, but the conversation has moved towards the process of learning rather than teaching (Siegel and Kirkley 1997). Pedagogical models have shifted from a teacher-centred approach toward a student-centred one (Figure 1).
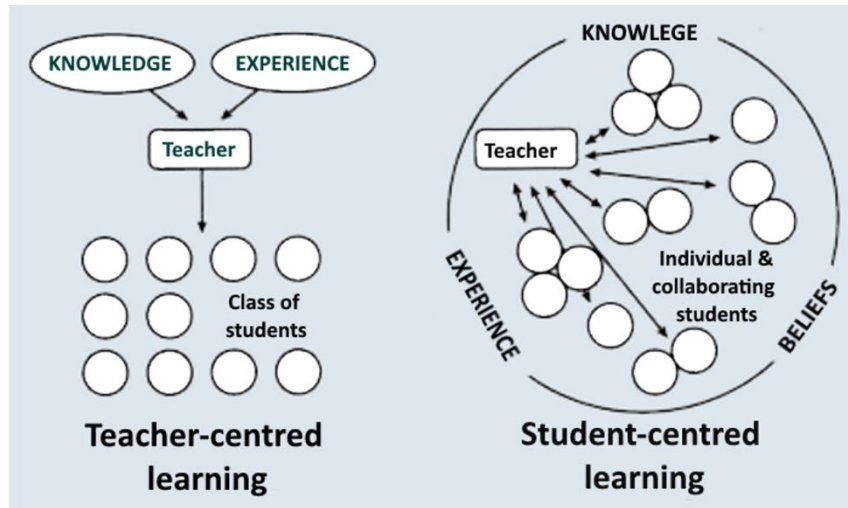
Figure 1: Teacher-centred learning and Student-centred learning

Student-centred learning is also known as learner-centred education, and it broadly covers teaching methods that shift the focus of teaching from the teacher to the student (Doyle and Zakrajsek 2011). Student-centred learning aims to develop the learner's autonomy and independence (Jones 2007) by placing more responsibility for the learning path in the hands of the students. For students to learn a particular subject, they are given basic information, models, and instructions necessary for learning a particular topic. Students are measured against specific performance requirements.(Rogers 1983; Pedersen and Liu 2003; Hannafin and Hannafin 2010) Student-centred teaching focuses on skills and practices that enable lifelong learning and independent problem-solving (Young and Paterson 2007; Hannafin and Hannafin 2010). Student-centred learning theory and practice are based on constructivist learning theory, emphasising the learner's critical role in building meaning through new knowledge and previous experience.

Developing the student's competence is a priority in student-centred learning, and the student's learning experiences play a central role. In a student-centred learning environment, students choose what they want to learn and how they want to learn

(Crumly, Dietz and d'Angelo 2014) and evaluate their learning (Hannafin and Hannafin 2010). The difference to traditional education, also called "teacher-centred learning," is that students play a more active role, while the role of the teacher is more passive and more of an observer and mentor. In teacher-centred classroom teaching, teachers choose which students are taught, how students are taught, and how student learning is assessed. In student-centred learning, the prerequisite is that students are active, responsible participants in their learning at their own pace (Johnson 2003).

The Learning by Development (LbD) action model was developed at Laurea University of Applied Sciences (Laurea UAS), starting in 2004, by closely examining teaching and learning in some Universities of Applied Sciences in Finland (Raij 2007). The LbD model has been successfully used at Laurea for over fifteen years. In particular, studies on LbD-based learning have been mostly conducted among social and healthcare students but not very comprehensively among computing students. In the LbD action model, learning new ways to act and renew work life is essential. This learning method is thought to be well suited for students in computer science in Laurea because several study units are linked to real-world projects. The study results from computing students' experiences of the LbD action model learning have limited availability. Besides the student's learning experiences, an essential subject of the study is how their problem-solving skills and working methods developed in LbD action model projects are implemented in conjunction with working life.

The inner circle of the LbD model features individual learning, community learning and building a new competence – according to the LbD model, these must always be considered in learning (Raij 2014). The characteristics of LbD are on the outer ring in Figure 2: authenticity, partnership, experiential nature, creativity, and research-oriented approach.

Figure 2: The characteristics of the LbD model (Raij 2014)

- Authenticity refers to a genuine working-life connection (Raij 2014).

- Experiencing means giving meanings to constructing competence and the basis of processes that lead to new ways of action, which are important for reflecting on personal experiences and creating new habits of action.

- Partnership means cooperation among students, lecturers, workplace experts and clients, featuring mutual commitment.

- The requirement for a research orientation arises from the higher education context.

- Creativity is vital for bringing forth something new.

1.1 Research Background

The starting point of the research is to study the use of the LbD model in the studies of computer science students. The LbD model was developed in Finland at Laurea and has been used since 2006. Much has been written about using the LbD model as a pedagogical model for students, but it has not significantly been studied concerning computer science students. The background idea of this study is to examine whether the LbD model is also suitable for studying computer science. In the research, this issue is analysed with the help of a student survey and with the help of thematic interviews with lecturers and project clients participating in LbD study modules.

The starting point of the students' survey is the general skills needed in working life defined in Laurea's 2030 strategy ('Strategy 2030 of Laurea University of Applied Sciences' 2020). These general working life skills are divided into six areas: self-management and an entrepreneurial attitude; critical thinking and problem-solving skills; foresight and innovation skills; communication and interaction skills; global skills; and responsibility skills. The purpose is also to collect information about the student's experiences in teaching according to the LbD model and how they think it fits into studying computer science.

1.2 Basic Assumptions and Positioning

The starting point of the research is the LbD model commonly used at Laurea University of Applied Sciences. Background information on the LbD model has been collected from the literature and Laurea's LbD pedagogical staff to understand the background of LbD. After this, the first target group of the research was Laurea's computer science students, lecturers, and project clients. Research material was collected from students with the help of a survey and from lecturers and project clients with thematic interviews. Student surveys, lecturers and project client interviews were conducted after completing the study modules. After the first data collection, the research results were analysed using qualitative and quantitative methods.

The following research cycles were carried out in the UK at RGU, where LbD was piloted to determine whether it would be a suitable pedagogical model for RGU. Background information regarding RGU has also been collected from the literature and a pedagogical staff within the university. After the interview, the collected research material was analysed. The study aims to determine whether the LbD model is suitable as a teaching and learning method for computer science students at RGU for a project-based study module, how the students' competence develops during the study module, and what kind of experiences the students have with it. The research results will assist the organisation in evaluating whether the LbD model could be used as one of the teaching methods at RGU in the future. The research results provide information on what the implementation of LbD would require from the organisation, lecturers, and other staff. It also highlights possible problems or obstacles to its implementation.

The third research target was Haaga-Helia University of Applied Sciences in Finland. One research cycle was carried out in Haaga-Helia, where the target was computer science students, lecturers and project clients participating in the project-based study

module. This research object was included so that the results obtained from Haaga-Helia can be compared with Laurea, thereby getting valuable information about how suitable the LbD model is for computing students in Finnish Universities of Applied Sciences. Haaga-Helia's research was carried out in the same way as the research carried out at Laurea.

1.3 Research Aims

The aim is to conduct research in three higher education institutions, Laurea and Haaga-Helia in Finland and RGU in the UK. The study aims to get new information from computing students' learning experiences in the LbD action model-based study module and determine how their competencies and working life skills will develop during that module. The study focuses on computing studies in all these higher education institutions. The study subjects are computing students, lecturers, project clients, and pedagogical staff on teaching methods. Questionnaires for computer science students were planned, and the general competencies needed in the working life of higher education students were chosen as their background. In all three higher education institutions, the study subjects were those study modules in which the project client's IT projects were implemented in connection with the study module. The studies were carried out after the end of the study modules. The lecturer's experiences of the LbD model were collected by interviewing the lecturers participating in these study modules after the end of the study module. Pedagogical staff were also interviewed in the study. Information was also collected from project clients participating in the study modules through interviews after the end of the study module.

Laurea's instruction for the LbD model has been in place since 2011 (Raij et al. 2011). The existing LbD model has been used in Laurea for the past 16 years. The LbD action model must be continuously improved and maintained to keep it current. The improvement of the LbD action model must also consider future needs. The purpose of this research is first to study and later improve the LbD action model to be better suited to computing studies. In addition, the goal is to examine whether the LbD model can be used successfully in different institutions.

Therefore, the first research cycle was conducted at Laurea, where the LbD model is familiar. The LbD model has been widely used at Laurea since 2006. The following research cycles were carried out at RGU in 2020 and 2021. The LbD model has not been previously used at RGU, so it is unknown. The purpose of the study is to gather

information on whether the LbD model would be suitable as one of the teaching methods there and what kind of possible obstacles there might be to its implementation. Before using LbD in RGU, a background study was conducted on all factors that must be considered when implementing the LbD action model. The background study explores current pedagogical models, cultural differences, possible changes in the curriculum, the willingness to try something new, and what could be a barrier to adoption.

The last research cycle was carried out in Haaga-Helia in the spring of 2021. At Haaga-Helia, it is a principle that lecturers can decide what pedagogical method they use with the study modules they teach. In Finnish Universities of Applied Sciences, all lecturers must complete a teacher's pedagogical qualification. Haaga-Helia also has a vocational teacher training college, where, among other things, personnel can achieve that pedagogical qualification.

1.3.1   Research Questions

The LbD action model has been used as the background theory of the research and the pedagogical method of the research objects. The answer to the first research question is sought through a literature review to understand the background of the LbD.

> Q1: *Why and for what purpose has the LbD model been developed?*

This question is answered in Chapter 2.

Research question 2 seeks answers to whether the LbD action model is a suitable pedagogical method for computer science students' project-based studies. Research question 2 has several sub-questions to which answers are sought from pedagogical staff, students and lecturers. Chapters 4, 5 and 6 answer these questions in more detail.

> Q2: *Is the LbD action model a suitable pedagogical method for higher education computing students' project-oriented studies?*

In research question 3, the study collects information about project clients' cooperation experiences according to the LbD action model. In addition, the study seeks answers from the project clients on how the students succeeded in the projects and how well the project succeeded in the opinion of the project clients. These questions are answered in more detail in Chapters 4 and 5.

> Q3: *What are the project clients' experiences of LbD model collaboration?*

Research question 4 seeks answers to whether the LbD action model could be successfully implemented in different institutions. Research question 3 has sub-questions that ask what benefits the LbD model could bring or what obstacles to its implementation. In addition, we are looking for answers to the critical success factors in implementing the LbD model, what background factors affect the implementation, and what needs to be considered in the organisation if the LbD model is implemented. This question is answered in Chapters 4 and 5.

Q4: *Can the LbD action model be implemented successfully in a different institution?*

Research question 5 is related to the development of the LbD action model. The development of the LbD is one crucial aspect from the point of view of the research. Answers to this question are sought from the responses of all participants in the research, pedagogy staff, lecturers, students and project clients. This question is answered in Chapter 6.

Q5: *What kind of suggestions for improvement are seen in the LbD model?*

1.3.2 Motivation

The LbD action model has been used at Laurea for some time, and it has been recognised in many fields of education, such as hospitality management and the social and health sector, as a good and effective way of developing students' skills and working life cooperation. Little research has been done on its benefits in computer curricula. Therefore, an exciting research topic was how well the LbD model fits computer science students' work-oriented project-based studies.

The background of interest was also to find out how the LbD model should be practised in the organisation so that it would work in the best possible way and the lecturers would understand its meaning. Familiarising students with the principles of the LbD model is also essential; therefore, the study aims also to get information on how this matter could be improved.

LbD pedagogy is firmly based on work-life cooperation, so project clients are also a research target. Project clients were also involved in the study to get valuable information about the functionality of LbD and its improvement.

An essential part of the research is also the continuous development of the LbD model. In this research, one of the purposes was to get information from a wide range of different parties on how they think the LbD model should be improved so that it is always up-to-date and considers future needs.

1.4 Research Contributions

The research results have been analysed in several parts, and various conclusions have been drawn based on them. The most important results to be analysed are: whether the LbD model is suitable for the study of computer science, whether the students' skills and working life skills will develop in teaching according to the LbD model; what are the experiences of students, lecturers and project clients when using the LbD model; what are the strengths, threats or weaknesses of the LbD model in higher education institutions; and how the LbD model should be improved; and what kind of methods and tools would be needed to introduce the matter.

1.5 Thesis Structure

This thesis consists of six chapters. After this introduction, Chapter 2 provides an overview of the background and related work. The leading background theory in this thesis is the Learning by Developing Action Model (LbD). In the literature review of pedagogical models, the models that have informed the development of the LbD model have been included so that the reader understands the backgrounds of the LbD. In addition to the literature review, Chapter 2 contains an overview of the backgrounds of the Finnish and UK higher education systems and the teaching methods commonly used in them.

Chapter 3 presents the research strategy and the methods used in the research. First, the data acquisition methods used in the study are discussed. After that, the data analysis methods and the action research cycles used in the research are presented. At the end of Chapter 3, the ethical principles, questions related to the reliability of the research, and its limitations and delimitations have been reviewed.

Chapter 4 presents the action research carried out in four cycles. The first cycle was implemented at Laurea. The following two research cycles were carried out at RGU, and the fourth cycle was carried out at Haaga-Helia. In Chapter 4, all these research cycles are described in their sections. The issues of the different research subject groups have been reviewed separately. Each research cycle has a reflection section at the end of the

research cycle. The results of each higher education institution have been analysed separately, and conclusions have been drawn based on them. At the end of Chapter 4, a conclusion is made about this chapter.

Chapter 5 summarises the key results. Different target groups have compiled the research results of all three higher education institutions. Research results have been compared in Chapter 5 to the extent that the results of different organisations have been comparable. At the end of Chapter 5, there is a reflection on the research results.

The thesis ends in Chapter 6 with a summary of the research findings, where the research questions presented in this thesis are revisited and discussed. After this, the effects of the research results are reviewed, and the limitations of the work are discussed. Next, Chapter 6 discusses what is planned to produce the development needs found through the research results. Potential future research needs regarding LbD have also been reviewed. Finally, Chapter 6 contains the researcher's final remarks about research in general.

Chapter 2: Background and Related Work

The starting point of this research is mainly based on the Learning Development Action Model (LbD) developed at Laurea. The principles and background factors of the LbD model will be explored in more detail to understand why it has been implemented at Laurea. Teaching and learning have changed with the times in higher education institutions, and the traditional teaching methods no longer fit well in today's society. Instead of teaching, people now talk more about learning and how students would learn things as well as possible. The change is related to the pedagogical paradigm shift and has been studied extensively and is still being studied. In Finland, the higher education system was reformed at the beginning of the 1990s, and at that time, a dual model was chosen for higher education, whereby higher education was divided into Universities of Applied Sciences and universities of science. With the change, instead of higher education pedagogy, the terms university pedagogy and University of Applied Sciences pedagogy began to be used in Finland. Here, the research mainly goes through pedagogical models used within Universities of Applied Sciences because the two Finnish higher education institutions that are the subject of the study are Universities of Applied Sciences.

Higher Education in the UK has a long history. The reason for this is that universities in the United Kingdom are based on the royal charter, the papal bull, and the law of parliament (the Higher Education and Research Act of 1992 or the Higher Education and Research Act 2017). The authority to grant degrees and "university" property rights are protected by law (Aftab 2016), but the exact arrangements for obtaining them vary between the member states of the United Kingdom. Oxford and Cambridge are among the oldest universities in the world. Many different stages and events in history have significantly impacted the development of UK education (Harrison 2011). Significant historical events have been the French Revolution and the Second World War.

The UK maintained a "binary division" between universities and polytechnics in the previous century. A significant change in higher education in the United Kingdom occurred in 1992 when this division was abolished by the Further and Higher Education Act of 1992, and the polytechnics and the Scottish central institutions became universities in Scotland (*Further and Higher Education Act 1992*). These new or post-1992 institutions almost doubled the number of universities in the UK.

2.1 Introduction

In the literature review, constructive pedagogy and pragmatism are first reviewed. After that, the study examines problem-based learning, project-based learning, learning by doing, exploratory learning and developing learning models. The model of learning through development is the leading background theory of this research. Indeed, since the LbD model has elements from all the above-mentioned pedagogical methods, they have been opened in this context. In the research, computing students have been chosen as the target group because the research seeks to understand how well the LbD model fits the computing studies. There has been much research on applying the LbD model among business management, social science, and healthcare students in Laurea (Kallioinen 2008; Korkiakangas 2015; Reilio 2017). However, how well the LbD model fits the studies of computing students has received little attention.

In addition to action research, the research uses a case study as a research method, which is a detailed study of a specific subject, such as a person, group, place, event, organisation or phenomenon. Case studies are commonly used in social, educational, clinical and business research. Qualitative methods are usually used in case study design, but quantitative methods are sometimes used. Case studies are suitable for describing, comparing, evaluating and understanding different aspects of the research problem. A case study is an appropriate research plan to get concrete, contextual and in-depth information about a real-life topic. It can be used to study the case's most important features, meanings and consequences. This study has chosen a strategy in which Laurea, RGU and Haaga-Helia are the case study subjects studied for comparison and to obtain different aspects of the research problem.

After that, an overview of the teaching methods used in higher education institutions in Laurea and Haaga-Helia in Finland and RGU in the UK will be made to determine the background factors affecting the research. The review goes through the cultural differences and similarities between the two countries and the differences and similarities in teaching methods between the three universities. Going through these background factors is vital from the point of view of the research because they can have a significant impact on the research result and, therefore, must be known before the research is carried out.

2.2 Pedagogical Models

Views on learning and teaching have varied a lot over time. In 1997, Siegel and Kirkley (1997) have already compared the characteristics of the problems to be solved in traditional school education to solving problems in real life. Enqvist (1999) presented a comparison of the key characteristics of learning in his dissertation. According to Siegel and Kirkley (1997), education must produce an understanding that enables one to solve real-life problems.

The pedagogical model means a theory-based structuring of teaching situations and the progression of the learning process. The pedagogical model describes how teaching takes place according to the pedagogical layout. Pedagogical models structure the learning process into different stages and act as a framework for teaching planning. In newer, commonly used pedagogical models, the learner is an active knowledge builder who learns in a community with other learners.

A teaching method is a teaching implementation or work method that should promote the learner's learning (Vuorinen 2001). The teacher organises teaching and activates and motivates learners to choose teaching methods. Successfully using teaching methods depends on, for example, the course goals and the teacher's teaching skills and style. A skilled teacher masters several teaching methods, chooses the appropriate ones and uses them versatilely in different teaching situations. The versatile use of teaching methods promotes the students' learning process because using different methods enables consideration of different learners and increases the interaction between the teacher and the learner.

Knuuttila and Virtanen (2001) write that the following factors influence the choice of teaching method:

- Students' level, habits, and motivation.
- The teacher's skills, willingness to experiment and experience with different teaching methods.
- Subject to be taught, course content and goals.
- Requirements of different teaching methods, e.g., teaching facilities, group size and time.
- Variability and appropriateness of teaching methods.

Teaching is the most central concept of didactics and means goal-directed interaction in line with educational goals, which aim to achieve learning (Hirsjärvi 1982). Teaching is considered an essential part of education. Today, teaching is understood as both a systemic phenomenon and a continuous process, and for clarity, teaching is sometimes referred to as the teaching-studying-learning process (Hellström 2008). Teaching is a sub-concept of what the teacher does as part of teaching. Teaching is the educational institution's way of raising students and aims to promote their personal development.

Didactics seeks an answer to the question of what good teaching is like. The research object of didactics is teaching, not teaching or learning (Uusikylä and Atjonen 2000). Descriptive didactics studies the conditions prevailing in teaching and their effects (Räsänen 1992). On the other hand, normative didactics lead from teaching theory to instructions for teaching planning, implementation, and evaluation (Uusikylä and Atjonen 2000). In simplified terms, didactics means learning from teaching, while pedagogy means learning from education.

The term didactics is based on the Greek word "didascalia", which means teaching poem. Until the 1970s, didactics was used as a teaching method in Finland, after which the word didactics became commonly used among education professionals. One of the most established ways of classifying didactics is to divide it into the study of the teaching event, the study of learning, i.e., teaching method theory, and the study of the curriculum, i.e., curriculum theory.

Teaching refers to what the teacher does as part of teaching and is a sub-concept of teaching, although laypeople often confuse the two terms (Hellström 2008). The teacher can teach directly or indirectly. Direct teaching is, for example, lecturing, asking, or telling. In indirect teaching, the teacher guides the students to discover things themselves. With the constructivist understanding of learning, teaching also includes guidance. In the most general way, teaching can be seen as regulating environmental factors, which aim to change children's behaviour by specific goals.

Learning is the acquisition of knowledge, skills, or habits. Learning can happen either by studying, learning, or practising or through experience, example, or the influence of the environment (Huotilainen 2019). From a behaviourist perspective, learning means permanent changes that can be observed in behaviour, which arise mainly in the interaction between the object and the environment (Hirsjärvi 1982).

In psychology, learning usually means learning about a person or an animal, while in didactics, learning is looked at specifically from the perspective of teaching. In other disciplines, we talk about learning data programs, learning organisations and learning areas. At its basic level, individual learning requires memory and sensory activity. Learning occurs almost always when a person compares an action that has taken place and an intended action (feedback) or an action that has taken place and a previous action (learning from experience). There are many ways of learning because different learning methods are suitable for different situations and because of individual differences in learners.

2.3 Constructive Pedagogy

Constructivism is based on a view of the learner as an active shaper of knowledge and a theory of the dynamics of knowledge formation itself (von Glasersfeld 1995). Also, according to Siljander (2014), learning in constructive pedagogy is seen as an active process of building knowledge. According to the constructivist concept, knowledge cannot be transferred to the learner. Indeed, the central idea in constructive pedagogy is that knowledge is not transferred, but the learner reconstructs it (von Glasersfeld 1995; Siljander 2014). The learner is, therefore, an active knowledge builder, i.e. the creator of knowledge structures in the learning process. The learner interprets and creates new information based on previous knowledge and experiences (von Glasersfeld 1995). The physical and social factors of the learning situation also affect the resulting construction. The activity of the learner's thinking, information processing skills and the metacognitive skills that guide them are central to understanding constructivist learning.

Through the learner's previous knowledge, observations, and experiences of the subject, they are learning to regulate what the learner perceives and interprets. Learning is related to activity and serves the activity. The learner's learning experiences, personal experimentation, problem-solving and understanding are all essential to the process. Learning is the result of the learner's actions. It is context-specific, contextual, contextually linked, and interactive. Self-directedness, growth and self-reflectiveness are possible for an individual of the human species, but they must be learned. Subjective experiences become objective information through social interaction and the cooperation of learners.

Rauste-von Wright and von Wright (1994) describe constructivism with the following generalisations:

- New information is absorbed by using previously learned information.
- Learning is the result of the learner's activity.
- The activity is guided by its goal, and the learning criteria guide the goal - but learning is regulated by what the learner himself does.
- There is an emphasis on how understanding promotes meaningful structuring of knowledge.
- The same thing can be understood and interpreted in many ways.
- Transferring what has been learned to new situations depends on the connection of knowledge and skills.
- Social interaction plays a central role in learning.
- Goal-oriented learning is a skill that can be learned.
- Assessment of learning should be versatile.
- Curricula should be flexible and consider the learner's capabilities and the relativity and changeability of knowledge.

According to Singer and Moscovici (2008), researchers have long tried to understand how the mind works in problem-solving situations. They have proposed a cyclical model of learning (Figure 3), where the approach starts with informal ideas, which are developed, ideated, changed, and formulated. Learning cycles are not necessarily all the same, equally long, or parallel. Students are encouraged to use different techniques and gradually build their ideas in a structured way. The critical essential criteria of the cyclical model is consistency, the topic's relevance, the development of students' competence during the cycle, continuity over a certain period, and feasibility.

Teacher

Transfer

Actualization
Anticipation

Applying

Immersion

Extending

Evoking

Student

Questions
Reflective
attitude

Practicing

Exploring

Reinforcement

Problems
Construction

Explaining

Synthesizing

Conceptualization

Systematization

Structuring
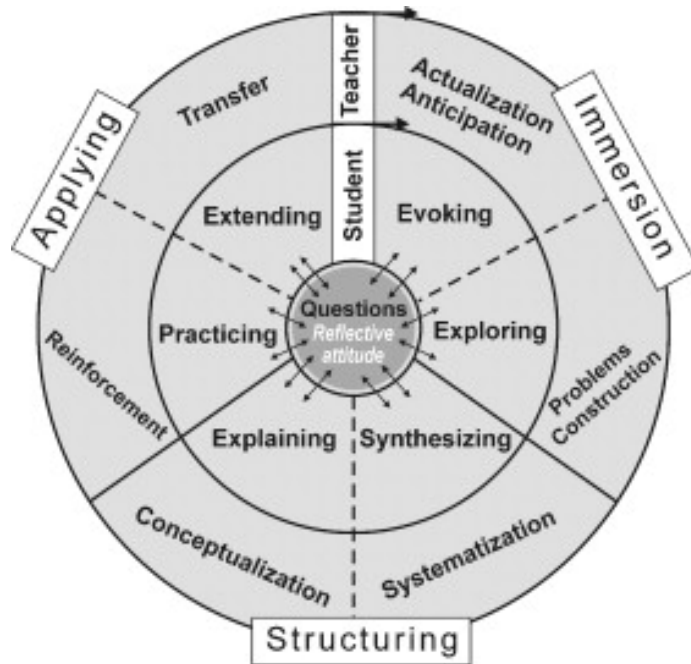
Figure 3: Teaching and learning cycles in a constructivist approach to instruction
(Singer and Moscovici 2008)

According to constructivism, learning results from an individual construction process, in which case the teacher's task is to create a framework and support the learner's learning processes (Tynjälä 1999). In constructivism, the teacher is the instructor of individual learning processes and the mediator of expert culture. The teacher's task is to uphold the learner in his endeavours, promote the development of metacognitive skills, and plan the learning environment from social and physical components to support the learner's activity. Forms of guiding the learner based on a constructivist view are modelling the learning task, timely learner support (scaffolding) and reflecting the learner's thinking.

2.4 Pragmatism and Experiential Learning

Pragmatism is a philosophical school originating in the United States at the end of the 19th century by Peirce and later at the beginning of the 20th century by James and Dewey. Pragmatism is the only academic philosophical tradition of American origin (Pihlström 2001). Pragmatism has, for example, mainly included naturalism, anti-Cartesianism, empiricism, instrumentalism, anti-scepticism, fallibilism and, above all, the emphasis on practice as the criteria for evaluating truth and meaning.

The international debate sparked by traditional pragmatism gradually died down in the 1920s (Pihlström 2001). Along with the British analytical tradition, the logical empiricism

of the Vienna Circle gained dominance in Anglo-American philosophy. The focus was on the philosophy of science. Dewey most strongly maintained the tradition of pragmatism. After World War II, European logical empiricism and American pragmatism were thought traditions that merged in the United States.

The experiential learning (ExL) perspective dates to the 1930s, from the axiom "learning by doing". Dewey was an American educator and the pivotal developer and representative of pragmatism. In the early 1900s, the so-called progressive pedagogical trend spread widely also to Europe and Asia. Pragmatism is a philosophical trend and, at the same time, a pedagogical way of thinking. The progressive education idea is based on pragmatism, emphasising the close connection between knowledge and action. The basic principle of pragmatic education is that all human thought, scientific knowledge formation and learning should be viewed as practical activities (Kolb 2014).

Experiential learning (ExL) is often narrowly defined as "learning by reflecting on doing" (Patrick 2011). In practice, learning can be a form of experiential learning, but it does not necessarily require students to think through the output. In routine or didactic learning, the learner plays a relatively passive role (Beard, 2010). Experiential learning differs from these because the learners play an active role. Experiential learning relates to other forms of active learning, such as activity, adventure, free choice, collaboration, service, and location learning. However, it is not synonymous with them, i.e., it does not fully correspond to them (Itin 1999).

The concept of learning through experience is ancient. Around 350 BC, Aristotle wrote in the Nicomachean Ethics that "for the things we must learn before we can do them, we learn them by doing them"(Chase and Smith 1911). Kolb helped develop modern experiential learning theory beginning in the 1970s, drawing on the work of Dewey, Lewin, and Piaget (Dixon, Adams and Cullins 1997).

Experiential learning has been found to achieve significant educational benefits. Peter Senge, an author of The Fifth Discipline (Senge 2006), says that teaching is necessary to motivate people. When the learner wants to absorb information, learning has only good effects. Experiential learning requires a practical approach to learning and showing instructions to learners (Hawtrey 2007). Experiential learning goes beyond just transferring the teacher's knowledge to the students. Experiential learning extends beyond the classroom, focuses on the individual's learning process, and aims to bring more inclusive learning.

The concept of experience is central to Dewey's thinking (Kolb 2014). The theory is based on continuous interaction between the organism and the environment. The organism tries to adapt to its environment and adapt it to its needs with its own choices and active activities. In Dewey's theory, the concept of experience seeks to break the insight into the distinction between thinking and action. Experience can be either an educative or an uneducated experience. Increasing experience requires continuous interaction between the individual's activities and their consequences.

Kolb started developing the experiential learning model further. Kolb developed a four-stage model (Loo 2002) (Figure 4). Learning in the first stage of "Concrete experience" means that the learner physically interacts with the thing to be learned at that moment (Kolb, 1984). Acquired blindness forms the basis of observation and reflection, through which the learner can reconsider what works or fails (reflective observation). After this, the learner can formulate a general theory or idea about the learning topic (abstract conceptualisation) and think about ways to improve the next learning attempt (active experimentation). Each new attempt informs the cyclical pattern of previous experience, thinking and reflection. The learner supports this as necessary because it emphasises the importance of experiences and self-reflection in the learning process.
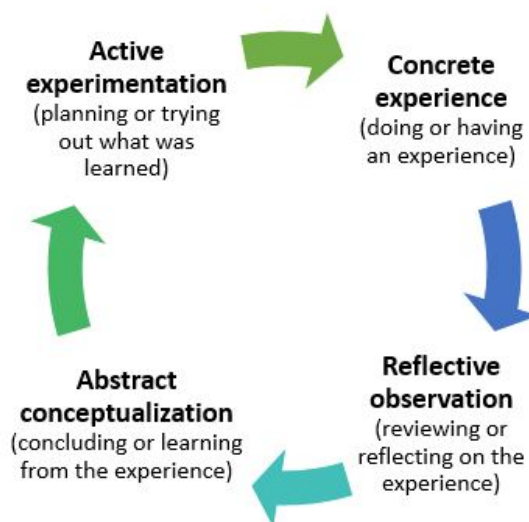
Figure 4: The cyclical model of Kolb's learning (Kurt 2020)

The mere existence of experience does not guarantee to learn as it can remain superficial without deliberate processing, e.g. reflection (Kolb 1984). Not all experiences lead to learning. Learning can also be inappropriate, for example, by reinforcing existing prejudices. Experiential learning also includes a cognitive perspective that transforms

the experience into a constructive view of learning. Reflection is an intellectual and effective activity in which individuals examine their knowledge and experiences to reach a new level of understanding. Reviewing and evaluating experiences can help to find and create new perspectives and ways of working. Teaching methods that promote reflection include, for example, student self-assessments, groups, and feedback discussions.

Experiential learning is exclusively related to the meaning-making process of an individual's direct experience, and it can happen without a teacher (Itin 1999). An authentic learning experience requires specific elements, even though acquiring knowledge is natural. Knowledge is constantly acquired through personal and environmental experiences (Merriam, Caffarella and Baumgartner 2007). Kolb has stated that to gain authentic knowledge from experience, the learner must have the following four abilities:

- Be willing to participate in the experience actively
- Be able to reflect on his experience
- Have analytical skills and use them to conceptualise experiences
- Have decision-making and problem-solving skills to utilise new ideas gained from experience.

Experiential learning requires initiative from learners, a desire to learn and an active approach to learning (Moon 2004). Kolb's experiential learning cycle can be used to examine different phases (Kolb 1984). According to Moon, experiential learning is most effective when it includes: a reflective learning phase, a learning phase consisting of experiential learning activities, and a feedback learning phase (Moon 2004). The learning process can lead to an individual's feelings, skills, or changes (Chickering 1977) and serve as a guide for activities and evaluation choices (Hutton 1980).

Most teachers understand the central role of experience in the learning process. Emotions and the role of emotions in learning from experience have been recognised as essential parts of experiential learning (Moon 2004). However, experiential learning can also take place without them. However, it is vital in experiential learning that the individual is encouraged to participate directly in the experience and then reflect on the experience using analytical skills to understand the new information better and to retain it longer.

Reflection is essential to experiential learning, which can be facilitated or conducted independently. According to Dewey, successive parts grow and support each other in reflective thinking. It creates a framework for further learning and reflection and enables different experiences (Kompf and Bond 2001). Experiential and reflective learning are iterative processes where learning continues and develops through experience and reflection (Jacobson and Ruddy 2015). Facilitating experiential learning and reflection can be challenging. Still, a competent instructor can help people with new thinking and learning by asking questions and guiding reflective discussion during the learning process. Jacobson and Ruddy created a simple, practical inquiry model that facilitators can use to promote critical reflection in the context of experiential learning. Jacobson and Ruddy's "5 questions" model is as follows (Jacobson and Ruddy 2015):

- Did you notice?
- Why did that happen?
- Does it happen in life?
- Why is this happening?
- How can you use it?

The facilitator introduces these questions after the experience and gradually leads the group to reflect on their experience and understand how critically they can apply the learning to their lives (Jacobson and Ruddy 2015). Although the questions are simple, they allow a relatively inexperienced instructor to use the theories of Kolb, Pfeiffer, and Jones and deepen the group's learning.

Although the learner's experience is essential for the learning process, the experience that a good facilitator brings should also not be forgotten (Rodrigues 2004). A facilitator or "teacher" can enhance the likelihood of experiential learning, although it is not necessary for experiential learning. The mechanism that works in experiential learning is instead the reflection of the learner's experiences with the help of analytical skills. Experiential learning can therefore take place without the presence of an instructor, and the presence of an instructor does not define experiential learning. In developing a course or program content, experiential learning provides an opportunity to create a framework for varying teaching and learning techniques that can be adapted to the classroom.

Higher education must adapt to new expectations, and, for example, experiential learning in business and accounting programs has become even more important among students.

Clark & White (2010) write that a quality university business education program must include experiential learning. Referring to Clark and White's (2010) research, employers hope that graduates can develop 'professional' skills during their studies, which can be taught through experiential learning. Students also value experiential learning as much as employers.

Learning styles also affect the teaching of business in the classroom. Kolb places the four learning styles, Diverger, Assimilator, Accommodator, and Converger, at the top of the experiential learning model, using the four stages of experiential learning in "four quadrants," one for each learning style (Loo 2002). An individual's dominant learning style can be identified using Kolb's Learning Style Inventory (LSI). Based on the research results, it has been found that the learning styles defined by Kolb were not evenly distributed. This would provide evidence that it is useful for teachers to be aware of common learning styles, they should encourage students to use all four learning styles appropriately, and it is useful for students to use different learning methods.

In the experiential business learning process, business skills are learned and developed through shared experience (Kolb 1984). The difference between this and academic learning is that the learning experience of the learner, or recipient, corresponds to reality.

Providers of this type of experiential business learning are often organisations that offer projects or situations that use peer group learning, professional business networking, expert speaker sessions, mentoring and/or coaching. The dimensions of academic knowledge are constructive and incremental learning, while the dimensions of experiential learning are analysis, initiative, and immersion (Figure 5).
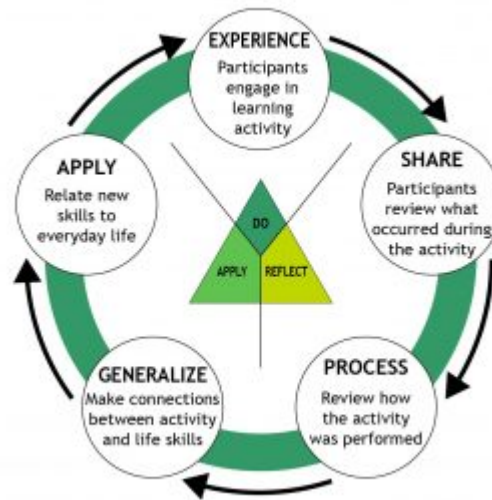
Figure 5: Experiential Learning ('Experiential Learning Model' 2020)

The extremes of the modification dimension are reflection and action (application). This dimension includes the variation between internal and external action. We can observe by thinking both during and after action what happens to us (Kolb 1984).

Following the model of experiential learning, four different ways of learning can be highlighted:

- active experimentation, where practical activities and influencing people or situations are emphasised
- concrete experiencing, where personal experiences, feelings and "artistic" orientation are in the foreground
- reflective observation, which focuses on versatile reflection of experiences and situations
- abstract conceptualisation, which is characterised by systematic thinking and problem-solving.

The circle of experiential learning is formed by combining these ways or stages of learning.

2.5 Learning by Doing

Learning by doing refers to the educational theory explained by the American philosopher Dewey and the Latin American pedagogue Freire. In learning by doing, students need to interact with their environment to adapt and learn, so it is a very hands-on approach to learning (Freire 1982; Jordan 2022). Freire emphasised the vital role of individual development in cultivating critical skills and creating awareness (Freire 1982). Dewey's views have been influential in creating progressive educational practices. He implemented this idea by founding the Laboratory School at the University of Chicago (Pegg 2022). DuFour (DuFour et al. 2006) adopted the theory of learning by doing, which was then applied to developing professional learning communities.

Learning by doing is one of the oldest forms of vocational training, and it can be considered a boundary between an educational institution and working life, where operating systems with different starting points and operating methods meet (Wenger 1998). Learning by doing can be compared to theory-oriented, classroom-oriented, and teacher-oriented school teaching (Ahola, Kivelä and Nieminen 2005). On the other hand, learning by doing does not necessarily require a concrete workplace as a context.

"Learning by doing" is active, practical, and interesting for students. This learning method approach aims for learners to build mental models that enable "higher level" performance, such as applied problem-solving and knowledge and skill transfer (Churchill 2003). The development of lesson plans should focus more on "doing, producing, practising and observing" instead of teacher-directed lectures (Hedrick 2011).

Therefore, learning by doing is just that - a way of learning by doing that emphasises the importance of practice and achieving knowledge through reflected experience. This means the students can try things in practice and be allowed to fail (Newbury 1957). Learning by doing since learning utilises the student's natural learning ability in a practical environment, and answers are given to learners only after they have questions (Schank 1995). Answers are given after questions have arisen.

Aristotle's utterance that "Things that have to be learned to do are learned only by doing them" contains the idea that knowledge comes from experiential activity (Venkula 1993). Learning new skills in learning by doing takes place experientially through doing (Aaltola 1998; Salakari 2009). Learners often follow a professional's actions initially and learn from a model. Learning can also happen by solving a problem or through a mistake.

What is learned is then applied to practice, which results in learning. When learners repeat actions by repeating, their skills develop, and experience accumulates (Venkula 2008). Learning by doing also includes Kolb's theory of experiential learning.

2.6 Problem-Based Learning (PBL)

Problem-based learning is often understood simply as a learning method. However, as a PBL approach, it requires changes to the entire learning environment as a teaching technique, educational strategy or even philosophy (Poikela and Nummenmaa 2006). However, using PBL as an educational philosophy involves holistic consideration of many issues, such as the organisational context, curriculum content and design, and the teaching-learning approach, including assessment and evaluation methods.

Problem-based pedagogy can also bridge the gap between work and education. Problem-based learning deals with problems related to the reality of working life and society. Solving the problems requires developing diverse skills in information-seeking and independent studying, which crosses the borders of different fields of science.

Problem-based learning is a comprehensive approach to the learning environment, curriculum, learning, studying, and teaching (Savin-Baden, Howell Major and Major 2004). It is the basis for experiential, collaborative, contextual and constructive learning theories, and it sees links to informal forms of everyday or working learning. Problem-based learning can be widely applied as a lecture lesson or problem-based laboratory, but in its basic form, it is considered appropriate for a small group tutorial.

The central idea of problem-based learning is that learning begins with problems arising from working life or other social reality (Savin-Baden, Howell Major and Major 2004). A strategic approach to the problem-based curriculum and learning environment level is comprehensive, not just a methodological solution for teaching. Problem-based learning is closely connected to the whole school's activities, from the concept of learning to assessment and the facilities or tools used.

Problem-based learning is based on the idea of situational learning. According to it, the learning content achieves a better use value when the learning takes place by solving genuine real-life problems instead of being just a theoretical treatment of the subject (Capon and Kuhn 2004). Problem-centred learning has also been found to have desirable effects on many issues: developing problem-solving skills, planning one's learning, attitudes related to learning, understanding the subject to be learned, and

connecting the content being studied to previous knowledge structures and self-regulation.

Problem-based learning activities include steps, phases, and syllabuses that tune into pedagogical thinking and principles. The most well-known and well-established models in the world are problem-solving and the individual knowledge-based approach, which focuses on "the seven-step model" (Table 1) (Woods 1994).

Table 1: The Seven-Step Model (Woods 1994)

STEP	Activity
Step 1	Identify and clarify unfamiliar terms presented in the scenario; scribe lists those that remain unexplained after discussion
Step 2	Define the problem or problems to be discussed; students may have different views on the issues, but all should be considered; scribe records a list of agreed problems
Step 3	”Brainstorming” session to discuss the problem(s), suggesting possible explanations based on prior knowledge; students draw on each other’s knowledge and identify areas of incomplete knowledge; scribe records all discussion
Step 4	Review steps 2 and 3 arrange explanations into tentative solutions; scribe organises the explanations and restructures them if necessary
Step 5	Formulate learning objectives; group reaches consensus on the learning objectives; tutor ensures learning objectives are focused, achievable, comprehensive, and appropriate
Step 6	Private study (all students gather information related to each learning objective)
Step 7	Group shares results of private study (students identify their learning resources and share their results); tutor checks learning and may assess the group

Problem-based learning is a holistic approach to examining the learning environment, curriculum, learning, studying, and teaching (Poltimojärvi 2006). It is seen to be based on experiential, collaborative, contextual and constructive theories of learning, converging with informal forms of everyday or on-the-job learning. Problem-based learning can be broadly understood as lectures or problem-based laboratories, but the basic structure is still guided tutorial work in a small group.

The central idea of problem-based learning is that learning starts from problems that arise from working life or other social reality (Poltimojärvi 2006). It is a strategic alignment that impacts the curriculum level and learning environment and is not just a systematic solution for teaching. Thus, problem-based learning connects to the entire educational

institution's operations, from learning concepts to assessment and the facilities or tools used.

Problem-based learning modes of action are described as different step, phase and cycle models that concretise pedagogical thinking and principles. The most internationally known and established models are the so-called seven-step model (Woods 1994) and the so-called eight-task (Schmidt 1983) model based on Barrows and Tamblyn's (1980) modelling of problem-based learning.

2.7 Project-Based Learning

The teaching model of project-based learning is based on students encountering real issues and problems that they consider meaningful, deciding how to solve them, and then working together to create problem solutions (Bender 2012).

In work-oriented project learning, students study and work in different learning environments in many ways and at different paces. In work-life-oriented project learning, the set of learning environments includes the physical environment, psychological factors, and social relationships where studying and learning occur (Guile and Griffiths 2001; Billett 2002, 2010; Griffiths and Guile 2003; Helle, Tynjälä and Olkinuora 2006; Tynjälä 2013). In working life-oriented project learning, the working life representative is the client in the project-related study module, and the client is involved in the different phases of the project. However, the teacher has the primary responsibility for guidance. According to Virtanen and Tynjälä (2013), the characteristics of a learning environment that develops working life skills include, in particular, active learning methods, the versatility of assessment methods, the development of understanding and competence, and interaction between teachers and students. These are vital features in learning environments that support constructivist learning. According to Virtanen and Tynjälä (2013), the learning process includes at least taking previous knowledge into account, supporting metacognitive and reflective skills, conversational and community learning, solving genuine problems and producing so-called artefacts, evaluation connected to the learning process, and the role of the teacher as a supporter of learning. The basic idea is that theory and practice are tied together with the help of various pedagogical and reflective tools (Guile and Griffiths 2001; Griffiths and Guile 2003; Iiskala and Hurme 2006; Poikela and Järvinen 2007; Virtanen and Collin 2007; Poikela 2008; Billett 2010b, 2010a; Järvi 2012; Harteis and Goller 2014; Ahonen and Kankaanranta 2015; Griffin and Care 2015; Lackéus 2016). In this way, implicit information is made visible and

theoretical knowledge, and practical experience can be reflected and analysed. Expanding the students' living world to networks outside the educational institution teaches problem-solving and reflection and creates new knowledge according to the functional learning model in authentic learning and work environments. When students learn to reflect in real work situations, they simultaneously learn professional lifelong learning skills.

Education and working life should not be seen as independent contexts because the skills required for working life bring many development challenges to educational learning environments (Korhonen 2005; Walker 2006). Learning environments should be modified in such a way that they support each learner's learning process in the best possible way. The educational challenge is to develop learning environments so that their operating culture promotes interaction between people, learning and knowledge sharing, and creating new knowledge (Walker 2006; Jylhä 2007; Kumpulainen and Lipponen 2010; Krokfors et al. 2015). Activity-oriented authentic learning environments expand the context, and education involves continuous learning and is a life-long process (Kumpulainen and Lipponen 2010). Kangas, Venninen and Ojala (2016) emphasise that a comprehensive understanding requires crossing borders and multi-professional pedagogical cooperation. In cross-border pedagogy, teaching and learning are tied to the surrounding society and its activities and phenomena (Vartiainen 2014; Krokfors et al. 2015; Vesterinen et al. 2017; Jääskelä, Nykänen and Tynjälä 2018). This requires pedagogical cooperation and expertise also from parties outside the educational institution. Forms of activity involving students and the community should be established in the operating culture of the educational institution.

Acquiring skills in a work-life-oriented project is a collective learning event. Analysing project learning develops the student's ability to regulate the learning based on metacognitive information, i.e. the perception of themselves as a learner, the nature of the task and different strategies. Learning is seen as an individual process and socially shared metacognition (Tynjäjä 1999; Rauste-von Wright, von Wright and Soini 2003; Hakkarainen 2008; Reeve et al. 2008; Sawyer and DeZutter 2009; Hurme 2010; Hakkarainen, Lallimo and Toikka 2012; Iiskala 2015). This means expanding the concept of metacognition to, for example, community knowledge-building situations where students develop ideas and build knowledge together. The metacognition manifested in students' work cannot be checked from the perspective of only one student. Indeed, it is built up, developed and manifests itself between individuals and in the collaborative

thinking activities of students. Reactivity is central to project learning, where the learner takes a critical look at their learning process and the resulting results. The student develops metacognitive skills and knowledge about learning and study strategies. When learning is shared, metacognitive skills are socially shared and regulated (SSMR – Socially Shared Metacognitive Regulation) (Tynjäjä 1999; Rauste-von Wright, von Wright and Soini 2003; Hakkarainen 2008; Reeve et al. 2008; Sawyer and DeZutter 2009; Hurme 2010; Hakkarainen, Lallimo and Toikka 2012; Iiskala 2015), and socially shared metacognitive regulation should be viewed similarly to an individual student's metacognition. In addition to supporting the student's learning, the teaching should strongly support the students' common ability to regulate learning and thinking processes. The skills of joint learning and thinking regulation also help importantly the development of different skills in general, which are practised as a community. (Reeve et al. 2008; Sawyer and DeZutter 2009; Hurme 2010). We can talk about honing the key skills of lifelong learning.

Working life-oriented project studies are suitable for acquiring skills that emphasise competency-based skills, and they naturally practise the key skills of lifelong learning. According to Hakkarainen, Lonka and Lipponen (2004), in human competence, the emphasis is not only on knowledge but also on various gradually growing personal resources, such as the key lifelong learning skills. These relate to a person's identity and how they learn to combine their personal and professional identity creatively and uniquely. An individual's lifelong learning process includes conscious choices, hard work, risk-taking and chance (Siurala 2006; Kaskinen et al. 2010; Tynjälä et al. 2016). According to lifelong learning, a person learns new things formally, non-formally and informally throughout their life cycle.

Practical social skills, which include communication, listening and responding to others, initiative, sharing, helping and raising issues and taking care of boundaries, play a vital role in the success of social interaction in work-life-oriented project learning (Coleman 1998; Reiss 2015). With the help of behaviour, emotional life and interaction skills, the student takes his place as a group member to achieve the social and emotional goals that are important to him(Weissberg et al. 2015; Määttä et al. 2017). At the same time, s/he is aware of the needs and goals of others.

Awareness of one's skills is an essential factor in learning. The better a student knows their knowledge, skills and ways of acting in different situations, the better they can appropriately control and apply different learning methods (Tynjäjä 1999; Reeve et al.

2008; Poikkeus 2011; Lappalainen and Sointu 2013; Papaleontiou-Louca 2014; Myszkowski et al. 2015). In work-life-oriented project learning, the teacher's guidance supports students' self-understanding skills. The view that emphasises metacognitive skills is based on a cognitive understanding of knowledge, where knowledge is understood as belonging to the individual (Järvelä et al. 2006; Tynjälä 2008). The learner tries to regulate the learning situation and environment's cognitive, motivational and emotional factors. Individual regulation processes related to learning and studying are called self-regulation, which arises in studies, for example, when a student sets goals for himself, assesses his ability to perform a required task or chooses learning strategies suitable for different learning situations.

According to Lee and Hannafin (2016), the student must have ownership of his learning and gradually take more responsibility for it. Self-assessment skills are learned and developed through teaching and practice (Lappalainen and Sointu 2013). The student should revise and rehearse their cognitive skills and metacognitive skills. In work-life-oriented project learning, the goal is effective action, which promotes strengthening the student's ability to believe, an essential part of self-understanding skills (Rauste-von Wright, von Wright and Soini 2003; Helle, Tynjälä and Olkinuora 2006; Iiskala 2015; Karjalainen et al. 2016). A student's ability to analyse and justify the solutions s/he makes indicates good self-understanding skills. Self-understanding competence is also indicated by continuous self-evaluation in developing one's own and project activities.

2.8 Exploratory Learning

Exploratory learning is a pedagogical model that works like scientific research (Hakkarainen, Lonka and Lipponen 2001). The aim is to understand the phenomena under study or to solve complex problems. New information is sought individually according to the agreed division of labour, but information on the subject is constructed socially together with the group. The information found is analysed and discussed critically in group sessions. Learning takes place as a spiral process so that the object to be learned is narrowed down and examined more deeply. As the work progresses, the object is specified with the help of new questions (research problems). The best results are achieved if the research problems are genuine and authentic to the students.

Exploratory learning is a pedagogical model where learners are supposed to participate in the community's knowledge production, which is typical for expert communities (Hakkarainen, Lonka and Lipponen 2004). The exploratory learning model emphasises

intentional work to develop shared ideas, social practices, and collective knowledge. The exploratory learning model emphasises the learning community working on conceptual creations, and at the same time, it aims to support individual learning. In the exploratory learning model, the knowledge-creation process is communal. The effort of the individual to produce knowledge is linked to the efforts of the community and vice versa. The exploratory learning model is a reference framework for working with long-term knowledge.

The central idea of exploratory learning is to nurture and develop the student's ingenuity and Creativity. Exploratory learning helps realise the goals mentioned in the curricula's basics. Many critical issues in exploratory learning emerge from the curricula' basics, which discuss problem-oriented working, exploratory learning, interaction skills, and community spirit. These are all items related to inquiry learning.

Exploratory learning is a pedagogical model that aims to support the knowledge acquisition typical of an expert. The model is based on the knowledge construction theory of Carl Bereiter and Marlene Scardamalia, which was developed from their pioneering research on writing, goal-oriented learning, and expert (Scardamalia and Bereiter 1996) self-assessment of the acquired knowledge. Another theoretical starting point of investigative learning is the inquiry model of the philosopher Jaakko Hintikka's research, which emphasises the importance of creating and following questions for knowledge creation (Hintikka 1999).

The exploratory learning model guides students to participate in a joint research project and share their knowledge and expertise (Hakkarainen et al. 2004). It can also be considered a strategy for personal development and self-transcendence. The inquiry learning model is used, tested and developed in many Finnish schools and universities. In exploratory learning, knowledge is not only devoured and assimilated into previous knowledge but also dismantled and reconstructed by solving problems related to understanding. Participants are guided to participate in in-depth research by imitating the practices of mature knowledge communities. The starting point in exploratory learning is a meaningful and multidimensional topic (setting up the context), which the teacher chooses and develops with the students. Students are challenged to guide their learning by forming questions related to the topic (presenting research problems) and creating intuitive working theories to explain them (creating working theories). These steps are reviewed before familiarising them with new scientific or authoritative information. The learning community members evaluate (critical evaluation) jointly produced ideas and

acquire new knowledge (searching deepening knowledge) from many sources. Based on this, further research questions (developing deepening problems) and corresponding new working theories (new theory) are formed to deepen the process gradually. What is essential in the process is its division into parts among the members of the learning community (distributed expertise). Figure 6 shows the components of exploratory learning.
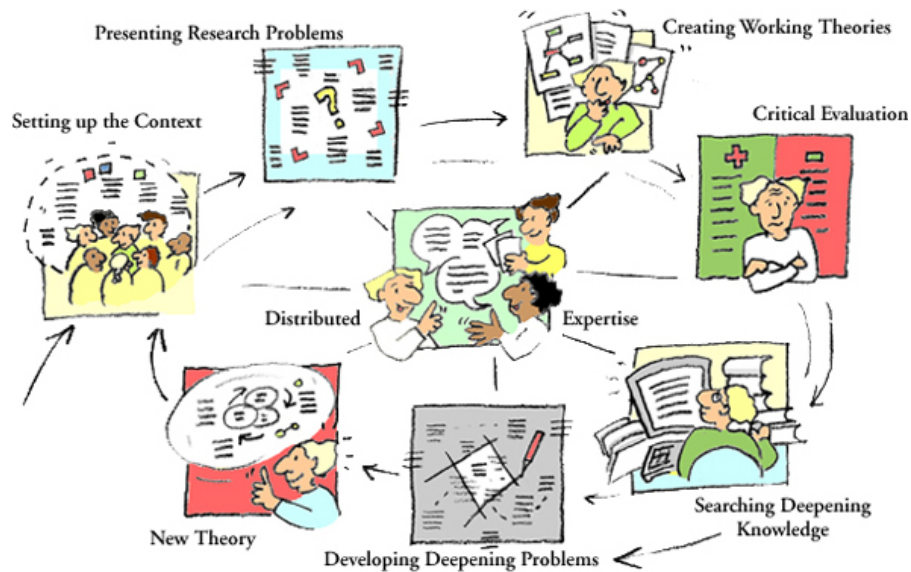
Figure 6: The components of exploratory learning (Hakkarainen et al. 2004)

The basis of the exploratory learning phase model is not doing itself, but working with information, i.e. what is done with information and questions (Hakkarainen et al. 2004). Exploratory learning often does not have a clear beginning and end. Still, each phase of learning raises new research questions, whereby the steps of research are repeated and, at the same time, gradually deepen the process. Working together to solve shared problems and develop thoughts and ideas the community can address is essential in exploratory learning. Collaborative learning means presenting research topics in some shared space.

2.9 Learning by Developing

The Learning by Developing (LbD) Action Model was developed at Laurea University of Applied Sciences (Raij 2014). In 2002, a new learning and knowledge understanding model was recorded and approved in Laurea's pedagogical strategy, according to which learning at Laurea takes place through teaching, research, and development. In this pedagogical strategy, learning is a gradually advancing research process, where the

student is a collaborator, and the teacher is the student's guide and supporter of professional growth. Universities of Applied Sciences in Finland were given three tasks in the Act on Universities of Applied Sciences (Ammattikorkeakoululaki 2003), teaching, research and development work, and regional development. At Laurea, the requirements set by the law wanted to be combined into a whole, and a new kind of pedagogical model, the LbD, was chosen as the method to combine all these. Raij (2000) defined that the four components of the University of Applied Sciences' competencies are research-based knowledge, understanding the context and its phenomena, know-how and the ability to manage different situations. According to Raij (2003), the competence environment can be divided into knowledge, skill, experiential, and value. In 2004, Laurea's state of will was defined as the desire to become a fully-fledged international University of Applied Sciences for innovation activities (Raij 2006). In 2005, the board defined the desire to be recognised as an expert in network processes.

In the 1990s and early 2000s, Laurea's strategy prioritised learning via projects, which integrated the three tasks of the Universities of Applied Sciences. However, the problem was fitting the projects into the general curricula. This was the starting point for practical developers at Laurea to refine learning in projects into exploratory learning in development projects, and it became the LbD model. LbD combines two central traditions of the University of Applied Sciences pedagogy, vocational education and research-based higher education (Fränti and Pirinen 2005). The difference to previous learning in projects is that the starting point is developing a working life instead of the usual activities (Raij 2006). The projects included are thus of even higher quality and better support learning, in which the three tasks of the University of Applied Sciences are integrated. The integration of these three tasks is also how the high-quality education requirements can be met. The background criteria for selecting projects are the student's skills, the needs of the innovation system, and the focus areas of Laurea's expertise. This change in the learning model also required an entirely new type of competence-based curriculum so that the development of working life and individual learning could be implemented.

Based on developing learning, Learning by Developing (LbD) follows a pragmatic learning concept in its current development stage (Raij 2007). Dewey emphasises the closeness of school and learning as a tool that produces new forms of action as a continuous interaction between man and the environment. Located in a higher education context, LbD is a key factor in developing new ways of working and renewing working life. The pragmatic concept of learning focuses on changing the individual and the environment, working together, and the importance of experience and interaction (Figure 7). Learning is active, and its essence is the experiences of different activities and their consequences, which lead to new ways of acting.
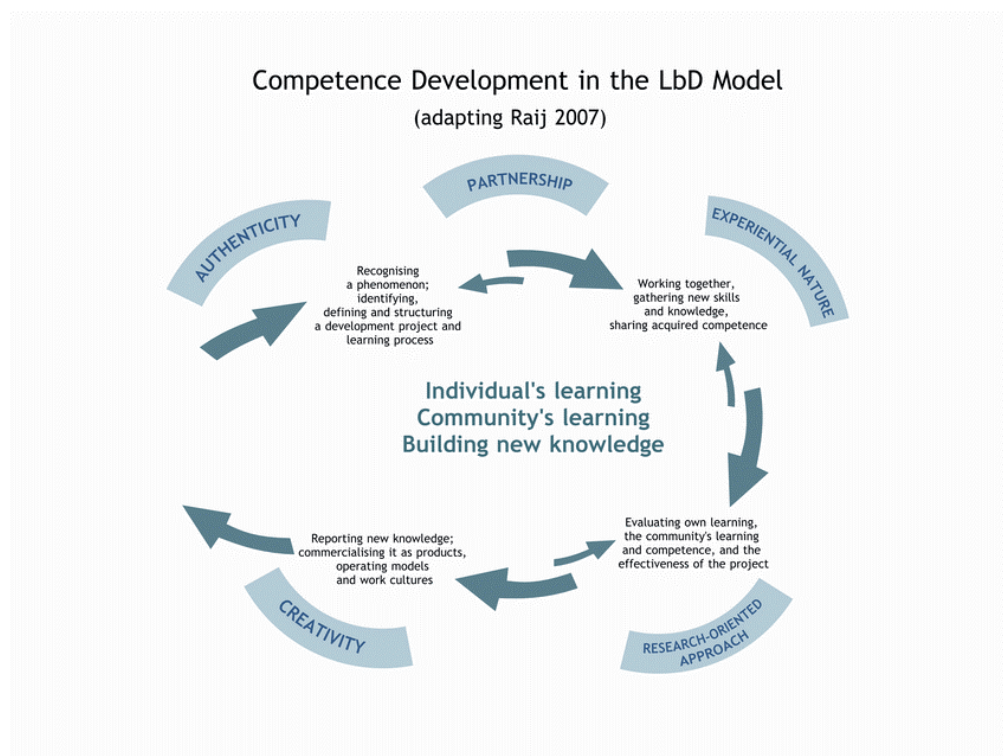
Figure 7: Competence Development in the LbD Model (Raij 2007)

In the long-standing constructive concept, the learner's active role is also emphasised, but the emphasis is different (Raij 2007). Constructive learning conceptualizes learning as creating new knowledge and building a cognitive structure. The practical, pragmatic learning concept identifies learning as a tool to create new working methods. Knowing the pragmatic learning concept is related to work habits that help to cope with the environment. Language, words and concepts are tools that enable a more meaningful way of working. Reality is built on the interaction between action and thinking. Functional interaction with the world is essential in the operation of pragmatism. Man is seen as a

naturally active being for whom the activity is rewarding. Through action, people and the environment change.

The concept of practical learning can be seen in Laurea as closely related to the context emphasising the working life of the University of Applied Sciences (Raij 2014). The Finnish higher education system is a mixture of dual and binary models. However, it is often called only the dual model, where higher education institutions are divided into universities and Universities of Applied Sciences. Universities typically focus on scientific research and doctoral education, while Universities of Applied Sciences focus more on working life and regional development.

The philosophical education classification's pragmatic understanding of learning represents an interpretive paradigm (Raij 2014). Here, the social world is seen as constantly changing and renewing itself, and the ability to operate in a continually changing world and participate in change is central. Learning is seen as changing the world and working life by developing essential development-oriented learning practices.

The development chains of learning theories of the 1980s and 1990s opened up different perspectives on learning (Raij 2014) and prompted reflection on how the learning was conducted in the past compared to how we learn today. The basis for Laurea's first pedagogical strategy was Raij's previous research and views on the comprehensive competence model (Figure 8). A comprehensive competency model was designed to guide the construction of learning environments where information can be found to enhance the development of professional practices, which is seen as combining the identified components.
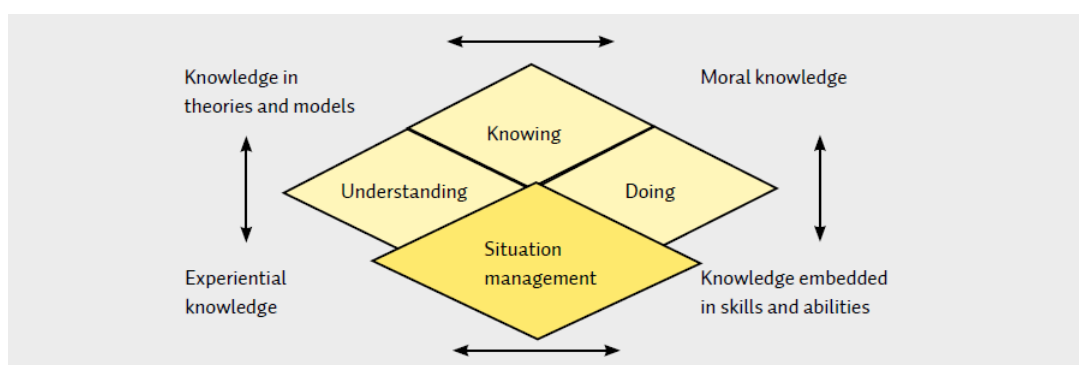
Figure 8: The holistic model of professional competence (Raij 2014)

In the development of the LbD model, the stages of development-based learning were classified. The perceptions of the participating participants about the implemented and ongoing development project processes were considered. In addition, the perceptions based on the participants' experiences of what the development project requires as a process were evaluated. Figure 9 shows the identified stages related to the progress of learning and the development project.
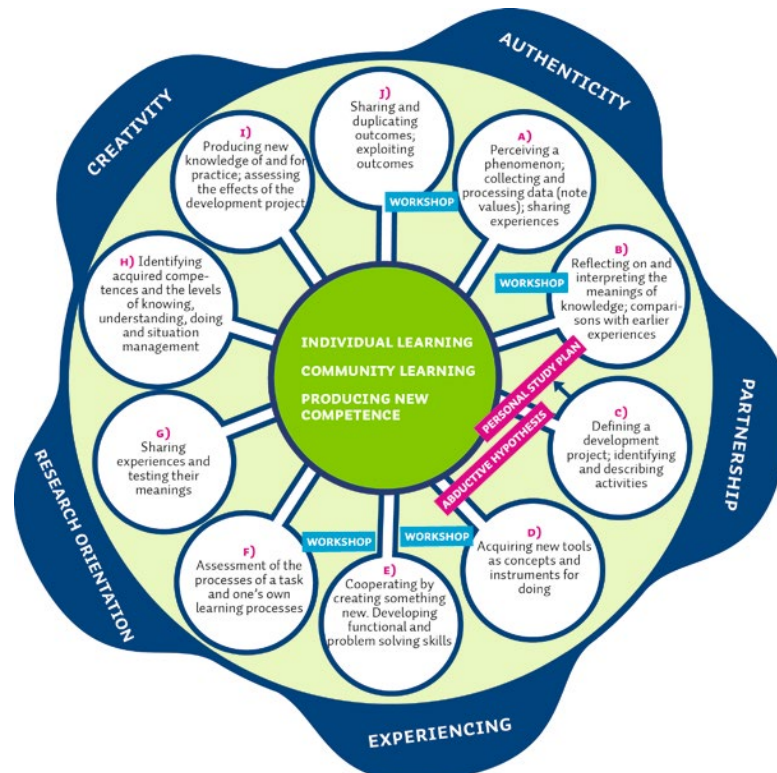
Figure 9: LbD Stages (Raij 2014)

The learning and development project process is closely related (Raij 2006). It shows that in the learning environment built around the development project, the individual's learning, learning together and constructing new know-how become possible. It includes knowledge of working life skills (in practice), the knowledge that explains it (of practice) and knowledge that develops it (for practice). The starting point of a development project is always a recognisable phenomenon, the object of which is the development of working life and which is part of the development project. The starting point for finding innovations can also be a problem caused by contradictions or renewal. The goals of development projects can be a new product and its refinement or productisation, development and renewal of the operating process, development of new operating models or development of new work culture. Working life-based development projects involve teachers, students and working life experts. Some can participate as researchers, some as developers

(those who move the project forward), and some as mediators and transferees of the know-how related to using work tools. All participants are responsible for the entire development project and related research.

The development project includes the continuous evaluation of one's learning, evaluation of things learned together, evaluation of the progress and effectiveness of the development project, and evaluation of new know-how by sharing experiences and testing their meanings (Raij 2006). Competences are identified, for example, as acquired knowledge, skills and value competence or experiential competence. Sharing the results can occur in many ways depending on the working life partnership, such as productisation or research reports. However, the learning process continues and offers a new competence base for learners as individuals and as a community in new development projects.

Based on the development work, a new model of development-based learning, LbD, was created in 2004-2006, which has been further developed since then (Raij 2006). The stages are built on authenticity, partnership, experientiality, creativity and research. In authenticity, the starting point is a genuine working life development project in which the student wants to develop into an expert. Ideas for development projects can come from working life, teachers, and students, or they can be ideated together. The starting point in development projects can be problem-based or renewal-based, where the aim is to find innovations. A partnership is also meaningful in the model but also challenging. The partnership means doing things together, sharing know-how and learning together. Different roles are identified in the partnership, such as researcher, developer, teacher, or mentor. Important in the partnership is the responsible commitment of the participants to the development project and equality.

Experientiality emphasises each participant's active and responsible role in working together, learning, sharing experiences, reflecting and searching for meanings (Raij 2006). It is essential to understand the information in working life and the information that explains it, as well as to identify new skills. Along with evaluating learning and the concepts related to knowledge structure, the importance of experience comes to the fore. Inquisitiveness in development-based learning means exploratory and critical approaches and scientific research. Research is always involved in development projects as part of the learning of individuals and communities. The results of the development project as new information and their effectiveness are also significant in terms of research. The study requirement is linked to the fact that it is part of the research

and development mission of the University of Applied Sciences. Creativity is seen as an asset of the development project. In the background, the need for creativity change has been identified together, and the development project introduces creativity. Innovation aimed at creativity can be realised as new products, work models or work culture.

Based on the LbD model, Laurea was named an education quality unit at the University of Applied Sciences for the first time in 2005 (Salminen and Kajaste 2005). In the opinion of the evaluation group appointed by the Higher Education Evaluation Council, LbD showed high-quality, innovative activities that fulfilled the various aspects of the quality criteria set by the evaluation council either excellently or well

The development of the LbD model took place in stages. First, the LbD action model was identified and named, which became Laurea's trademark (LbD guide 2011). However, the starting point was identifying the effects of changes, such as learning in the projects, which eventually led to developing the LbD action model. Some of the teachers had already used the LbD model since 2004. In the 2006 personnel program at Laurea, it was agreed that the LbD model would be widely adopted throughout the organisation, and its implementation would be supported in training. Training for the whole staff was organized on different campuses. The training was planned and implemented in 2004-2006 with the University of Tampere. Firstly, 25 senior lecturers were trained over two years, after which they acted as LbD mentors on their campuses. The training program was reorganised during 2008-2009, and the results were presented at the European Educational Research Conference in Vienna in 2009. Laurea was also the 2008-10 annual host of the international 'Learning by Developing - new ways to learn' conferences, where the teachings of the model were shared and presented, and further development was made possible.

The LbD model was developed by studying the effect of changes on the nature of learning in projects (Raij 2014). This also led to the development of campuses, where various workshops, test laboratories and living labs were created. In addition, this led to the development of a competency-based curriculum. These changes enabled the successful implementation of LbD. The curricula were therefore changed to competence-based, which means broad areas that describe the ability to act as a developer and reformer of working life. Competence-based emphasises the development of new action methods as a result of learning. The competence-based curriculum was based on the National Qualification Framework, which is based on the European Qualification Framework (levels 6 and 7).

LbD has been evaluated twice by international evaluators. It was first studied and compared to other models widely used in higher education in 2007 (Vyakarnam, Illes, Kolmos & Madritsch 2007). Evaluators compared LbD and other existing project-based and problem-based learning models. The assessment also included a review of sustainability and scalability. The evaluators gathered information about experiences and insights from those involved in implementing, planning and developing LbD. The evaluation team learned Laurea's scientific literature and publications and interviewed several stakeholders, such as students, alums, staff, faculty, external influencers and decision-makers. The comparison showed that the most significant advantages of LbD are based on the ownership of model creation. According to the evaluators, "LbD is value-oriented and gives students a more holistic view than just participating in a project and solving problems. LbD was also an advantage because it ensures students can 'do things' instead of repeating what they have learned in exam answers. LbD recognises the competencies related to the student's research and social skills and the substantive competence in question". The evaluators identified the strengths of LbD as increased independence, better self-confidence, an experiential atmosphere, high responsibility, experiences of personal responsibility and obligation to colleagues, and the experience that people trust each other and are equal. Regarding the development of LbD, the evaluators pointed out that the model should pay more attention to project management, student guidance and competence assessment, and the model should be institutionalised more strictly.

The follow-up evaluation was done in 2009 when the material was collected by interviewing target groups; project managers, students, staff, faculty and external influencers and decision-makers from all Laurea campuses (Vyakarnam & Illes 2009). From the beginning, two members acted as evaluators: Dr Vyakarnam, head of the CfEL entrepreneurship unit at Cambridge University, and Dr Illes from Anglia Ruskin University's Ashcroft Business College. The evaluators noticed that the meaning of LbD had become more uniform in two years. However, the evaluators saw a constant need in the organization to share concepts and knowledge based on pragmatic learning theories. LbD users also needed to clarify the appropriateness of the service model further and use more precise language to support the students' learning process in research and development projects. According to the evaluators, the priority should be finding and strengthening a common purpose. They also noted that there are many talented individuals among Laurea's students, but they need clarity, supported structures, good operating systems and effective communication between everyone.

Furthermore, they commented that students also need a network of community culture based on success stories and a sense of pride and collective identity. Laurea's quality program has considered the recommendations and development areas identified by the evaluators, and practices have been further developed based on them.

Kallioinen's (2008) study collected student feedback from business management, hospitality management, safety management, and corporate information technology, totalling 1204 respondents. The respondents described their experiences with the Learning by Developing model and how it improved their learning. According to the study's conclusion, the LbD model can significantly contribute to students' general working life skills and enhance the quality of their learning. LbD facilitates cooperation and the development of partnerships and enables students to act as partners. The growth and development of self-directed learning also challenged the practices of guidance creation processes. Through the LbD model, the processes of new and cooperation-based competencies emerged. Taatila's (2007) research has identified evidence that students participating in LbD learning were more competent in practical situations than their peers. Students also integrated better with working life before graduation because they had already worked with several organisations during their studies. They also had a better knowledge of the requirements of working life, as a result of which they probably spent less time familiarising themselves than those students with less practical experience.

One criterion has been integrating research and development, regional development and pedagogy (Taatila and Raij 2012). The pragmatic LbD action model has created several advantages in these areas, and the impact of the LbD action model on the surrounding society has been diverse. Local organisations receive a constant stream of new ideas and innovations and a developing workforce. R&D projects are carried out in cooperation between public, private and third-sector organisations, giving room for combining different competencies and moving forward. Similarly, the organisations offer the university continuous interesting research and areas for development, sharing knowledge and experiences, and the job's requirements.

The competency-based curriculum is essential to the LbD model to achieve the new working methods described in the learning outcomes (Juvonen, Marjanen and Meristö 2019). The curriculum guides students and teachers when they prepare R&D projects related to working life and make decisions to participate in them. On the other hand, it is open to question whether a student who learns a particular subject and passes the exam

understands the issue profoundly, remembers it for a long time, and can use the knowledge later.

The purpose of the pragmatic learning concept is not to build cognitive structures and knowledge bases but to create new habits (Mao and He 2021). Research information and its implementation play an essential role in developing new operating methods, but only as a part of the whole. A comprehensive competence model is a suitable combination of knowing, understanding, doing and managing situations. The lecturer is responsible for creating opportunities to build this larger entity. Each new R&D project offers participants a new adventure by introducing a unique situation where previous ways of doing things are not enough, as will be in the ever-changing social world. The question of how to do it appropriately still remains.

The global economy and the need for new solutions and service innovations also challenge higher education institutions. We can ask how to prepare our students for the future in a constantly changing world of work posing unexpected new situations. It is now more than clear that the current solutions are insufficient and that the world described in the textbooks will not be relevant to the landscape of tomorrow (Juvonen, Marjanen and Meristö 2019). Students should be ready to create new habits and be allowed to see how the world changes around them. The LbD action model will enable them to face such future challenges. Higher education is expected to prepare students for the future and give them sufficient competence and skills to function in a constantly changing society and working life. Learning by Developing is a pedagogical model designed to provide students with the competence they can use in working life after graduation and in the future. The LbD action model also effectively combines the three tasks given to the Finnish Universities of Applied Sciences, including RDI and regional development.

Pedagogical models must be constantly developed to stay up-to-date and be helpful to the entire learning community (Nurkka and Niinikoski 2020). The LbD pedagogy also develops together by learning, developing and sharing good practices. The more extensive continuous development of the LbD action model was brought up again in 2020, designated as the LbD theme year. In 2020, Laurea's pedagogy development group challenged the personnel to develop new ways to build the LbD model, which is judged to still work in terms of principles, so that the strategic and pedagogical LbD model would continue to live and be strengthened in the coming decade. During 2020, so-called LbD stops were arranged, where they returned to the roots of LbD and delved more deeply into the essence of LbD. The idea was that during the current year, the personnel

could create a new LbD culture of the 2020s and think about reforms to implement solutions through the experiences of current and even retired personnel. An essential theme in the LbD theme year was also LbD in digital time. The personnel were challenged to think about how LbD can be applied in digital environments and how to get working life and R&D partners on the learning journey with the help of versatile digital solutions. To support updating LbD competence, the LbD competence badge was also planned, which can be completed by staff members and serves as concrete proof of competence in LbD pedagogy.

The development of the LbD action model is, therefore, continuous development of pedagogy and a good sharing of practices throughout the organisation. Ongoing personnel training is also essential so everyone understands LbD's ideology and knows how to apply it in any situation. Teachers also play a vital role in increasing students' understanding of the principles of LbD pedagogy so that students can better recognise their competence development holistically. Familiarising customers with the principles of LbD is also essential so that they understand their role and know how to act according to LbD's thinking while participating in projects.

2.10 Digitalisation and Innovative Pedagogics

Digitisation is a process in which digital technologies change different aspects of society, such as communication, education, business and entertainment. Digitalisation significantly impacts higher education by creating new opportunities and challenges for students, teachers and educational institutions (Dussauge 2018; Kaputa, Loučanová and Tejerina-Gaite 2022; Mohamed Hashim, Tlemsani and Matthews 2022; Røe, Wojniusz and Bjerke 2022). Digitalisation's essential effects on higher education are better access and flexibility, better quality and innovation, increased competition and cooperation, and changed roles and expectations. Digitisation enables students to access higher education from anywhere in the world, regardless of their location, time zone or financial situation. Students can also learn independently and choose from various online courses and programs that suit their interests and goals. Digitisation also allows teachers to reach a broader and more diverse audience and use different methods and formats to deliver content and interact with students. Digitisation promotes the creation and dissemination of new information and the development of new skills and competencies. Digitisation encourages innovation and experimentation in teaching and learning as well as in curriculum planning and evaluation. Digitisation can also improve the quality of higher education by providing more information and feedback on student performance and

learning outcomes and enabling peer evaluation and collaboration between teachers and researchers. Digitisation increases the competition between higher education institutions as they compete for students, faculty, funding and reputation in the global market. Digitalisation also creates new opportunities for cooperation between institutions when they can share resources, expertise and best practices. Digitisation can also promote collaboration among students, teachers and researchers between different disciplines, cultures and countries. Digitalisation is changing the roles and expectations of students, teachers and higher education institutions. Students must become more autonomous, self-directed and responsible for their learning. Teachers must become more facilitators, mentors and learners than lecturers or experts. Institutions must be more agile, adaptable and responsive to their stakeholders' changing needs and demands.

Innovation pedagogy is a strategic approach to learning, implemented in learning and teaching and the structures and processes that support these (Penttilä et al. 2014; Komulainen, Konst and Keinänen 2016; Keinänen and Oksanen 2017; Konst 2017; 'Kasvatustieteet: Innovaatiopedagogiikka' 2023). The key cornerstones of innovation pedagogy, i.e. the means to implement it, are working life orientation, multidisciplinary, innovative learning and teaching methods, research, development and innovation activities, flexible learning plans, entrepreneurship and internationality, versatile and developing assessment as well as renewing teaching and renewing learning ability. Working life orientation in a university of applied sciences refers to methods of operation based on cooperation between education and working life, implemented in different ways, which improve the employment opportunities of graduating students and ensure that the education meets the demands of working life. Innovations are born at the confluence of different skills. The development projects in networks and teams support the birth of innovations and develop the actors' innovation capabilities and the ability to work in multidisciplinary work communities. Versatility enables the change and renewal of expert knowledge; the creation of the new is supported by the shared expertise of multidisciplinary teams and networks and the ability for community learning. The learning and teaching methods are student-activating and aim to develop students' innovation competencies. Applied research and development work in regional competence and innovation networks is tied to teaching. It offers authentic projects, development tasks and learning environments for studies and produces new applied research information. Flexible learning plans are developed and planned in an open and network-like environment so that the development pressures of the surrounding society can be detected and quickly reacted to. Flexibility in learning plans means students have

opportunities for individual learning paths and choices for their career development needs. Entrepreneurship is promoted in learning by the needs of working life, and studying develops an entrepreneurial attitude and thinking. The aim of the studies is also to guarantee the capabilities of international operations. Studies and learning environments are international. Students are encouraged to move internationally. The assessment focuses on the student's skills (competencies) with the competence goals so that it is versatile (not only aimed at learning results) and development-oriented (the student knows how to assess their skills and knows how to develop them). Teaching is reformed towards coaching and guiding so that the promotion of learning is still the core of the teacher's work. Students must take an active and participating approach and take responsibility for their studies.

2.11 Institutional Reviews of Teaching Methods

Educational institutions in different countries often use various teaching methods ('Suomen Koulutusjärjestelmä Pähkinänkuoressa' 2023). In higher education institutions, many factors influence the choice of pedagogical approaches, and culture, education level and traditions are the most critical. The subject of this research is three higher education institutions from two different countries, so it is essential to determine these background factors. There are many cultural and historical differences between these countries. In the UK, universities have a much longer history than in Finland, and they have been in a prestigious position for a long time. The oldest university in Finland was founded in 1640, and the Universities of Applied Sciences were established only in the early 1990s.

The higher education sectors in Finland are traditional science-oriented universities and Universities of Applied Sciences (Opetus- ja kulttuuriministeriö 2023). The dual model of these fields means that the goals of different institutions differ. The primary division of operations is that traditional science-oriented universities create new knowledge based on primary research. On the other hand, Universities of Applied Sciences follow scientific or artistic developments, apply knowledge and produce skills so that the educational institution helps and produces added value for customers. From a broader perspective, creating new knowledge is not enough for Universities of Applied Sciences.

In Universities and Universities of Applied Sciences, the students' high-quality learning is central to pedagogical choices and teaching planning (Mäki and Vanhanen-Nuutinen 2022). In both places, the teacher is seen as an enabler of learning. At a university, a

teacher is an expert in the research and dissemination of their discipline and a producer of the latest research information. In contrast, at the University of Applied Sciences, a teacher is a developer of working life and a researcher whose core competence is professional expertise. In Universities of Applied Sciences, students are seen as active players who take responsibility for their learning. The learning situation is built in cooperation, and the student is not a passive recipient of information.

2.12   University of Applied Sciences Pedagogy in Finland

Over the years, the curriculum in Finland has been changed more in a European direction (European Higher Education Area and Bologna Process 2023). The so-called Bologna process began in 1998. The Bologna process aims to unify the higher education systems of different European countries. As a result of the process, a European higher education area has been established, the aim of which is to facilitate the transfer of students and staff from one country to another, to promote the inclusiveness of higher education so that all groups have the opportunity to access higher education, and to improve the competitiveness and attractiveness of European higher education in the world. All countries belonging to the European Higher Education Area are committed

- to introduce a three-tier degree system (lower and upper university degrees and doctoral degrees)
- to ensure that higher education institutions mutually recognize degrees and study courses completed in foreign higher education institutions
- to implement a quality assurance system to ensure the quality and relevance of higher education teaching and learning outcomes.

That is when the ministers of education responsible for higher education in Germany, France, and Great Britain signed the Sorbonne Declaration. The Sorbonne Declaration was changed in 1999 to the Bologna document, which the education ministers of 26 countries signed. At that time, Finland was also involved. Forty-nine countries are currently signed up to the Bologna process.

Ekola (1992), in his work Introduction to University of Applied Sciences Pedagogy, linked the pedagogy practised in Universities of Applied Sciences to the socio-constructivism and working life orientation. Ekola writes that the basis for a University of Applied Sciences, like research culture, was then created and linked to practical development. At the beginning of the 2000s, the theoretical starting points of the University of Applied

Sciences pedagogy were developed, the central themes of which were concepts of knowledge and skill in learning, exploratory and developmental learning, issues of guidance in different learning environments, international cooperative projects as an operating environment for online learning, and assessment and teaching (Mäki and Vanhanen-Nuutinen 2022).

In the work edited by Kotila and Mäki (2012), University of Applied Sciences Pedagogy 2, the central themes were still learning concepts and developmental learning. Furthermore, the essential elements had gained depth, and the actors and operating environments around them had diversified. In particular, competence and the evaluation of competence were highlighted. The topic was examined from the perspectives of pedagogical leadership, pedagogical support, mosaic-like work at the University of Applied Sciences and curriculum work. At this stage, research, development, and innovation activities were intensely involved, which were integrated with the needs and expectations of business life. The University of Applied Sciences pedagogy took shape as a community-based way of operating in diverse environments, so working life orientation was described more concretely and pedagogically than in research and development-oriented activities.

The activities of the University of Applied Sciences were clearly distinguished by the three tasks set for them: teaching and supervision work, research work and development work, which formed the core of the pedagogy of the Universities of Applied Sciences (Kotila and Mäki 2012). These three tasks were integrated, and the strong connection to working life was emphasised even more. Universities of applied Sciences developed project-like working methods and different forms of learning in their pedagogical activities. Dewey's Learning by Doing thinking and the research and development approach were emphasised in the background of pedagogical thinking. The development of working life was aided by research, development, and innovation activities, where research results were refined into products. This pedagogical model integrates academic research methods and professional tradition. Some Universities of applied Sciences profiled themselves pedagogically by emphasising pedagogy. Models with active research and development, such as Learning by Developing - LbD and Learning and Competence Creating Ecosystems - LLCE, were developed in many places.

The next development step in the University of Applied Sciences pedagogies related to the global recession (Aaltonen et al. 2012; Kotila and Mäki 2012). In Finland, the cutting of resources and funding of the higher education sector led to their results being guided

even more from the view of credits and graduation times. At that time, the pedagogical activity was based on competence. The idea was to combine previously acquired competence and recognition of competence acquired during studies as part of university studies, learning and credits. Competence-baseness challenged the pedagogy of Universities of Applied Sciences, which meant that the nature and position of the knowledge base had to be rethought in pedagogical activities. This started a discussion about the working life orientation of studying at a University of Applied Sciences and learning on the job at a University of Applied Sciences.

The development path of the University of Applied Sciences pedagogy has been very varied, and the views on its development have varied in the work of the University of Applied Sciences teachers. Some teachers have felt that the most important thing is teaching and promoting substantive competence in Universities of Applied Sciences (Salminen et al. 2003; Kotila and Mäki 2012, 2015). On the other hand, some RDI and project-oriented pedagogues wanted to integrate authentic work and teaching. During the short history of the University of Applied Sciences pedagogy, the emphases have fluctuated from an academic orientation to a substance-centeredness emphasising professionalism and from there to competence-based and phenomenon-oriented.

Ensuring the skills produced by degrees for future working life is one of the critical factors related to the quality of education (Kotila and Mäki 2012; Kotila et al. 2012). Today's trend is to jointly anticipate and build the knowledge base of the future working life. This means that working-life cooperation is emphasised in higher education pedagogy. Research and development projects that have a working life order and work in multidisciplinary teams promote the development of students' skills in teamwork, social interaction, problem solving and cooperation.

2.13   University Pedagogy in the UK (and Scotland)

All UK universities are independent bodies. Universities in the UK have a variety of legal structures, leading to differences in their rights and powers and who is a member of the university's governing body (Committee of University Chairs 2009; Farrington and Palfreyman 2012). Each university's constitution determines the university administration, typically based on an act of parliament, a royal charter or an advisory decree issued by the Privy Council.

In Scotland, the Universities (Scotland) Act (1966), as amended by the Higher Education Governance (Scotland) Act (2016), contains the minimum requirements for the composition of courts, where students elect a rector (at the University of Edinburgh, staff also vote) and a vice-chairman.

UK higher education is respected worldwide for its renowned standards and quality (Atherton, Lewis and Bolton 2023). The prestige of its higher education also stems from the work of its graduates afterwards. British universities have produced outstanding people in many fields whose work has been recognised worldwide. Some universities and other higher education providers are among the top universities in the world. London, the capital of Great Britain, is considered the capital of higher education in the world (Guthrie 2019; Atherton, Lewis and Bolton 2023). London has the most globally respected universities per city, with four of the top ten universities in the world. In the UK education system, there is a difference between a college and a university. In Great Britain, a college is a further education institution that prepares students for a degree. The university is a licensed higher education institution that grants students a degree at the end of their studies. In the British education system, most curricula are developed by the universities that offer them and are not controlled by the government or some British educational institutions. The only exception are teacher training programs, over which the government has much say.

The British government has established the Office for Standards in Education, Children's Services and Skills (Ofsted) to maintain standards related to education ('An Introduction to Higher Education System in the United Kingdom' 2023). The United Kingdom is considered to have the best teacher education programs in the world because of the strict rules and high standards that apply to teacher education programs there.

Although the universities set the curricula, the UK school system's Office for Fair Access (OFFA) has much say in the university's admissions procedures of each university (UK Education System Guide 2023). This office was established to enable anyone wishing to study at a university in the UK. They also promote equal access to higher education, even for those studying at university as international students. Appropriate access also includes people of different cultures, races, nationalities and people with disabilities.

The higher education system in the UK encourages self-study, discussions and practical work ('Teaching Methods in the UK' 2023). Students may have scheduled classes or be encouraged to do more independent work in the course for a significant amount of time.

The teaching methods can differ a lot from the teaching methods of other countries. The lectures guide the students through the course material by explaining the topic's main points and bringing new topics to the study or discussion. The class size is usually large and can exceed 100 students. The main advantage of this teaching method is that students get up-to-date information not necessarily in textbooks and are offered the core material of the subject area.

Seminars provide a forum for students to share their views on a particular topic. The students are told about the topic in advance and must prepare a presentation. The discussions around the presentation often help students to understand the topic better and develop their communication skills.

Tutorials give students targeted guidance on a specific topic. Students meet with professors in person to discuss their concerns about the topic they have taken and thus seek individual guidance.

Students can also study through practical work. The goal is to give the students practical experience with the theories studied in class and to develop practical skills that help prepare them for a future career. Practical work can be done alone or as part of a group. In some courses, students can spend some time away from their lessons working in connection with their studies, which gives them ground-to-air market visibility.

Independent study is also an essential part of studying in Great Britain. The students study the topic in detail and form their view of it. Independent study usually means working alone or in a small group with other students to research a topic, write a paper, or present for a seminar.

Written work can include essays, projects, dissertations or assignments. They can be evaluated and given grades. The evaluation method can be essays, projects, dissertations, workshops, portfolios, presentations, and performance in exercises or exams, which can be open or closed-book exams depending on the course.

The Quality Assurance Agency (QAA) Scotland has decentralised the responsibility for quality work in Scotland ('Our Work in Scotland' 2023). The work uses the Quality Enhancement Framework (QEF). QEF supports higher education institutions in managing the quality of students' learning experience and creates public confidence in academic standards. QAA works closely with higher education providers, financiers and

student organisations. The partners are the Scottish Government, Scottish Funding Council, Scottish universities, NUS Scotland, Student Partnerships for Quality in Scotland (sparqs) and Advance HE.

Cooperation with students is an essential part of QAA's activities. Each evaluation group of the educational institution has a student member, and student representatives are involved in all working groups and committees. This work aims to ensure that international perspectives and contributions are considered. Cooperation includes developments in the Bologna process and the European higher education sector.

The Quality Enhancement and Standards Review (QESR) is an assessment method for Scottish higher education institutions for the academic sessions 2022-23 and 2023-24 ('Quality Enhancement and Standards Review' 2023). It forms the first stage of a two-stage external institutional quality assessment approach, developed in conjunction with the Scottish Funding Council's (SFC) wide-ranging review, Coherent Provision and Sustainability: A Review of Higher Education and Research. As a result of this review, the SFC is currently working with the Scottish sector to develop tertiary arrangements for quality assurance and improvement, which will be implemented from the start of the 2024-2025 academic session.

In phase 1 of the developing quality improvement arrangements, the QESR focuses on managing the academic quality and standards of the higher education institution and how the higher education processes incorporate an enhancement-based approach to improving learning, teaching and the broader student experience. QESR also considers the institution's performance under the previous assessment method, the Enhancement-led Institutional Review (ELIR), and subsequent performance to address findings. QESR is supplemented in phase 1 by Institutional Liaison Meetings (ILM).

The Office for Students (OfS) is the education control body for providers who can register there ('Higher Education Review and Annual Monitoring' 2023). Eligible providers wishing to apply for or retain Tier 4 sponsor status must register with the OfS. The OfS is also the body for service providers who require specific course designation.

The QAA is a training control body only for those providers who are not eligible to register with the OfS. Training supervision takes place every four years, and depending on the nature of the service provider, we use different evaluation methods for this purpose:

- Higher Education Review (alternative providers)
- Higher Education Review (foreign service providers)
- Recognition system for education supervision
- Supervision of education: exceptional arrangements.

Service providers must submit an annual report between complete inspections and follow-up visits every year.

The Further and Higher Education (Scotland) Act 2005 placed a new duty on the Scottish Funding Council (SFC) to improve and assess the quality of funded education ('12 - Scotland - Teaching Methods' 2023). The Quality Assurance Agency (QAA) (Scotland) works with the SFC in this role.

2.14   Sociocultural Factors

Sociocultural factors are essential in higher education studies, as they affect students' learning experiences and results from different backgrounds and contexts (Harve 2023). Some of the sociocultural factors studied in the literature include the quality of the educational service provided by the educational institution, which has dimensions such as certainty, empathy, responsiveness, reliability and concreteness. These factors affect the satisfaction and adaptation of international students, as they may face challenges in adapting to a new cultural and academic environment. Students' social class of origin shapes their habitus, or system of dispositions, which guides their educational choices and aspirations (허수원 and Chongwon Park 2013; Yılmaz and Temizkan 2022).

Students from lower social classes may have more barriers and limitations to accessing higher education opportunities or lower expectations and confidence in their abilities.

Students' academic success can be influenced by the volume and type of cultural, social and financial capital of students and their families (허수원 and Chongwon Park 2013; Spiliopoulou, Koustourakis and Asimaki 2018; Yılmaz and Temizkan 2022). Cultural capital refers to knowledge, skills and values valued by the dominant culture, which can be converted into educational recognition. Social capital refers to networks and relationships that can provide access to resources and opportunities. Financial capital refers to material and financial assets that can support education. These forms of capital can affect students' chances of success and their perception of their position in the social structure.

The way teachers interact with students from different social backgrounds and convey their expectations and beliefs is also relevant. Teachers may have implicit or explicit prejudices or stereotypes about certain students or adopt different pedagogical approaches based on their cultural background (허수원 and Chongwon Park 2013; Cherry 2022). These factors can affect student motivation, engagement, and performance in the classroom.

These are some of the socio-cultural factors studied in higher education studies. They show that learning is a cognitive, social and cultural process influenced by several factors at different levels. Understanding these factors can help teachers design more effective and inclusive learning environments for diverse learners.

2.15   Summary

Several different pedagogic models have been chosen as the background theory because the starting point of the research is the LbD Action Model, to which these pedagogical models are related. At first, constructive pedagogy was discussed, which has been a starting point in developing LbD. Important pedagogical methods discussed here are pragmatism and experiential learning, learning by doing, problem-based learning, project-based learning, exploratory learning and Learning by Developing.

In addition, this section contains an overview of the teaching methods of institutions included in the study. The University of Applied Sciences pedagogy has been reviewed from the Finnish teaching methods because the object of the study was two Universities of Applied Sciences from Finland. One study target institution is one University from the United Kingdom, Scotland; therefore, the background in pedagogy and universities from the UK has also been included in the review. Finally, there is also one section about perceived barriers to adoption.

Due to these background factors and the object and nature of the research, a specific research strategy and methods suitable for this research have been chosen. In section 3, the research strategy and research methods are reviewed in more detail.

Chapter 3:   Methodology

3.1 Introduction

The starting point of the research is to find out how LbD pedagogy fits the project-oriented study modules of computer science students, which include a customer project. When making the research plan, qualitative research was chosen as the research method because the purpose was to study the use of LbD in teaching and learning, and the qualitative research method is well suited for this type of research. Quantitative methods have also been used in the research to analyse student surveys.

The research framework is mainly a qualitative study because the purpose is to understand the phenomenon under investigation, that is, to collect the authentic experiences of students, lecturers and customers about using the LbD model in teaching (Hirsjärvi, Remes and Sajavaara 2009). Qualitative research is based on several traditions, approaches, data collection, and analysis methods for studying people and their lives. Qualitative research can be used in any research that aims for findings without statistical methods or other quantitative means (Strauss and Corbin 1990). Qualitative research aims at an in-depth understanding of the phenomenon and does not aim for generalisations similar to quantitative research (Kananen 2008).

What qualitative studies have in common is that they examine the living world, focusing on meanings in the most diverse ways (Metsämuuronen 2006; Kananen 2008). This study aims to get information about students' learning experiences in teaching according to the LbD model and to find out how well it fits the study of computer science according to both students and teachers. However, the research cannot be fully classified as qualitative research but can be called mixed-method research. Qualitative research is often equated with material-based research and theory-based with quantitative research. Both surveys and thematic interviews are used as research material in this study. This kind of research approach is called triangulation. This research uses material triangulation (data objects: students, pedagogical staff, lecturers and project clients) and method triangulation (questionnaires and thematic interviews).

3.2 Research Philosophy

Research philosophy is collecting, analysing and using information about a phenomenon. Two major research philosophies have been identified in the Western scientific tradition: positivism (sometimes called scientism) and interpretivism (also known as antipositivism) (Galliers 1991). In the pragmatism research philosophy, concepts are accepted as meaningful only if they support action. Pragmatics has many ways of interpreting and researching the world(Saunders, Lewis and Thornhill 2012). However, no point of view can give a complete picture, and there can be several realities. In the research philosophy of pragmatism, the research question is an essential element. Pragmatists use several methods to find answers to research questions. There is no need to do this, but when necessary, pragmatists use combinations of methods that promote research in the best possible way.

The research philosophy of this study is based on pragmatism. Figure 10 shows the so-called onion structure of the research philosophy. This study investigates development-based learning in the university by collecting research data from three different higher education institutions. The research is carried out as action research, where the researcher is involved as a participant, external observer, data collector, and analyser (Heikkinen and Jyrkämä 1999; Huttunen et al. 1999; Kuula 1999; Ferrance 2000; Heikkinen et al. 2012; Taber 2013). The purpose is to develop practices based on the knowledge obtained through the research results. Student surveys are essential, and research data has been collected and analysed using quantitative and qualitative methods. Through thematic interviews, research information has been collected from lecturers, project clients and pedagogical staff. Narrative and content analysis have been used to analyse these theme interviews.
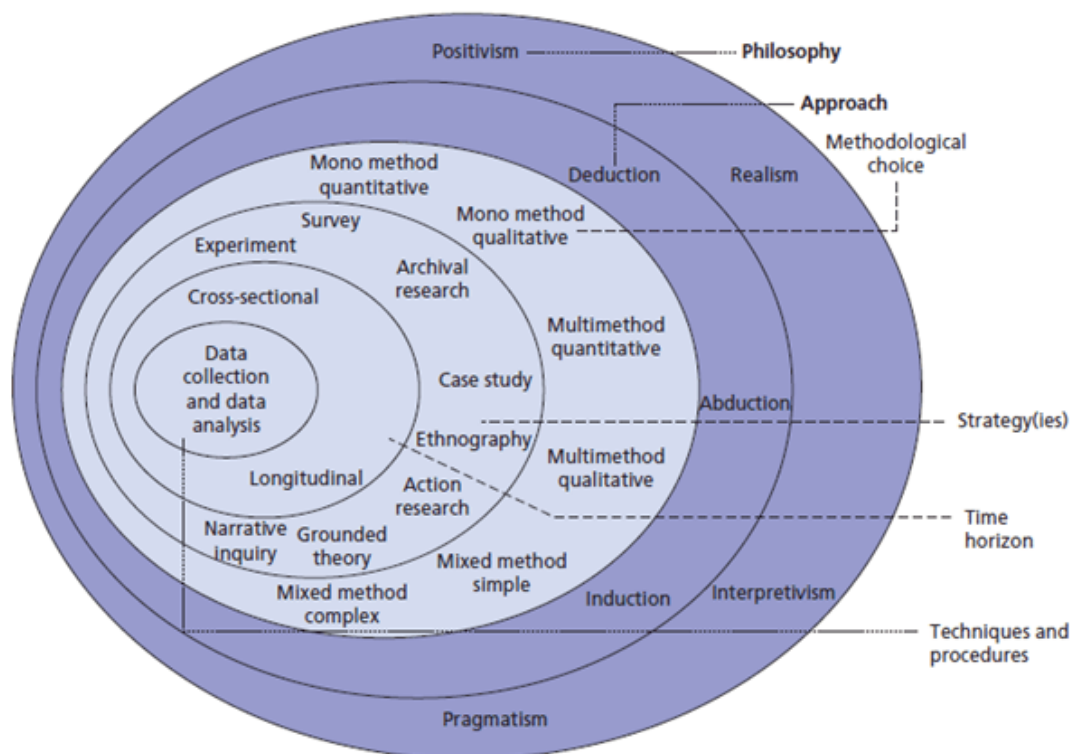
Figure 10: Research philosophy in the 'research onion' (Saunders, Lewis and Thornhill 2012)

As a scientific, philosophical orientation, pragmatism is suitable for research that emphasises action and orientation to practice when conducting research (Niiniluoto 1997; Bird 1998). Through the research results, the purpose is to develop activities, solve the observed problems and produce new information about the researched matter. Action research is also well-suited as a research strategy where the research subject is studied in several cycles.

3.3 Research Methods and Process

The research process is carried out as an active study with several cycles, as is generally the case in action research. The purpose of action research is to investigate and change prevailing practices. Action research seeks solutions to problems, and the researcher and other research participants are actively involved (Kemmis and Wilkinson, 1998.)

Action research is inclusive and cooperative; individuals do it with a common purpose. It is also situational and context-specific; it develops reflection based on the interpretations made by the participants; it is information generated through the activity and from the application targe; it is related to problem-solving if the solution of the problem leads to

the improvement of practice, and it is one in which observations arise as the activity develops, but they are not final or absolute.

Because action research is conducted in actual conditions and involves close and open interaction between the people involved, researchers should pay attention to ethical aspects in their work (Lewin 1946). Definitions of action research often emphasise an empirical and logical problem-solving process that includes cycles of action and reflection. Lewin's definition: It proceeds in a cycle of steps, each consisting of a circle of fact-finding about planning, action, and the results of action (Figure 11).
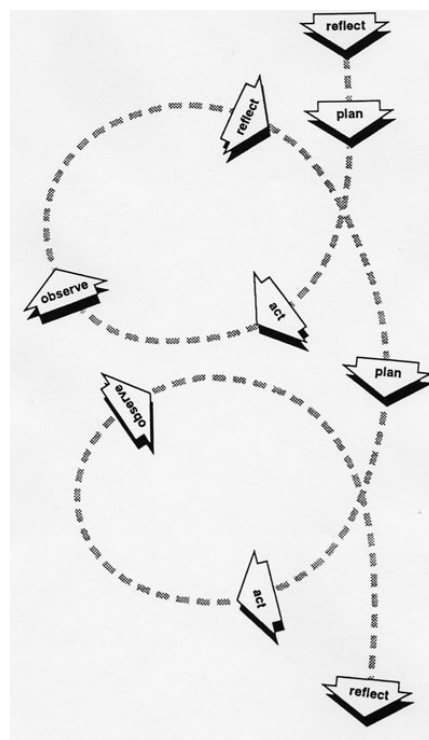
Figure 11: Lewin's 'action research' spiral (Lewin 1946)

Action research is a participatory process of developing practical knowledge to achieve successful human purposes (Reason and Bradbury 2008). It aims to bring together action and reflection, theory and practice, participating together with others to find a suitable solution to the questions weighing on people's minds and, more generally, to the flourishing of individuals and their communities.

In action research, participants systematically and carefully examine their educational practice using research techniques (Lewin 1946). An individual teacher, a collaborative group of colleagues or the entire school faculty can participate in the educational action

research. Action research has been chosen as the research strategy of this study because the purpose of action research is specifically teachers' participation in research, the purpose of which is to provide information and change their practices in the future. Action research is characterised by a practical orientation, problem-centeredness, the roles of the research subjects and the researcher as active agents in the change process, and the cooperation that is the basis of the relationship between the research subjects and the researcher (McNiff and Whitehead 2009; Whitehead and McNiff 2012; Coghlan and Brydon-Miller 2014; McNiff 2016). From these features, three different factors related to the self-understanding of action research can be derived: the aim of the research is not only to describe or explain but also to change social reality, understanding the researched subjects is a requirement included in the research practice itself, and with the help of change, it is possible to produce unique information about the subject/issues under study. In action research, a change may or may not occur, or the difference may be completely different from what was initially intended. In situations where change does not happen, attitudes, power structures, and work cultures may become visible, which would not necessarily appear with other investigations. In action research, it is essential to change different states of affairs in real-time by promoting and improving them in one way or another. However, it is equally important to remember that it is also a study. The material is always produced in action research, and new research information is based on it, even if the intended functional changes are unsuccessful.

Action research is participatory, collaborative, emancipatory, action learning, community-based, and action science (Kemmis 2008; McNiff and Whitehead 2009). Action research is like "learning by doing" and is a commonly used approach to improving real-life conditions and practices. The goal of action research is to contribute to the practical concerns of people in immediate problem situations and simultaneously promote social scientific purposes. The double commitment of action research is to study the system and cooperate with its members to change it in a mutually desired direction.

Several characteristics distinguish action research from other types of research (Ferrance 2000; Heikkinen 2006; Metsämuuronen 2006, 2008; Heikkinen et al. 2012; Coghlan and Brydon-Miller 2014). The primary focus is to turn the people involved into researchers of what they have learned by doing it themselves. It also has a social dimension - research takes place in real situations and aims to solve real problems. Unlike in other disciplines, the researcher does not try to remain objective but openly admits bias towards other participants. The possible subject of action research and the

substance of the study can be almost any feature related to human life. The initiative for research can come from the need to solve problems found in previous studies, that is, from the initiative of universities and researchers. However, it is equally possible, and in practice also more likely, that the research object itself or an organisation representing it or similar is the initiator of the research. An initiative can also be born as a combination of these. In this study, the initiative came from the researcher's interest in investigating the suitability of the pedagogic model in his organisation for computer science students' project-based studies and the possibility of developing the model to suit that purpose better.

Educational Action Research has its roots in the writings of Dewey, the American educational philosopher of the 1920s and 30s, who believed that professional educators should participate in community problem-solving data (Noffke et al. 2009; Bloomberg and Volpe 2012). Its practitioners operate mainly outside educational institutions and focus on curriculum development, professional development and the application of learning in a social context. Action research can include collecting quantitative and qualitative data.

The action research process often progresses in cycles, which is why it is sometimes described as a cycle of action and reflection (McNiff and Whitehead 2011). The cycle consists of the following areas that drive activity: observe, reflect, act, evaluate, modify and move in a new direction (Figure 12). According to the cycle, the action research process starts with defining a specific concern or development target and ends with utilising a new action model or practice. The development cycle that led to introducing a new action method may take several years because solving one problem can bring up new, previously unrecognised contradictions and challenges (Virkkunen et al. 2001).
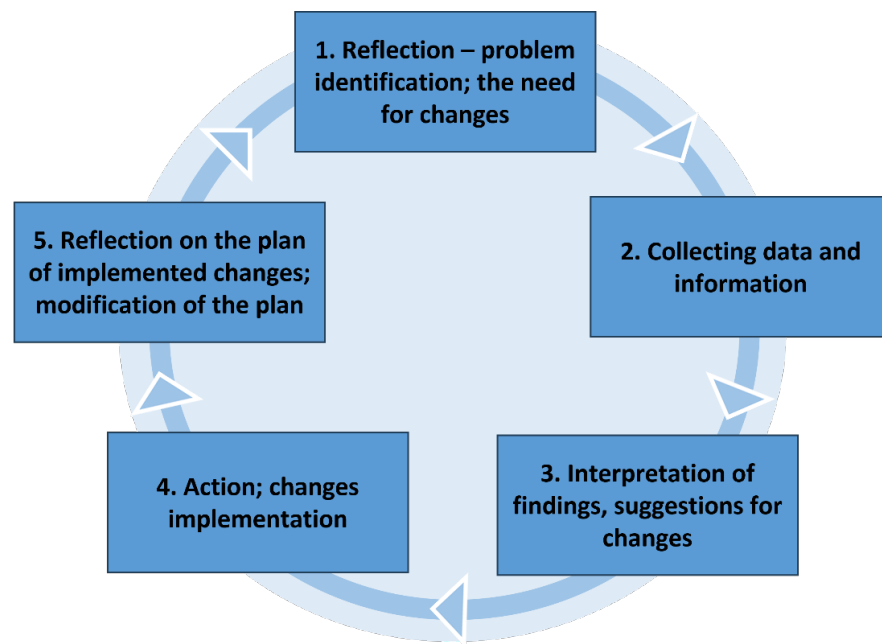
Figure 12: Action Research Cycle Activities (Seberová and Malčík 2014)

The planner of the research process is required to be systematic and goal-oriented. The research process can be divided into the following steps.

Step 1: Defining the research topic

The action research process begins with defining a research topic, the accuracy of which can vary from, for example, a hypothesis to be tested to trying out a particular idea (McNiff 2016). The topic could be a person's reflection on how he could improve the quality of his work. The research topic of working life is often based on some factor that causes challenges for the researcher and, most often, other employees (McNiff and Whithead 2011).

Step 2: Formulation of the research question

The researcher defines the purpose and goals of his research and formulates a research question (McNiff 2016). For example, the following reflection could serve as a research question: "How could I improve the quality of my work?".

Step 3: Develop a research plan

The researcher prepares a research plan to record the reasons for conducting the research and the research method (McNiff 2016). Sometimes it is appropriate for the research plan to be modifiable, in which case new topics that raise questions that arise during the research can be flexibly considered. The research plan describes how the validity of the claims made based on the study will be demonstrated. The desired result of the research must work as a red thread throughout the plan. In the planning phase, in describing the vision, the expanding re-evaluation of the object and result of the activity is central; it is necessary to consider how the new operating model will best serve its users in the future as well (Virkkunen, Engeström, Pihlaja & Helle 2001).

Step 4: Getting started

At this stage, the researcher acts. The activity should show the development in learning critical thinking and behaviour (McNiff 2016). The activity also involves other community members and promotes the interests of others other than the researcher.

Step 5: Data collection

The data collection phase includes observation, practical supervision, data collection and progress monitoring (McNiff 2016). Collected data can be in physical or electronic form. First-degree knowledge is generated now, while second-degree knowledge is processed. Data from reports and various documents are secondary information.

Step 6: Defining the set of criteria and standards to be followed

Next, the researcher must define the criteria and standards for making. The criteria and standards are usually agreed upon in advance, but requirements can also appear during the process, for example, as a result of ongoing discussions. Instead of the requirements often used in traditional research, the generalisability and reproducibility of results, the values are transformed into a set of criteria in action research. The quality

is determined by how well the researcher can demonstrate the realisation of values when negotiating with the research participants.

Step 7: Generating a description from the collected data

Information directly related to the research question and the claims should be selected from the data (Denzin and Lincoln 2008; Hirsjärvi, Remes and Sajavaara 2009; McNiff 2016; Eskola and Suoranta 2022). For example, if the study's goal is a workplace where people are treated fairly and respectfully, the definition of quality is based on the values of fairness and respect. In this case, the aim is to select the information that illustrates the manifestation of justice and respect resulting from the action taken. In an imaginary situation, the researcher's colleague could say that he has experienced a new way of working and that his supervisor has treated all his subordinates more equally than before. In addition, according to his experience, the number of fair decisions has increased.

Step 8: From claim to information

At this stage, it must be shown how new information has been produced and that the claim has become valid (McNiff 2016). Traditional research describes how the hypothesis has been tested and accepted or rejected. On the other hand, action research is about how the researcher demonstrates that he has encouraged others to think and act critically - and that he also acts this way. The transformation of a claim into information requires, among other things, that new meanings have arisen through research and that tacit knowledge has become explicit.

Step 9: This claim should be linked to existing knowledge

At this stage, the researcher tries to show how his new knowledge is positioned about other literature and people's way of thinking (McNiff 2016).

Step 10: Testing the validity of the claim

Testing the validity of a claim is to determine whether the claim is believable (McNiff 2016). In action research, the claim's validity is established by

showing that a change has occurred, progressing together in the direction of values. The usefulness of the study is discussed with others.

Step 11: Exposing the argument to criticism

It is essential to expose the claim to criticism by checking the validity of the claim both personally and from the perspective of others (McNiff 2016). In other words, the examiner should assess whether he can demonstrate a change in his actions and other people's satisfaction with the claim.

Step 12: Describing Significance

The next step is to describe the potential significance of the research and the claim (McNiff 2016). In action research, significance relates to how the benefit can be produced for the researcher's learning and others. The opportunity to use both the practitioner's and organizational, cultural and social perspectives also adds to the importance.

Step 13: Generating theory based on research

Knowledge refers to what is known, and the theory explains what is known and how it comes to be known (McNiff 2016). The theories of traditional research are based on literature and verbal explanations. In action research, the theory is formed through practices and action descriptions. While traditional theories are abstract and static, action research theories are characterised by dynamism and practicality.

Step 14: Make the practice robust to evaluation

The policy should be modified to withstand evaluation (McNiff 2016). Action research assumes that anyone can be both a research practitioner and a user of research: everyone can improve their practices by learning from each other, together and individually. Research practitioners must be able to offer valid explanations of how and why the desired change has occurred.

Step 15: Preparing the report and describe the findings

In the final stage of the action research, a report is drawn up, and the findings are described (McNiff 2016). The phase includes making the findings of the study generally available. All the stages of the research process described above contribute to building the validity and legitimacy of the research. Completing these steps results in the study being publicly accepted and classified as part of a more extensive knowledge structure.

Action research is qualitative, as it can be used to examine textual descriptions of how people see a specific topic. It provides information about 'human', often conflicting behaviours, beliefs, opinions and feelings. Qualitative research includes numerous different traditions, approaches and data collection and analysis methods for studying people and their lives, so it is not a research sample of any specific discipline or just one type of research (Denzin and Lincoln 2008; Hirsjärvi, Remes and Sajavaara 2009; Eskola and Suoranta 2022). The study of the living world is common to the entire spectrum of qualitative research. Qualitative research focuses on meanings manifested in diverse ways (Varto 1992). Qualitative methods are also effective in identifying intangible factors that quantitative methods do not reveal (Töttö 2000; Alasuutari 2019). For the students, data collection took place using questionnaires, in which case specific data could also be analysed using quantitative methods. When quantitative methods are used in conjunction with qualitative research, they can help researchers better interpret and understand the complex reality of a given situation and the implications of quantitative data (Mertler 2021). The advantage of qualitative methods is that they provide a wealth of detailed information and participant experience of the experience and provide multiple contexts for understanding the phenomenon under study (Töttö 2000; Alasuutari 2019; Eskola and Suoranta 2022). For this reason, qualitative research can express living phenomena or compare and analyse individual cases or groups.

The limitations of qualitative research methods also reflect their inherent strengths (Töttö 2000; Alasuutari 2019; Eskola and Suoranta 2022). Small sample sizes help to investigate research problems holistically and thoroughly and simultaneously reduce the possibilities of generalising or horizontal recommendations. In qualitative research, researchers are often involved in cultures and experiences that can cause a lack of objectivity in data collection, interpretation, and reporting. This is one reason why research questions must be carefully designed to be reasonable, reliable and comparable. Some of the questions students answered on a scale of 1-5 according to

the Likert scale. In addition, there were questions that the students responded to freely. Through these questions, the material can be accessed through qualitative analysis and should be carefully planned. The data collection method for the lecturers, project clients and pedagogical staff was a semi-structured interview. The number of interviewees was not very large because the interview was only conducted for those lecturers involved in implementing the module, project clients and pedagogical staff. The interviews were recorded and transcribed, after which the data were classified for analysis.

3.4 Data Collection and Data Collection Process

Research materials can be diverse, with different acquisition methods (Kananen 2008; Metsämuuronen 2008). Data acquisition methods are influenced by how the data is intended to be used in the research. Certain types of materials are suitable for certain types of problem-setting, and correspondingly, it is natural to analyse certain types of materials with specific analysis methods. Broader ethical choices can be structured from the data acquisition methods. Figure 13 illustrates the different data collection levels by placing the method types near the circle's centre or outer edge. Qualitative research data can be collected using various methods, such as surveys and interviews.
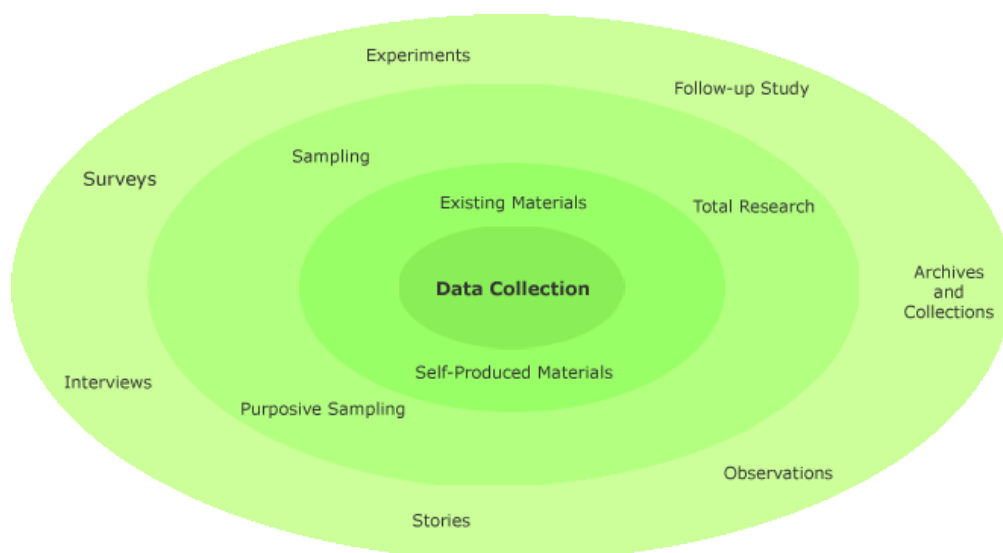
Figure 13: Data collection methods ('Data Collection' 2010)

In action research, the approach to problem-solving is more holistic than a single data collection and analysis method (Hirsjärvi and Hurme 2000; Stringer 2010). Action research enables the use of several research tools during the process. Standard methods of the qualitative research paradigm include keeping a research diary, collecting

and analysing documents, participant observation recordings, questionnaires, structured and unstructured interviews, and case studies.

3.4.1   Surveys

Surveys can be divided into two broad categories: questions and interviews (Hirsjärvi, Remes and Sajavaara 2009; Trochim 2023). The survey can be done in many ways. For example, what the researcher wants to find affects the choice of survey methods, the content of the question and the respondent group's limitations. Questionnaires can be paper and pen tools that the respondent fills out, or they can be implemented with an electronic questionnaire. The interviews are conducted by an interviewer, to whom the respondent answers orally. Interviews are usually recorded, after which they are transcribed for more detailed analysis. Interviews mostly ask open questions, but they can also have closed questions. Questionnaires may contain open-ended questions, but they are usually shorter than interviews. Many factors affect the preparation and implementation of the survey. These can affect the answers received in the survey, the informativeness of the answers, the survey's response rate and reliability. Implementing the survey requires focusing on its problem areas in advance and piloting it before implementation. The answers can be analysed quantitatively and qualitatively, depending on the form of the survey.

One way to collect research data is through a questionnaire (Hirsjärvi, Remes and Sajavaara 2009). The advantage of a questionnaire is that it can be used to collect extensive research material. A questionnaire can get many respondents, and they can be asked many things. The questionnaire should be designed carefully so that the material can be processed quickly and stored and analysed easily with the help of a computer. The weakness of the questionnaire is that the material can be superficial, and verifying how seriously the respondents take the research is impossible. From the respondents' point of view, the answer options of the questionnaire can also be such that there can be misunderstandings. One danger of the questionnaire is that the response rate is not very high if the survey respondents are not motivated to answer.

In this study, research data from students has been collected using surveys. The survey contains numerical questions self-assessed on a Likert scale and questions for free-form answers.

3.4.2   Interviews

An interview is a data acquisition method in which the researcher participates interactively in data production (Anttila 2023). Interview methods can be classified according to the researcher's role in the interaction. There are also different interview structures and implementation methods, and other types of interviews have developed their practices.

Different interview types can be classified, for example, according to the degree of interaction between the interviewer and the interviewee (Metsämuuronen 2006; Kananen 2008; Hirsjärvi, Remes and Sajavaara 2009; Silverman 2010). The interview can be, for example, unstructured, i.e. open, semi-structured, or structured. Often, an open interview approaches a conversation between the interviewer and the interviewee. The interview format can be, for example, a themed interview, a group interview or an expert interview. Interviews can be recorded in many different ways, for example, by filling in a form, taking notes, recording or videoing.

Regarding formality, the theme interview falls somewhere between a form and an open interview (Hirsjärvi and Hurme 2000; Eskola and Suoranta 2022). The interview does not proceed through precise, detailed, pre-formulated questions but more broadly targets specific pre-planned themes. A themed interview is a degree more structured than an open interview because in it, the topics, and the themes, prepared based on previous research and familiarisation with the issue, are the same for all interviewees, even though they move flexibly without a strict progression route. Thematic interviews aim to consider people's interpretations and their giving of meaning. Space is given to people's free speech, although the pre-determined themes are discussed with all subjects.

A theme interview is a conversation-like situation where pre-planned themes are discussed (Metsämuuronen 2006; Kananen 2008; Hirsjärvi, Remes and Sajavaara 2009; Silverman 2010). The order in which themes are discussed is free, and not all subjects are necessarily discussed to the same extent with all interviewees. During the interview, the researcher takes brief notes on the topics to focus on the conversation. For example, the themes can be listed in French lines, and additional questions or keywords can be prepared to fuel the discussion. In a themed interview, asking a few detailed questions in exact order is not a good idea. The goal is to discuss the themes and their sub-themes reasonably freely. For example, a theme interview is suitable when information about lesser-known phenomena and problems is needed.

A thematic interview requires thorough familiarity with the subject area and the interviewees' situation so that the interview can be focused on specific themes. Therefore, a thematic interview's content and situational analysis are crucial(Hirsjärvi and Hurme 2000). The themes to be discussed are chosen based on familiarity with the researched topic. The research topic and questions must be changed into a researchable, operationalised form. In addition to considering the questions, the selection of the interviewees should also be considered: Research participants should not be chosen randomly by tagging any passerby. The people to be researched should be selected from those from whom it is thought that material on matters of interest can best be obtained.

The popularity of thematic interviews is based, for example, on the fact that the freedom to answer gives the interviewees the right to speak. In addition, it is relatively easy to analyse an interview-focused theme by theme. However, it is good to keep in mind that the themes set in advance by the researcher are not necessarily the same as the themes that, by analysing the material, essentially structure the content of the material and the research topic. The research can also progress from the thematisation of the material to writing. Theme interview material can also be analysed quantitatively or as a combination of quantitative and qualitative. Depending on the research problem, linguistic approaches are also possible. The thematic interview, therefore, does not need to be analysed in a specific way, even though thematisation and typification are a common and logical continuation of the type of interview in question. One explanation for the popularity of thematic interviews is the widely read and widely used work of Hirsjärvi and Hurme on this website, the first edition of which was called "Thematic Interview". More recently, it has taken on a new form as the work "Research interviewing. The theory and practice of theme interviewing" (Hirsjärvi and Hurme 2008).

3.5 Data Analysis and Synthesis

It is meaningful and natural to choose specific types of analysis methods to solve certain kinds of problems (Kananen 2008; Metsämuuronen 2008; Tuomi and Sarajärvi 2018; Alasuutari 2019; Eskola and Suoranta 2022). Although the analysis methods are methodological choices of the research, they also involve theoretical starting

assumptions. These starting assumptions follow the theories of knowledge production linked to scientific and philosophical trends.

The primary division of analysis methods can be divided into quantitative and qualitative (Varto 1992; Metsämuuronen 2006; Tuomi and Sarajärvi 2018; Alasuutari 2019; Eskola and Suoranta 2022). The analysis methods on the left of the circle are typically quantitative. In contrast, the methods on the right and at the top and bottom of the circle are generally qualitative (Figure 14). On the other hand, several analysis methods can be placed in the middle ground between quantitative and qualitative analysis methods. The analysis methods in development serve as links to their more detailed presentation.
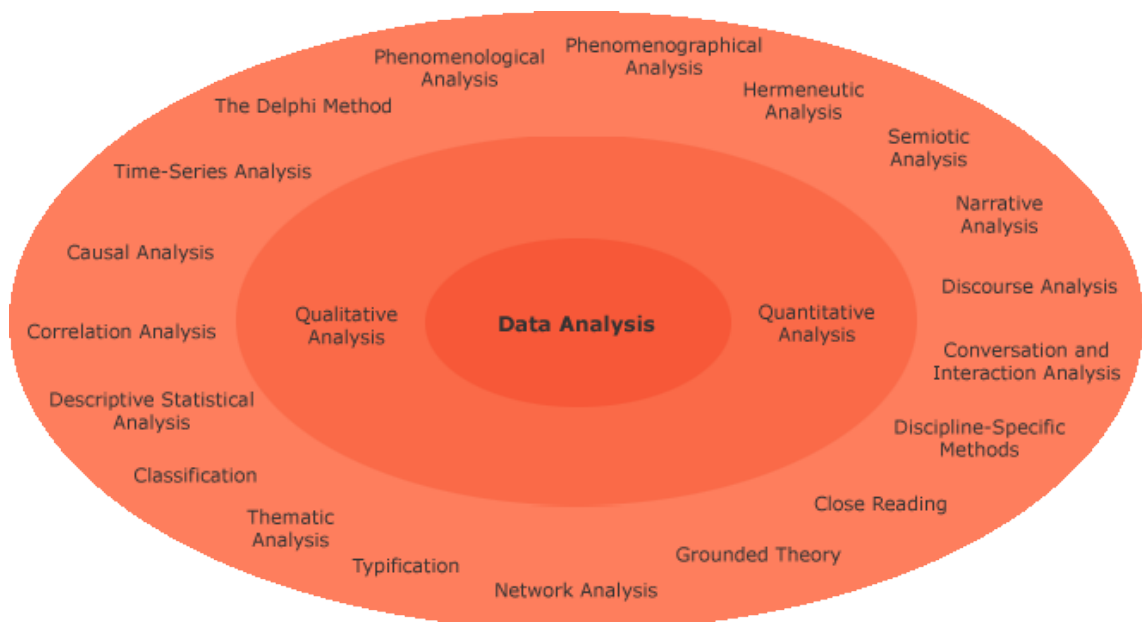
Figure 14: The selection of data analysis methods ('Data Analysis' 2016)

In qualitative research, people's experiences, views, values and meanings are examined profoundly and over a wide area (Strauss and Corbin 1990; Varto 1992; Denzin and Lincoln 2008; Silverman 2010; Frost 2011; Bernard, Wutich and Ryan 2017; Alasuutari 2019; Eskola and Suoranta 2022). It is based on a subjective point of view, and the researcher's role is often participative and active. Qualitative research is usually non-standardised and aims to create a deep understanding of the phenomenon under study. It is well suited for topics without clearly defined metrics, or that cannot be measured numerically.

Qualitative research is beneficial in developing teaching methods, as it provides a deep and wide-ranging understanding of teachers' and students' experiences, views and needs (Alasuutari 2019; Eskola and Suoranta 2022). It can provide important information about the effectiveness and efficiency of teaching and help develop teaching methods that better meet the needs of students and support learning. For example, interviews, focus groups, case studies or participatory research can be used in qualitative research. Such analysis can help to understand the needs of teachers and students better and develop teaching methods that are more effective and better meet the needs of students.

In qualitative research, several analysis methods structure and interpret the obtained data (Bernard, Wutich and Ryan 2017; Eskola and Suoranta 2022). The primary analysis methods are:

1. Content analysis: A text or speech analysis method in which the researcher looks for themes and categories in the researched material.

2. Theory-guided content analysis: A method where the starting point is an already existing theory and where the material is interpreted from the perspective of the theory.

3. Thematisation of content analysis: A method in which the researcher looks for general themes and organises the material according to them.

4. Narrative analysis: A method of analysing stories and narratives in which the researcher examines how the stories are structured and what they tell about the phenomenon being studied.

5. Theoretical content analysis: A method in which the researcher creates a new theory or develops an existing theory about the phenomenon being studied.

Together or separately, these analysis methods can provide in-depth information about the phenomenon under study and help develop new perspectives and theories. The most important thing is to choose the most suitable method according to the goals and topic of the research.

Content analysis, narrative analysis and SWOT analysis are used in this study, and the mean and standard deviation are used to analyse quantitative results. With the help of

content analysis, the material is identified and categorised, focusing on the content of the text and its interpretation, the apparent content and hidden, cunning messages. The material is organised, described and classified, and the text is analysed systematically, but the emphasis is mainly on examining the results after the categorisation. Narrative analysis is used to analyse thematic interviews so that the results can be interpreted and different stories can be compared to each other and common themes or patterns found in them. In the SWOT analysis, the answers of the research participants are sought regarding the strengths, weaknesses, opportunities and threats related to the LbD model. The quantitative analysis uses the mean and standard deviation to interpret the students' Likert scale answers.

3.5.1   Quantitative Analysis

The quantitative analysis aims to investigate, for example, various causes of phenomena, the relationship between phenomena, or the prevalence and occurrence of phenomena through numbers and statistics (Vilkka 2007; Hirsjärvi, Remes and Sajavaara 2009; Mertler 2021). Quantitative analysis includes a wide variety of computational and statistical methods. Typically, quantitative analysis begins with a statistical KU-scaled analysis, which can also be the objective of the study as such. Depending on the study, this will progress, for example, to analysing common variations, addictions or time series or to do different classifications. When using quantitative analytical methods, the entire research process is generally outlined in advance, as choices related to problem arrangement, material procurement and analysis method are affected.

Quantitative data analysis is often distinguished between descriptive statistical analysis and statistical reasoning (Vilkka 2007; Eskelinen and Karsikas 2014). Descriptive statistics (descriptive statistics) seeks to describe and summarise the distribution of a quantitative variable or the typical variation of a quantitative variable without trying to generalise to any broader population based on the results. For example, if the target is only one variable, the average number of variables or dispersion figures may be used to describe it. For example, correlation coefficients may be used to describe their joint variation in a multiple-man variable.

The mean and standard deviation are commonly used to aid quantitative research. In quantitative analysis, the average is widely used to compare estimates (Collins 2002). The more comprehensive the range, the less the mean predicts the magnitude of a single

observation. However, the mean value does not indicate the frequency of average observations, but the standard deviation calculation is suitable for that. The standard deviation is helpful if the observations follow a normal distribution. Valuable information can be obtained by a simple arithmetic method if the observation population is known and the standard deviation is known. The standard deviation tells how concentrated the observations are. It describes the average variation of the values around the average and tells how far the observations are on average from each other. The larger the standard deviation, the more variation there is in the observations.

In quantitative research, it is common to involve form hypotheses. A statistical hypothesis is a statement that concerns the primary population of the study, and its veracity is assessed using probabilities (Kärkkäinen and Högmander 2006; Dementyev 2022). Statistical hypotheses must be tested, and the starting point is forming a null and alternative hypothesis. The null hypothesis (H_0) means that there are no differences between the basic sets being compared, which means that the deviations are just a coincidence. In the alternative hypothesis (H_1) of the null hypothesis, the result often means that there is a difference between the results. Phenomena are usually modelled using a null hypothesis, and the results are studied. The null hypothesis is usually chosen as the starting point for testing, even if it is desired to refute it, because "no difference" is not attractive as a research result. The null hypothesis is measured by the observed significance level of the test, i.e. the p-value. In empirical research, 5% is usually used as a limit, and an observation that refutes the null hypothesis is called statistically significant.

Hypotheses refer to a specific set, not a specific result. H0 and H1 are always presented as parameters of the basic set (Moore, McCabe and Craig 2014). H1 represents the effect for which the study seeks evidence. H0, however, describes that the desired effect does not occur. Choosing H1 is often a more difficult task because it should be known whether the parameters differ from the value of the null hypothesis in a specific direction or both directions, determining whether the counter-hypothesis should be one- or two-tailed (Kärkkäinen and Högmander 2006; Salonen 2018). A counter-hypothesis is used to express wishes or assumptions about the results of the groups being compared. In a one-way test, it is assumed that the average of the results of either of the compared sets is greater than the other.

The t-test is a statistical test that follows the Student's t-distribution when the null hypothesis is valid (Salonen 2018). The t-test tests the mean values of normally

distributed random variables. In the test, the t-value is calculated and compared to the limit value extracted from the t-distribution, which was chosen as the significance level. The most common significance level is 0.05, also chosen as this study's significance level. The dependent t-test looks for "differences" between mean values when participants are measured with the same dependent variable in different situations and time points, which is standard practice in pre-post research design. In this study, the dependent t-test has been chosen as the t-test, because the study has examined students' self-assessments of their competence development at the beginning and end of the module. The distribution of the differences between the scores of the dependent t-test must be normally distributed. The normal distribution is realised and has been tested in this study. The premise of the null hypothesis of the dependent t-test is to test the means of two related groups when there are no differences between the groups. If the t-test result is statistically significant, the null hypothesis (H_0) can be rejected, according to which there are no differences between the mean values of the basic set. In this case, the alternative hypothesis (H_1) can be accepted, and it can be stated that there are differences in the average values of the basic set. A one-way hypothesis can be presented as follows:

$$H_0: \mu_n = \mu_m$$

$$H_1: \mu_n < \mu_m$$

This study uses the mean and standard deviation in the quantitative analysis to evaluate students' self-assessment skills. The dependent t-test is used to test the statistical significance of the results. The t-distribution is a type of normal distribution used for smaller sample sizes (Bevans 2023). Normally distributed data form a bell shape when plotted on a graph with more observations near the mean and fewer observations in the tails. The t-distribution is used when the data is approximately normally distributed, meaning that the data follows a bell shape, but the population variance is unknown. The variance of the t-distribution is estimated based on the degrees of freedom of the data (total number of observations minus 1). The t-score is the number of standard deviations from the mean of the t-distribution.

In statistics, t-scores are primarily used to find two things: the upper and lower limits of a confidence interval when the data are approximately normally distributed; and the p-value of the test statistic for t-tests and regression tests. Confidence intervals use t-scores to calculate the upper and lower bounds of the prediction interval. The t-point

used to create the upper and lower bounds is also known as the critical value of t or t*. Statistical tests generate a test statistic that shows how far your data is from the null hypothesis of the statistical test. Then, they calculate a p-value that describes the probability of your data if the null hypothesis were true.

In this study, the students' self-assessments regarding competence development during the study module follow a normal distribution. However, the sample sizes are small, especially for the results of RGU and Haaga-Helia students, and therefore, the t-test is well suited as a statistical analysis method in addition to the mean and standard deviation.

In the survey, the students answered six different areas and 20 questions. Students evaluate their skills at the beginning of the study module and the end of the study module. The analysis of the answers examines the change in the mean and the standard deviation during the study module.

3.5.2   Content Analysis

The research results are analysed using verbal feedback and content analysis of the transcribed interviews (Kananen 2008; Tuomi and Sarajärvi 2018; Alasuutari 2019; Eskola and Suoranta 2022). This study's content analysis is based on the data (data-driven) and guided according to the chosen theory (theory-driven). The data-driven content analysis here refers to a method in which the categories formed from the original expressions of text or speech are built from the data. The aim is to create them in principle independently of theoretical presuppositions. Here, theory-guided analysis refers to a method in which the structure of the categories formed from the material is guided by theoretical concepts based on literature. A third approach to content analysis has also been mentioned in the literature, the theory-based analysis method.

Content analysis proceeds according to the typical process (Figure 15). In the data-driven analysis process, the material is initially reduced by asking questions based on the research task (Tuomi and Sarajärvi 2002; Denzin and Lincoln 2008, 2013; Kananen 2008; Silverman 2010; Frost 2011; Bernard, Wutich and Ryan 2017). Concretely, comments on the margin of the material are written about a text that provides different subjects. In the next step, the same statements or ideas with the same mean are combined with the same category. The categories that contain the same are then combined into different upper categories. This merger will continue as long as it is

meaningful for the material and analysis. Finally, the categories formed are interpreted as meaningful to them. In theory-guided analysis, literature forms a loose analysis frame that contains mainly key concepts for research questions. Inside the analysis frame, categories are formed from the data described above.
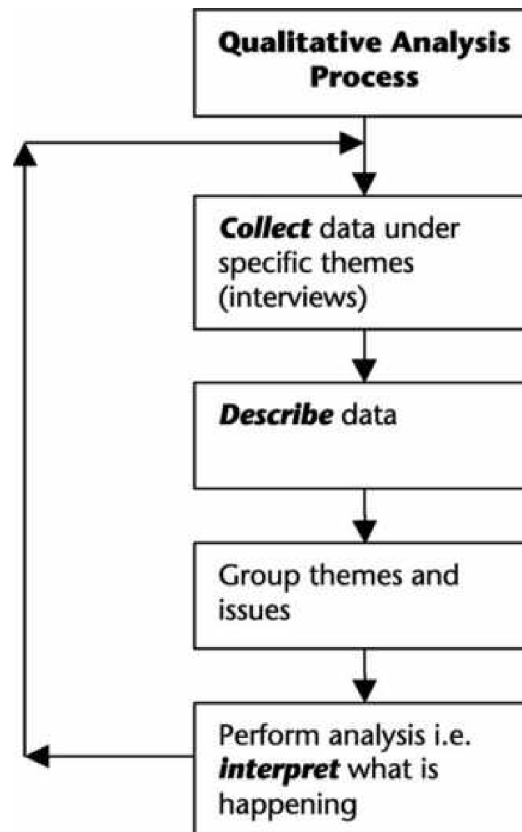
Figure 15: Qualitative Data Analysis Process (Biggam 2008)

The content analysis proceeds in slightly different ways depending on whether it is a material-oriented, theory-oriented or theory-driven approach.

The data-driven analysis follows the following steps (Tuomi and Sarajärvi 2018):

1. *Simplification of the material, i.e. reduction:* The parts relevant to the study are searched for in the material, and they are marked, for example, with underlines. Marked points are reduced by rewriting them in condensed form.
2. *Grouping or clustering:* Simplified expressions are grouped so that expressions meaning the same thing form a subcategory. Subcategories are named with a title that describes the content.

3. *Forming general concepts, i.e. abstraction:* The classification is continued so that the subcategories created in the grouping phase are combined into supercategories. Primary classes are formed from the upper classes and one unifying class from the primary classes. All categories are named with a title that describes the content.

The content analysis gives students authentic views and perceptions of learning in the LbD action model. The analysis explores how students describe their learning in the LbD action model and how this approach has promoted their learning. These are mirrored in selected objects: self-management and entrepreneurial attitude, critical thinking and problem-solving skills, foresight and innovation skills, communication and interaction skills, global skills, responsible skills, and fit for IT studies. Content analysis also studies transcribed thematic interviews with pedagogical staff, lecturers and project clients. Their classifications are made for each different background group, and it is implemented as far as the analysed results of the life groups of different organisations can be combined or compared.

3.5.3   Narrative Analysis

Narrative analysis can interpret interview research by studying the stories and their meaning to those being researched (Cortazzi 1993; Riessman 1993; Huttunen Heikkinen and Syrjälä, 2002; Dauite and Lightfoot 2004). This method makes it possible to understand and examine the personal experiences and views of the interviewees. Narrative analysis can help to detect themes and patterns appearing in the interviews, which can be interpreted as relevant to the life experiences and views of the persons under investigation. This method can also help understand the interviewees' thoughts and meanings on various events and experiences. Overall, the narrative analysis offers a more in-depth and personal way of looking at the interview data and interpreting the stories and their meanings that appear in the interviews.

The results of the narrative analysis can be interpreted in different ways depending on the research question and the research goals (Herman and Vervaeck 2005). The essential interpretation methods are:

1. *Identifying theme*s: involves detecting and describing common themes in the research material.

2. *Interpretation of meanings:* This includes understanding the story's meaning and role for the person being interviewed.

3. *Interpretation of interaction*: This includes understanding and examining the interaction between the storyteller and the listener.

4. *Interpretation of description:* This involves examining and understanding the choices and flaws in the storytelling.

In addition, the results of the narrative analysis can be interpreted by comparing different stories to each other and noticing common themes or patterns in them. An essential part of interpreting the results of the narrative analysis is their theoretical and cultural significance. Overall, the results of the narrative analysis should be interpreted carefully and critically, and their interpretation should consider the goals and approaches of the research.

Narrative analysis is suitable for research analysis in studies where the subject of research changes in one way or another. Background information may be essential in a report, and the researcher often combines texts for their narrative and narrative environments. In this case, narrators can be considered to possess a significant role as narrators and drawers. There were not many interviewees, but the interviewees' roles were partly different in this study. Therefore, the interviewees' "stories" content has been analysed as a story.

3.5.4 SWOT Analysis

The SWOT analysis model is also used to help analyse and classify the results. SWOT Analysis is an analysis method used to evaluate the 'strengths', 'weaknesses', 'opportunities' and 'threats' involved in an organization, a plan, a project, a person or a business (Gürel 2017). SWOT Analysis is a tool for strategic planning and management in organisations. SWOT Analysis is a simple but powerful and significant situation analysis tool that helps managers identify organisational and environmental factors.

The basic division of SWOT analysis is internal and external factors (Figure 16). Strengths and weaknesses are internal, and opportunities and threats are external factors (Dudovskly 2011).
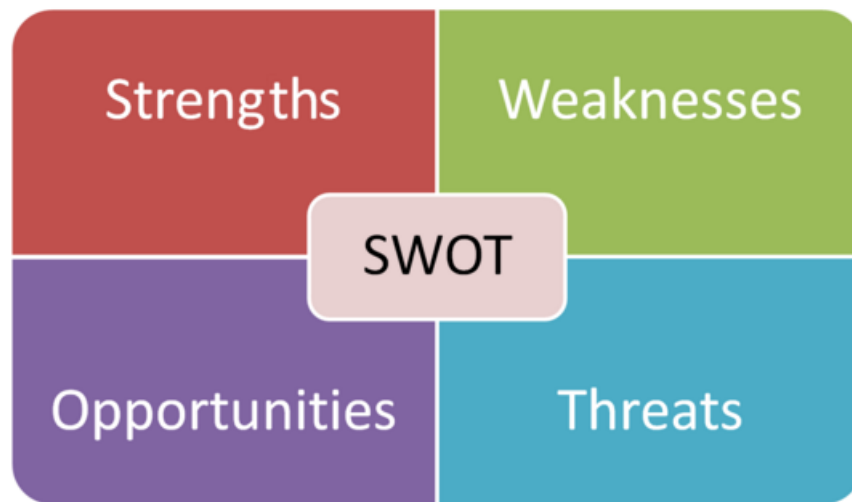
Figure 16: SWOT Analysis Framework

3.6 Planned Method

In action research, the research progresses in cycles, and the research plan is reviewed and updated as the research progresses. In action research, several research cycles can be implemented in the same organisation, or the research cycles can be implemented in similar organisations. In action research, this is justified when one wants to obtain broad-based information and insight about a specific research subject through the activities of different organisations (Kananen 2014). Figure 17 shows the research cycles of the study. After the analysis phases of the different research cycles, several conference articles have been written to discuss the research results.
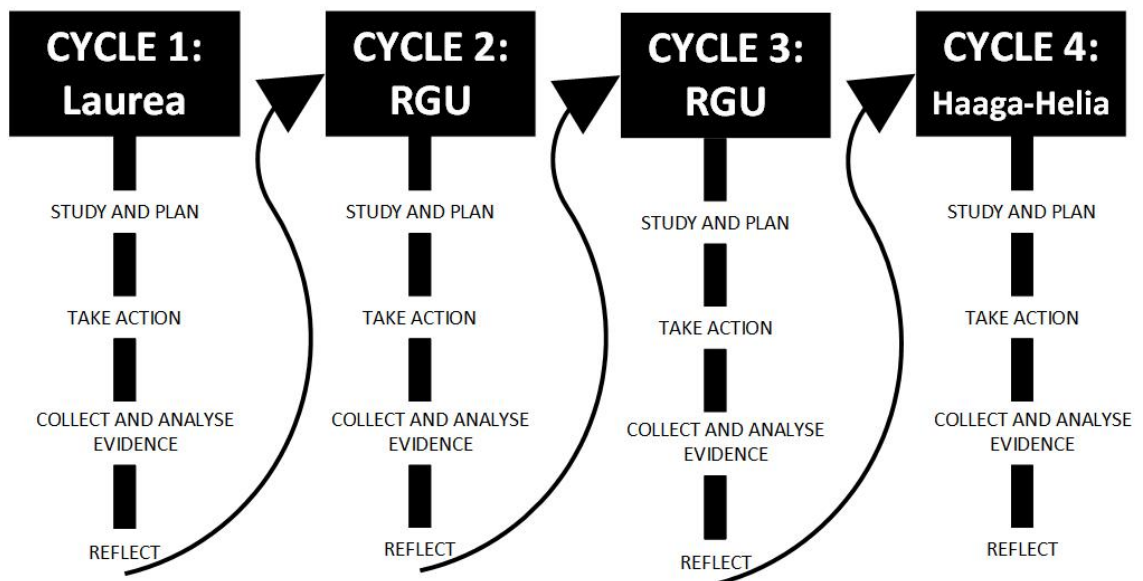
Figure 17: Action research cycles in this study

Case studies have been used as the research method in the higher education institutions involved in the study. A case study focuses on a few cases in depth and examines them from different angles (Bronwyn et al. 2005). The goal is not to find generalisations, but to describe phenomena and make new observations. The cases investigated in this study are computer science students from Laurea, RGU and Haaga-Helia, lecturers, project clients and pedagogy personnel. A case study is suitable for understanding phenomena strongly and multithreaded in a particular context (Aaltola and Valli 2007). A case study should also be used when little empirical research has been done on the topic. A case study is a qualitative research approach, but quantitative data can also be used in it (Eriksson and Koistinen 2005).

Research data from the lecturers of the study modules have been collected through thematic interviews. Research material has also been collected from project clients participating in study units through interviews. The purpose is also to determine the project client's perception of applying the LbD model and their experiences.

Through thematic interviews, the necessary background information for the research has been collected from the pedagogy staff of Laurea, RGU and Haaga-Helia. Interviewing the pedagogy staff was important because these background factors affect the study results and therefore had to be carefully clarified in advance. The information was needed so that their possible effects on the research results were known in advance. At Laurea, the LbD model has been a teaching method for more than ten years and is already very familiar to most lecturers. At RGU, the LbD teaching method is not familiar;

therefore, the lecturers teaching at RGU in the study module that is the subject of the study must be trained in the LbD model. At Haaga-Helia, the LbD model is used extensively in study modules that include real customer projects. In Haaga-Helia, however, the LbD model is not generally discussed; therefore, in Haaga-Helia, familiarising lecturers with the LbD model must be done before the beginning of the study module. Haaga-Helia also needs to take care of the orientation of students and project clients.

Regarding the thematic interviews of lecturers and customers, narrative analysis is also used as an analysis method because there were only a small group of interviewees, and the things they told were individual (Riessman 1993; Dauite and Lightfoot 2004). The participants in the research each had a slightly different background on the matter. The narrative analysis has been used to analyse thematic interviews and students' free-form responses. The meanings of human activity and phenomena are based on different stories essential for research. In narrative research, the story can be used through interviews. Narrative research is interested in what stories are told about the research object or what kind of narrative the research object is in culture or society. The strategy is primarily based on the meanings of language and language use. A narrative perspective helps to understand things at personal and collective levels, both in individual meanings and interpretation cases.

This study uses SWOT analysis to analyse lecturers' opinions using the LbD model as a teaching method. A SWOT analysis has been made for the lecturers of all three higher education institutions. In thematic interviews, the lecturers were asked to answer, according to the SWOT analysis, what kind of strengths, weaknesses, opportunities and threats they see related to using LbD. The lecturers' interview questions included questions according to the SWOT analysis classification.

For the SWOT analysis, information has been collected from the lecturers of all three higher education institutions. In the summary of the lecturers' research results, everyone's answers have been gathered into four fields of the SWOT analysis. The SWOT analysis can be used in the development process of the LbD model and identify the critical points of related good practices. For the SWOT analysis, data from the research material has been collected and classified according to the four-field division, i.e. strengths, weaknesses, opportunities and threats. The SWOT analysis is helpful for the pedagogy staff responsible for Laurea's pedagogy because it makes it easy to see

these different dimensions quickly, evaluate the different areas based on them, and think about how the model should be developed.

In this study, the first research cycle was carried out at Laurea in the fall of 2019, where the LbD model, the background theory and target for development, was developed. In the first research cycle, material-based content analysis was used to analyse the thematic interviews of pedagogy staff. This method of analysis is suitable here because there were six interviewees. The pedagogy staff answers were classified after transcription. After classification, the pedagogy staff answers were grouped, and similar answers were gathered into one category. Chapter 4 describes the pedagogy staff categorised and grouped answers and the conclusions based on them. The answers to the thematic interview of the lecturers have been analysed with the help of material-based content analysis and SWOT analysis. There were three lecturers from Laurea; therefore, their answers could also be analysed using content analysis. In addition, the lecturers were asked what kind of strengths, weaknesses, opportunities and threats they think are related to using LbD. The answers to these questions were compiled into a SWOT analysis table, and based on them, conclusions have been made about issues related to using LbD. The SWOT analysis is justified because it was used to easily find topics that still need development in LbD.

The students' research results were analysed using quantitative and qualitative analysis. Students evaluated the development of their skills during the study module according to the Likert scale, and these results were evaluated using the mean and standard deviation. The free-form answers of the students have been evaluated with the help of content analysis. Chapter 4 describes the students' analysis in more detail. Laurea's study module includes four clients with six projects. The project clients participated in a thematic interview, and their answers were analysed with the help of content and narrative analysis. The interviews of the project client were transcribed, after which classification was made. The answers were grouped based on the classification, and conclusions were made based on them.

The following research cycle was carried out at RGU to determine if the LbD model could also be used in an educational organisation with a different cultural background in another country. The thematic interview of the RGU pedagogy staff was recorded and then transcribed. After transcribing, the RGU pedagogy staff answers were interpreted using narrative analysis since only one respondent existed. With the help of narrative analysis, general ways of thinking and acting, meanings, and attitudes towards

development-based pedagogy were searched for in the pedagogy staff answers. The answers of RGU's pedagogy staff were essential for the research because RGU's background factors are different from Laurea's, and understanding them was essential for piloting it at RGU. In Chapter 4, RGU's pedagogy staff answers and their interpretations are described in more detail. Only one lecturer and project client were involved in RGU's study modules.

For this reason, the responses of the RGU lecturer and the project client were also mainly analysed with the help of narrative analysis. Regarding the lecturer's answers, a SWOT analysis was also used because the interview questions of the lecturers were the same as those of Laurea's lecturers. In Chapter 5, a few responses from all project clients have been collected in the same summary table for comparison. At RGU, the research material was collected in two cycles because only one student answered the student survey in the first RGU research cycle. The research plan was updated, and the following collection of research material was carried out at RGU the following year (autumn 2021). The 2021 survey was answered by all students of the study module under study, but there were only five of them in total.

After the second research cycle of the RGU, the responses of the lecturer and the client were again analysed using narrative analysis. After RGU's second research cycle, the same analysis methods were used to analyse the students' answers as in the analysis of Laurea's student surveys. In RGU's second research cycle, research material was not again collected from RGU's pedagogy staff.

The research plan was updated after the research cycles were carried out at RGU, and one more organisation, Haaga-Helia, was included in the research to get more research data. Haaga-Helia's research cycle was carried out in the spring of 2022. With the inclusion of Haaga-Helia, the focus of the research changed somewhat because Haaga-Helia and Laurea are both Finnish Universities of Applied Sciences, which enables a better comparison point for research results. Only one pedagogy staff also participated in Haaga-Helia's research cycle. The thematic interview of Haaga-Helia's pedagogy staff was also recorded and transcribed. The pedagogy staff answers were analysed with the help of narrative analysis, and answers were sought from Haaga-Helia's ways of thinking and acting concerning pedagogical models. Haaga-Helia's study module included four lecturers who were interviewed. The lecturers' answers have been analysed using content analysis and SWOT analysis. There were four project clients in Haaga-Helia's study module, three of whom participated in the interview. The project clients' responses

have been analysed using content and narrative analysis. In Chapter 4, the research results are described in more detail, and in Chapter 5, comparisons have been made between all three higher education institutions, as far as possible.

3.7 Ethical Issues

In action research, the research object is typically people and communities. This study's research subjects are students, lecturers, pedagogy staff and project clients. Research ethics principles have been taken into account in the research. It has been explained to all subjects that the research results will be anonymised and only used for the purpose stated in the research permit.

3.8 Ethical Considerations

In qualitative research, there are usually research-related ethical questions. A critical general ethical principle is that one must avoid causing significant risks, damages or harm to the people, communities and other research subjects being researched (Guillemin and Gillam 2004; Vakimo 2010; Gould 2016). In this study, the researcher has already committed to following good research ethics before starting the study and has received consent from the RGU Ethics Board. Of the three higher education institutions that are the subject of the study, a research permit was applied for and obtained separately for each one because the research subjects are the staff and students of these higher education institutions. The research permit states that all research results will be anonymised so that the respondents cannot be identified. Research materials are also carefully stored so that outsiders cannot access them. Research materials are also disposed of after they are no longer needed. RGU's pedagogy staff was separately asked for consent to participate in the study. The pedagogy staff was provided with written information on the purpose for which the collected research material will be used and other related ethical principles and matters related to the observance of good research ethics.

Good scientific practice includes the fact that the research follows the procedures recognised by the scientific community; honesty, general care and accuracy in research work, recording and presenting and evaluating research and its results (Tutkimuseettinen neuvottelukunta 2012). Research following good scientific practice applies data acquisition, research and evaluation methods that are under the criteria of scientific research and that are ethically sustainable. The research also implements the

transparency and responsible scientific communication inherent in scientific information when publishing the research results.

Good scientific practice also includes that researchers take the work and achievements of other researchers into account in an appropriate way and respect the work done by other researchers and appropriately refer to their publications and give their achievements the value and importance they deserve in their research and when publishing its results (Tutkimuseettinen neuvottelukunta 2012). In addition, the research is planned, implemented and reported on, and the resulting datasets are stored according to the requirements set for scientific information. The necessary research permits must also be obtained. The rights of all parties, the author's principles, responsibilities and obligations, and questions related to the storage of material and rights of use must be agreed upon before starting the research in a manner that all parties approve. As the research progresses, the agreements can be refined. Good scientific practice has been followed throughout the research. All research results have been presented as they have been answered and have been analysed carefully and accurately.

When making choices regarding the research process, the researcher has many opportunities and responsibilities. The researcher must be as objective as possible so that he does not influence the information produced about the phenomenon too much. Complete objectivity would require the researcher to look at the research object and phenomenon from the outside perspective of an impartial bystander (Eskola and Suoranta 1998). However, complete objectivity is impossible because no one can completely exclude their thinking. However, it is sufficient that the researcher actively tries to be aware of the researcher's attitudes and beliefs and tries to act so that they do not affect the research too much. In this research, action research has been used as a method, which is an exception because, in action research, the researcher can be an active player in the field and participate in seeking change. Action research aims for authenticity and equality, in which case the researcher's personality is essential, for example, in creating a whole and empathetic researcher character and collecting reliable research material. In the researcher's position, trust is vital. Research subjects must be able to trust that their anonymity will be preserved and that they will be told honestly about the purpose of the research and the possible effects. Therefore, The researcher must act worthy of the researcher's trust (Mahlamäki 2006). In addition to the production of new knowledge, the general values of science include independence and impartiality.

The researcher has tried to be as objective as possible in this study. The researcher has also honestly informed the research participants about the purpose of the research and its potential effects. The researcher has also tried to create the interview situations as empathetic opportunities as possible so that the interviewees feel comfortable and relaxed in the interview situation. The researcher has also ensured that the anonymity of the research subjects is maintained and that the research data is kept in a safe place and is not disclosed to any outside party.

3.9 Issues of Trustworthiness

The research's reliability is usually examined per the principles of validity and reliability. Validity means studying the right things. Validity aims to ensure that the proper research methods are used, the right measure is used, and the right things are measured. Reliability means the permanence of measurements. If the study is repeated, the same results will be obtained using the same measure. As such, validity and reliability are unsuitable principles for evaluating qualitative research.

In qualitative research, reliability assessment focuses on the collection of research material, the analysis of the material and the reporting of the research. The reliability criteria of qualitative research are truth value, applicability, permanence and neutrality (Tynjälä 1991). In addition, the different approaches and methods of qualitative research, such as the approach that uses narration, have their own reliability criteria.

Reliability increases because the material has been collected from where the phenomenon occurs (Tuomi and Sarajärvi 2018; Alasuutari 2019). The data must be based on the principles of representativeness. In the report, the research stages are recorded in detail. If the material is collected by interviewing or, for example, using open-answer forms, the themes or questions used are recorded in the report. The interaction relationship that arises in the interview situation and the factors that influenced it should be evaluated, as well as factors that may have influenced the answer. The time spent on the interview or observation and its adequacy is also evaluated.

For the reader to follow and evaluate the analysis, the material must be of sufficient quality, i.e. direct quotations are presented in the report. The reliability criterion is that the generated codes, i.e. the meaning entities identified and structured from the material, are mutually exclusive.

In assessing the reliability of the analysis, the researcher's ability to think abstractly is central. The assessment of the reliability of the analysis is also influenced by how versatile the phenomenon has been studied. In reporting reliability, it is essential to be precise in using the concepts used and generated based on the results and for clarity to be shown in expressing the analysis. The consistency criterion means the researcher has created a meaningful and comprehensive understanding of the phenomenon under study.

In action research, repeating the research does not aim to reach the same result because the goal is to reach changes in action research. Regarding the reliability of action research, the aim is to use several different research samples and methods. Action research is not just a one-off study but a series of studies or research cycles in which the phenomenon under study is examined.

In action research, the starting point for evaluating the reliability of research results is always a sufficiently accurate documentation of the results, methods and data collection. In this way, the possibility of an external evaluator to conclude the reliability of the research can be ensured. The generalisability of action research results is also based on documentation because the transferability of research results can be examined based on the research's starting situation and descriptions. If the starting assumptions correspond to the new situation, the results can be assumed to be transferable. However, the action research results can only be considered valid for the case it handles. Transferability is not the actual goal of qualitative research.

The use of triangulation increases reliability. More than one data collection method is used in data triangulation, and more than one analysis method can also be used in data analysis. In this study, research material has been collected using a survey and thematic interviews. The research sample has been analysed using several different analysis methods.

3.10   Limitations and Delimitations

The limitations of the study are related to the reliability of the results. In the student survey, students were asked to make a self-assessment of the development of their skills. The answers to these questions are based on how honestly the students have answered the questions. In addition, the reliability of the answers is also affected by how well students can evaluate their competence. Lecturers and project clients were also

asked to evaluate the development of the students' skills to increase reliability. This study wanted to determine how well the students' skills developed during the study module and their experiences of LbD pedagogy in project-based learning.

Regarding the thematic interview of pedagogy staff, lecturers and project clients, the answers are also based on the story they tell. The reliability of the interview results is affected by how honestly they have answered the interview questions. The study aims to get background information from the pedagogy staff because their answers provided additional information for the research. The study also aims to discover the lecturers' experiences and opinions, for which a semi-structured thematic interview was well suited. Similarly, the study aims to get information from the project's clients about their experiences participating in the project study module, where LbD pedagogy is applied.

The study targeted three higher education institutions, two from Finland and one from the UK. The research results give a picture of the project-based study module of computer science students at these three higher education institutions but cannot be directly generalised to all computer science studies. The purpose of this study was to investigate the suitability of LbD in the project-based study module of computer science students at these three higher education institutions and to find, with the help of the research, the issues by which LbD can be further developed to be more suitable for this purpose.

3.11   Perceived Barriers to Adoption

At Laurea, using the LbD model in teaching computer science students is an established practice, as the LbD model has been chosen as the primary pedagogical method. However, based on the answers, opinions have also been received that using LbD requires a strong commitment from all parties and knowledge of LbD's principles. It also requires the organisation to have a strong competency-based curriculum and a lot of background work so that the LbD model correctly supports student skills development.

Obstacles identified in RGU are the academic requirements from the administration, the assessment of which is strictly regulated. RGU also does not possess strong business cooperation in teaching. The LbD model requires a well-planned and coordinated business cooperation model to easily include business projects in study modules. Several different pedagogical models are used at RGU, and the lecturers themselves are free to choose which pedagogy they use. Curricula must also be defined based on

competence, and lecturers must be able to commit to them. RGU also has many study modules based on project-based learning, but including the LbD model as one pedagogical method would require a lot of familiarisation, new thinking and consistent implementation.

At Haaga-Helia, the LbD model is used in many study modules, perhaps unconsciously. However, unlike Laurea, Haaga-Helia also uses a lot of other pedagogical models, perhaps one of the most important of which is exploratory and developmental learning. Haaga-Helia also has a vocational teacher training college, giving Haaga-Helia's teachers good preparation for lecturers to develop their pedagogical skills continuously. In this lecturer's opinion, Haaga-Helia does not want to limit the lecturer's freedom to choose the most appropriate pedagogical method for each study module. At Haaga-Helia, however, there is a lot of business cooperation, and the study modules develop ideas with company representatives in the form of projects. In principle, there is no obstacle to the broader use of LbD in Haaga-Helia, but the management's policy is that they do not want to limit themselves to just one pedagogical method.

3.12   Summary

This chapter presented the research methods used in this thesis. Qualitative methods have been used in all research cycles to collect and analyse research data from different research groups. Quantitative methods have been used to analyse the students' self-evaluation answers. The use of the methods is described in Chapter 4, where all research cycles of action research are described. This section presents the methods so the reader understands the theory behind the research methods. This section also describes the research cycles in order and the activities carried out in them.

Chapter 4:   Action Research

4.1 Introduction

Action research has been used as a research strategy because it is well-suited to educational research. The research is based on the LbD action model developed at Laurea. This study investigates the use of LbD in teaching computer science studies. The research aims to get information on how well the LbD model fits the teaching of computer sciences study modules, including a real customer project. The research aims to obtain information about the background factors of LbD from Laurea's pedagogy staff. Information is collected from the lecturers, students and project clients of the study modules under study about their experiences of using LbD in practice. The purpose is to investigate how well the LbD model fits the project-based study module of computer science students. Action research enables the participation of all parties, such as pedagogy staff, lecturers, students and project clients in this study. All these parties' participation is vital because they give more comprehensive information about using the LbD model from the perspective of each party.

In the research of educational activities, the goal is the development of operational methods, and often, the action research itself changes and develops as the research progresses. One of the goals of this research is to find out how LbD should be developed and changed to make it work even better. The purpose of action research in this study is to improve the quality and efficiency of the LbD model based on the results obtained in the research sites. The study also aims to get information on how the lecturers could develop and improve the teaching quality and their operation methods. In addition, the research seeks to know what development is needed for LbD to help students better recognise the development of their skills and learn an even more independent way of working. In addition, the study aims to get information on how the participation of project clients in the LbD learning module could be even more successful.

The action research was carried out in cycles. In this study, there have been four cycles (Figure 18). The first cycle was carried out at Laurea, where the research started. Before starting the full-time research cycle, there is a survey of the current situation in the action research, which is compiled in the literature review section of this study. Laurea's LbD model was the starting point for the study, and background information has been collected for this study.

The task of the first research cycle was to define the problem, analyse it and map the factors influencing it. Before the first research cycle, the general background factors related to the research had been mapped with the help of a background study, and the research's necessity had been identified. The primary purpose of the research is to study how suitable the LbD model is as a teaching method for computer science students in project-based study modules that include a customer project.

In order to improve LbD, the study also aims to use LbD in an entirely different higher education environment than at Laurea, where it was developed and has been in use for a long time. The second research target in this study was RGU, from the UK, where the LbD model had not been used before. The purpose was to get information on how well the LbD model fits into a different cultural and higher education environment than the Finnish University of Applied Sciences context. In addition, the aim was to get an international view of the LbD model in the research. Two research cycles were carried out at RGU because insufficient research material was received from the students who participated in the study module in the first RGU research cycle. After RGU's second research cycle, the research plan was changed, and one Finnish University of Applied Sciences was added because the researcher wanted to get research material from a larger group of students about the experiences of using LbD.

It is very typical in action research that the research plan is changed as the research progresses. This study reviewed the research plan after each cycle, and the necessary changes were made based on the results. Changes to the plan were made after the research cycles were carried out at RGU because insufficient research data was obtained. After the first research cycle at RGU, a second research cycle at RGU was added to the plan. After the second research cycle at RGU, one more research cycle was added to the plan, which was carried out in Haaga-Helia, Finland. The purpose of the study was to collect experiences of using LbD and its suitability for computer science students' studies. Therefore, the study subjects in all three research higher education institutions were computer science students, lecturers, and project clients involved in the study modules. In addition, pedagogical staff from all three institutes participated in the study and were interviewed.

4.2 Cycle 1: Laurea

The first research cycle at Laurea was started by conducting thematic interviews with six pedagogy staff at Laurea. After this, a student survey and thematic interviews were conducted with lecturers and project clients. Figure 18 shows the first steps of cycle 1, which will be explained more in the following subsections.
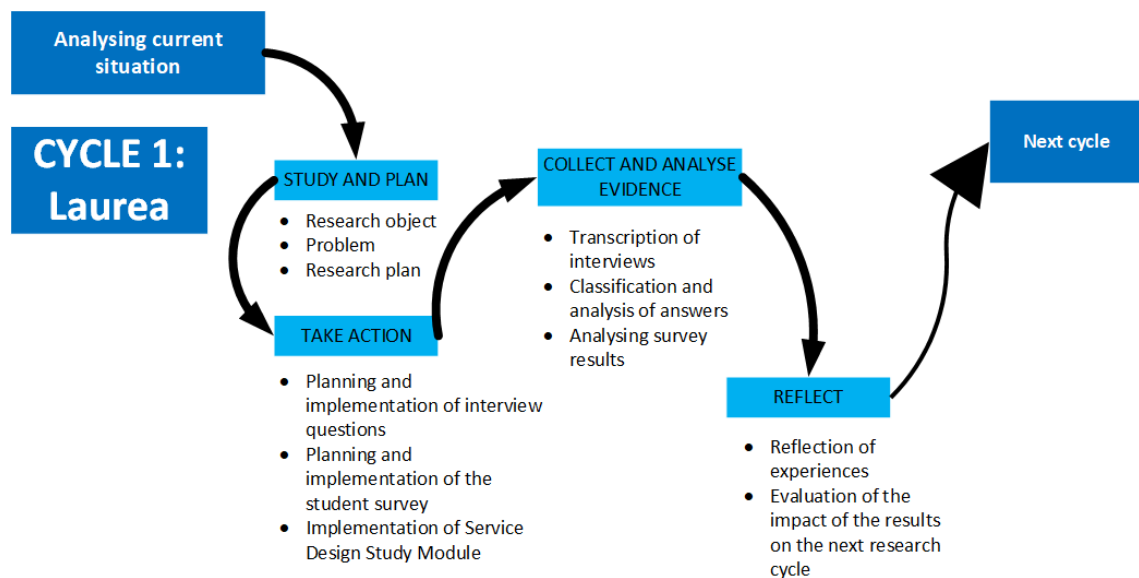
Figure 18: Research cycle 1 in Laurea

4.2.1   Institutional Context

Laurea University of Applied Sciences was founded in 1991, operating under Espoon-Vantaa University of Applied Sciences ('About Laurea' 2023). In 2001, it was established as a University of Applied Sciences. At Laurea, students can study for Bachelor's and Master's degrees and specialised studies. Bachelor-degree programs include Hospitality Management and Service Design, Business Information Technology, Developing Digital Services, Nursing, Safety, Security and Risk Management, Business Management and Social Services. The Master's degrees are in Service Innovation and Design, Global Health and Crisis Management and Leading Transformational Change. In addition to this, students can complete various specialisation studies. Laurea's operation is based on the Learning by Developing Action Model, which brings together University of Applied Sciences students and pedagogy staff in teaching and R&D activities in numerous cooperation projects. Laurea University of Applied Sciences has approximately 7,800 students and 500 staff members. Laurea is on six campuses, the largest in Leppävaara in Espoo and Tikkurila in Vantaa. At Laurea, the use of LbD has been studied extensively

in social and health studies and restonomy studies. Computer science students have hardly been involved in the research on LbD because it is not such a large field of study at Laurea.

The LbD action model is Laurea's pedagogical model, according to which learning occurs in community development activities. The model development started at Laurea in 2000 (Raij 2000). Since 2002, the LbD action model has been systematically developed. The LbD action model was subjected to an international audit in 2008 (Ora-Hyytiäinen and Rajalahti 2009). In the international audit, the LbD action model was found to be an innovative way of studying if assessing the student's professional competence and growth is a real challenge. According to the LbD action model, the key to studying at a University of Applied Sciences is the creation of new action methods and renewing working life.

4.2.2   Study and Plan

This study aimed to determine how suitable the LbD model, widely introduced at Laurea in 2006, is for the learning method of Laurea's computer science students in project studies. In addition, the study aims to get information about how computer science students' skills develop during the project-based study module. The background of the competence development survey was the areas derived from Laurea's strategy 2030. There were six sub-areas, each with three or four more specific questions related to the sub-area. There were a total of 20 questions.

From Laurea, the research object of this study was the Service Design Study Module aimed at computer science students. In Laurea, the Service Design Module has been implemented in other fields of study for several years, but the first implementation, intended only for computer science students, was in the spring of 2019. The researcher was involved in the planning and implementation of this study module.

The study also aims to get information from the computer science lecturers and project clients who participated in the study module, for whom the research was conducted using thematic interviews. For this study, the researcher also collected research material from the lecturers of another Service Design Study Module to get the views of more than one lecturer. In this second implementation, the researcher was not involved.

In addition, background information was needed from Laurea's pedagogy staff, and their views were gathered through thematic interviews before implementing the study module.

4.2.3   Action

The first research cycle was carried out at Laurea in the fall of 2019, starting in September and ending in December. Based on the research plan, the material was collected from Laurea's pedagogy staff, lecturers and project clients through thematic interviews. The thematic interview questions of Laurea's pedagogy staff were planned and implemented first. The pedagogy staff participating in the study were carefully selected to obtain comprehensive information about the backgrounds of LbD from the pedagogy staff through the interview.

In addition to this, research material was collected from students using a survey. As a first action, research material was collected from the pedagogy staff. The second action was a student survey, followed by interviews with lecturers and project clients.

Narrative analysis, material-based content analysis and SWOT analysis have been used as analysis methods. Methods of quantitative analysis have also been used as a method for analysing students' answers.

4.2.4   Staff Experience

Among Laurea's staff, both pedagogy staff and lecturers were interviewed. The subsection analyses the pedagogy staff answers in more detail and the lecturers' answers.

Interview with Pedagogy Staff

With the help of interviews with Laurea's pedagogy staff, factual background information related to LbD was collected. The selection of Laurea's pedagogy staff for the study was made by contacting the department responsible for developing Laurea's pedagogy, all of whom had slightly different backgrounds. The interviews were conducted either face-to-face or remotely. All interviews were recorded, after which they were transcribed for more detailed analysis.

The interviews were thematic, so their progress varied slightly depending on the interviewee. The interview questions had been carefully planned and delivered to the pedagogy staff participating in the study for familiarisation in advance (Appendix A). The interviews of pedagogy staff were transcribed and then grouped by question. The essential and most central answers to matters important to the research were compiled

into the same category from the interviewees' answers. The interview with Laurea pedagogy staff aimed to get more in-depth information about the general background factors for implementing LbD in higher education institutions and what aspects and reasons were behind implementing LbD at Laurea. Questions 1 and 2, which were asked of the pedagogy staff in the thematic interview, were related to background factors.

The answers to questions 1, *'What are the general background factors for introducing LbD in higher education?'* and 2, *'What were the reasons behind the introduction of LbD at Laurea?'* (Appendix A), were combined because the staff's answers were almost identical. Through the classification, categorisation and grouping of the content analysis, three clear reasons were found for introducing LbD at the University of Applied Sciences and its introduction at Laurea (Figure 19). The staff's answers were aligned with what has been written about LbD in the literature and why LbD has been widely implemented at Laurea.

Reasons for introducing LbD
Law change 2003: the requirement given to universities of applied sciences for three tasks: regional development, R&D activities, and teaching
A change in the pedagogical paradigm
Working life cooperation and working life development

Figure 19: Laurea pedagogy experts' compiled answers for questions 1 and 2

The study sought to obtain information from pedagogy staff on the prerequisites for introducing and using LbD as a teaching and learning method in higher education, question 3 *(What are the absolute conditions for using LbD in higher education?).* Responses to question 3 were compiled, and categories were derived and modelled in a mind map diagram (Figure 20). It can be seen from the mind map diagram that six entities were found based on the classification, all of which must be to use LbD successfully. One of the essential background factors is the entire organisation's commitment to implementing and using the model. The organisation's management must also understand the matter and enable and commit to using the LbD model. The entire

staff, and especially the lecturers, must also commit to using the LbD model so that it is controlled and leads to the desired results. Using LbD requires that everyone has a good understanding of what LbD pedagogy means. For that, training, mentoring, and everyday experiences of using LbD must be shared with the entire organisation continuously. Other necessary background factors include using a competency-based curriculum, recognising student orientation, close work-life cooperation and working together.

Regarding question 4 *(Is LbD suitable for all teaching, all fields of education, all teachers,*
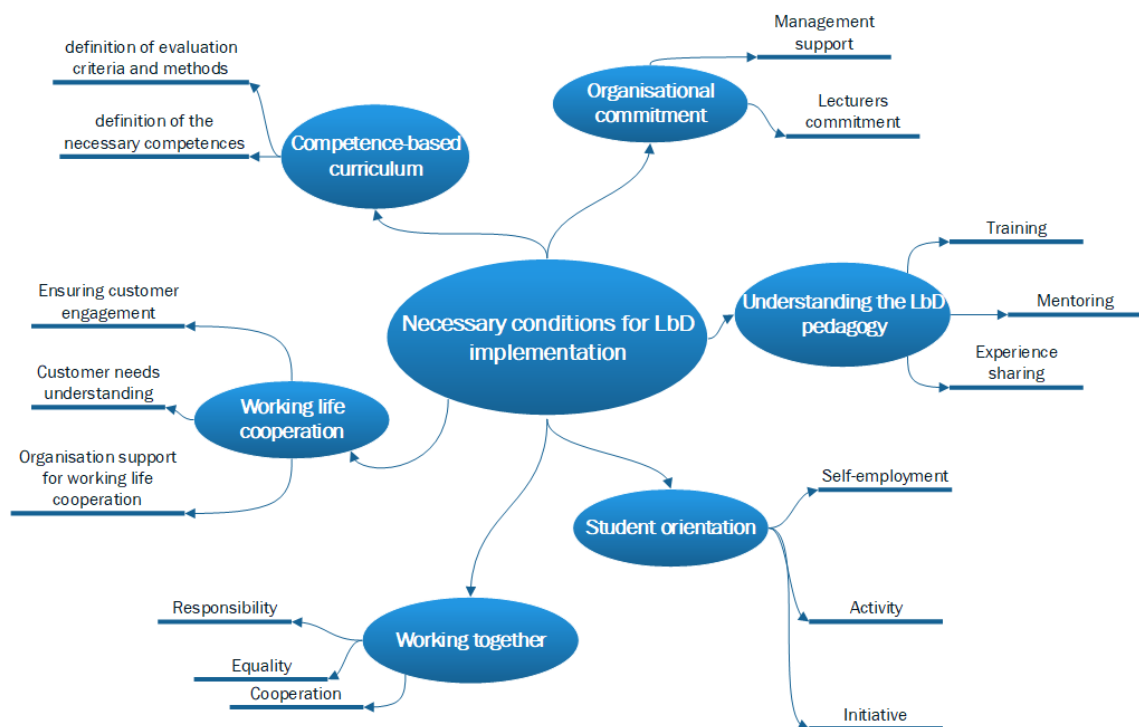
Figure 20: Laurea pedagogy staff opinion on absolute conditions for LbD implementation (Question 3)

all situations, and new students just starting?), four staff answered that it is unsuitable for all teaching and situations. According to them, LbD is not suitable, for example, for teaching very theoretical subjects, and according to one pedagogy staff, it is not suitable for early-stage studies. *"Maybe it is not worth taking from the very beginning, and it is not suitable for everything, but it is probably suitable for all educational fields, and there are applications for it. In most cases, you will probably be able to apply it, but in some areas, it may be a bit more challenging"* (Laurea, pedagogy staff 4). In the opinion of two respondents, LbD is suitable for all teaching, but the boundary conditions related to LbD pedagogy must be understood, and the learning environments must be built to support the development of competence correctly. "*In principle, yes, but the boundary conditions*

must be considered. You have to understand that LbD does not mean that you learn in some project, but it is more about developing working life and developing the student's skills through various means" (Laurea, pedagogy staff 5).

The staff were also asked, in question 5 *(Could you recommend the LbD action model to other universities worldwide?)* if they would recommend the LbD action model to other universities worldwide. To this, everyone answered - with some reservation - 'yes', but that it requires a progressive organisation and a culture that fits it and, where a competency-based curriculum is used, the goal is the development of competency and where co-teaching works. *"I could recommend it, but it is certainly not suitable for everyone, but it is for the most progressive organisations"* (Laurea, pedagogy staff 1*). "I would definitely recommend. However, it can be quite challenging in some places"* (Laurea, pedagogy staff 5).

In response to question 6 *(What kind of effects has LbD had on Laurea's teaching?)*, each pedagogy staff had a slightly different view: *"It has sparked a discussion about the University of Applied Sciences' pedagogy"; "It has also aroused envy in other Universities of Applied Sciences"; "It has increased closer working life cooperation"; "It has completely changed the way of learning, brought a new dimension, and changed the role of the teacher a lot"; "It caused much confusion in the beginning. Most students are positive and interested in the new way of learning, but there are many differences depending on the field of study"; "It has increased Laurea's reputation, resulting in several awards".*

These answers indicate that introducing the new pedagogical model, LbD, significantly changed Laurea's operations. The implementation phase of LbD was associated with much confusion and sparked a broad debate about pedagogy in Universities of Applied Sciences. At the same time, it also wholly changed Laurea's way of combining teaching, work-life cooperation and R&D.

The staff were also asked about their experiences with using LbD and their views or information about how lecturers and students have experienced using LbD in question 7 *(What are your own experiences of using LbD?)*, question 8 *(What have the students' experiences been like?)*, and question 9 *(What have the teachers experiences been like?)*. In Figure 21, the information from all three questions is grouped as a mind map diagram.
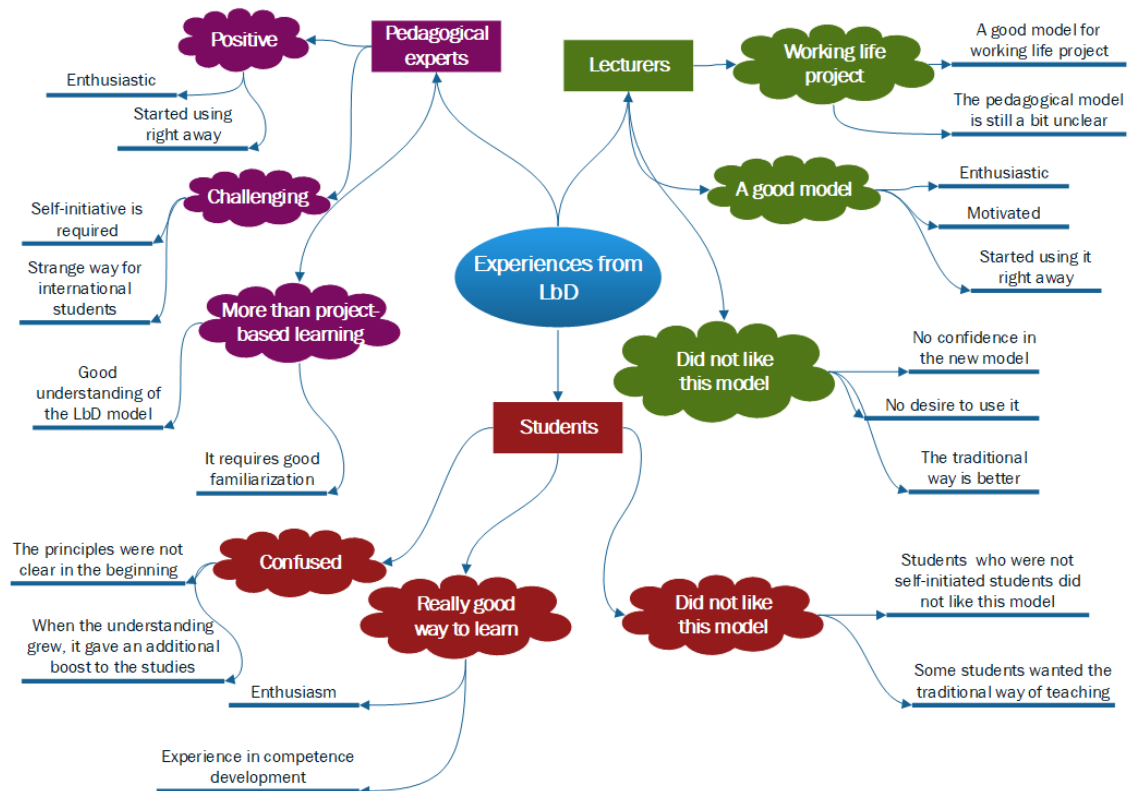
Figure 21: Laurea's pedagogical staff views of experiences from LbD

Laurea's pedagogy staff questions 7, 8 and 9 were grouped using a mind map (Figure 21). All questions were related to experiences of using LbD but with different target groups. Three categories were formed from the personal experiences of the pedagogical staff, to which the respondents' answers were related. Everyone had both good experiences and some challenging experiences using LbD. One category was 'More than project-based learning', which was the opinion of all respondents. The lecturers' experiences, according to the pedagogy staff, also formed three categories: 'working life projects', 'good model', and 'did not like this model'. All respondents' answers about the lecturers' experiences using the LbD model were consistent. Thirdly, the pedagogy staff answered the students' experiences with LbD. Three categories were also formed from these: 'confused', 'really good way to learn', and 'did not like this model'. Everyone's answers concerned about students' experiences were almost identical.

Figure 22 shows a summary made with the help of content analysis, in which the categorisation based on the transcribed interview material is compiled and where the pedagogy staff's own experiences and their views on how lecturers and students have experienced the use of LbD in teaching and learning are grouped. It can be seen from the summary that for lecturers and students, there is a clear division between people

who consider the LbD model good practice and are enthusiastic about it and motivated to use it and people who do not like the new LbD model and are not motivated by it. Those who have a negative attitude towards the LbD model think that the traditional way of teaching is better than the new LbD model. According to pedagogy staff, these students are those who lack self-initiative. Regarding the lecturers, this study did not ask the pedagogy staff why some lecturers do not like the new pedagogical model or do not want to use it. Pedagogical staff had many positive experiences with LbD, but they said there have also been many challenges in implementing LbD. The pedagogy staff responded that LbD is much more than project-based learning.

Questions 10 *(How to get teachers to use LbD?),* question 11 (*How is the introduction to the LbD action model done?)*, and question 12 *(How is the use of LbD supported and expertise maintained at Laurea?)* are connected to the use of LbD and the support and maintenance of LbD. In connection with the content analysis, when classifying the pedagogy staff answers, questions 11 and 12 were combined because the answers were almost similar depending on the respondent. In connection with the classification, an observation was also made that the answers to question 10 can be found in the answers to questions 11 and 12. Figure 22 summarises the classifications of questions 10, 11 and 12 and the factors that connect them.
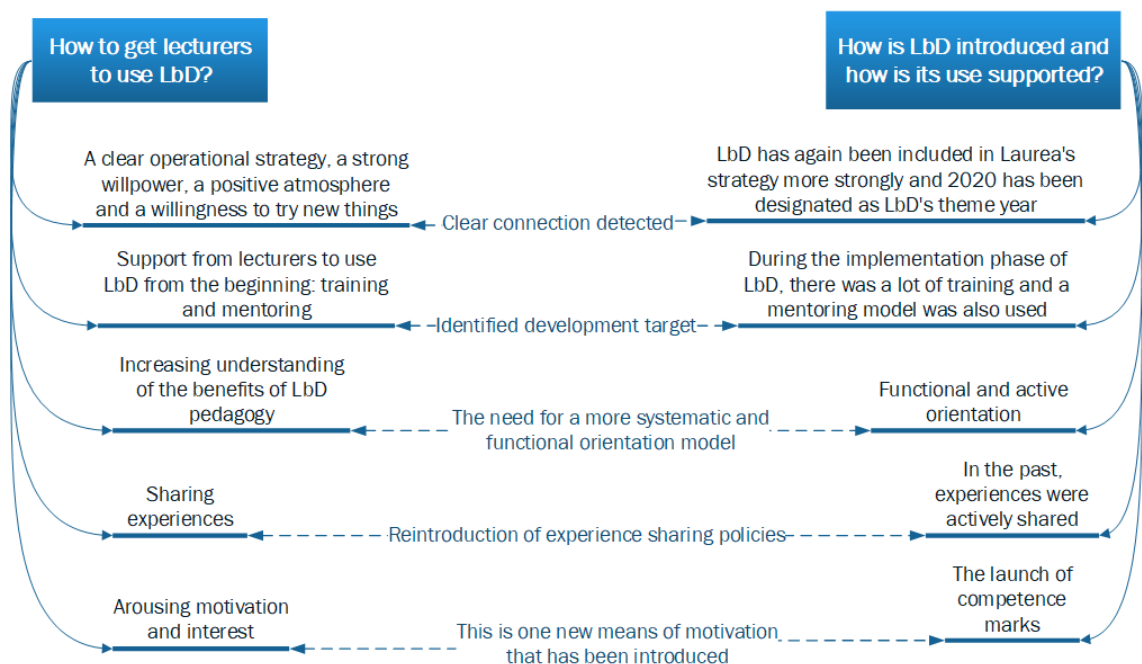
Figure 22: Laurea pedagogy staff answers to questions 10, 11 and 12

The pedagogical staff answered that the critical factors for lecturers adopting LbD are a clear operational strategy, strong willpower, a positive atmosphere and a willingness to try something new. Figure 22 shows that this issue has been recognised at Laurea, and therefore, LbD was again raised as an essential focus in Laurea's 2030 strategy and the year 2020 was designated as the LbD theme year. Another point identified is that lecturers need continuous training and mentoring to use LbD. During the introduction of LbD, much training and a mentoring model were also in use. According to the pedagogy staff, a similar model was not actively used during the interviews. Continuous training and mentoring were identified as areas of development that need to be considered in the future. Pedagogy staff also said that lecturers should better understand the benefits of LbD pedagogy, and lecturers' experiences of using LbD should be shared more. Both of these needs have also been identified, and measures were added to the goals for 2020 to move these issues forward and implement them in the organisation. There is a need to increase the interest and motivation of lecturers so that LbD can be used continuously and benefit from it. As one of the means of arousing motivation and interest, it is planned to introduce LbD competence badges.

In their responses to Question 13 *(How is the LbD action model developed at Laurea?)*, all the pedagogy staff recognised that raising LbD again is strongly included in Laurea's strategy, and with that, they think there are good opportunities to raise the development of LbD to a new level. The importance of LbD has been raised again in Laurea's strategy. Several measures have been planned to familiarise the entire staff with LbD. Several events have been planned where the staff can get to know LbD again, discuss it, and think together about how LbD should be used and developed. The plans also include restarting mentoring activities. The development of LbD towards the world of online education has also been raised as a new development target, using the entire organisation and the tools provided by technology. These are then intended to aid in developing the LbD action model.

Interviews with Lecturers'

The target of this study is also the lecturers participating in the Service Design Study Module, which was chosen as the study target in the research plan. The purpose is to gather information about the lecturers' experiences in LbD-based teaching in computer science project-based study modules, find improvement suggestions for the LbD action model, and collect data on this purpose.

Of the lecturers of the Service Design Study Module that is the subject of this research, only one lecturer was interviewed because the other was a researcher. In addition, two other lecturers who taught the corresponding Service Design Study Module simultaneously were interviewed to obtain more research data and valuable information from more lecturers about their experiences of LbD-based teaching.

The interview questions were delivered to the lecturers in advance for familiarisation, and the interviews were conducted as thematic interviews using a remote connection. There were twelve interview questions, which can be seen in Appendix B. The interviews were transcribed for more detailed analysis. The lecturers' research material has been analysed using material-based content analysis, narrative analysis and SWOT analysis.

In question 1, the lecturers were asked how well they knew the LbD model before starting the study module. At Laurea, the orientation also includes getting to know the principles of LbD. However, different lecturers have different levels of knowledge about the principles of LbD for many reasons. The research also included a review of the principles of LbD with the lecturers because the researcher wanted to ensure that all lecturers had at least a basic understanding of LbD. Based on the classification, four categories were formed into which the lecturers' answers were classified. Classification is 'no prior knowledge', 'basic understanding', 'good knowledge', and 'in-depth knowledge'. Table 2 shows Laurea's lecturers' knowledge about the LbD model before starting the study module.

Table 2: Laurea lecturers' knowledge of the LbD model before starting the study module

Laurea lecturers	No prior knowledge	Basic understanding	Good knowledge	In-depth knowledge
Lecturer 1		X		
Lecturer 2				X
Lecturer 3				X

Two lecturers had worked at Laurea for many years and used the LbD model for a long time, so they knew the LbD model deeply. One of the lecturers was relatively new at Laurea, and the lecturer knew the principles of the LbD model but did not know it in great depth.

Table 3 summarises the answers of the lecturers to questions 2 *(How well the LbD model fits your organisation, in your opinion?)* and question 6 *(How well does the LbD fit into*

the study module you teach, in your opinion?) based on the classification of the content analysis. This classification has been made based on the answers of the lecturers, and answer categories were obtained: 'fits well', 'fits very well' and 'fits perfectly'. Laurea lecturers' answers are classified into all three categories. In the answers of the lecturers, it was also stated that the LbD model is particularly well suited to working life-oriented project-based studies.

Table 3: Laurea lecturers' opinion for LbD suitable for studies

Question		Fits well	Fits very well	Fits perfectly
How well do you think the LbD model fits in your organisation?	Lecturer 1		X	
	Lecturer 2			X
	Lecturer 3	X		
How well do you think LbD fit into the study module you teach?	Lecturer 1		X	
	Lecturer 2			X
	Lecturer 3	X		

Question 3 *(Do you think the LbD model is suitable for all study modules?)* indicates all three lecturers' beliefs that LbD might not fit very well in some basic theoretical studies. In question 4 *(What studies or situations is the LbD best suited for, in your opinion?),* the answers of the lecturers were consistent with question 3 answers. In the opinion of all three lecturers, LbD is well suited to all study modules that include a working life project because then the students also learn things in practice, and it deepens their knowledge.

Table 4 summarises the lecturers' responses to question 5 *(What were your roles in this study module implementation in which you were involved?),* which shows that the lecturers had several different roles concerning the study module. Everyone answered that they had played the role of teacher, designer and evaluator. Two lecturers had performed other roles, such as mentor, organiser and preparer, and one lecturer answered that another role undertaken was that of a project supervisor.

Table 4: Laurea lecturers' roles in the study module

Lecturers roles	Laurea lecturer 1	Laurea lecturer 2	Laurea lecturer 3
Teacher	X	X	X
Mentor	X	X	
Organisator	X	X	
Designer	X	X	X
Preparer	X	X	
Evaluator	X	X	X
Project supervisor			X

These answers align with the principles of the LbD model, where the lecturers usually have many different roles, which can differ in each study module. The roles of planners, teachers and evaluators are those that also belong to more traditional teaching methods, but other roles are not present in traditional pedagogical models, such as mentor, organiser and project supervisor.

In questions 7 *(What strengths do you think the LbD model has?),* question 8 *(What are the weaknesses or shortcomings of the LbD model, in your opinion?)*, question 9 *(What are the opportunities in the LbD model, in your opinion?)*, and question 10 *(What kind of threats do you think the LbD mole includes?)*, the lecturers were also asked what opportunities, weaknesses, strengths and threats they see in the LbD model. The answers have been collected in the SWOT analysis model (Figure 23). Close cooperation with companies, students' and lecturers' better understanding and knowledge of the business world, and students' better motivation and connection to working life already during their studies were considered strengths. One lecturer saw the LbD model as also bringing a competitive advantage compared to other educational organisations. The lecturers saw the lack of clear instructions and a tool close to practice as a weakness. According to the lecturers, a good understanding of the LbD model is also needed; otherwise, it can cause problems. In addition, the absence of clear evaluation criteria can cause challenges in the lecturers' opinion. As opportunities, the lecturers saw the students' better connections with working life and the deepening of the students' skills in customer projects. In addition, it was seen as a good thing that the students already learned such new skills during their studies that they need in working life. The lecturers saw it as a threat that there could be misunderstandings if the principles

of LbD were not known. In addition, one threat is that it is not necessarily possible to ensure the achievement of all the students' competence goals. It was also seen as a threat that if the client's project goals are not achieved, and the clients are not satisfied, it can bring a bad reputation to the educational institution.

SWOT ANALYSIS

STRENGTHS
- Close cooperation with companies
- Students' and lecturers' better understanding and knowledge of working life
- Students' better motivation
- Working life contacts during studies
- Brings competitiveness compared to others

WEAKNESSES
- Needs for clearer instructions
- Lack of practical tool for participants
- Needs for good understanding for basis of LbD
- Needs for well understood evaluation criteria

OPPORTUNITIES
- Students' better connection with working life
- Deepening students' skills in clients projects
- Students' learn new things which needed in working life

THREATS
- Misunderstanding, if the principles of LbD are not known
- Challenge how to ensure all competence goals
- A bad reputation for education institutions, if the project goals are not achieved and clients are not satisfied

Figure 23: SWOT analysis of LbD according to Laurea lecturers

In question 11 *(Do you have something in mind that should be developed in the LbD model to make it work better?)*, all three Laurea lecturers thought that good instructions on using LbD are needed for all parties: lecturers, students and project clients. The instructions should be clear and include instructions on applying LbD in different situations. In addition, the instructions should be such that they would be helpful for all parties and that they would also help parties who are involved for the first time.

In question 12 (How well did the students' skills develop during the study module?), all three lecturers believed that the students' skills developed well, and the customers were most satisfied with the results. However, the lecturers believed that students who were not as engaged as others did not develop as well as the more active students. According

to the lecturers, everyone performed well, but the skills of the most active students developed particularly well because LbD requires students to take the initiative.

4.2.5 Students Experience

The purpose of the study is to collect computer science students' experiences of LbD-based learning. In addition, the research examines the development of the students' competence during the study module and asks about students' experiences of participating in the study module according to the LbD model. The research material was collected from the students using an electronic Google Forms questionnaire (Appendix C). The survey was completed after completing the study module, and the research material was collected from Laurea's computer science students in the fall of 2019. The subject of the study module was service design and agile methods, and client projects were implemented during the study module. The total number of students in the study module was 31, seven of whom were exchange students. The language of the study module was English. The students were told about this study at the start of the study module. In addition, they were told that the end-of-study module questionnaire would be used to collect research material. The students were also introduced to the LbD approach at the start of the study module so that they understood the basics of LbD and their role in it and knew how to act accordingly.

93.5% of students answered the survey (Lintilä and Zarb 2020a). 29% of the respondents were female students. 61.3 % of students were studying in their third year. Nine students were studying in their second year, and one had studied for over three years.

The survey background related to developing students' skills is higher education students' general working life skills. The purpose of the LbD model is to ensure that the skills of university students meet the demands of working life and help them find employment after graduation. For this reason, Laurea's 2030 strategy was taken as a background, where these have been included ('Strategy 2030 of Laurea University of Applied Sciences' 2020). Laurea's 2030 strategy, in addition to the defined and identified general skills of the degree, also strongly considers the competence needs of working life, which are perceived as increasingly essential skills for those who have completed a degree from a University of Applied Sciences. These common and general working life skills for all degrees consist of six competencies: 'self-management and entrepreneurial attitude', 'critical thinking and problem-solving skills', 'foresight and innovation skills', 'communication and interaction skills', and 'global skills and responsibility skills'.

Students evaluate their competence development in these six areas with a survey, where each area of competence contains three or four questions (Appendix C). There were six competence areas and a total of 20 questions. These questions are referred to in the text by number and letter abbreviations. For example, the first question of the first competence area is 1a, and the second is 1b. The self-assessment questions of the survey by competence areas can also be seen in Appendix C, starting with number 7. The students self-assess their competence level before and at the end of the study module on the topics of each sub-area. It is the student's self-assessment which must be taken into account in the interpretation of the answers and presented as a limitation of the reliability of the results.

Analysis of Students' Classified Questions

The first competence area was 'self-management and an entrepreneurial attitude', and its first question (1a) concerned: 'life management and well-being' (Lintilä and Zarb 2020b). Students were asked to rate their competence on a scale of 1 ("no competence") to 5 ("expert"). The results for 'life management and well-being' at the start of the module show that M (mean) = 3.34, SD (standard deviation) = 0.857, and by the end of the module M = 3.69, SD = 0.761 (Figure 24). Therefore, the student's level of competence increased by an average of 0.35. The results are statistically significant (t(28) = 3.025, p = 0.005).
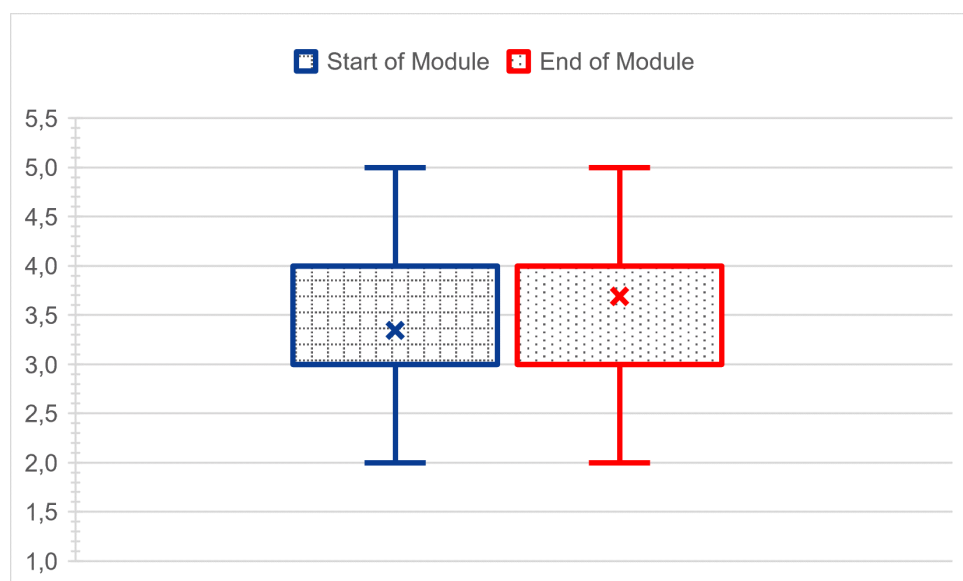
Figure 24: Laurea students' survey results for 'life management and well-being'

The following questions related to the same competence area (1b) were the students' level of 'own skills and skills for continuous learning' (Lintilä and Zarb, 2020b). The results are shown in Figure 25. The reported M = 3.07, SD =0.799 at the start of the study and M = 3.76, SD = 0.739 at the end. The Mean value increased, and the results are statistically significant (t(28) = 4.882, p < 0.001).

Figure 25: Laurea students' survey results for 'own skills and skills for continuous learning'

The third question in the first competence area was (1c) students' 'sales skills' (Figure 26). The results for 'sales skills' at the start of the module show that M = 3.14, SD = 0.953. By the end of the module, M = 3.59, SD = 0.953. The Mean increased, and the results are statistically significant (t(28) = 3.822, p < 0.001). What is interesting about this result is that the competence goals of the study module did not include sales skills, but in spite of this, eleven students rated their sales skills as developed during the study module. These results can be influenced by the fact that all the clients' projects were different, and in some projects, the goal was also sales promotion issues and familiarisation with them. These results clearly show that when working on customer projects, students' competence often develops in areas not part of the competence objectives of the study module.
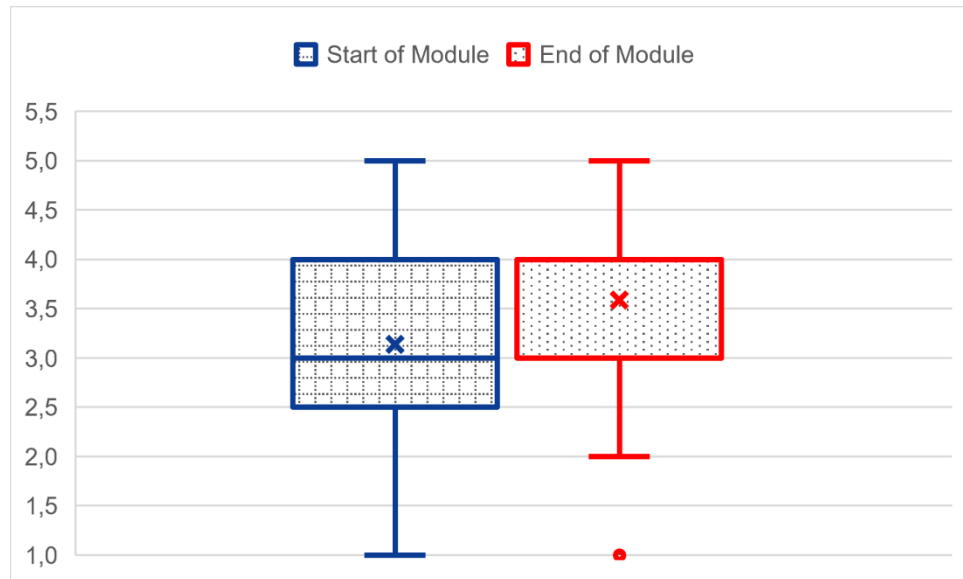
Figure 26: Laurea students' survey results for 'sales skills'

The second part of the students' survey was about 'critical thinking and problem-solving skills' (Figure 27). This sub-area first question (2a) was about 'critical knowledge acquisition, evaluation and utilisation'. M = 3.21, SD = 0.675 at the start of the study module; at the end, M = 3.79, SD = 0,620. The Mean increased, and the results are statistically significant ($t(28) = 5.029$, $p < 0.001$). It is noteworthy in these answers that none of the students chose the value 1. Three students estimated that their level of competence was level 2 at the start of the study module, but all of them estimated that it had risen to either level 3 or level 4 at the end. According to students' self-assessment, all students' competence levels were at the end of the study module at least level 3.
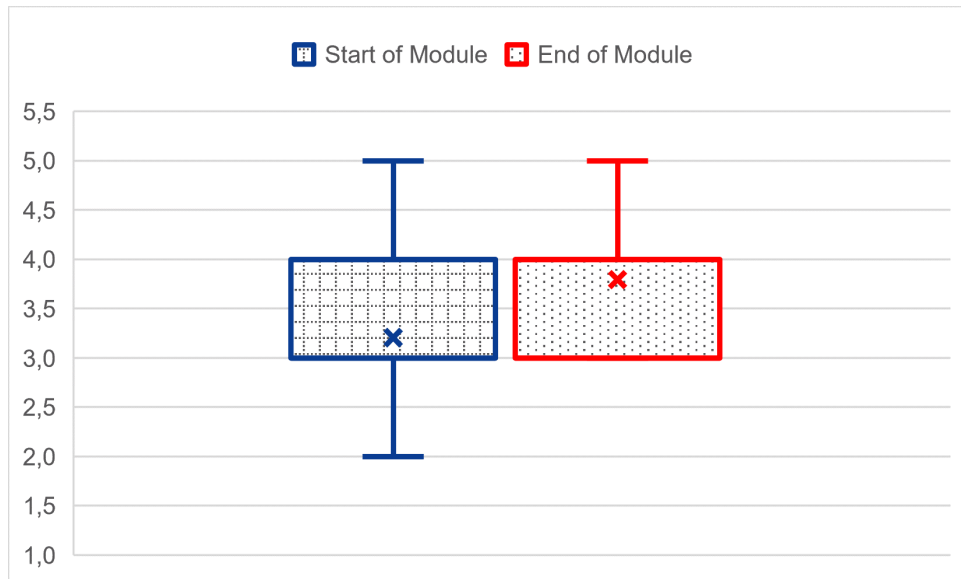
Figure 27: Laurea students' survey results for 'critical knowledge, evaluation, and utilisation'

The second question in this sub-area (2b) was 'entity management and systematics' (Figure 28). The Mean on this answer was the lowest in this research, M = 2.69, SD = 1.039 at the start of the study module. However, at the end of the study module, the Mean had risen to M = 3.21, SD = 1.146. The results are statistically significant (t(28) = 4.396, p < 0.001).
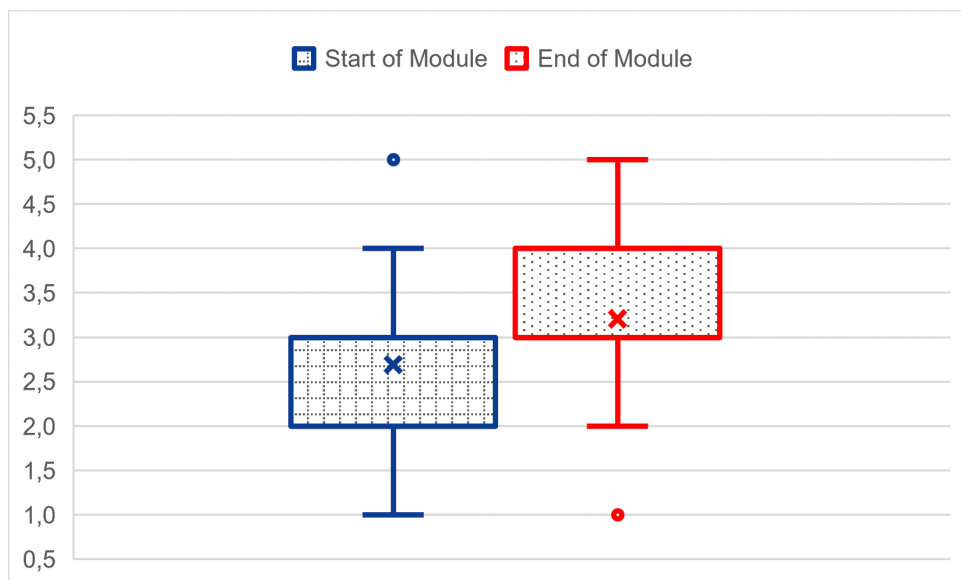
Figure 28: Laurea students' survey results for 'entity management and systematics'

This sub-area's last or third question (2c) was about 'analytical thinking and argumentation' (Figure 29). At the start of the study module, M = 3.34, SD = 0.670; at the end, M = 3.69, SD = 0.541. The results are statistically significant ($t(28) = 3.839$, $p < 0.001$). Only ten students estimated that their competence in this area had increased during the study module. According to their self-assessment, the student's competence level in this area was already relatively high on average, and at the end of the study module, all students had a competence level of at least level 3 in this competence area as well.
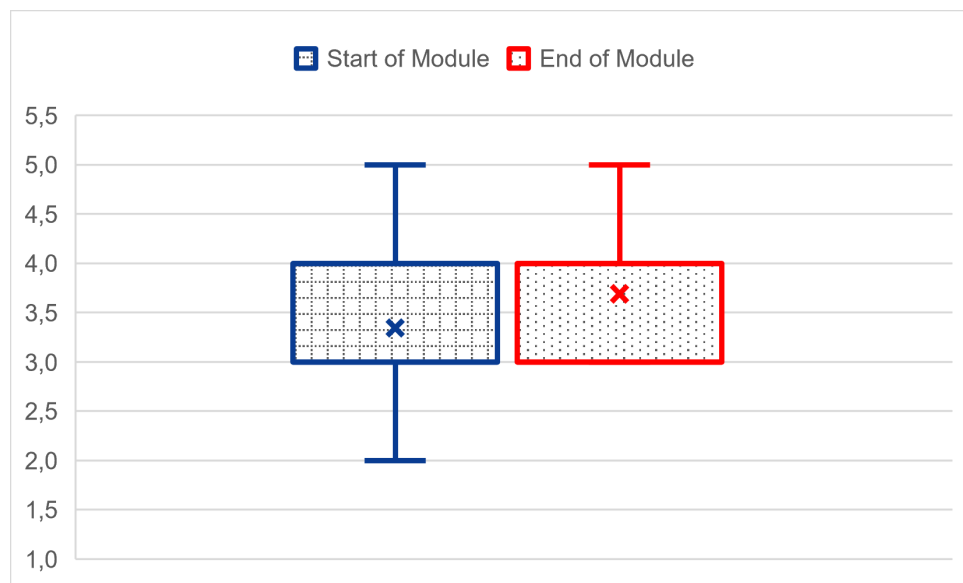
Figure 29: Laurea students' survey results for 'analytical thinking and argumentation'

The third competence area was 'foresight and innovation skills'; its first question was about 'creativity and initiative' (3a) (Figure 30). For this competence area, M = 3.34, SD = 0.814 at the start of the study module. The Mean value increased during the study module M = 3.97, SD = 0.680 at the end. The results are statistically significant ($t(28) = 5.375$, $p < 0.001$). At the end of the study module, everyone's competence level was at least level 3 in this area.
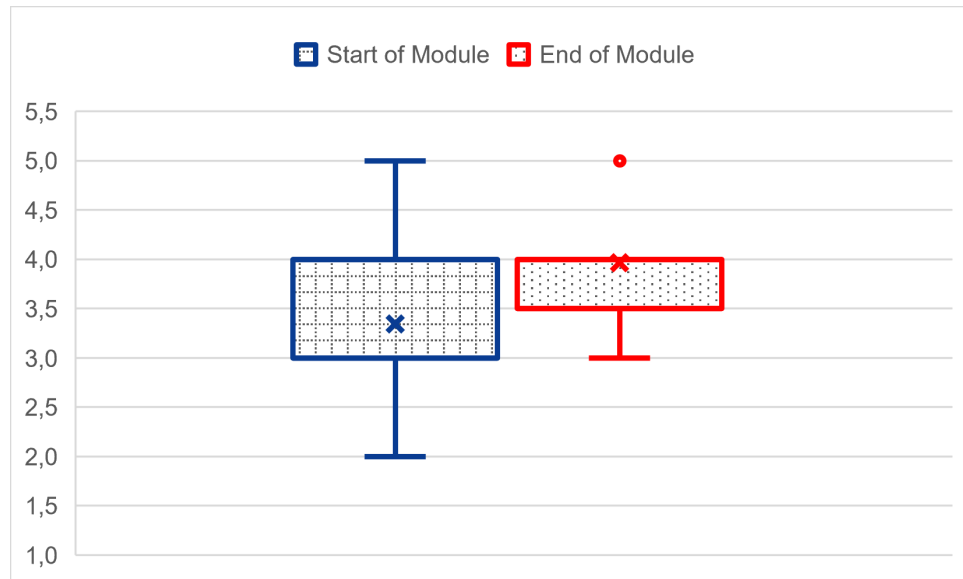
Figure 30: Laurea students' survey results for 'creativity and initiative'

The second question in this competence area (3b) was 'co-development and service design skills' (Figure 31). In this competence area, the students' M = 2.97, SD = 0.865 at the start of the study module and M = 3.93, Sd = 0.530 at the end. The Mean increased by 0.96%, and the results are statistically significant (t(28) = 7.112, p < 0.001).
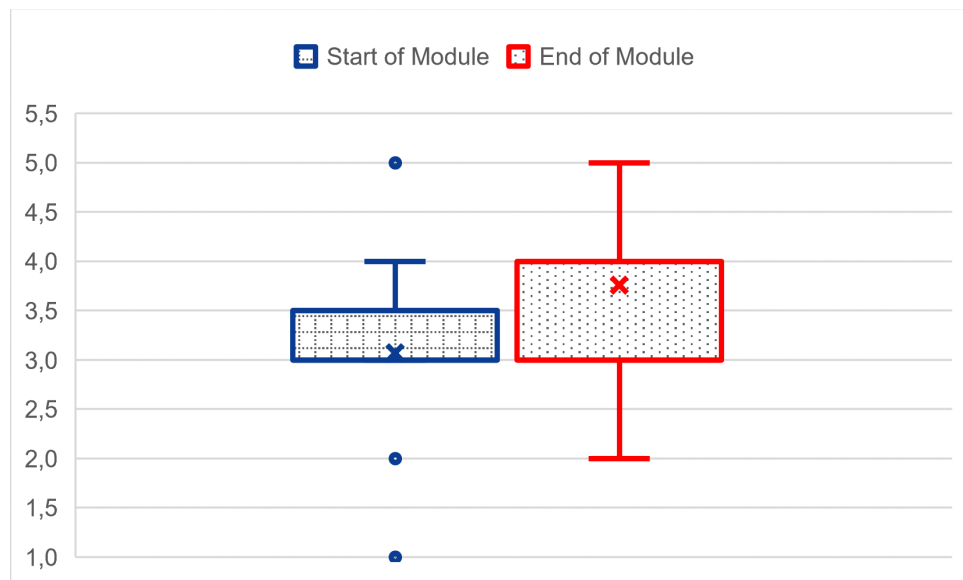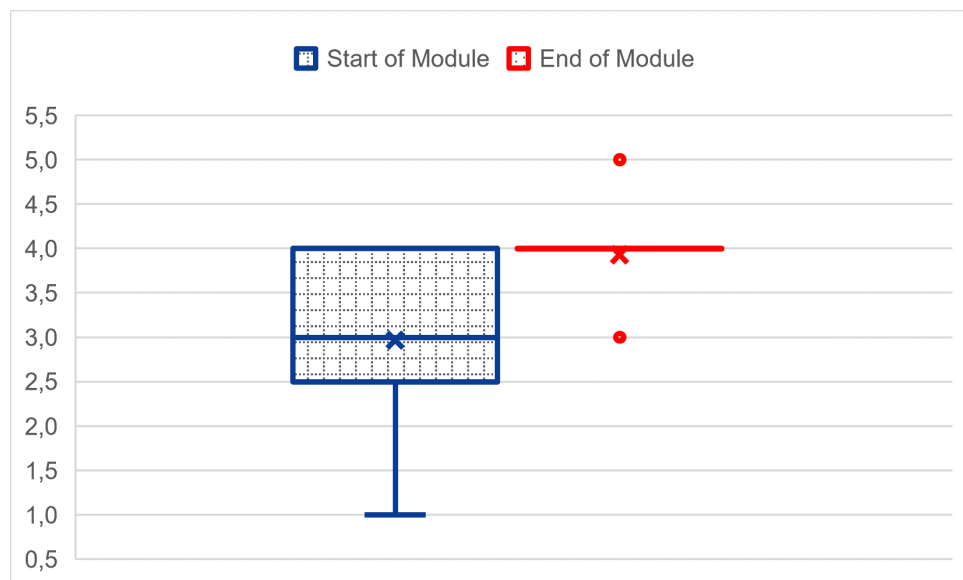

Figure 31: Laurea students' survey results for 'co-development and service design skills'

The third question (3c) was about 'technology and digital competence' (Figure 32). In this competence area, M = 3.69, SD = 0.761 at the start of the study module and M =

4.00, SD = 0.535 at the end. The results are statistically significant (t(28) = 3.550, p = 0.001).
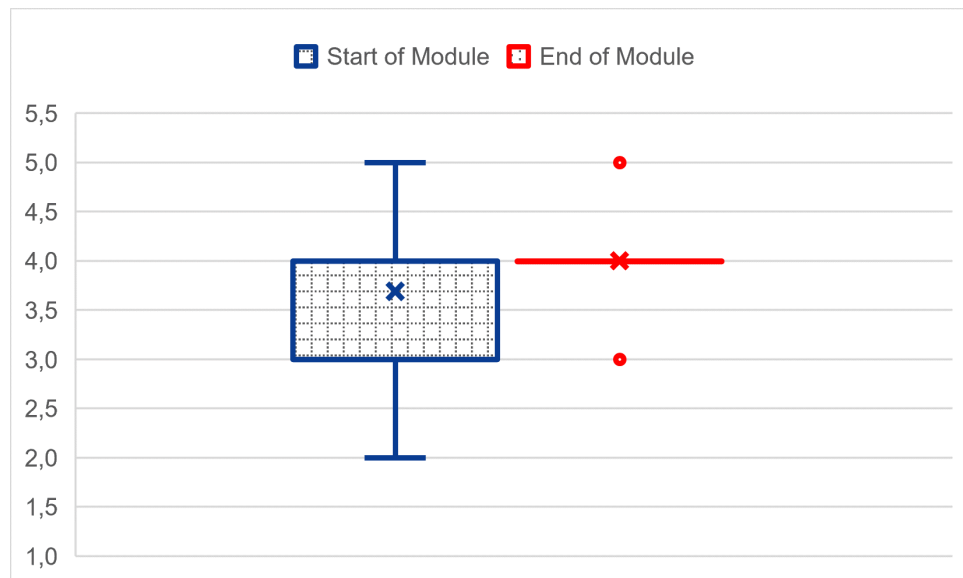
Figure 32: Laurea students' survey results for 'technology and digital competence'

The fourth question (3d) in this competence area was 'the ability to change' (Figure 33). M = 3.41, SD = 0.733 at the start of the study module. At the end of the study module, the Mean increased, M =3.83, SD = 0.539. The results are statistically significant (t(28) = 3.923, p < 0.001).
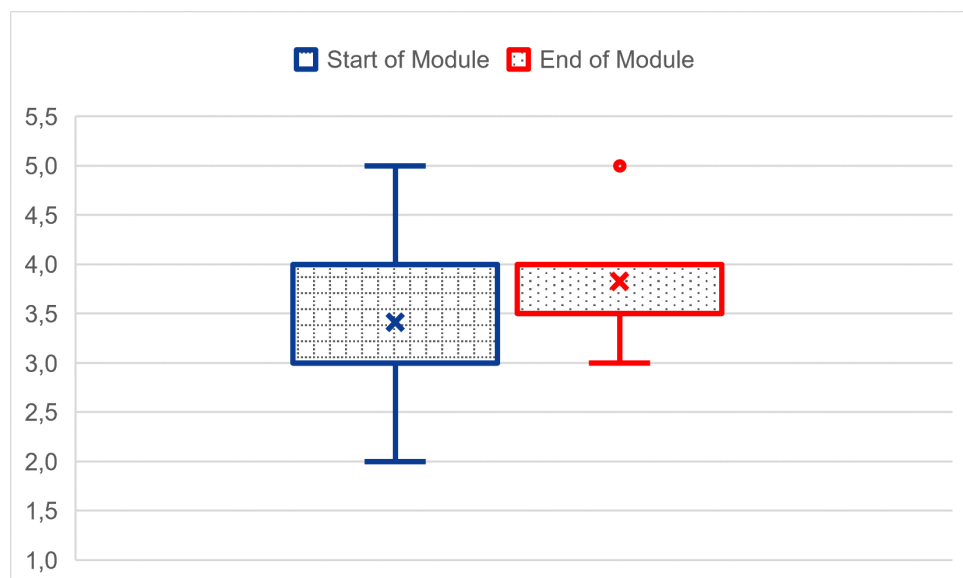
Figure 33: Laurea students' survey results for 'the ability to change'

The fourth competence area was 'communication and interaction skills', where the first question (4a) was about 'impressive oral and written communication skills (including language skills)' (Figure 34). M = 3.45, SD = 0.827 at the start of the study module. Only seven students assessed that their competence level increased during the study module; M = 3.76. SD = 0.689. The results are statistically significant (t(28) = 2.768, p = 0.010).
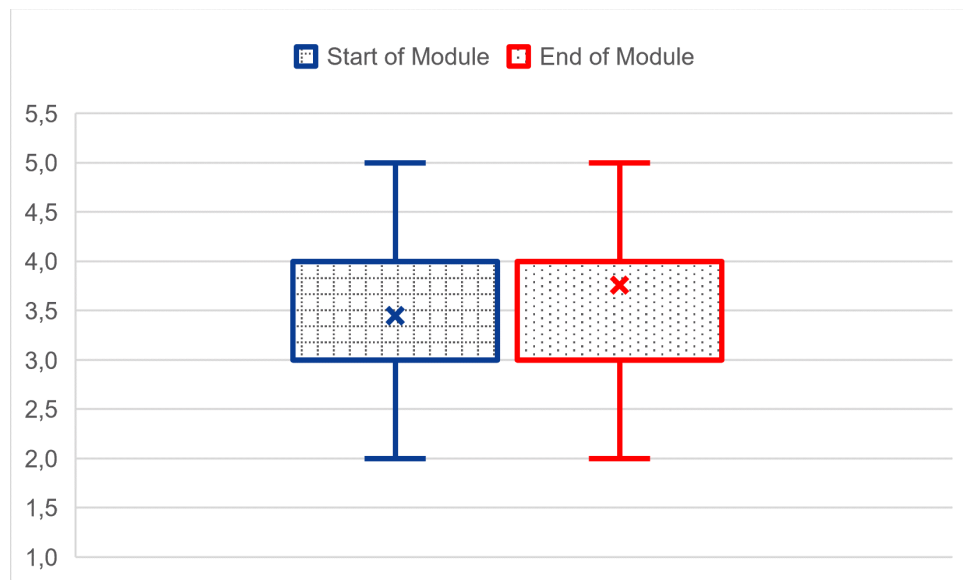
Figure 34: Laurea students' survey results for 'impressive oral and written communication skills (including language skills)'

The second question in this competence area was about 'networking skills' (4b) (Figure 35). M = 3.28, SD = 0.797 at the start of the study module, M = 3.55, and SD = 0.686 at the end. The results are statistically significant (t(28) = 2.816, p = 0.009). At the end of the study, everyone's competence level was at least level 3.
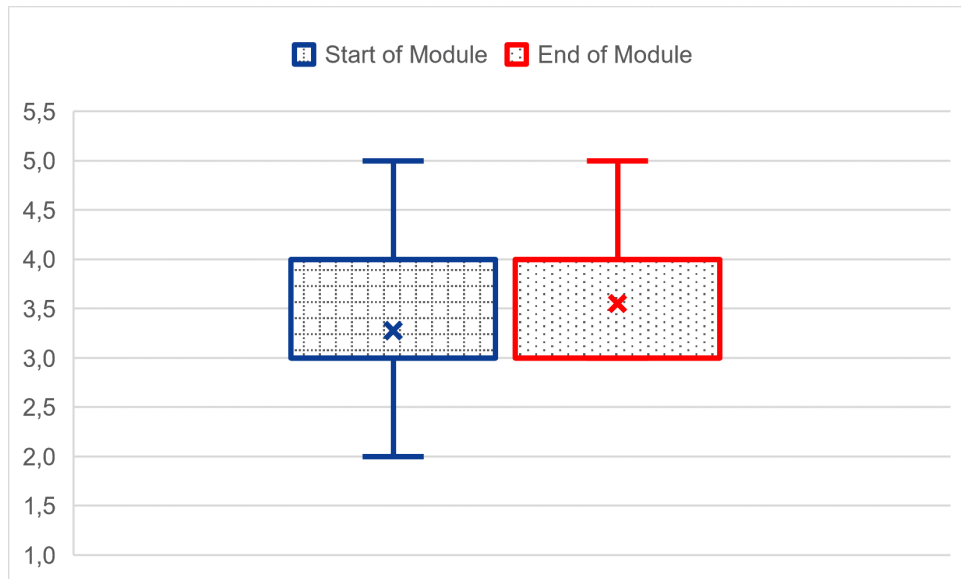
Figure 35: Laurea students' survey results for 'networking skills'

The third question in this competence area (4c) was about 'social impact' (Figure 36). The results for 'social impact' at the start of the study module show that M = 3.10, SD = 0.618, which increased to M = 3.34, SD = 0.670 by the end of the module. The results are statistically significant (t(28) = 2.544, p = 0.017).
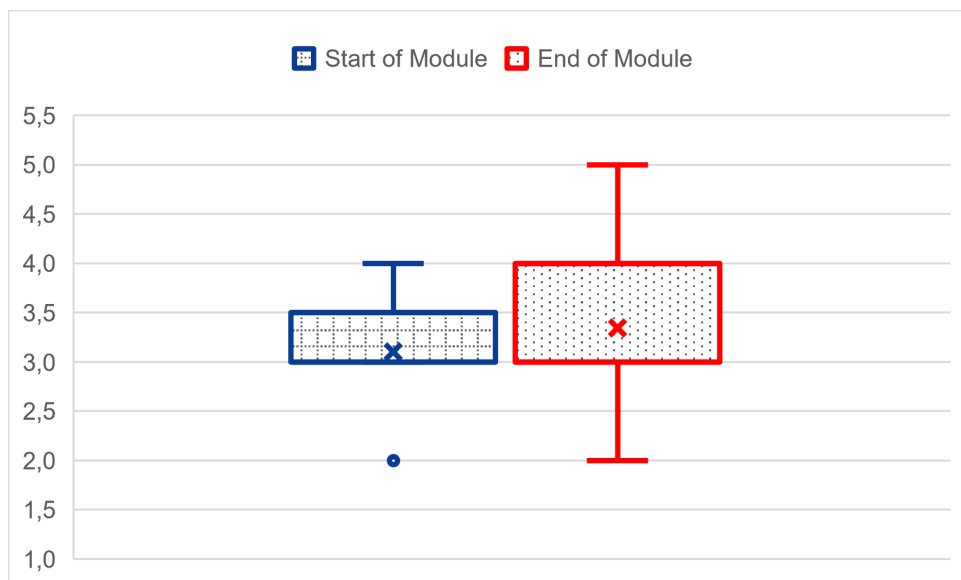
Figure 36: Laurea students' survey results for 'social impact'

The fourth question in this competence area (4d) was about 'customer understanding and customer knowledge' (Figure 37). At the start of the study module, M = 3.21, SD = 0.861; at the end, M = 3.93, SD = 0.593. The results are statistically significant (t(28) =

5.556, p < 0.001). Regarding this competence area, 17 students estimate their competence level has increased.
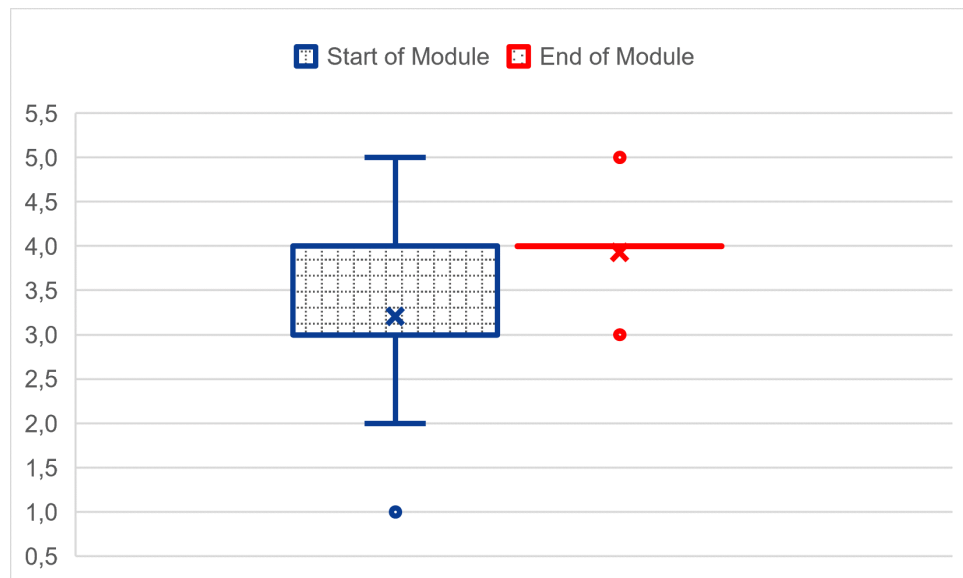
Figure 37: Laurea students' survey results for 'customer understanding and customer knowledge'

The fifth competence area was 'global expertise'; the first question (5a) was about International capacities (Figure 38). M = 3.17, SD = 0.658 at the start of the study module, and M = 3.62, SD = 0.561 at the end. The results are statistically significant 8t(28) = 3.822, p < 0.001).
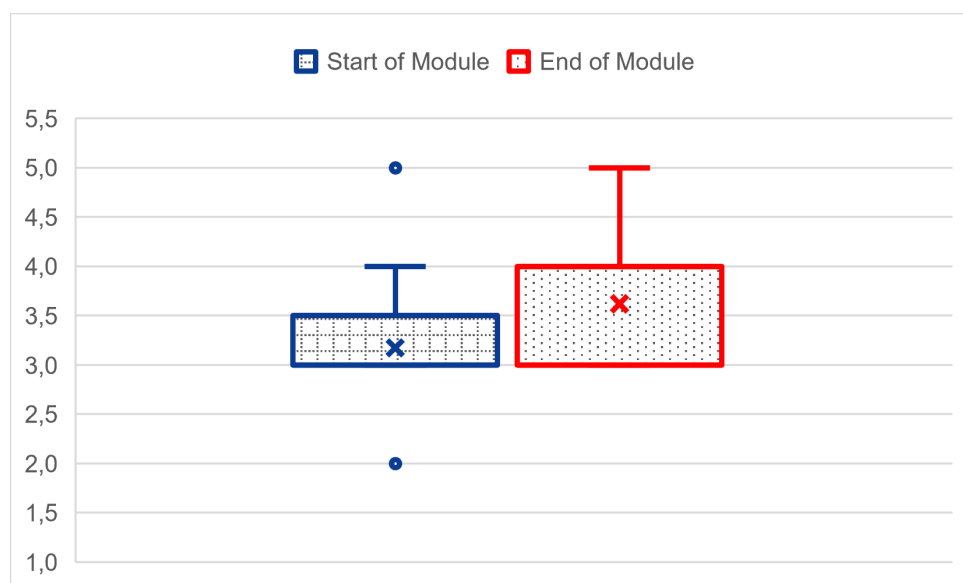
Figure 38: Laurea students' survey results for 'international capacities'

The second question of the fifth competence area (5b) was about 'understanding cultural meanings' (Figure 39). M = 3.14, and SD = 0.743 at the start of the study module. M = 3.48, SD = 0.688 at the end of the study module. The results are statistically significant (t(28) = 3.360, p = 0.002).
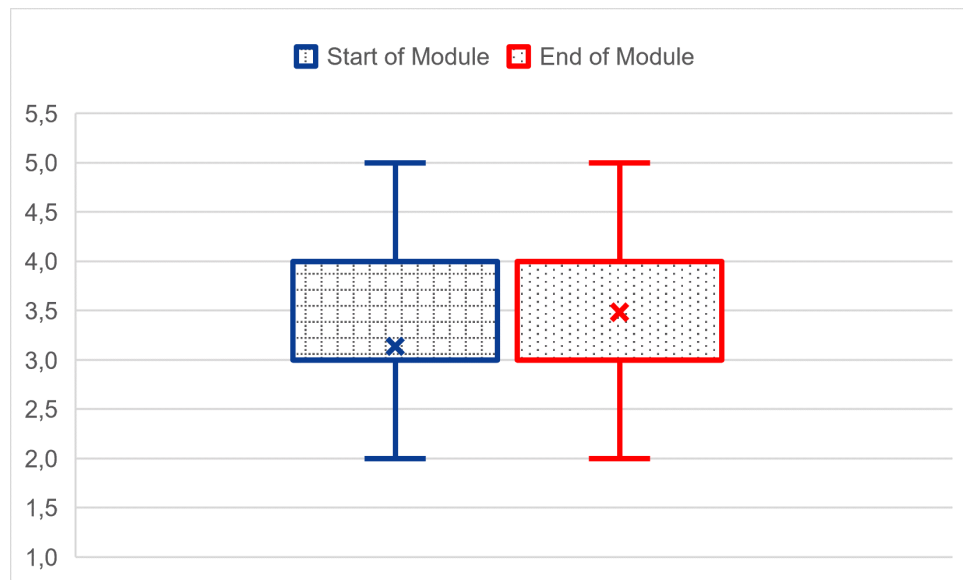
Figure 39: Laurea students' survey results for 'understanding the cultural meaning'

The third question (5c) in this competence area was about 'ethical engagement in a global media and technology environment' (Figure 40). M = 3.17, SD = 0.711 at the start and end of the study module, M = 3.41, SD = 0.733. The results are statistically significant (t(28) = 2.985, p = 0.006).
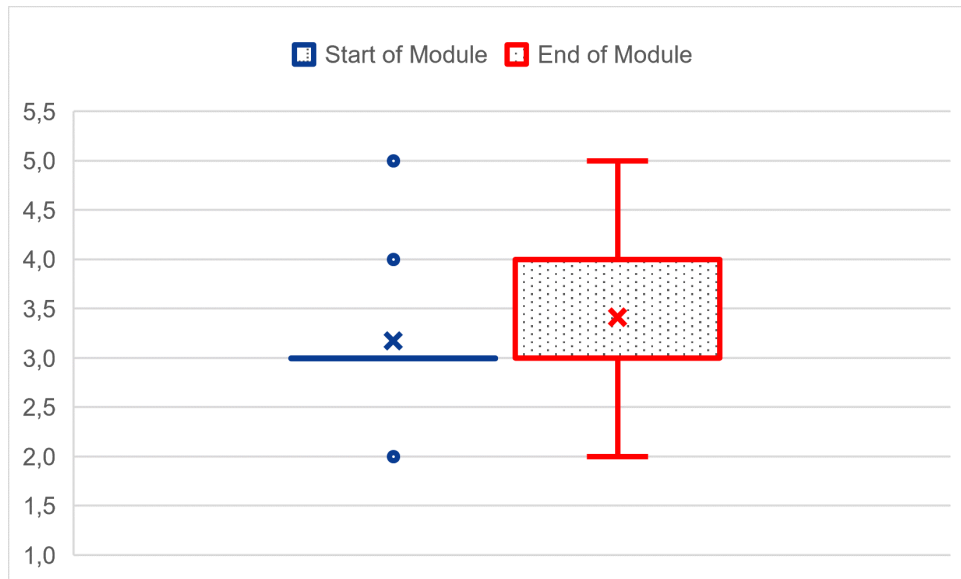
Figure 40: Laurea students' survey results for 'ethical engagement in a global media and technology environment'

The sixth and last competence area was 'responsibility expertise'. The first question of this competence area (6a) was 'ethics and empathy' (Figure 41). M = 3.38, SD = 0.862 at the start of the module and M = 3.55, SD = 0.827 at the end. The results are not statistically significant (t(28) = 1.983, p = 0.057).
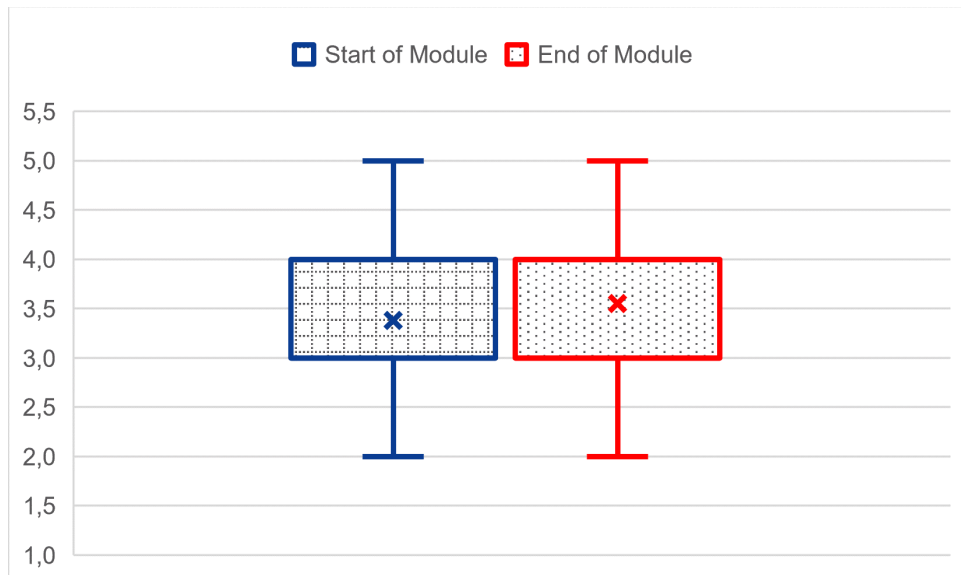
Figure 41: Laurea students' survey results for 'ethics and empathy'

The second question (6b) in this competence area was about 'equality and justice' (Figure 42). M = 3.66, SD = 0.769 at the start of the study module, and M = 3.79, SD = 0.819 at the end. The results are statistically significant ($t(28) = 2.117$, $p = 0.043$).
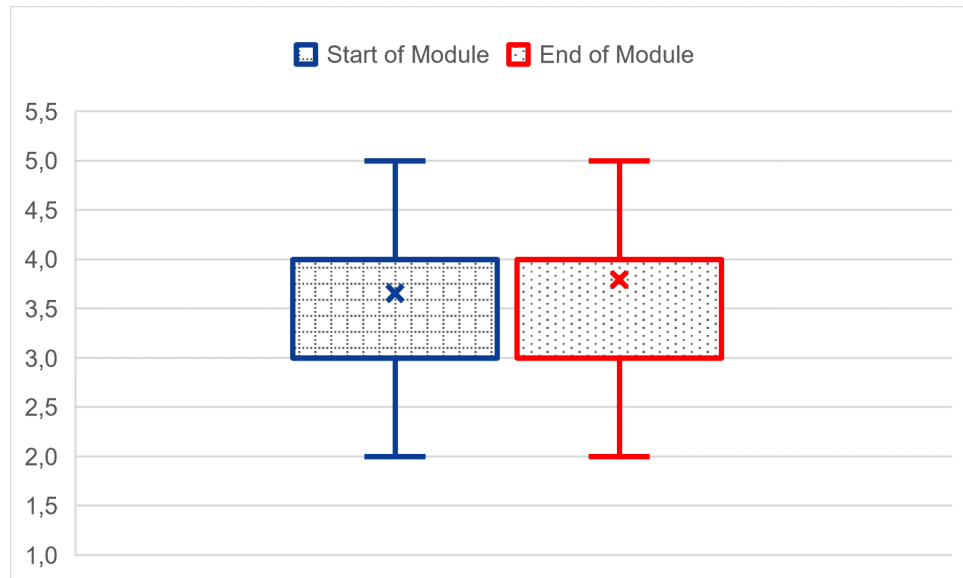
Figure 42: Laurea students' survey results for 'equality and justice'

This competence area's third and last question (6c) was 'ecological, social and economic sustainable development' (Figure 43). M = 3.17, SD = 0.805 at the start of the module, and at the end, M = 3.38, SD = 0.775. The results are statistically significant ($t(28) = 2.703$, $p = 0.012$).
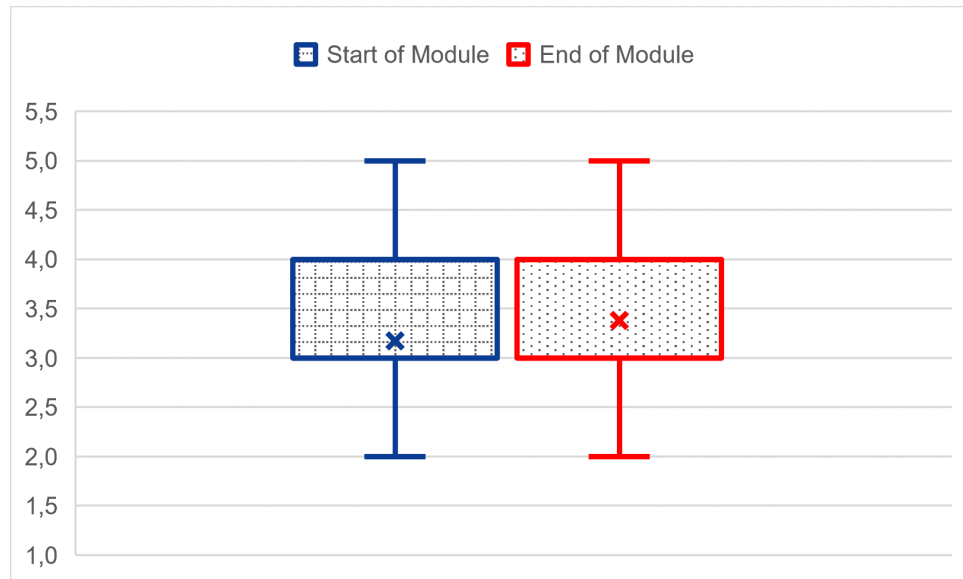
Figure 43: Laurea students' survey results for 'ecological, social and economic sustainable development'

Analysis of Students' Free-form Questions

Students were asked to freely answer what new things or skills they learned during the study module. The students' free-form answers have been classified using content analysis (Table 5). Table 5 contains the answers to question 7. Table 5 shows that students' competence developed in teamwork, international competencies, and working with customers in addition to technical skills. In addition to these, the personal skills of many students grew or deepened, such as patience, working on challenging projects, ethical principles and confidence in one's abilities.

Table 5: Laurea students' competence development during the study module

What new things or skills did you learn during the study module?				
Technical skills	**Team work skills**	**International compencies**	**Working with the customers**	**Development of personal skills**
Service design skills	Team work, team management and time management	Working in multicultural environment	Customer oriented project skills	Ethical perspectives in designing
Agile methods	Working with different people	Working with people from other cultures	Understanding the customer needs	Changing my point of view
Designing a full service	Group working	International co-working	Creating and developing customer oriented services with the customer	Working with difficult project assignment
Deepening skills in designing services	How to improve when working with a team	Working in a project group in English		Trust more myself and my skills
Service design and agile methods and use them in the project	Leading and project management	How to work with different people for other cultures and use that as a strenght		Patience
	Improving at being proactive during team work			Companing earlier knoweledge with others in a new way (technical and soft

The students were also asked about their roles during the project (Question 8). The ready-made roles were project manager, developer, designer, tester, participant and researcher. Students were also asked to rate their level of competence in these roles on a scale of 1 to 5. Figure 44 shows the students' answers about their different roles during the study module and their self-assessment of their level of competence in each role. The value 0, in Figure 44, means that the student had not chosen this role in question in the survey. Therefore, those students did not act in that role during the study module.

Students were asked to evaluate their level of competence in how well they thought they understood what LbD meant in practice on a 5-point Likert Scale (Question 9) (Figure 48). 6.5% of Laurea's students estimate their understanding of LbD to be at level two. 19.4% of students rated their level of understanding at three and fifteen at level four. 19.4% of students estimated that they understood the practical significance of LbD was level five. This self-assessment question also included an answer point where students were asked to describe in their own words what LbD meant in practice (Question 10).
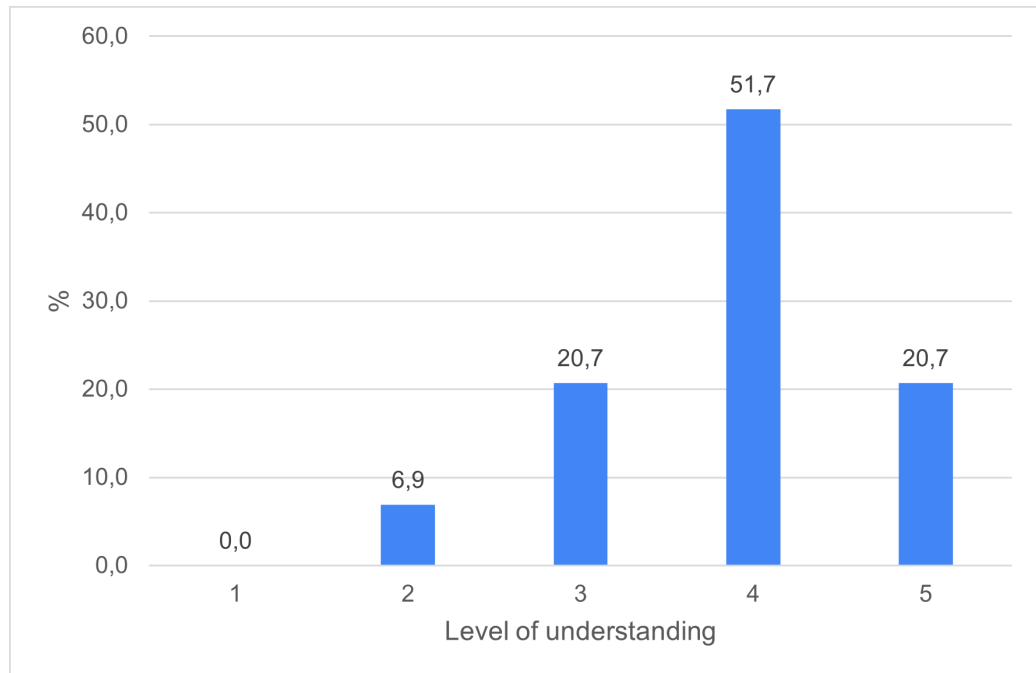
Figure 44: Laurea students' understanding of what the LbD mean in practice (1 = no understanding, 0 = high understanding)

When comparing free-form responses to the 5-point Likert Scale responses, the students who assessed their competence level as three or four were also quite in line with this self-assessment. For example, one student who had estimated the level of understanding to be three was written up as: *"Authentic working situations with developing solutions for customers help the student learn more about actual work-life projects."* Another authentic example of the answer of a student who estimated that understanding level was four was written up as: *"Combination of transformative teaching, competence-based curriculum and including / Renewing working life."* However, what is interesting in the responses is that one student who rated competence level as five had written in a free-form response that LbD is *"a chaotic method and its results are usually useless"*. The motivation of the student in question to answer this way is unknown, and it was not intended to be investigated in this study. On the other hand, the two students who rated their level of understanding as two could answer well what LbD meant in practice.

The students were also asked how well LbD fits into computer science studies in general (Question 11). The majority of students (41.9%) thought it fitted either well or very well (29.0%) (Figure 45). One student estimated the suitability level to be two, and 19.3% of

students estimated the level to be three. No one chose level one, meaning everyone had at least some knowledge of the meaning of LbD.
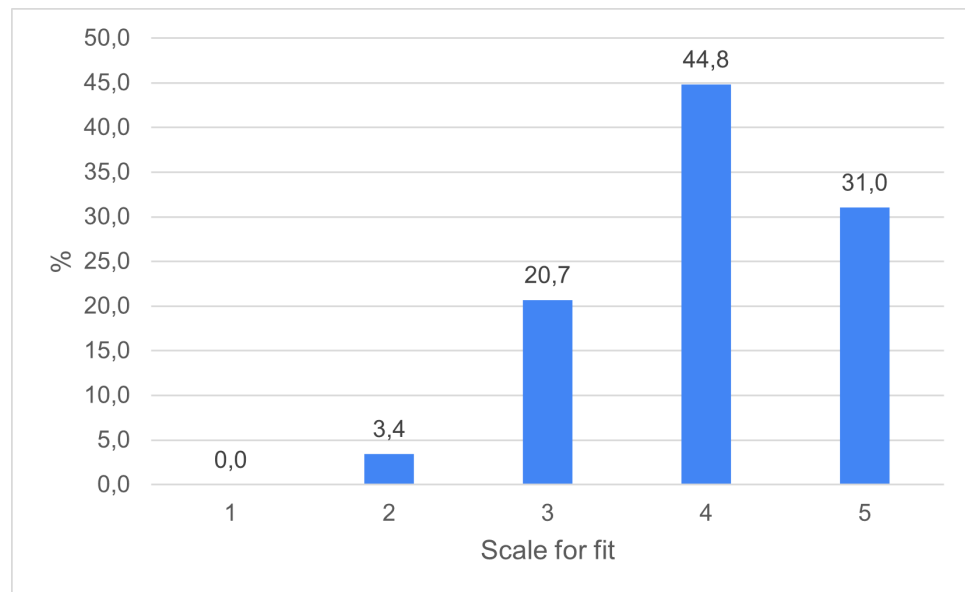
Figure 45: How well does the LbD Action Model fit into studying computing science studies (1 = no understanding, 0 = high understanding)

Attached are some authentic student answers to question 12 *(Describe in your own words whether LbD is suitable for computing science studies and justify your answer.:* "*It is a good way to prepare students for the future and give them good tools for future work*" (Laurea, student 2). *"It fits well as the process helps in learning better in-depth knowledge while studying"* (Laurea, student 3). *"It suits perfectly because, in computing science, the best learning outcomes occur when trying things out and learning by successes and mistakes"* (Laurea, student 4). *"It works very well. Learning through this model translates well into work-life"* (Laurea, student 5). *"It is because computing science often includes developing services, products and whatnot, which are done by working in teams. So it prepares students for their future jobs"* (Laurea, student 6). *"It is suitable because you can better understand the methods used in "real life" rather than just learning the theory"* (Laurea, student 8). *"I think LbD is suitable for IT studies because it gives valuable experience working in that field through different projects, which helps students develop knowledge and skills"* (Laurea, student 9)*.

One student found LbD a good method but replied, *"LbD is a good method in every study but should not be the only learning method. The theory is more like university teachings if studies are only in the classroom. Companies need workers with skills and know-how*

of real working life before graduation" (Laurea, student 8). One student was critical of using only one method and replied, *"I do not see LbD as a suitable way of studying anything as the primary method"* (Laurea, student 10).

It can be seen from the answers that the students saw many benefits in the LbD model and considered it a good way to learn new things and, at the same time, deepen their practical knowledge of customer projects.

Students were also asked to evaluate the suitability of LbD for the study module they attended (Question 13). It can be seen from Figure 46 that the students' answers to this question were almost identical to how well they think LbD fits into computer science studies. The only difference in the results is that two fewer students rated three. Correspondingly, two more students chose assessment four, i.e. a total of 15. One student estimated that the LbD suitability level for that study module was two. This student was the same student who answered that LbD is a chaotic and useless way of learning.
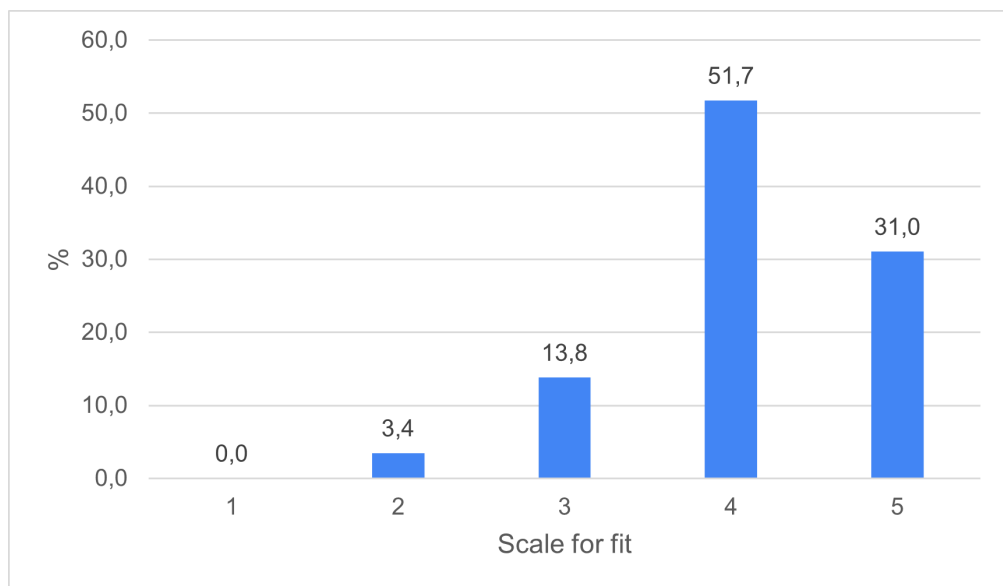
Figure 46: How well LbD fits the study module where students' attended (1 = no understanding, 0 = high understanding)

Attached are some of the students' authentic answers to question 14. From the answers, it can be seen that most students believed that LbD was an excellent way to learn and helped them understand and internalise things better: *"It was really efficient, and I know I will remember what I learned in this module for a long-time!"* (Laurea, student 1). *"LbD*

worked greatly for this study module" (Laurea, student 3). *"Working with a customer was fun and a learning experience, creating something based on their needs. I do not think this study would have been as effective without them."* (Laurea, student 18). *"It fits well, as also creativeness is important"* (Laurea, student 5). *"It suited us well because we had to research things independently and then put them to use, so we had to understand the subjects"* (Laurea, student 12). *"There are many things about handling a project that cannot be understood without actually using them. Also, it helps to learn new tools, software and methods when you can create something. It is always more rewarding to see your achievements"* (Laurea, student 17). *"We built a practical app project during the study module, which is very much suited to the LbD process"* (Laurea, student 26). *"The LbD model fitted perfectly for this study module because we were given a work-life project where we had to research and create solutions based on that"* (Laurea, student 23). One critical student answered, "I think LbD was a pretty *worthless method of teaching this. Supported by actual teaching, LbD might work, but in its current form, no."* (Laurea, student 10):

The students were also asked to evaluate how well they thought the project clients had internalised the meaning of LbD (Question 15). It can be seen from Figure 47 that two students thought that the project client did not correctly understand the purpose of LbD. The six students who chose level two said they did not know the client's level of understanding of LbD. Ten students estimated that the level was three, but some were unsure that the client was completely clear about the principles of LbD, even though they were introduced to them at the start of the study module. The students who chose an

estimated clients' understanding of level four or five thought that the project client had understood and internalised the meaning of LbD.
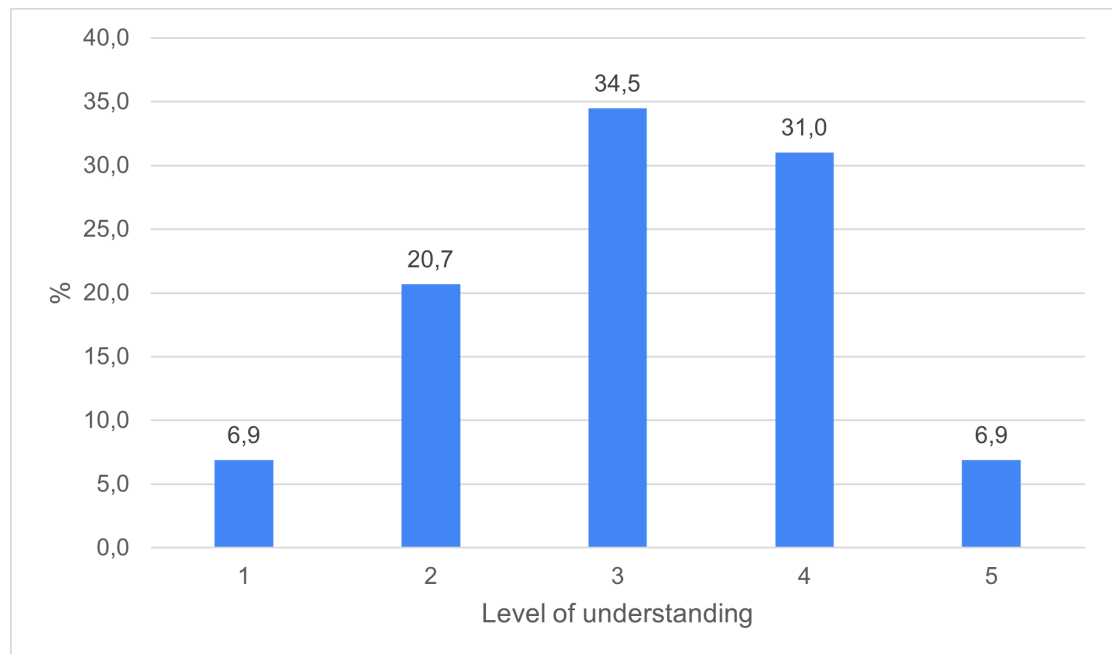
Figure 47: Students' assessment of project clients' level of understanding of the LbD (1 = no understanding, 0 = high understanding)

The students were also asked whether introducing the LbD model at the start of the study module was sufficient and whether they understood the LbD model (Question 17). 89.6% of respondents thought that the familiarisation with the LbD model was sufficient; based on that, they understood the central principles of LbD. According to one student, the introduction to the LbD model could have been more in-depth. The student did understand the basics but would have liked more information about the LbD model, even though the student stated that he could have read more about it because the material was available. Two students could not answer this question because they were away from the lectures when the LbD model was reviewed.

Regarding survey question 18 concerning whether the lecturers' roles aligned according to the LbD model, most students (82.8%) answered that they were. The lecturers had several different roles depending on the client project, but according to the students, they all fit well with the roles of lecturers according to the LbD theory. 17.2% of students were not quite sure whether the lecturers' roles were in line with LbD. The answers of all these students differed slightly from each other. One student did not answer this, and one answered that he was unsure. Two answered that because they were absent from the

LbD orientation, they were not quite sure what the role of the lecturers should have been, and one student thought that in this study module, there would have been no need for lecturers.

For question 19 *(What is good about LbD, and what is the best about it?),* the students' answers were analysed using material-based content analysis. The answers were categorised and classified, and answers were grouped into three main categories: a new way to develop competencies; practical learning; and customer cooperation. The students' answers were very similar, and it can see from Figure 48 what kind of things the students highlighted as the good or best aspects of LbD.
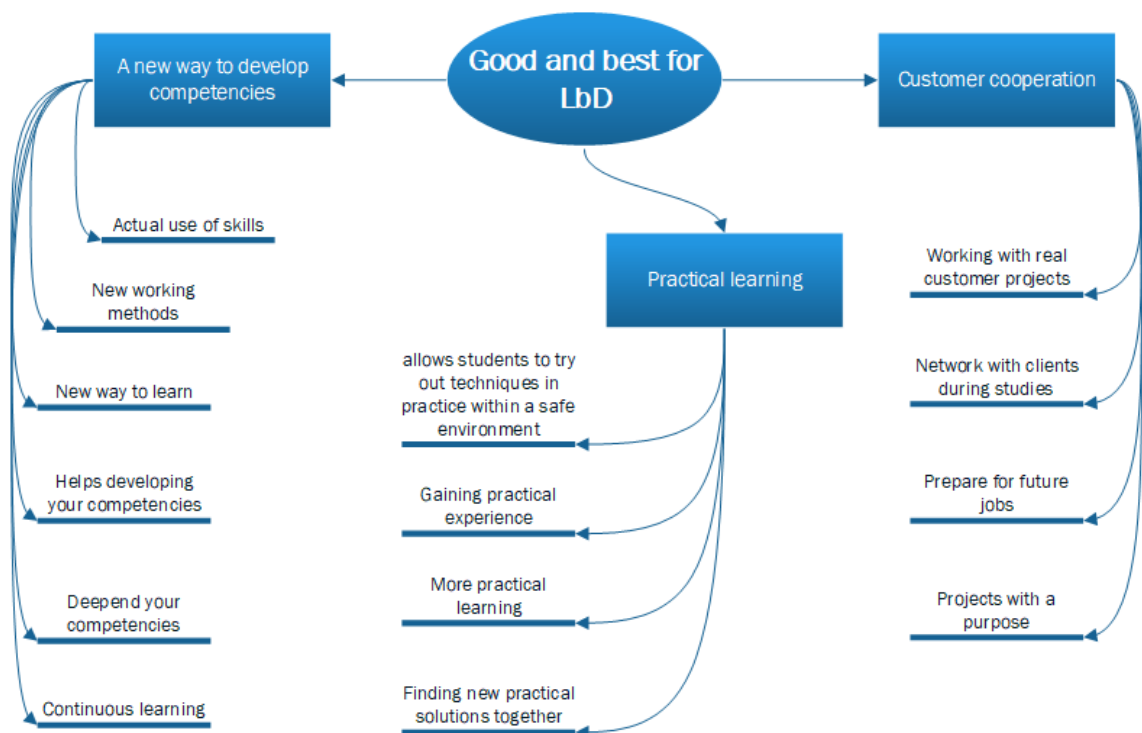
Figure 48: Good and best for LbD model in the opinion of Laurea students

Similarly, students' answers to question 20 *(What weaknesses do you see in the LbD-based study?)* were also classified using data-based content analysis, and based on that, the answers were classified into four categories: project clients', project topic, teamwork and students. Figure 49 shows that weaknesses related to project clients may be because the client is not sufficiently committed to cooperation or is not sufficiently active. A weakness in LbD could be that no relevant project can be found or that it is not suitable for the content of the study module. It was seen that teamwork could sometimes be difficult, especially if there are some conflicts within the team. The fact that the LbD

model is not necessarily suitable for all students was also seen as a weakness. Also, if there is an unmotivated student in the group, it can cause problems. It was also seen as a weakness that if the students do not have sufficient basic knowledge, it can cause challenges during the project.
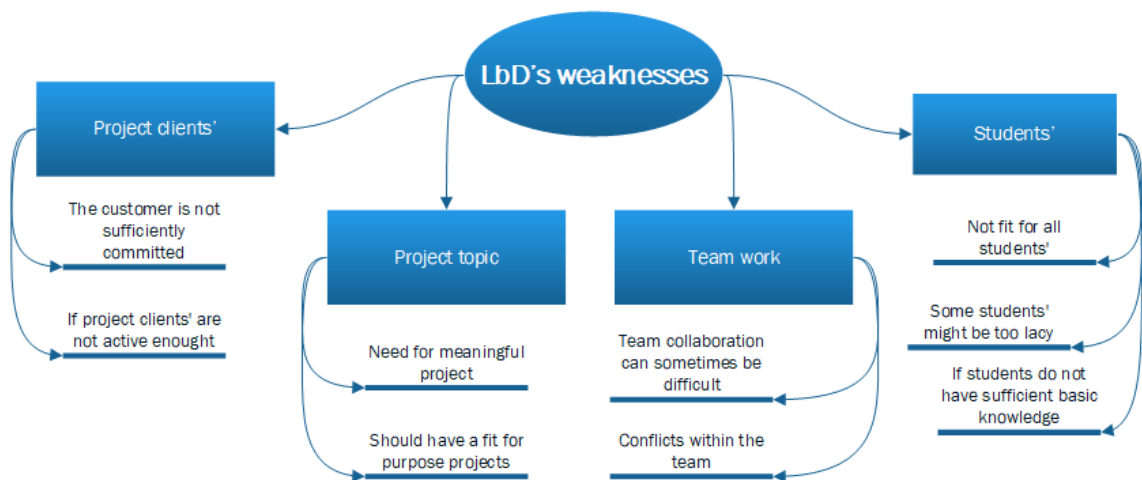
Figure 49: Weaknesses of LbD in Laurea students' opinion

In question 21 *(How do you think the LbD Action Model should be developed?),* the students were asked how they thought the LbD model should be developed. Not everyone could answer this, but the students also came up with beneficial development suggestions. The students hoped for a more in-depth introduction to the LbD model for all parties and some concrete tool they could use during their studies. The students also said that the lecturers must deeply understand the client's needs before accepting projects for the students' study module. Lecturers must be able to assess well whether a project is suitable for the purpose intended to be combined with teaching. Lecturers should also be able to tell clients what competence the students have before starting the study module and what kind of competence they should achieve during the client project. This would ensure that the customers' requirements were in line with the students' skills and that the customers would understand what kind of skills the students have and what skills they should learn during the study module.

In question 22 *(What kind of learning situation do you think best suited for the LbD Action Model?)*, the students were asked what kind of study situations they thought the LbD model best suited. To this, the students answered that the LbD model was optimal for: practical customer projects, development, planning, practical training of things already

learned in projects, the deepening of knowledge in practice, application of new things in practice and many skills taught at the University of Applied Sciences.

4.2.6 Project Client Experience

Research data was also collected from the project clients who participated in the study module to obtain information from all parties involved in the study module implementation according to the LbD model. The project clients were from different organisations, and their needs varied. All project clients participated in the kick-off event held on campus at the start of the study module, where they were introduced to LbD pedagogy and their role in it. The clients also presented the students with their project topics, after which they agreed with the student groups on working methods, schedules and tools.

Laurea's students were divided into six groups. Each group had a different client project topic. There were four clients in total and six project topics. There were 11 interview questions for project clients (Appendix D). The interview questions were planned and presented to the project clients at the beginning of the study module, and they were told about the thematic interview to be conducted after the study module. With the help of interview questions, information was collected from the project clients about the success of the students in the project, the flow of cooperation and practical matters, roles, possible challenges, the achievement of goals and the usefulness of the project outputs. In addition, the project clients were asked how well they knew the LbD model before and whether they thought the LbD model was suitable for client projects with students. The project clients were interviewed remotely, after which the interviews were transcribed for analysis. Data-based content and narrative analysis have been used to analyse the research results.

Table 6 shows the customers' classified answers to question 1 *(How well did the students succeed in the project?)*. The answers were categorised into weak, satisfactory, good and excellent. In Table 6, the category weak is perhaps unnecessary because, in the opinion of the project clients, none of the group's results were weak, but it has been deliberately left in the classification. Three of the six groups were rated excellent by the project clients, two were rated good, and only one group's result was satisfactory.

Table 6: Laurea clients' assessment of the projects' results

Laurea projects'	Weak	Satisfactory	Well	Excellent
Client 1, project 1				X
Client 1, project 2		X		
Client 2, project 1				X
Client 2, project 2			X	
Client 3				X
Client 4			X	

The project's clients could not answer Question 2 *(How well do you think the cooperation between students and teachers worked?)* very well because the visibility of the collaboration between lecturers and students was not very high. However, the project clients said what they saw and experienced about the cooperation between lecturers and students on-site at the campus worked well. One customer said the lecturer was more in touch with them initially, but after that, the students took responsibility for communicating with the customer.

In regard to Question 3 *(Did everyone have clear roles during the project?)*, 50% of project clients replied that the roles had been agreed upon, and they were clear. Two clients did not precisely know the students' role in the project because they had agreed that only one of the students in the group would act as a contact with the client. However, the customers believed that the students had agreed on the roles in the group among themselves well.

Concerning Question 4 *(Were the project goals mutually agreed upon, and were they clear?)*, 50% of project clients answered that their goals were clear and reviewed with the group. One of the customers answered like this: *"I think it was, but in the beginning, maybe I did not know how to express my goals correctly, so it took a little time at the beginning of the project"* (Laurea, project client 3). According to one customer, they felt things were clear at the beginning of the project and agreed with the students. Since the subject was unfamiliar to the client, the project's goals had to be redefined with the student group as the project progressed.

To question 5 *(How well did the practical matters related to the project go?)*, all project clients answered that the practical matters went well or reasonably well, and the schedules were kept as agreed. According to one customer, initially, there were a few challenges, but things were agreed upon in a joint meeting, and everything went smoothly afterwards.

For question 6 *(Were there any challenges or problems during the project, and if so, were they resolved, and if so, how?)*, one customer answered that there were no problems or challenges. According to other customers, there were some minor challenges along the way, but they were all solved in joint meetings. According to one customer, lecturers were essential in solving such challenges.

Questions 7 *(How well were the goals achieved?)* and 8 *(how beneficial was the result of the project for your organisation?)* are closely related, and the answers to them were very similar, so the answers are presented here combined. The answers to questions 7 and 8 are also relatively consistent with how they evaluate the students' success in the projects. Client 1 rated that the goals of Project Group 1 were achieved excellently and its outputs can be used immediately, and it has also brought a new approach to things for the client. Client 1 felt that the result of Project Group 2 was not quite as good, and it did not bring them many new insights, but it reinforced their previous activities. Client 2 estimated that the goals of Project Group 1 were achieved exceptionally well, and they received a new way of thinking and development suggestions for developing the organisation's operating methods. According to client 2, the final product of Project Group 2 was also good, but the final product of that group still required a lot of additional work and further refinement. Two other clients also assessed that the end products were helpful, but they still required additional work and further refinement to be utilised.

The project clients answered question 10 *(How well did you know the LbD model before starting the study module?)* as follows: *"This was a completely new model for me", "A little because I have been involved in a similar project before"* (Laurea, project client 1a): *"Pretty badly. I have been involved in similar projects, but otherwise, I was unfamiliar with this"* (Laurea, project client 2). *"I was unfamiliar with this model before"* (Laurea, project client 3). *"I had heard about it but did not really know it"* (Laurea, project client 4). The answers show that the project clients did not know the LbD model well before the study module.

The authentic answers for question 11 *(What do you think about collaboration according to the LbD model, and do you think it is suitable for such student customer projects?)* were. *"I think it is fine when you find the right project that also fits the students' goals"* (Laurea, project client 1a). *"This is a good model when students are self-oriented. This requires a lot of initiative and communication, which is when it works at its best"* (Laurea, project client 1b). *"I think it fits well because it is a meaningful way of learning from the student's point of view"* (Laurea, project client 2). *"I think it is well suited for such student projects"* (Laurea, project client 3). *"I think it is a very practical way to do this kind of cooperation"* (Laurea, project client 4).

According to the project clients, the LbD model is well suited for such projects carried out in cooperation with the customer, and in their opinion, it is an excellent practical way to learn. One customer's answer shows that LbD is a meaningful way to learn from the student's perspective. However, some customers highlight in their answers that LbD is well suited as a learning method when the project fits the students' goals, and LbD also requires students to work independently, take the initiative and have good communication skills.

4.2.7   Reflection

The first phase of the first research cycle was interviews with Laurea's pedagogy staff. Interviewing pedagogy staff in the early stages of the research was vital because it provided more information about LbD pedagogy and its backgrounds from pedagogy staff who know it. The pedagogy staff answers to questions 1 and 2 were related to why the LbD model was developed and introduced at Laurea. The background was a law change in 2003, where Universities of Applied Sciences were given three tasks: regional development, R&D activities and teaching. Another identified background factor was the paradigm shift of pedagogues. The third reason was the closer cooperation of the Universities of Applied Sciences to enhance and develop working life. At Laurea, these issues influenced the development of a new kind of pedagogy based on these, which was named LbD.

Interviews with pedagogy staff also provided valuable background information on their experiences of using LbD. The pedagogy staff also identified many things that needed to be developed in the future so that LbD remains up-to-date and a valid pedagogical method in Laurea's teaching, which has been chosen as the primary pedagogical model. The most important factors are the need for staff training, mentoring and peer support.

The pedagogy staff also pointed out that the organisation's management must be firmly committed to using LbD; otherwise, it will not succeed.

After interviews with pedagogical staff, the Service Design Study Module was chosen as the research target at Laurea, which started on 26th August 2019 and ended on 13th December 2019. The thematic interviews of lecturers and project clients were conducted after the end of the study module in December 2019 and partly in January 2020. The student survey was carried out in December 2019 after the end of the study module.

Based on the analysis of the lecturers' answers, LbD fits well as a teaching method at Laurea and for the computer science project-based study module that was the subject of the study. The lecturers had several different roles during the study module, as is typical in LbD. The lecturers saw many strengths in LbD, such as better student motivation and understanding of the needs of working life. The lecturers saw the lack of instructions and practical tools as weaknesses. Misunderstandings and challenges in achieving competence goals were seen as threats. Opportunities were seen to deepen students' skills, learn new things, and connect students to working life during their studies. The lecturers gave useful information about what should be developed for LbD to function even better.

The students' survey was successful, and the response rate was high, which provided a reasonable basis for analysing the research results. The students' answers provided valuable information about the current use of LbD at Laurea. In the survey, the students were asked about their competence level in six areas, which included 20 questions. Students evaluate their level of competence in these before the start of the study module and after it ends. Students' competencies increased in each competence area. The students' competencies increased the most in the competence areas 'co-development and service design skills' (0.97%); 'customer understanding and customer knowledge' (0.72%); and 'own skills and continuous skills' (0.69%). Competence grew the least in the competence areas 'equality and justice' (0.13%) and 'ethics and empathy' (0.17%). In the competence area, 'technology and digital competence' competence increased by 0.31%, but the starting level here was 3.69%, and at the end of the study, the competence level in this competence area was the highest of all, i.e. 4.00%. Students also learned many new things during the study module based on their answers. Students acted during the study module in many different roles, aligning with the principles of LbD. All Laurea students were at least somewhat familiar with the principles of LbD, even though there were also foreign exchange students. According to the students, LbD is

also suitable for computer science studies. Only one student estimates the suitability to be level 2 (on a scale of 1 to 5). According to the students, the best thing about LbD is a new way of developing skills, practical learning and cooperation with the client. The students saw it as a weakness if the client was not sufficiently committed or the project topic was unsuitable. Challenges can also be caused by conflicts within the team and students who do not commit sufficiently. Students also responded that LbD might not be suitable for all students.

The responses of the project's customers brought a valuable addition to the research. Understanding the role of the project client in the LbD model is particularly important. In LbD pedagogy, client projects related to the studied subject are needed, which can be included in the study module. When choosing projects, the needs of the customers and the students' competence goals must be considered to achieve the goals. According to all clients, the projects were at least satisfactorily successful. The project clients were unfamiliar with the LbD model but thought that it fitted this project-based study module well. According to the project clients, the cooperation with the students went well, and the outputs were at least somewhat useful, although many still need further development.

4.3 Cycle 2 and 3: RGU

To the research plan, the following research cycle was carried out at RGU because the researcher wanted to get information on whether the LbD model was suitable for computer science students' project-based studies elsewhere than in Finland, where it was developed. Research cycle two was carried out at RGU in the spring and summer of 2020. After research cycle two, the research plan was changed, and one more research cycle was added, and it was implemented at RGU in the autumn of 2021. Cycle three was conducted because the second research cycle did not produce enough research material in the students' survey. RGU was chosen because an international perspective was wanted for the research to get information on how well the LbD model would fit as a teaching method for computer science students outside of Finland.

At RGU, a thematic interview was conducted with one pedagogy staff in research cycle two. RGU lecturer and project client thematic interview was conducted in cycle two via Zoom. In cycle three, the lecturer and project client were the same, and the interview questions were emailed to the lecturer and project client, which they answered in writing. The lecturer and project client interview questions were the same as with Laurea lecturers and project clients. The student survey was conducted in cycles two and three

and was the same survey done with Laurea students. Figure 50 shows the second and third cycle stages, which will be explained more in the following subsections.
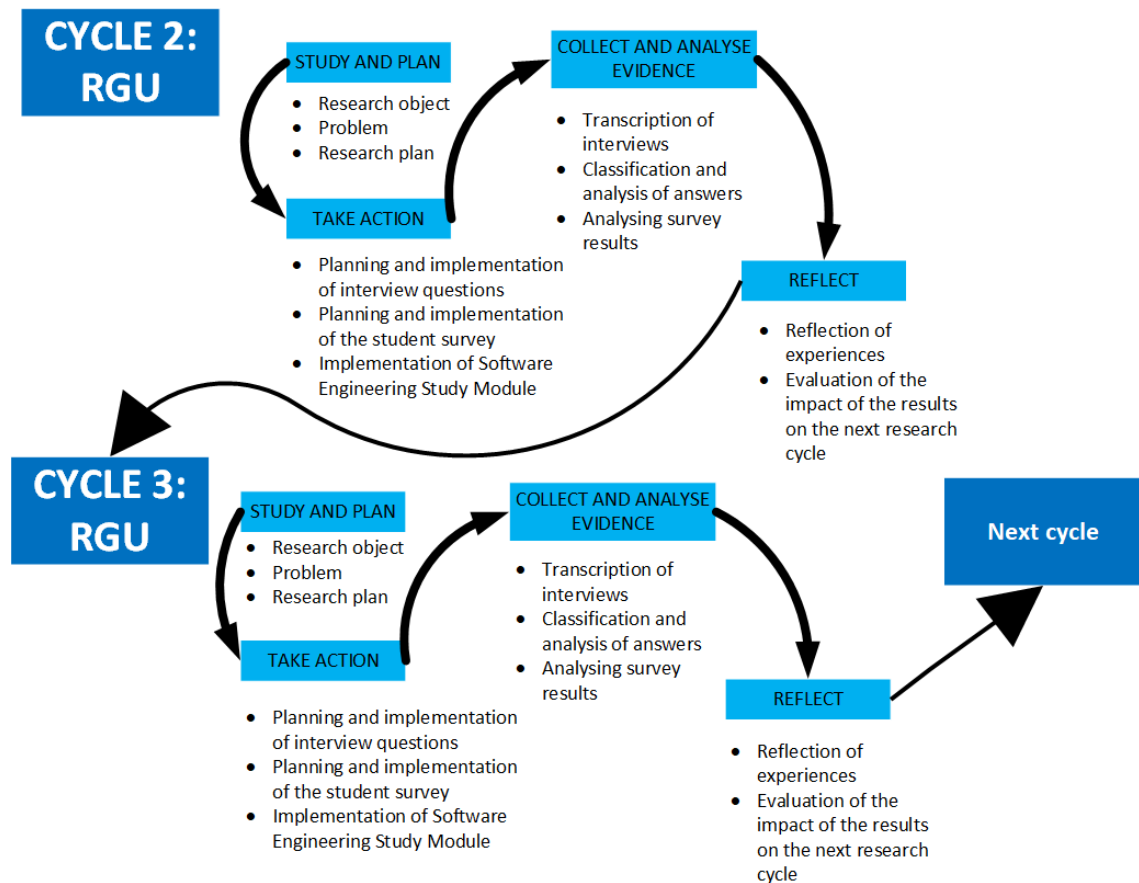
Figure 50: Research cycles 2 and 3 in RGU

4.3.1 Institutional Context

RGU received university status in 1992, but it already had 250 years of history behind it ('Who We Are' 2023). Throughout its development, the university has been committed to creating equal opportunities for everyone to receive a relevant and valuable education. RGU has eleven schools offering more than 300 courses in various fields, including technology, architecture, computing and life sciences, creative fields, healthcare, social care, and business. More than 16,500 students study at RGU. Students can study on campus or remotely online. RGU is one of the largest online learning providers in the UK. Courses are developed closely with employers, professions and industry to meet regional and national skills needs, ensuring that curricula are demand-driven.

The university is investing significantly to grow its globally influential research. Key areas include, for example, the field of sustainable transport, visualisation of the built environment, industrial biotechnology, intelligent data and artificial intelligence, and pharmacy practice. By prioritising strategic research partnerships, the university promotes the exchange of expertise and interdisciplinary cooperation. RGU is known for its close cooperation with industry and has significant national and international workforce development experience. RGU works with organisations, governments, trade associations, industry associations and educational institutions to promote innovation and economic development.

RGU has been selected as one of the top 10 universities in the UK regarding overall student satisfaction (National Student Survey 2022). RGU aims to build applied learning for students, create strong connections to different fields, and provide state-of-the-art facilities so that students have a great experience at university while acquiring the knowledge and skills required for a successful career.

Regarding learning and teaching, RGU wants to ensure that students get practical learning and teaching experiences during their studies. Practical opportunities can be used to ensure that students are successful in working life after graduation. RGU operates and builds industry connections to ensure that the courses are demand-driven, of high quality and tailored to meet employers' current and future needs. Many courses at RGU offer students the opportunity for work experience or internships during their studies. In addition, students cooperate with companies in live projects and can participate in guest lectures and master classes in the field. Connection to companies allows students to connect and network with potential future employers.

Innovation and entrepreneurship are part of RGU's activities, and students are involved in these activities to be able to make changes throughout their careers. RGU has also invested a lot in campus development, and students benefit from studying and implementing industry-level projects in a progressive environment that encourages independence and innovation.

4.3.2   Study and Plan

This study's second and third research cycles aimed to determine if the LbD model is suitable as a teaching and learning method for RGU computer science students in project studies. The students' survey was similar to Laurea's students' survey in the first

research cycle. The study also aims to learn how RGU's computing students' skills develop during the project-based study module. The background of the competence development research was the same as in the research cycle conducted at Laurea. There were six competence areas, each with three or four more specific questions related to the area. There were 20 questions in total.

In the research cycles at RGU, the research object was the study module aimed at computer science students, including a customer project in the spring/summer of 2020 and the fall of 2021. The module in question both times was a second-year Software Engineering study module delivered to full-time Online Distance Learning (ODL) students. The study module 2020 started in February and ended in June. The study module in 2021 started in September and ended in December. The researcher was involved in the research as an external observer. At the start of the study module, the researcher participated in the students' online classes, where the researcher introduced the students to LbD and told the students about the survey that would be done after the study module. Twelve students participated in the study module in 2020 and five in 2021. In the fall of 2021, the researcher participated several times in the online session of the study module so that the students could better understand both LbD and the purpose of the research. The students' surveys were carried out after the end of the study module.

The study also collected information from the computer science lecturer who participated in the study module and the project client after the study module ended using the thematic interview. In cycle three, the questions were sent to the lecturer and the project client by e-mail, and they answered them in writing. The reason for this was that both the lecturer and the project client were the same as in the previous research cycle, and the questions were already familiar to them, and they could answer them flexibly in written form.

In addition, background information from RGU's pedagogy staff was needed to understand the pedagogical models used at RGU. This collection of research material was also carried out with the help of a thematic interview.

4.3.3   Action

The second research cycle was carried out at RGU in the fall of 2020, and the third cycle in the fall of 2021. Based on the research plan, research material was collected from RGU's pedagogy staff, lecturers and the project client through thematic interviews. The

thematic interview questions of RGU's pedagogy staff were planned and implemented first. During the research plan phase, the researcher had asked which of RGU's pedagogy staff would be suitable to participate in the research. One of RGU's pedagogics staff, with experience in RGU's pedagogical methods, attended the interview. The research material received from the pedagogics staff is significant from the point of view of the research because RGU's background is very different from Laurea's, where the first research cycle was conducted and where the LbD model was developed.

The second action was a student survey. The surveys were identical to the survey conducted for Laurea students. The last actions were the interviews with lecturers and project clients, identical to those conducted with Laurea's lecturers and project clients.

First, the responses of the RGU pedagogy staff have been analysed using narrative analysis. The lecturer's responses to the study module and the project client have also been analysed using narrative analysis since there was only one respondent in both groups. In Chapter 5, the answers of the lecturers of all three higher education institutions are gathered together and examined as a whole. Project client answers are also examined as a whole in Chapter 5, as the pedagogy staff answers.

Only one of the twelve Software Engineering project-based study module students, the research cycle two target group, answered the survey in the fall of 2020. The study module implemented in the fall of 2021 was also Software Engineering project-based study module. The student answers regarding the 2020 study module have been combined with those of autumn 2021 study module students. The results have been analysed together using quantitative and qualitative methods.

The responses of the lecturer of the RGU and the project client were analysed using narrative and content analysis. The lecturer and project client of the 2021 study module was the same as in the 2020 implementation.

4.3.4   Staff Experience

Among RGU's staff, one pedagogy staff and one computer science lecturer participated in the research. The responses of both the pedagogy staff and the lecturer have been analysed using narrative analysis.

Interview with Pedagogy Staff

The RGU pedagogy staff interview was conducted as a thematic interview using a remote connection. The research questions and background information had been sent to the pedagogy staff in advance. The research's ethical principles and operating methods were also delivered to the pedagogy staff before the interview. The interview was recorded and transcribed, after which the results were analysed using narrative analysis. RGU's background factors are different from Laurea, which was the target of the first round of the research cycle, so with the help of an interview with RGU's pedagogic staff, the study aims to get more detailed information about RGU's pedagogic models and the prevailing teaching practices there. The interview questions and answers given to the RGU pedagogy staff, which were seven in total, are replicated in Appendix E.

The questions and answers to the thematic challenge of RGU's pedagogical staff can be seen in Appendix E. A summary and main points of the answers have been reviewed below. To question 1 *(What pedagogical models do you use to cross the university?).* RGU's staff answered that RGU is a professionally oriented university aiming to develop students' employability skills during their studies. A pedagogical staff person also answered that RGU uses active pedagogy and simulates work environments to ensure students have sufficient skills when entering working life. A pedagogical staff person also said that RGU has several study modules where learning is on-the-job learning, and in these study modules, 80% of students learn at the workplace and receive support for this. In them, students are supported to think about practical work and academic theory and thus develop their skills and competence, called active learning at RGU.

The pedagogical staff responded to question 2 *(Do you know the LbD model used in Laurea?)* that she was partially aware of LbD, had read publications on LbD, and thought it was very similar to the approach we use at RGU.

The pedagogical staff answered question 3 *(Have you used any similar pedagogical model in RGU?)* that studying and teaching at RGU is often more theoretical for some modules, and hypothetical case studies can be used in them, but some of the study modules also contain authentic client projects where students work in much the same way. According to the perception of the pedagogical staff, the development-oriented learning model has such pedagogical features that RGU lecturers could benefit from, but at the moment, it is not part of the formal RGU pedagogical model.

The pedagogical staff responded to question *4 (What obstacles could be to implementing the LbD model in RGU?)* by saying that potential barriers could include building functional relationships with the industry to have the ability to provide jobs and projects. Another obstacle may be that involving an external party in the learning process may cause academic quality problems due to the strict academic standards followed in Great Britain and Scotland, where evaluation criteria are defined in advance.

The pedagogical staff answered question 5 (Are there any cultural or societal challenges to using LbD in RGU?) that in the Scottish sector, there has been a discussion about the social differences between students and students with a particular social background can do worse in, for example, internship interviews and have challenges getting an internship. It can affect the students' learning experience. The LbD model could help overcome these challenges because all students have the same opportunities.

The pedagogical staff answered question 6 *(What kind of studies or situation do you think would be best suited for the LbD action model?)* that LbD is suitable for many industries where the importance of innovation has grown. LbD is well suited for projects with many challenges because the LbD model is a more multidisciplinary holistic approach to problems and their solutions*.*

The pedagogical staff responded to question 7 *(Do you think there are specific fields of education that are more suited towards this learning style*?) that the LbD is generally suitable for fields where practice and theory are applied and where added value can be produced.

Interviews with Lecturer

RGU's Software Engineering study module had one lecturer in both research cycles, and the lecturer was the same at both times. The lecturer participated in a thematic interview using a remote connection in cycle two. The interview questions for RGU lecturers were the same as those who participated in Laurea's research cycle (Appendix B). The interview was recorded and then transcribed for more detailed analysis. In research cycle three, the lecturer answered the same questions by email. In this paragraph, the responses of the RGU lecturer have been analysed mainly through narrative analysis.

Table 7 shows that the RGU lecturer's knowledge of the LbD model was good before the start of the study module. The lecturer answered the same way both times. The

researcher had gone through LbD principles with the RGU lecturer. The RGU lecturer had also gotten to know LbD through the literature, which explains why the lecturer had a good knowledge of LbD before starting the study module.

Table 7: RGU lecturer's knowledge of the LbD before the study module

RGU lecturer	No prior knowledge	Basic understanding	Good knowledge	In-depth knowledge
Lecturer			X	

The RGU lecturer's answers to questions 2 *(How well does the LbD model fit your organisation, in your opinion?)* and question 6 *(How well does the LbD fit into the study module you teach, in your opinion?)* can see in Table 8. Although the lecturer answered both questions that LbD fits well, the lecturer commented that it depends on the context. The lecturer believes LbD fits some study modules better than others. In the lecturer's opinion, LbD also demands a lot from all parties. It requires a new kind of thinking model and way of teaching from the lecturers. It requires students to be more active in their learning. It also requires the commitment of all parties to work together and assume responsibility.

Table 8: RGU lecturer answers to questions 2 and 6

Question	Fits well	Fits very well	Fits perfectly
How well do you think the LbD model fits in your organisation?		X	
How well do you think LbD fit into the study module you teach?		X	

Regarding question 3 *(Do you think the LbD model is suitable for all study modules?)*, the RGU lecturer answered that LbD is unsuitable for all study modules. To question 4 *(What studies or situations is the LbD best suited for, in your opinion?)*, the RGU lecturer answered that LbD is best suited for project-based teaching or modules involving an external stakeholder group. The RGU lecturer's answers to question 5 *(What were your roles in this study module implementation in which you were involved?)*, which were related to his roles during the study module, can be seen in Table 9. In cycle three, the lecturer placed more emphasis on ensuring students understand their roles in the LbD model more

Table 9: RGU lecturer roles in the study module

RGU lecturer roles	RGU lecturer
Teacher	X
Mentor	X
Preparer	X
Evaluator	X
Enabler	X
Ensure students understanding their role	X

The RGU lecturer's answers to questions 7 *(What strengths do you think the LbD model has?)*, question 8 *(What are the weaknesses or shortcomings of the LbD model, in your opinion?)*, question 9 *(What are the opportunities in the LbD model, in your opinion?)*, and question 10 *(What kind of threats do you think the LbD mole includes?)*are compiled in a SWOT analysis table (Figure 51).

SWOT ANALYSIS

STRENGTHS
- Puts pressure on everyone to perform as well as possible
- Teaches responsibility and independence
- Requires cooperation and professionalism from all stakeholders

WEAKNESSES
- If not used correctly, then it is not useful
- Need to understand LbD pedagogy. Otherwise, results are not useful

OPPORTUNITIES
- Help students better understand how they should learn
- Challenge students to do their best with others

THREATS
- Without understanding, it will not work

Figure 51: RGU lecturer SWOT analysis

According to RGU's lecturer, its strength is that it teaches responsibility and independence. In addition, it requires cooperation and expertise from all stakeholders and creates pressure to perform as well as possible. As a weakness, the lecturer saw

that the LbD is useless if it is not used correctly or known well. As possibilities, the lecturer saw that it helps students better understand how they learn and do their best with others. The lecturer saw using LbD without understanding its principles as a threat.

To question 11 *(Do you have something in mind that should be developed in the LbD model to make it work better?)*, the RGU lecturer answered that LbD works very well, but it should be introduced to students more profoundly. It would better suit students to know LbD's pedagogical mode of thinking to change their perception of learning more efficiently. Students are not necessarily used to thinking about how they learn things, and they may be embarrassed by the new way. With the help of a detailed introduction to LbD, students could learn to understand better how they learn things best, which would help them continuously develop their skills.

In question 12 *(How well did the students' skills develop during the study module?)*, the lecturer was asked how well the students' skills developed during the study module. In the lecturer's opinion, the students' skills developed well. The students who participated in this study module had a slightly different background than most students at RGU because they all work full-time and study alongside work. The students thus already had experience in working life. From an academic point of view, everything went well because the students learned how to use the skills acquired at university in a work-life project.

4.3.5 Students Experience

In the second and third cycles of the study, the experiences of LbD-based learning of computer science students who participated in RGU's fall 2020 and 2021 Software Engineering project-based study modules are analysed. In addition, the self-assessment results of the students' questionnaire about developing students' skills during the study module will be analysed too. The research material was collected from RGU students using an electronic Google Forms questionnaire (Appendix C). The surveys were undertaken after the study modules ended, and the answers were compiled. In both years, the subject of the study module was Software Engineering, and customer projects were implemented during the study modules. There were 12 students in the first study module, of which only one answered the survey. Five students participated in the fall 2021 study module, all of whom answered the survey. The language of the study module was English. The students were told about this study at the start of the study module. In addition, they were told that a survey would be used to collect the research material at the end of the study module, which they were expected to answer. The students were

also introduced to the LbD approach at the beginning of the study module. The purpose of the orientation was for the students to understand the basics of LbD and their role in it and know how to act accordingly.

The research background related to the development of students' skills was the same as in the survey for Laurea's students, which is derived from Laurea's 2030 strategy. These related to general working life skills consist of six competencies: self-management and entrepreneurial attitude, critical thinking and problem-solving skills, foresight and innovation skills, communication and interaction skills, global skills, and responsibility skills. According to the research plan, the survey of RGU students was the same as that of Laurea students, so that a comparison could be made based on the results.

Students evaluate their competence development in these six areas with a questionnaire, where each area of competence contains three or four questions (Appendix C). There were six expert areas and a total of 20 questions. These questions are referred to in the text with numerical and letter abbreviations. For example, the first competence area's first question is 1a and the second 1b. The questionnaire's self-assessment questions by competence area are also shown in Appendix C, starting with number 7. The students themselves assess their competence level before and at the end of the study module on the topics of each sub-area. When interpreting the answers, the student's self-assessment should be considered, and the results' reliability should be presented as a limitation.

Analysis of Students' Classified Questions

The first competence area was 'self-management and an entrepreneurial attitude', and its first question (1a) related to: 'life management and well-being'. Students were asked to rate their competence on a scale of 1 ("no competence") to 5 ("expert"). The results are shown in Figure 52. M = 3.00, and SD = 0.632 at the start of the study module. M = 3.83, and SD = 0.408 at the end of the study module, so the variance had decreased. The students' level of competence increased by a mean of 0.83 percentage points. The results are statistically significant ($t(5) = 2.712$, $p = 0.042$).
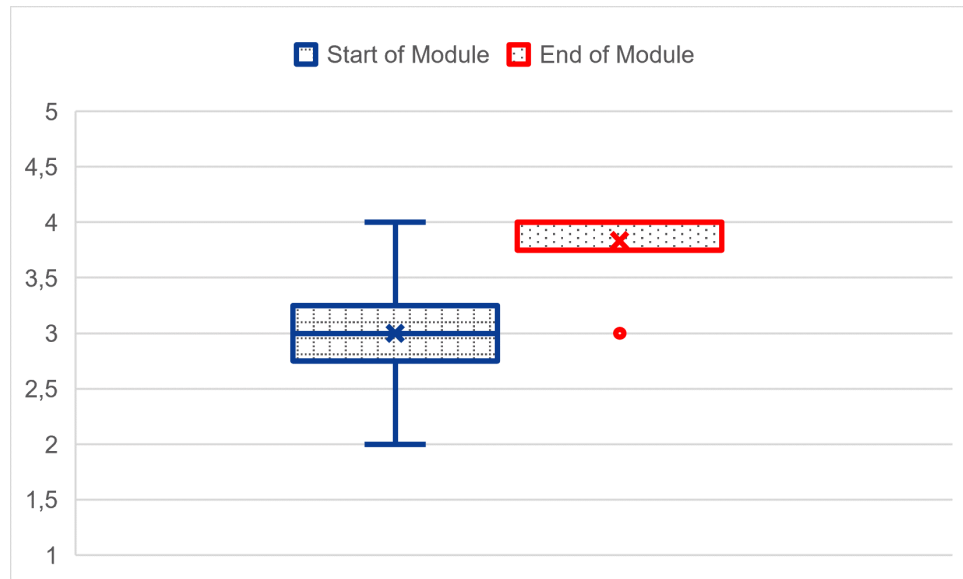
Figure 52: RGU students' survey results for 'life management and well-being'

The following questions related to the same competence area (1b): the students' level of 'own skills and skills for continuous learning'. The results are shown in Figure 53. M = 3.00, SD = 0.632 at the start of the study module and M = 3.67, SD = 0.516 at the end. The Mean value had thus increased by 0.67 percentage points, and four students' level was four after the study module, and two students' level was three. The results are not statistically significant (t(5) = 2.000, p = 0.102).
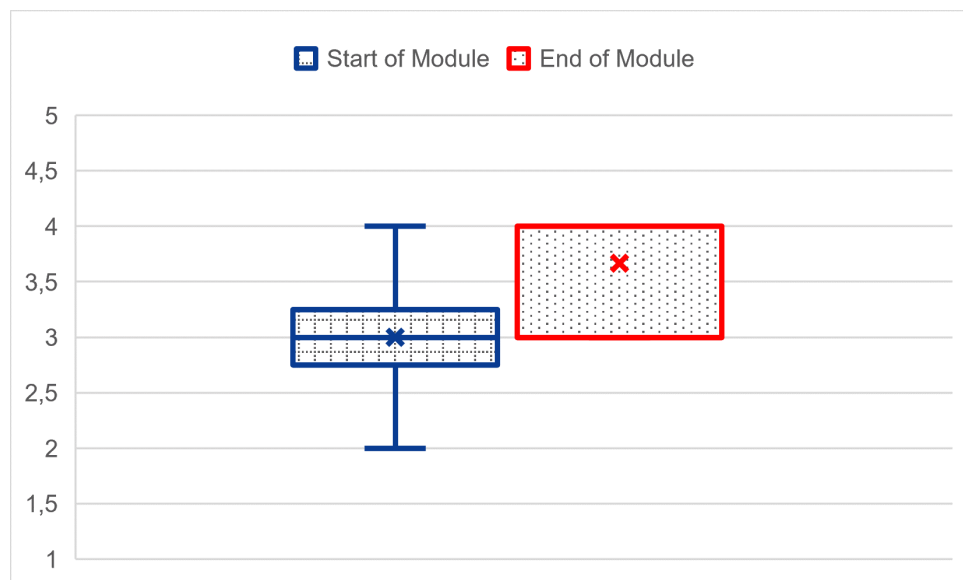
Figure 53: RGU students' survey results for 'own skills and skills for continuous learning'

The third question in the first competence area was (1c): students' 'sales skills' (Figure 54). M = 2.17, SD = 0.408 at the start of the module, and at the end, M = 2.67, SD = 0.516. Three students rated their sales skills level increase during the study module even though the competence goals of the study module did not include sales skills. Two students estimated that their knowledge stayed at level two, but three students estimated that their knowledge rose to level three. The results are not statistically significant (t(5) = 2.236, p = 0.076).
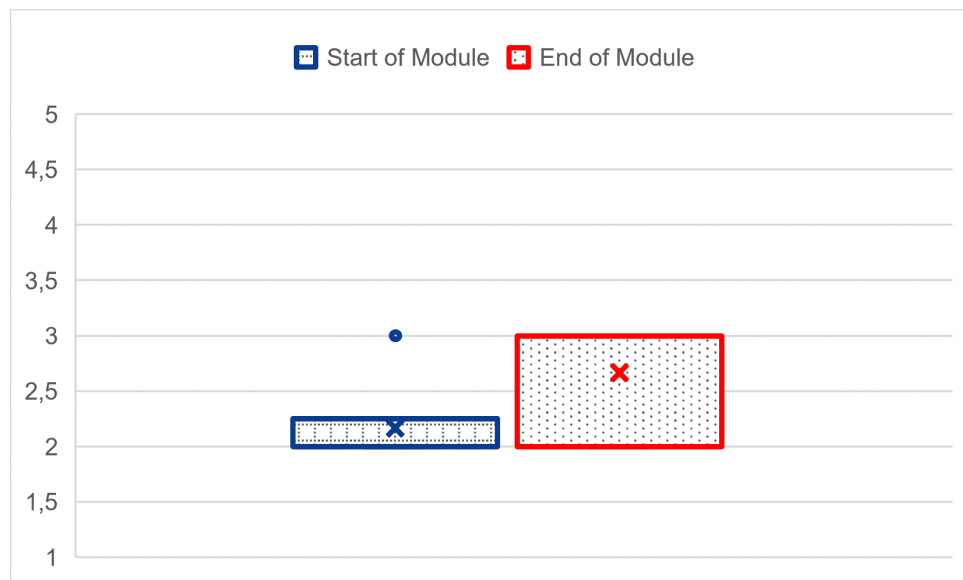
Figure 54: RGU students' survey results for 'sales skills'

The second part of the students' survey was about critical thinking and problem-solving skills (Figure 55). This sub-area first question (2a) was about 'critical knowledge acquisition, evaluation and utilisation'. M = 2.50, SD = 0.837 at the start of the study module; at the end, M = 3.33, SD = 1.211. One student's estimated level of knowledge rose from level two to level four, and one student's level stayed at level one, which means no knowledge. Two students estimated that their level of competence rose from level 3 to level 4 at the end. The results are statistically significant (t(5) = 2.712, p = 0.042).
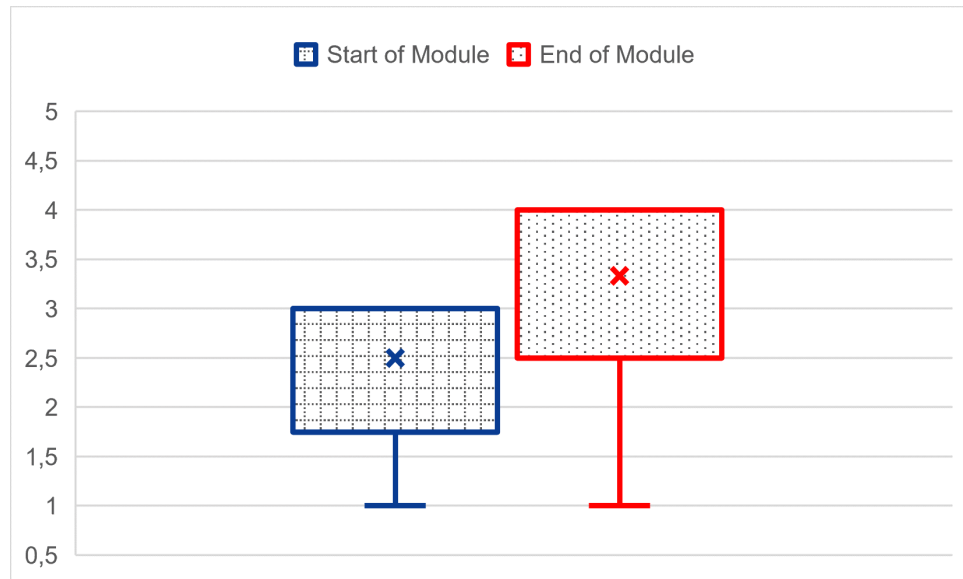
Figure 55: RGU students' survey results for 'critical knowledge, evaluation, and utilisation'

The second sub-area (2b) question was 'entity management and systematics' (Figure 56). In this question, M = 2.33, SD = 0.816 at the start of the module. However, M = 3.17, SD = 0.753 at the end of the module. One student estimated that the level of knowledge rose from level one to level three. The results are statistically significant ($t(5)$ = 2.712, p = 0.042).
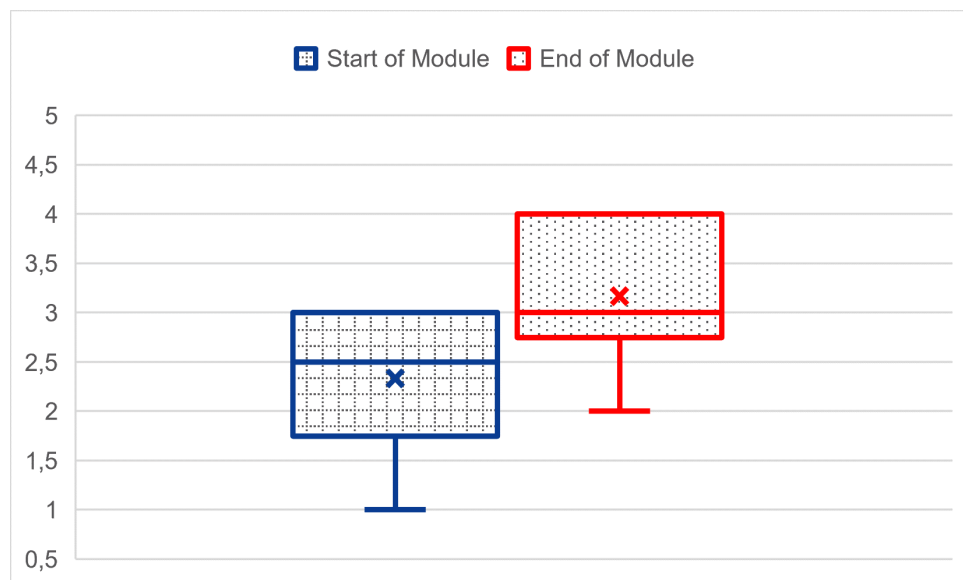
Figure 56: RGU students' survey results for 'entity management and systematics'

The last sub-area or third question (2c) was about 'analytical thinking and argumentation' (Figure 57). M = 3.33, SD = 0.516 at the start of the study module, and at the end, M = 4.00, SD = 0.632. The results are statistically significant (t(5) = 3.162, p = 0.025). Three students estimated their competence in this area had increased from level three to level four, and one student from level four to level five during the study module. According to their self-assessment, four students' competence level in this area was three, and at the end of the study module, only one of those students estimated that the level had not risen.
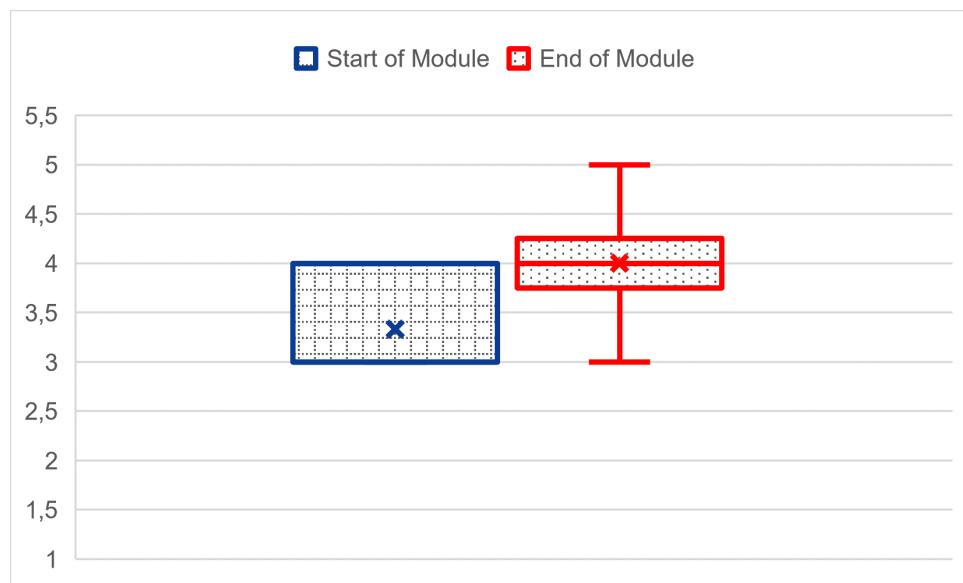
Figure 57: RGU students' survey results for 'analytical thinking and argumentation'

The third competence area was 'foresight and innovation skills'; its first question was about 'creativity and initiative' (3a) (Figure 58). For this competence area, M = 3.17, SD = 0.753 at the start of the study module. The Mean value increased during the study module and M = 3.83, SD = 0.408 at the end, but the results are not statistically significant (t(5) = 2.000, p = 0.102).
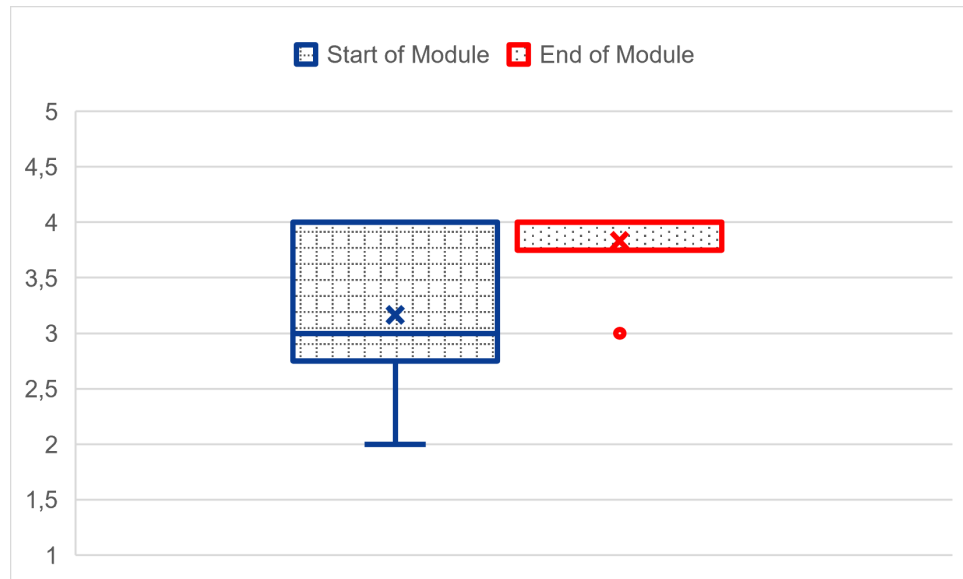
Figure 58: RGU students' survey results for 'creativity and initiative'

The second question in this competence area (3b) was 'co-development and service design skills' (Figure 59). In this competence area, M = 2.83, SD = 0.408 at the start of the module and M = 3.83, SD = 0.753 at the end, i.e. the Mean increased by 1.00%. The results are statistically significant (t(5) = 2.739, p = 0.041. At the end of the study module, only two students estimated that their level had not risen.
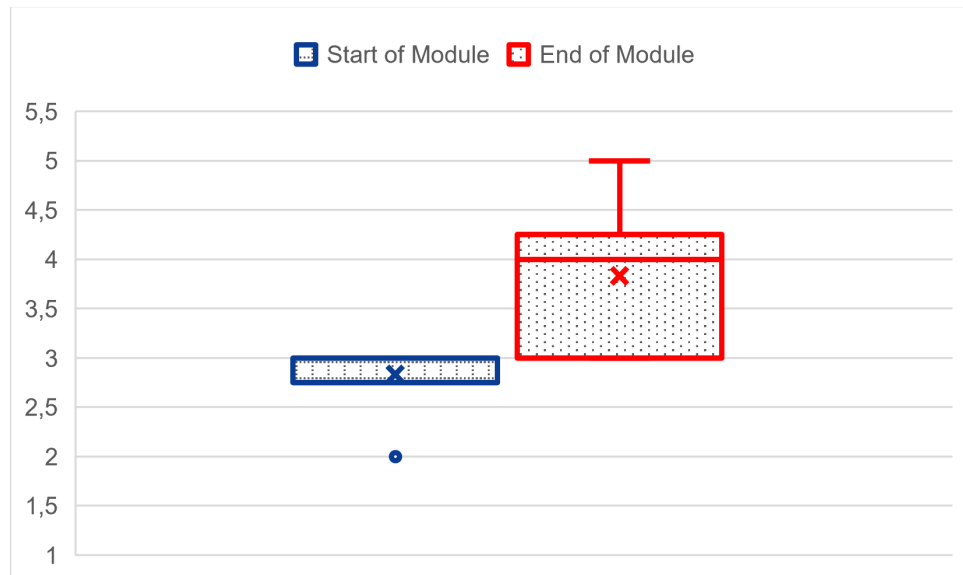
Figure 59: RGU students' survey results for 'co-development and service design skills'

The third question (3c) was about 'technology and digital competence' (Figure 60). In this competence area, M = 3.83, SD = 0.983 at the start of the study module and M =

4.50, SD = 0.548 at the end. At the end of the module, the Mean was relatively high, but despite that, the results are not statistically significant (t(5) = 2.000, p = 0.102). Three students estimated that their level of competence was five and three at level four at the end of the study module.
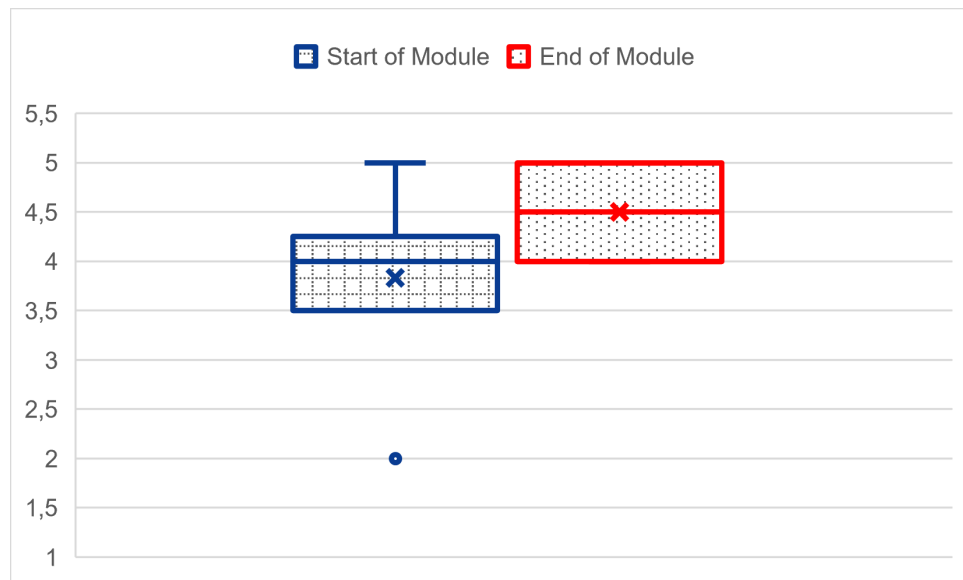
Figure 60: RGU students' survey results for 'technology and digital competence'

The fourth question (3d) in this competence area was 'the ability to change' (Figure 61). M = 3.17, SD = 0.753 at the start of the study module. At the end of the study module, the Mean increased to M = 3.67, SD = 0.516. The results are not statistically significant (t(5) = 2.236, p = 0.076). Three students estimated their competence rise during the study module; all students' levels were at least three.
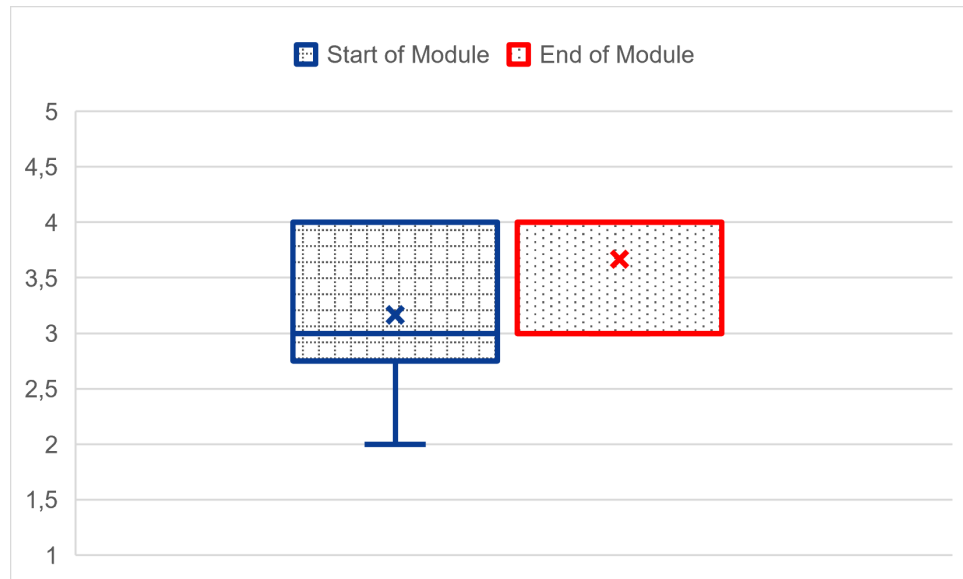
Figure 61: RGU students' survey results for 'the ability to change'

The fourth competence area was 'communication and interaction skills', where the first question (4a) was about 'impressive oral and written communication skills (including language skills)' (Figure 62). M = 2.83, SD = 0.983 at the start of the study module. Four students assessed their competence level increased during the study module; M = 3.50, SD = 1.049. The results are statistically significant t(5) = 3.152, p = 0.025. At the end of the study module, one student's level of competence rose from level four to level five and one student's level rose from level one to level two.
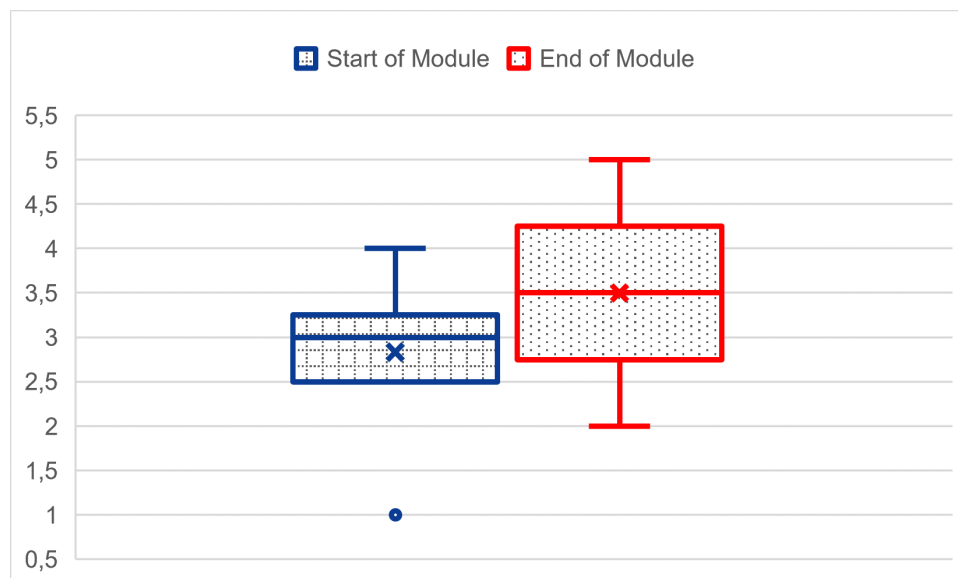
Figure 62: RGU students' survey results for 'impressive oral and written communication skills (including language skills)'

The second question in this competence area was about 'networking skills' (4b) (Figure 63). M = 2.83, SD = 1.169 at the start of the module. M = 3.50, SD = 0.837 at the end of the study module. Whilst there is an increase in the Mean, these results are not statistically significant (t(5) = 2.000, p = 0.102).
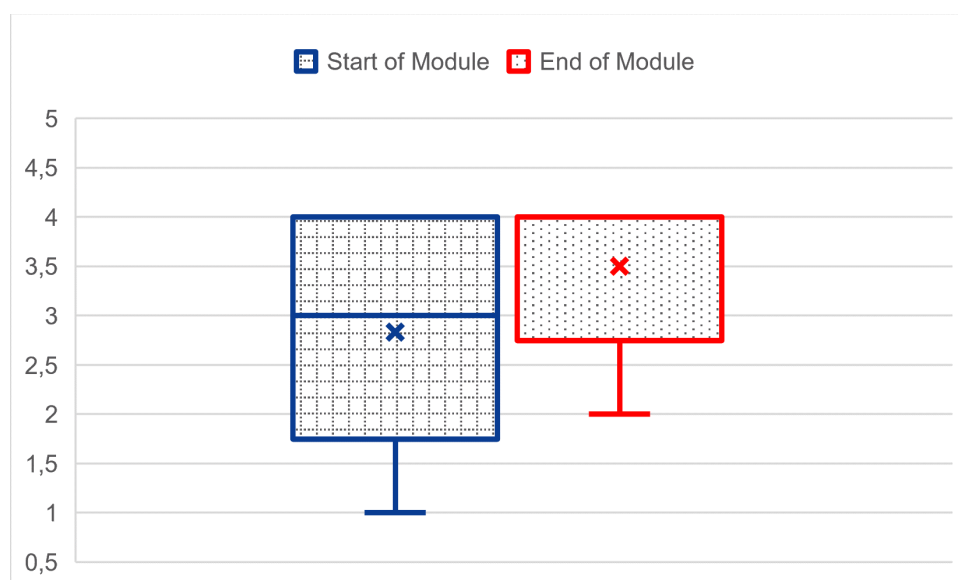
Figure 63: RGU students' survey results for 'networking skills'

The third question in this competence area (4c) was about 'social impact' (Figure 64). In this area, M = 3.00, SD = 1.095 at the start of the module and the end, M = 3.17, SD =

1.329. The results are not statistically significant (t(5) = 1.000, p = 0.363). Only one student estimated that the competence level increased in this competence area during the study module, from level four to level five.
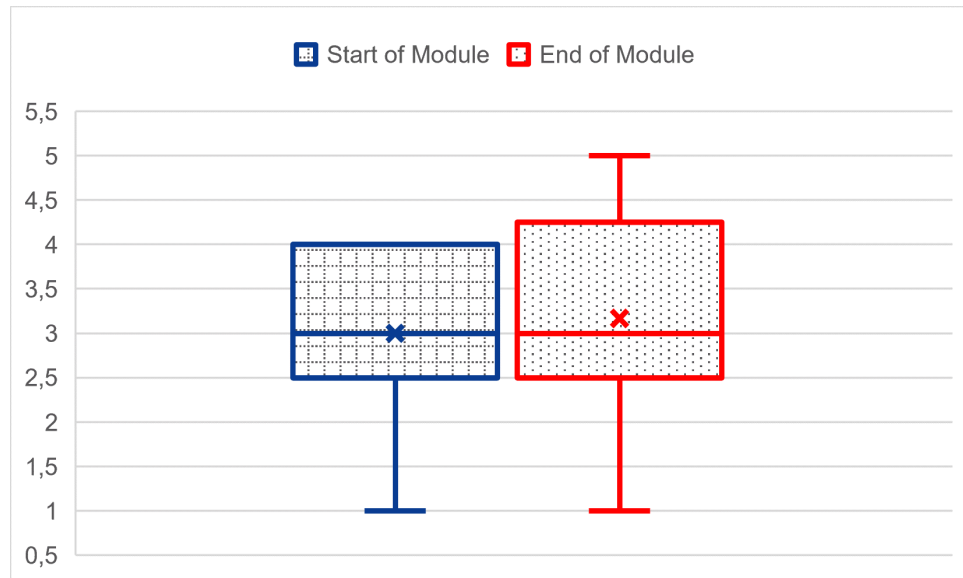
Figure 64: RGU students' survey results for 'social impact'

The fourth question in this competence area (4d) was about 'customer understanding and customer knowledge' (Figure 65). M = 3.17, SD = 0.753 at the start of the module, and at the end, M = 3.83, SD = 0.753. The results are not statistically significant (t(5) = 2.000, p = 0.102).
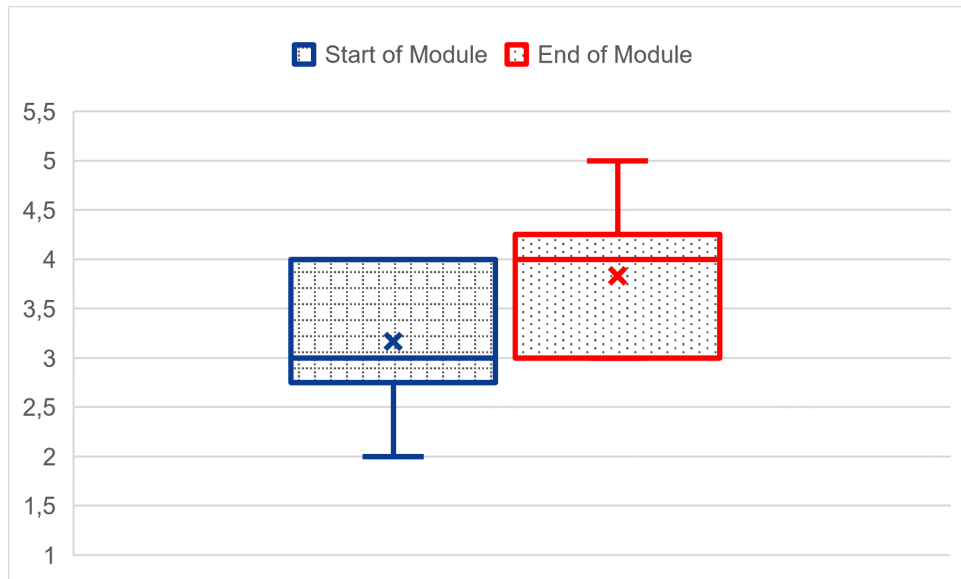
Figure 65: RGU students' survey results for 'customer understanding and customer knowledge'

The fifth competence area was 'global expertise'; the first question (5a) was about 'international capacities' (Figure 66). M = 2.00, SD = 0.894 at the start of the module, and. M = 2.33, SD = 1.211 at the end of the study module. The results are not statistically significant (t(5) = 1.000, p = 0.363). In this sub-area, only one student assessed that the competence level increased during the study module, from level two to level four.
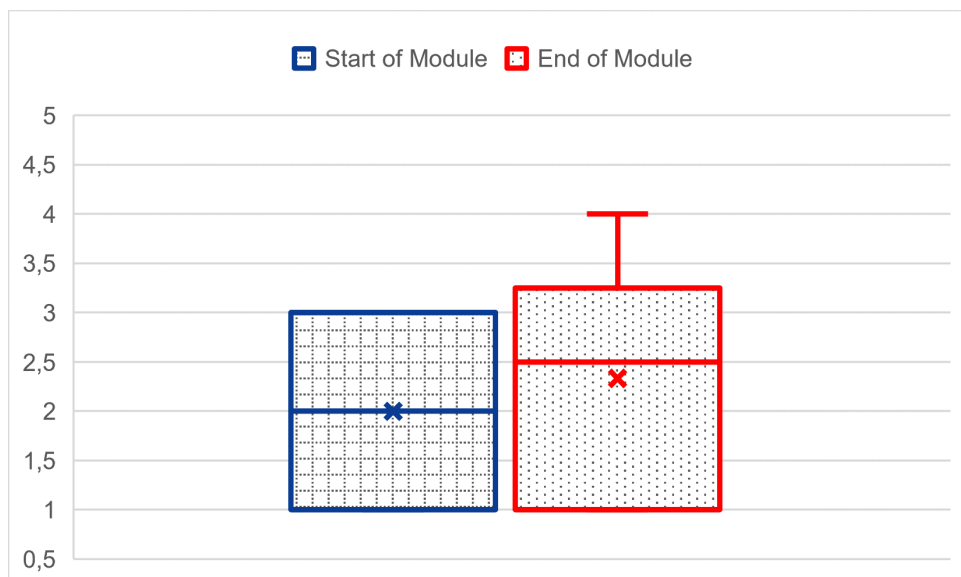
Figure 66: RGU students' survey results for 'international capacities'

The second question of the fifth competence area (5b) was about 'understanding cultural meanings' (Figure 67). M = 2.33, SD = 0.813 at the start of the module. M = 2.83, SD = 1.169 at the end of the module. The results are not statistically significant (t(5) = 1.464, p = 0.203).
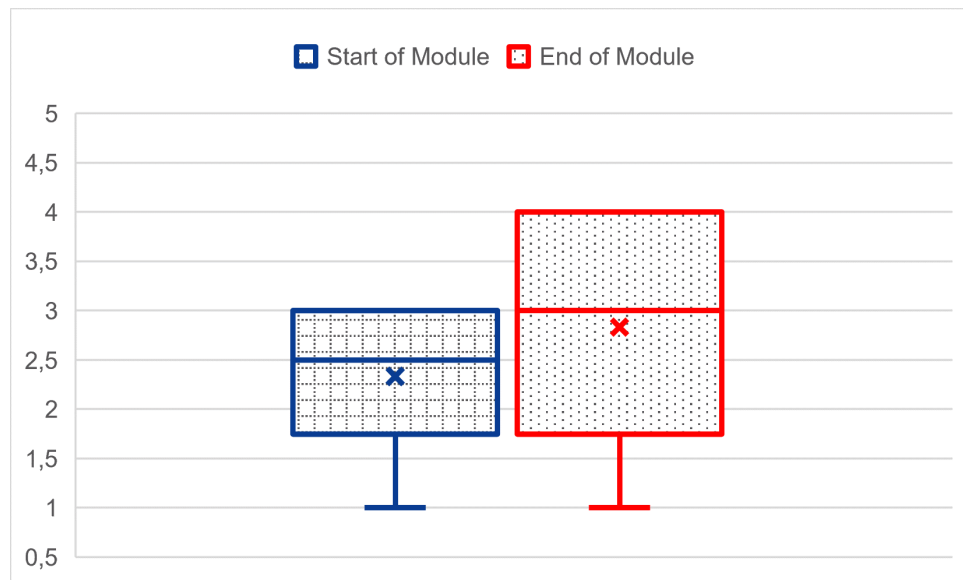
Figure 67: RGU students' survey results for 'understanding the cultural meaning'

The third question (5c) in this competence area was about 'ethical engagement in a global media and technology environment' (Figure 68). M = 2.50, SD = 1.049 at the start of the module, and the end, M = 3.17, SD = 0.753. The results are not statistically significant (t(5) = 1.581, p = 0.175).
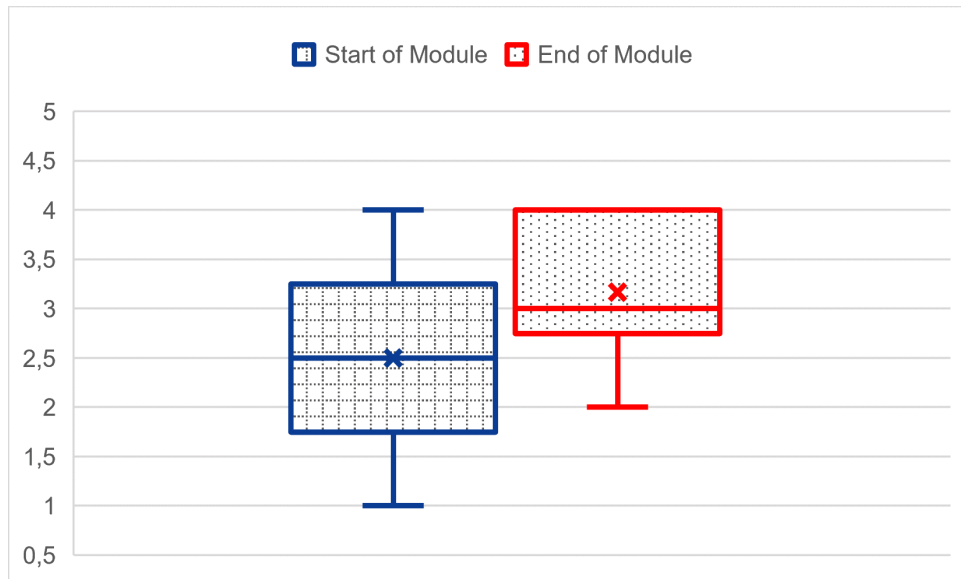
Figure 68: RGU students' survey results for 'ethical engagement in a global media and technology environment'

The sixth and last competence area was 'responsibility expertise'. The first question of this competence area (6a) was 'ethics and empathy' (Figure 69). M = 3.33, SD = 1.211 at the start of the module, and M = 4.00, SD = 0.632 at the end. The results are not statistically significant (t(5) = 1.348, p = 0.235).
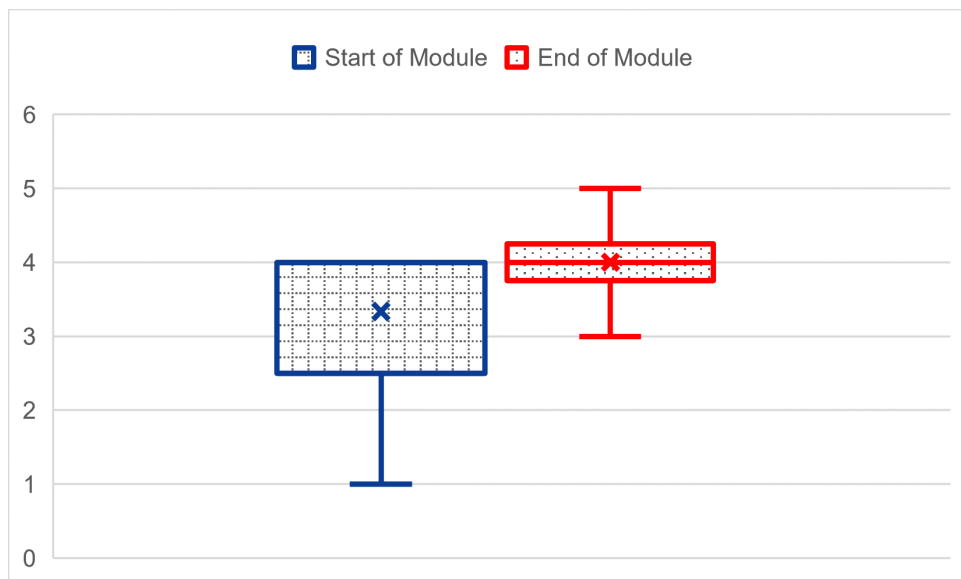
Figure 69: RGU students' survey results for 'ethics and empathy'

The second question (6b) in this competence area was about 'equality and justice' (Figure 70). M = 3.50, SD = 0.837 at the start of the module, M = 3.67, SD =0.516 at the end. The results are not statistically significant (t(5) = 1.000, p = 0.363).
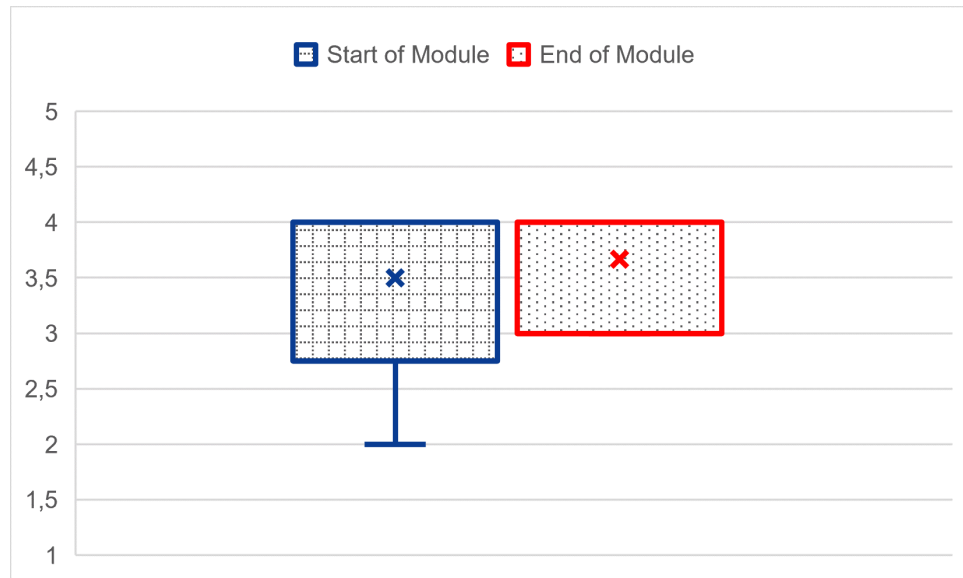
Figure 70: RGU students' survey results for 'equality and justice'

This competence area's third and last question (6c) was 'ecological, social and economic sustainable development' (Figure 71). M = 3.00, SD = 0.894 at the start of the study module, and at the end, M = 3.17, SD = 0.753. The results are not statistically significant (t(5) = 1.000, p = 0.363).
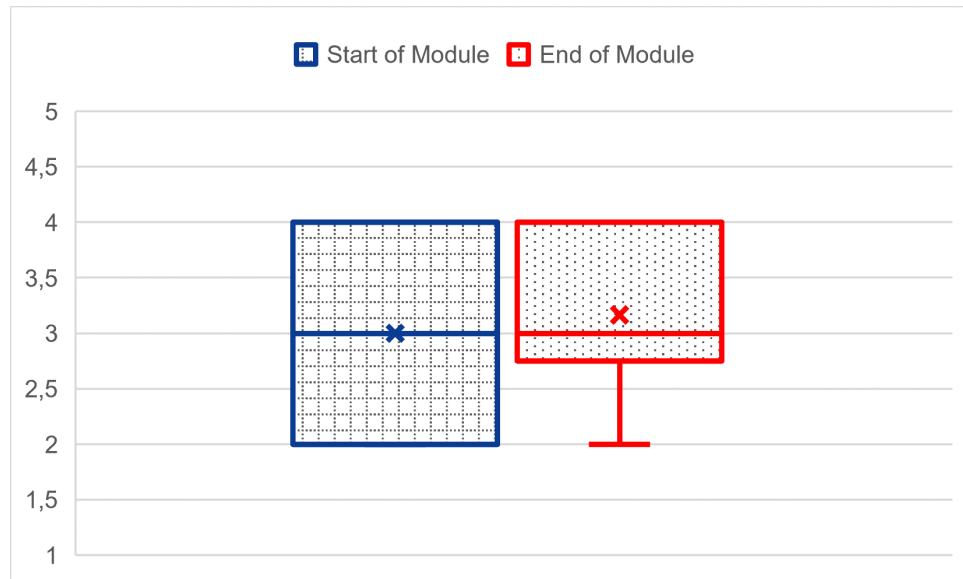
Figure 71: RGU students' survey results for 'ecological, social and economic sustainable development'

Analysis of Students' free-form questions

RGU students were asked open-ended questions about what new things or skills they learned during the study module. The students' open-ended responses have been classified using content analysis (Table 10). Table 10 contains the answers to question 7 (Appendix C). Table 12 shows students' self-assessments of their competence development in teamwork, work-based learning, and technical skills. In addition to these, the personal skills of many students grew or deepened, such as study skills, multi-tasking, planning skills, presentation skills and time management.

Table 10: RGU students' competence development during the study module

What new things or skills did you learn during the study module?				
Technical skills	**Team work skills**	**International compencies**	**Working with the customers**	**Development of personal skills**
Software development and engineering	Group working		Work based learning	Study skills
Developed a wider understanding of the artefacts	Team work skills		Mix of course learning and work based learning	Multi-tasking
Developed a software				Working full time and studying
A variation of tools already in use				Managing time efficiently, rethink and re-evaluate the most important use of my time
				A way of working
				Planning skills
				Presentation skills

Students were also asked to evaluate their level of competence in how well they think they understand what LbD means in practice (Question 9) (Figure 72). One RGU student estimated that the understanding of LbD was level one, meaning no understanding at all. Four students rated their level of understanding at three and one at level four. This self-assessment question also included an answer point where students were asked to describe in their own words what LbD meant in practice (Question 10).
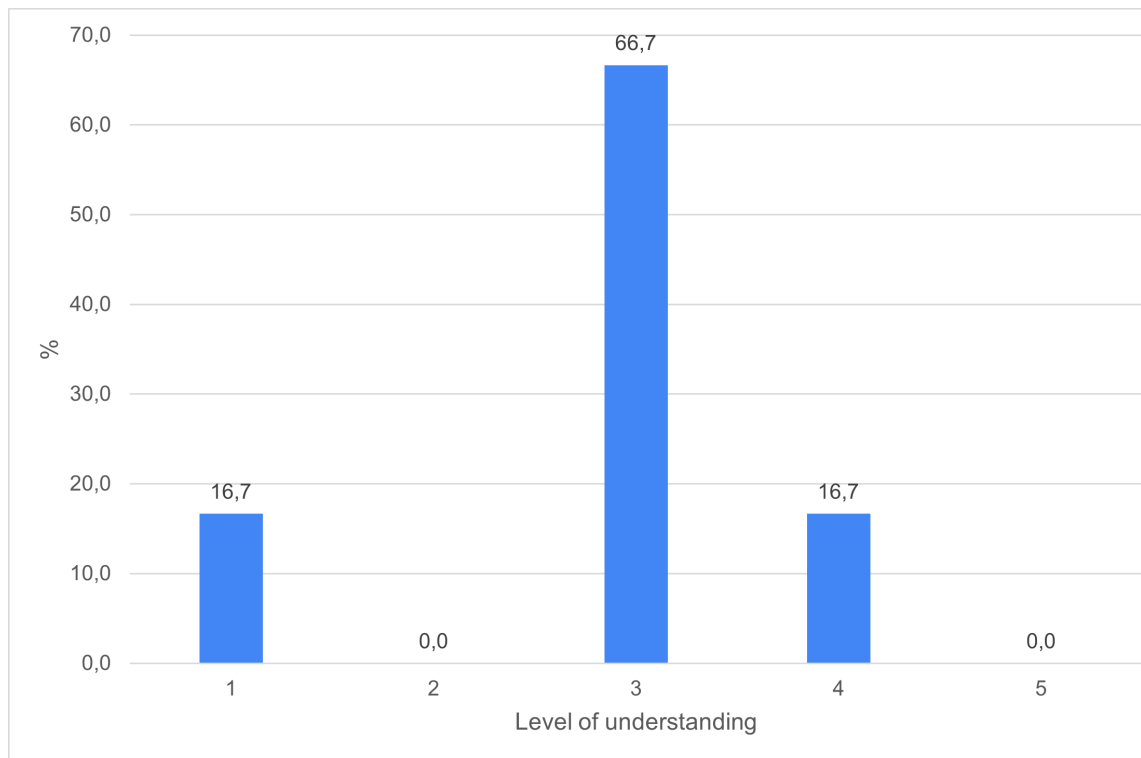
Figure 72: RGU students' understanding of what the LbD mean in practice (1 = no understanding, 5 = high understanding)

The student who assessed the competence level as one gave the open-ended response: *"I do not know"* (RGU, student 6), which aligns with this self-assessment. The student who assessed the competence level as four provided the open-ended response: *"Learn by doing; having less of a tutor-led study but more of an individual/group-led study using each participant's strongest traits to the fullest."* (RGU, student 4). One example of one student's open-ended responses who had estimated the level of understanding to be three was written up as: *"Applying what is learned directly in the everyday work requirements."* (RGU, student 2). Another authentic example of an answer from a student who estimated that understanding level was three is as follows: *"Student-led discover and delivery with minimum support from the organisation or tutor."* (RGU, student 5).

Based on these answers, we can conclude that the presentation of LbD should be improved because, at present, the students' understanding of LbD appears to be partial.

The students were also asked how well LbD fits into computer science studies in general (Question 11) (Figure 73).
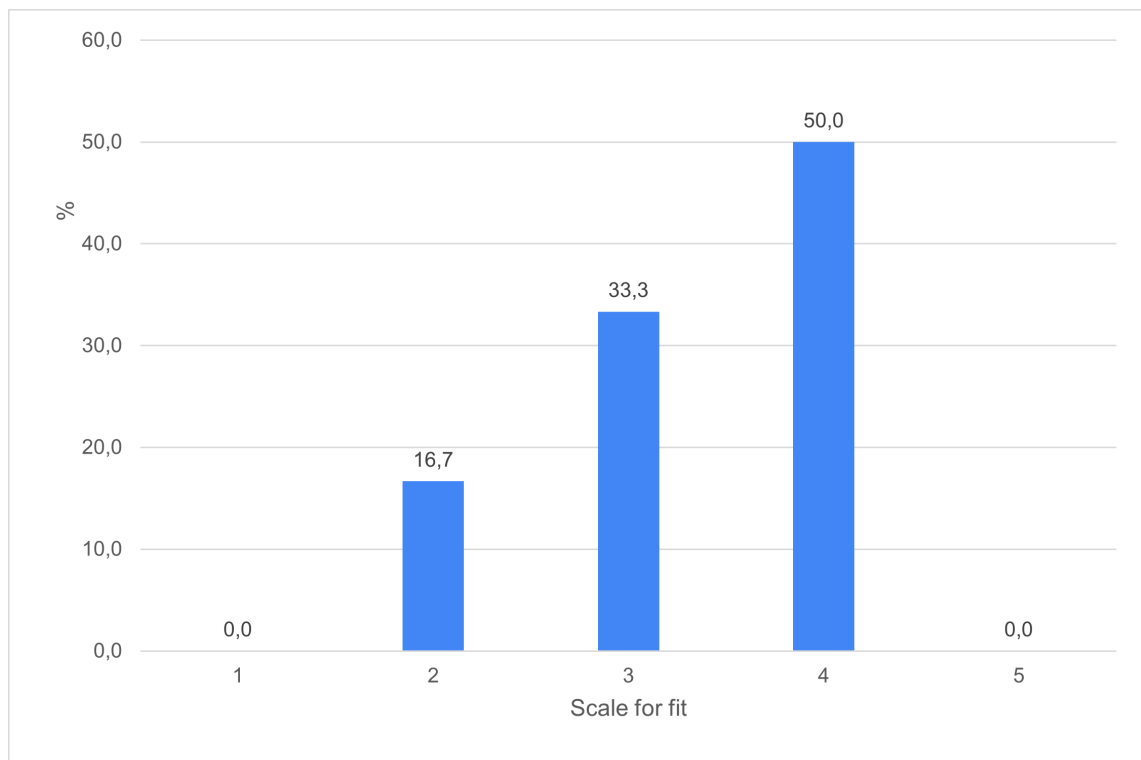
Figure 73: How well does the LbD Action Model fit into studying computing science studies (1 = no understanding, 5 = high understanding)

Attached are some authentic student answers to question 12 *(*Describe in your own words whether LbD is suitable for computing science studies and justify your answer?). "Knowing *your level of competence to improve is crucial in IT to continue to improve"* (RGU, student 1). *"Most modern work is including more IT elements into it which mean there are more and more option and opportunities to put these studies into working practice."* (RGU, student 2). *"You can develop software while applying your learning"* (RGU, student 6). One student's answer to this question was quite sceptical: *"For me, it is lacking in the availability of resources and a clear standard of expected delivery. Individuals do not know what they do not know, and they must know what good looks like to judge the quality of resources they have access to or need to find."* (RGU, student 5).

From the answers, it can be seen that a few students felt that the LbD model was suitable for computing science studies and helpful in developing competence when things are also learned in practice. According to one student, however, this pedagogical method means no clear standards and insufficient resources are available. The student also offers the criticism that individuals do not know how to evaluate what they do not yet know, which causes problems when quality should be evaluated. This student's answer indicates that in using the LbD model, more in-depth, jointly defined instructions are needed at the start of the study module to avoid ambiguities.

Students were also asked to evaluate the suitability of LbD for the study module they attended (Question 13). It can be seen from Figure 74 that the students' answers to this question were identical to how well they think LbD fits into computer science studies.
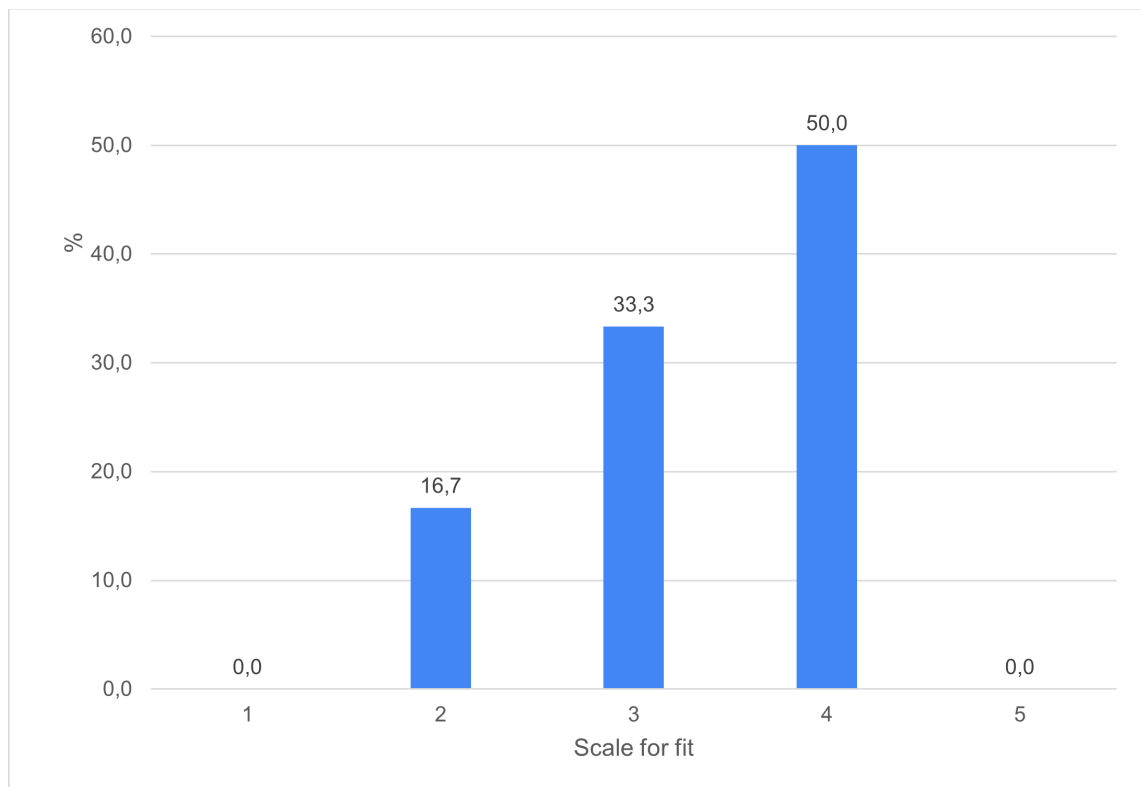
Figure 74: How well LbD fits the study module where students' attended (1 = no understanding, 5 = high understanding)

Attached are authentic student answers to question 14: "*Sustainable as everyone should be aware of their competence*" (RGU, student 1). *"I think so; it is difficult as, in my opinion, it depends on the members taking part and what they bring to the study"* (RGU, student 4). *"It helped to learn while developing this software"* (RGU, student 6). The answer of

the student who chose level two to this question was quite sceptical: *"We have full-time jobs, families and all that comes with it. We need to plan and deliver in a very controlled and structured way. This approach, in the beginning, did not have that and placed a great deal of burden on the individual and then the group to determine a path and set of deliverables. This stretches resources and causes stress in those early stages."* (RGU, student 5).

It can be seen from the answers that the students felt that the LbD model is suitable for computing science studies and that it helps in learning. However, the students felt that the LbD model could cause some stress if they did not know precisely what they were doing at the study module's starting point. One student's comment also shows that the LbD model study module is strongly related to the participant's level of competence and affects success.

The students were also asked to evaluate how well they thought the project clients had internalised the meaning of LbD (Question 15) (Figure 75).
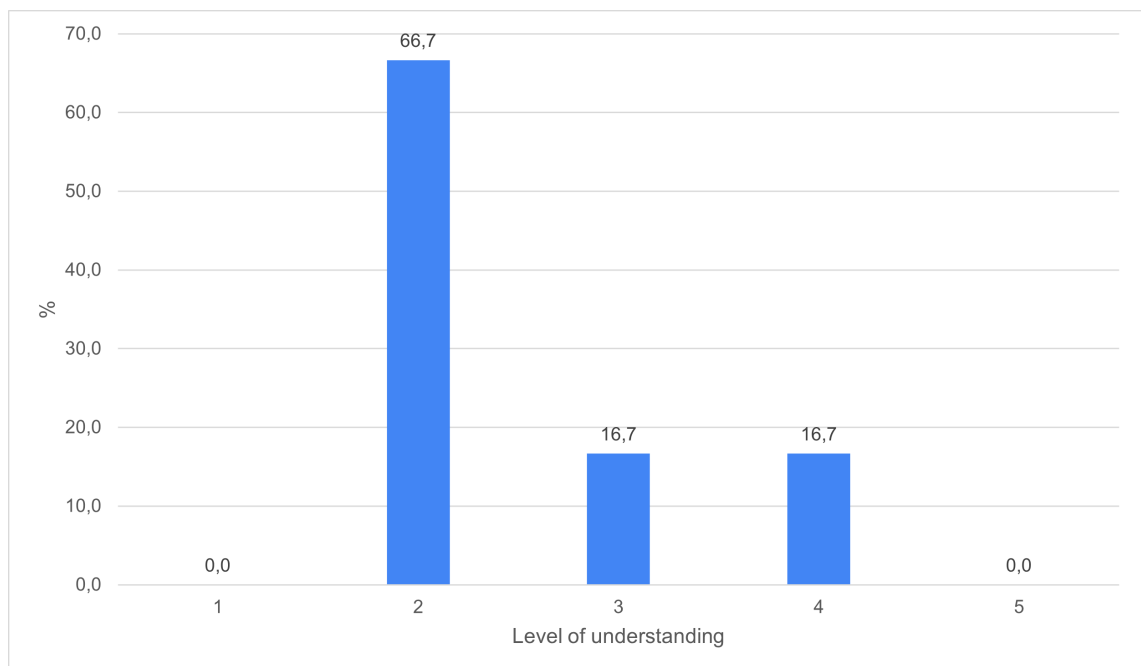
Figure 75: Students' assessment of project clients' level of understanding of the LbD (1 = no understanding, 5 = high understanding)

Attached are some authentic student answers to question 16 *(How well do you think the customers internalised the LbD Action Model?)*. *"It is fairly new and not yet found the correct footing, but that does not mean it has not been a good start and should continue*

to improve as more experience if the LbD action model is received" (RGU, student 2). *"Everyone within our module understood the principal and approach"* (RGU, student 4). One student answered: *"Not very well"* (RGU, student 6).

The students were also asked whether introducing the LbD model at the start of the study module was sufficient and whether they understood the LbD model (Question 17). Two students answered *"Yes".* One student was unsure, one did not have an opinion, and two students would have needed more familiarisation with the LbD model.

Regarding survey question 18 of whether the lecturers' roles aligned with the LbD model, one student answered: *"The lecturer was in line with LbD"* (RGU, student 6). One student was unsure, and one answered: "*Our course leader was excellent and provided suitable time for self-study"* (RGU, student 4). A student who was critical of the suitability of LbD answered this question quite sceptically*: "Very minimal in the approach, so we had no real resource of knowledge to contemplate via lectures or resources. We did not know what we did not know or what delivery standard was needed. This felt like the university was asking us to pay to teach ourselves and with a very ill-defined set of requirements."* (RGU, student 5).

For question 19 *(What is good about LbD, and what is the best about it?),* the students' answers are as follows: "*Learn in your way and learn what you are good at"* (RGU, student 1). *"Skills that are being learned are being put directly into use in a meaningful way to the student, which should slow the basics to stick but also expose them to the real world where learned method and practices are not usually aligned"* (RGU, student 2). *"I cannot recall the full discussion around this in week 2"* (RGU, student 3). *"I think it is a good approach, if learning on your own you can manage time/effort appropriately but if group learning then its dependant on the participants"* (RGU, student 4). *"You can apply your learning while developing software"* (RGU, student 6). *"I did not enjoy the experience but can see how it could work given better direction and an example of final standard for assessment and the time for students to have available to deliver it"* (RGU, student 5).

Students answered question 20 *(What weaknesses do you see in the LbD-based study?);* one student was unsure, and one thought there were no weaknesses. The open-ended answers of four students were as follows: "*Can sometimes be hard on yourself"* (RGU, student 1). *"Requires that there is a work environment that allows the learning section to be implemented at the right time. Real-world examples will sometimes not*

follow the usually quick learning timescales" (RGU, student 2). *"For groups, dependant on the participants"* (RGU, student 4). *"Risk is people dealing with life can very quickly become detached from a loosely defined requirement. Meaning there is no understanding check until you hit the assessments. There are no labs or exercises to check to understand and show a delivery standard."* (RGU, student 5).

In question 21, the students were asked how they think the LbD model should be developed. Three students did not have an answer for this. The authentic answers of the three students were: *"Deploying as early in the curriculum as possible so learners have a basic understanding"* (RGU, student 4). *"Clearly framed from the start of a module with a couple of exercises to demonstrate the approach giving knowledge of the requirements and showing approaches to get the best resources to deliver"* (RGU, student 5). *"Should be rolled out further."* (RGU, student 6).

In question 22, the students were asked what kind of study situations they think the LbD model best suits. The students answered*: "Work-based learning/course"* (RGU, student 1). *"For me, an individual study would be most successful for LbD"* (RGU, student 4). *"Computing"* (RGU, student 6). *"Certainly in a research, design or development environment where a wide spread of views and approaches are needed to push the envelope and disrupt the usual way of thinking or approaches. I feel the individuals involved need a level of information that can act as a foundation to although them develop the next steps in their learning journey."* (RGU, student 5). Two students did not know how to answer this, and from one student's answer, it can be seen that the understanding of LbD principles was unclear.

4.3.6   Project Client Experience

Research material at RGU was also collected from the project client who participated in the study module. There was only one project client who participated in both cycles. The project client was introduced to the basics of LbD before the study module. The project client was also told the purpose of the study. The client was also asked to participate in the interview at the end of the study module. RGU's study module was implemented remotely because, at that time, there were ongoing restrictions on campus due to COVID-19 in both times. The client also worked remotely with the students. The client introduced the project topic to the students at the start of the study module. The lecturer and the project client agreed with the student groups on work methods, schedules, and tools to be used.

The interview questions for RGU's project client were the same as those asked for Laurae's project clients (Appendix D) and were sent to the client in advance for familiarisation. The project client was interviewed remotely in cycle two, after which the interview was transcribed for analysis. In the third research cycle, research material was collected from the project client using e-mail. The questions were the same as in the previous research cycle, where the customer was interviewed. The project client was also the same as in the previous research cycle, so LbD was already familiar with the purpose of the research. Analysing research results included narrative analysis and material-based content analysis. According to the RGU project client, the students did well in the project (Table 11, Appendix D, Question 1).

Table 11: RGU project client opinion on how the project succeeded

RGU projects'	Weak	Satisfactory	Well	Excellent
Client			X	

For Question 2 *(How well do you think the cooperation between students and lecturers worked?)*, the project client responded that it worked well and that the lecturer helped and offered support to students. The project client answered question 3 *(Did everyone have clear roles during the project?),* that the lecturer had taught them about the different roles in the group, and the project client also guided the students at the beginning on what roles are needed.

Question 4 *(Were the project goals mutually agreed upon, and were they clear?)* answered that at the beginning, the students did not really understand what they had to do, but after the client presentation, they understood the goals better. The client also said that as the project progressed, students understood better what had to be done.

From the answer to question 5 (How well did the practical matters related to the project go?), it can be seen that the client thought practical matters worked well, and there were only a few minor practical problems during the project.

The project client answered question 6 (Were there any challenges or problems during the project, and if so, were they resolved, and if so, how?); that one challenge at the beginning was that the students did not properly understand what was being done. Another challenge was that not all students were used to dealing directly with customers who did not understand technical terms and the technical jargon they used. However,

the cooperation between the project client and the students began to flow well as the students' understanding and competence increased.

Questions 7 *(How well were the goals achieved?)* and 8 *(How beneficial was the result of the project for your organisation?)* are closely related, and the answers to these were very similar, so the answers to these have been grouped together. The answers to questions 7 and 8 are also relatively consistent with how they evaluate students' success in projects. The client estimates that the project's goals were achieved well and that the client achieved exemplary outcomes. However, the project's output cannot be used directly, but the client asked students to complete it after the study module. The project client stated that the project output received during the study module was not completed, but it was not the students' fault and that it was related to the scheduling and factors caused by the project client. However, according to the project client, the students achieved their personal goals well.

To question 9 *(Did the project's outcome produce new operating methods or other reforms for your organisation?)*, the project client answered that it gave a lot of new ideas and the understanding that such student projects should be used in customer projects. The project client said that students have many thoughts and ideas that might not necessarily come to the client's mind, giving new perspectives.

To question 10 (How well did you know the Lb model before starting the study module?), the project client answered that he did not know the LbD model very well before starting the study module in cycle two. In research cycle three, the project client answered that the knowledge about the LbD model was good. According to the project client's answer to question 11 *(What do you think about collaboration according to the LbD model, and do you think it is suitable for such student customer projects?)*, the LbD model is well suited to such projects implemented in cooperation with the client and is an excellent way to learn skills in practice.

4.3.7   Reflection

The second research cycle started with an interview with an RGU pedagogy staff. The interview with RGU's pedagogy staff produced important information about RGU's pedagogical background and what issues need to be considered if the LbD model is used in RGU. The RGU pedagogy staff answers have been analysed using narrative analysis since only one respondent existed. According to the pedagogy staff, several

pedagogical methods are used at RGU, from which the lecturers can choose which one to use. The RGU pedagogy staff said that RGU is a practical university with much cooperation with companies. In the pedagogy staff's opinion, LbD could also be well-suited as one pedagogical model for RGU. According to the pedagogy staff, RGU uses a lot of active pedagogy and work-life cooperation in many industrial sectors. According to the pedagogy staff, LbD may not be well suited to very theoretical studies.

Analysing the pedagogy staff results gave valuable information about what background factors are required to successfully use LbD in the organisation. This information helped to use the LbD at RGU in these project-based computer science students' modules. The answers from Laurea's pedagogy staff helped prepare the interview questions for RGU's pedagogy staff. The RGU pedagogy staff was provided with literature to read in advance so that the principles of LbD were familiar and the understanding of LbD was sufficient.

The pedagogy staff feels that one of the obstacles to implementing LbD at RGU relates to universities' high evaluation criteria requirements, which the government has set for the higher education sector. Also, creating an active and robust business collaboration would require many additional efforts to find enough suitable customer projects for the study modules. Such cooperation with large companies can be challenging, and for cooperation with small and medium-sized companies, much work should be done to work well. The pedagogy staff said there had been discussions in the Scottish sector about the social differences among students. Some students find it challenging to find an internship, which can hinder their learning experience. LbD could help solve this problem, allowing all students to collaborate with companies. According to the pedagogy staff, LbD is well suited for studying many fields, especially for topics with many problems and challenges to be solved, where things must be looked at as a whole, and the creation of something new is sought.

In RGU's research cycles, only one lecturer and project client were interviewed. The lecturer's answers have been analysed using narrative and SWOT analysis. The lecturer had familiarised himself with LbD beforehand and knew it quite well. In the lecturer's opinion, LbD fits well with RGU and the study module that was the subject of the research. The lecturer said LbD is best suited for project-based teaching or modules involving an external client. According to LbD, the lecturer had several roles during the study module. LbD's strengths are the cooperation and professionalism of all stakeholders, the pressure to perform as well as possible, and the lecturer's responsibility and independence. The lecturer saw it as a weakness and a threat that if participants do

not understand the principles of LbD and it is misused, it is not valid. The lecturer saw it as an opportunity to help students better understand how they should learn and do their best together with others.

According to the project client, the students succeeded, and the cooperation went well. The project client said that each student had different roles in the group, which were agreed upon in advance. According to the project client, the students did not understand the project's goal well at the beginning, but after going through it together, they understood the project's goals better. According to the customer, there were only a few practical problems during the project, which were well-resolved, and there were no significant problems. The project client said that the cooperation with the students brought many new ideas and gave a new perspective.

Only one student out of twelve responded to RGU's research survey, so the researcher conducted a second research cycle for the corresponding study module at RGU in the fall of 2021. The lessons learned from this research cycle two were to ensure a better response rate of students. It was agreed that the researcher should participate in the online implementations of the study module several times. The planning of the third research cycle to be carried out at RGU was started after the analysis of research cycle 2. The interview of the pedagogy staff was not included again because it had already been done. The following research cycle included the lecturer and customer interviews and the student survey.

Research cycle three was repeated at RGU, and more research material was acquired from the lecturer, project client and RGU students. The lecturer and the project client were the same as in the previous research cycle; therefore, the research questions were sent to them by email this time. The lecturer and the project client answered the questions in writing. The RGU lecturer's answers were almost the same as last time. Regarding the suitability of LbD, the lecturer replied that the suitability depends on the module and that it fits well with the Software Engineering study module. The roles of the lecturer were the same as last time, but this time, more emphasis was placed on the lecturer ensuring the students' understanding of their role in LbD. The lecturer's suggestion for improvement was that the presentation of LbD should perhaps be implemented as a workshop rather than a lecture.

In cycle three, five students participated in the Software Engineering study module. All students participating in the study module answered the survey, and the answer of one

student from the previous research cycle was added to the analysis of the study. A total of six answers were now included in the analysis. All students were British citizens and full-time Online Distance Learning (ODL) students. Students' skills increased in all areas. The students' competence increased the most in the following competence areas: 'co-development and service design skills' (1.00 %); 'life management and well-being' (0.83 %); 'critical knowledge acquisition evaluation and utilisation' (0.83 %); and 'entity management and systematics' (0.83%). Competence grew the least in the competence areas relating to 'social impact' (0.17%); 'equality and justice' (0.17%); and 'ecological, social and economic sustainable development' (0.17%). In the competence area 'technology and digital competence', competence increased by 0.67%, but the starting level here was 3.83%, and at the end of the study, the competence level in this area was the highest of all, i.e. 4.50%.

Students also learned many new things during the study module based on their answers. In addition to technical issues, students learned teamwork skills, working with the customer and skills for developing their skills. In contrast to Laurea's students, RGU's students did not mention international competence skills at all, but no international students were involved. During the study module, students acted in many different roles according to the principles of LbD. One of the RGU students replied that he did not understand the principles of LbD. The other students understood the meaning of LbD and could also explain it quite well. According to the students, LbD is also suitable for computer science studies. Only one student rated the suitability as level two. According to the students, the best thing about LbD is realising one's learning style and that the things learned can be used in a project in cooperation with the client. The students saw unrealistic schedules and the students' lack of competence as potential weaknesses. Ambiguous assignments can cause challenges. According to students, it is best applied to work-based learning and events where something new is developed.

The project client answered the written questions almost identically as in the previous round of interviews. This time, the project client already knew the LbD model quite well because this was done for the second time. According to the project client, the students succeeded well in the projects, and the results were good. However, not all project goals were completed during the study module, mainly due to the client's schedule. However, the students promised to complete the projects after the end of the study module.

However, after the third research cycle, there was still not as much research material as had been thought in the research plan, so the research plan was changed again, and

one more University of Applied Sciences was included. Haaga-Helia from Finland was chosen because the background factors are similar to Laurea's. The reason for including Haaga-Helia was that the results of the two Finnish Universities of Applied Sciences could be better compared because the background factors are more uniform than those in the UK. At the same time, the original purpose of the research also changed slightly. Including a new target enables a better comparison because the backgrounds of Laurea and Haaga-Helia are more identical. RGU's research results are also essential, and these are used for comparison in the areas where it is most suitable to do so. RGU's participation in the research also brings an international perspective to it.

4.4 Cycle 4: Haaga-Helia

The fourth research cycle was carried out in the spring of 2022 in Haaga-Helia to obtain more research material from computer science students. In Haaga-Helia, the research subjects were students, lecturers, project clients, and one Haaga-Helia pedagogy staff. Figure 76 shows the stages of the fourth cycle, which are explained in more detail in the following subsections.
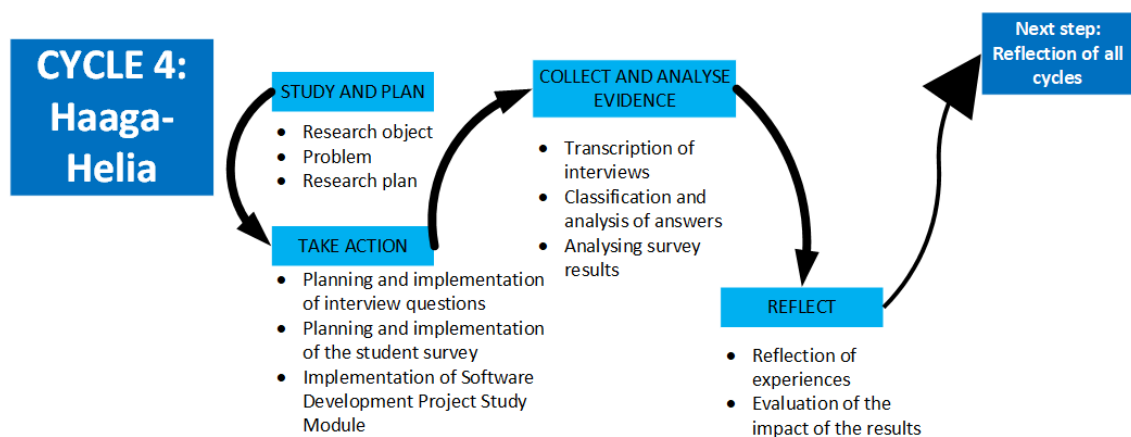
Figure 76: Research cycle 4 in Haaga-Helia

4.4.1   Institutional Context

The background of the present Haaga-Helia relates to the following educational institutions: Privat Handelsläroverket I Helsingfors (1881), Suomen liikemiesten kauppaopisto (1898), Porvoo Women's College (1912), Suomen urheiluopisto (1927), Tehtaitten Koulu Oy (1944), Malmi kauppaopisto (1957), Porvoo School of Commerce (1958), Helsinki Secretarial University (1967), Hotel and Restaurant School (1969), IT Institute (1972) and Porvoo Tourism School (1970) ('About Haaga-Helia' 2023). The

Finnish University of Applied Sciences system was reformed in the 1990s, and the first to receive a license was the Haaga Institute's University of Applied Sciences, founded in 1991. The following year, the Helsinki University of Business Administration (Helia) also received an operating license. In 2007, these two Universities of Applied Sciences merged to form Haaga-Helia University of Applied Sciences.

Haaga-Helia has strong ties to working life and strives to ensure that students are well-prepared for employment immediately after graduation. Haaga-Helia's operations focus on entrepreneurship, cooperation, innovation and internationality. Haaga-Helia operates on five campuses: Pasila, Haaga, and Malmi campuses operate in Helsinki; one is in Porvoo, and one is in Vierumäki. There are approximately 11,000 students studying at Haaga-Helia. In Haaga-Helia, there are several different bachelor's degrees. Indeed, Haaga-Helia students can study for bachelor's degrees to become experts in business, hotel, restaurant, tourism and events, sports, journalism and data processing. It is possible to complete the degree as a full-time day student or alongside work in a multi-format implementation in Finnish and English. The scope of the degree is 210–270 credits, and it takes approximately 3.5–4.5 years to complete.

At Haaga-Helia, several different pedagogical models are used, and the lecturers are free to choose the pedagogical method they think best suits each situation. Persons working as lecturers at Universities of Applied Sciences must have the pedagogical qualification of a teacher, so lecturers should have good skills in choosing a pedagogical approach. Haaga-Helia constantly develops higher education pedagogy, combining experience in pedagogic training, development and research activities. Haaga-Helia cooperates regarding higher education pedagogy in the national and international higher education fields.

4.4.2   Study and Plan

In the fourth cycle of this research, the target was Haaga-Helia, where it was studied whether the LbD model is suitable as a learning method for Haaga-Helia's computer science students in project studies. The students' survey was the same as in the previous three cycles. The research sought information on how Haaga-Helia's computer science students' skills develop during project studies.

In connection with the change in the research plan, a new suitable study module was selected for the fourth research cycle. The research object of the fourth research cycle

was chosen, the Software Development Project study module aimed at computer science students, which included a client project in spring 2022, starting in January and ending in May. The researcher was involved in the research as an external observer. At the start of the study module, the researcher participated in the students' online classes, introduced LbD and told the students about the survey to be carried out after the study module. Twenty-four students participated in the study module, of which seven were studying for an English-based degree.

The study also collected information from computer science lecturers and project clients participating in the study module. The research of lecturers and project clients was carried out as a thematic interview, and the interview questions were delivered to everyone in advance. The researcher also met all project clients at the start of the study module via Teams, told them about the study, and familiarised them with LbD. When the research plan was changed, one pedagogy staff member was recruited from Haaga-Helia. The pedagogy staff from Haaga-Helia also participated in the study and was interviewed.

4.4.3   Action

The fourth research cycle was carried out at Haaga-Helia in the spring of 2022, starting on the 17th of January and ending on the 13th of May. Based on the research plan, research material was collected from Haaga-Helia's pedagogy staff, lecturers and project clients through thematic interviews. The first action was a student survey. The survey is identical to the survey conducted for Laurea and RGU students. The second actions were the interviews with lecturers and project clients, and these were identical to those conducted with Laurea's and RGU's lecturers and project clients. One of Haaga-Helia's pedagogical staff, someone with long experience in Haaga-Helia's pedagogical methods, attended the interview. The thematic interview questions of Haaga-Helia's pedagogy staff are in Appendix F. The research material received from the pedagogy staff is significant from the point of view of the research because Haaga-Helia's background differs a bit from Laurea's, where the first research cycle was conducted and where the LbD model was developed.

54.2% of Software Development Project study module students, the research cycle four target group, answered the survey. The study module was implemented in the spring of 2022. The lecturer's responses have been analysed using narrative, content and SWOT analysis. The project client's responses have been analysed using narrative and content

analysis. The responses of the Haaga-Helia pedagogy staff have been analysed using narrative analysis. In Chapter 5, the answers of the lecturers of all three universities and project clients and pedagogy staff are gathered together and examined as a whole.

4.4.4   Staff Experience

Among Haaga-Helia's staff, one pedagogy staff and four computer science lecturers participated in the research.

Interviews with Pedagogy Staff

The Haaga-Helia pedagogy staff interview was conducted as a thematic interview using a remote connection. The research questions and background information had been sent to the pedagogy staff in advance. The research's ethical principles and operating methods were also delivered to the pedagogy staff before the interview. The interview was recorded and transcribed, after which the results were analysed using narrative analysis. The interview questions asked to the Haaga-Helia pedagogy staff, which were seven in total, are replicated in Appendix F.

The Haaga-Helia pedagogy staff answered question 1*(What pedagogical models are used in Haaga-Helia?)* that Haaga-Helia has a pedagogical vision based on continuous learning and exploratory learning and development ideology. However, in Haaga-Helia, there is not only one pedagogical model used; the lecturers themselves can choose the model that suits each study module, but all the starting point is competence-based.

The pedagogy staff answered question 2 *(Are you aware of the LbD model used in Laurea?)* that she already knows LbD from the early 2000s when it was developed at Laurea. It was then that universities of applied sciences became required to combine teaching with working life and include R&D work, and at the same time, it was also necessary to reform the competence assessment.

The pedagogy staff responded to question *3 (Do you use any similar pedagogical model in Haaga-Helia?)* that at Haaga-Helia, especially in master's degrees, the exploratory and developmental learning model is widely used.

The pedagogy staff answered question 4 *(What obstacles could be to implementing the LbD model in Haaga-Helia?)* that, in principle, there are no obstacles, but it would require strong staff participation and management commitment. At Haaga-Helia, there was no

desire to choose just one pedagogical model for the entire organisation, but the lecturers could decide if they wanted to use LbD pedagogy, but it also requires familiarity with it to be helpful.

The pedagogy staff answered question 5 *(Do you see any cultural or societal challenges to using the LbD in Haaga-Helia?)* that there are no cultural and social obstacles. However, the comprehensive implementation of such a model would require the organisation's structures and processes to support it.

The pedagogy staff answered question 6 (What kind of studies or situations would be best suited for the LbD model?) that the LbD is well suited to working life-oriented studies that include exploratory and developmental problem-solving.

Finally, the pedagogy staff responded to question 7 *(Do you think there are specific fields of education that are more suited towards this learning style?)* that the LbD is suitable for many fields, but not everything. In the context of a University of Applied Sciences, LbD fits well because the teaching there is applied and practical.

Interviews with Lecturers'

Haaga-Helia's Software Development study module was attended by four lecturers. The lecturer participated in a thematic interview using a remote connection after the study module in June 2022. Appendix B shows the interview questions for lecturers. The interview question for all three higher education institution lecturers was the same. The interview was recorded and then transcribed for a more detailed analysis. In this paragaph, the responses of the Haaga-Helia lecturer have been analysed mainly through context and narrative analysis. Chapter 5 has compiled and compared the lecturers' responses from all three higher education institutions.

Table 12 shows that the Haaga-Helia lecturers did not know the LbD model before starting the study module. The Haaga-Helia lecturer knew the development-based pedagogy principles, but the LbD action model name was unknown. The researcher had gone through LbD principles with the Haaga-Helia lecturer at the start of the study module.

Table 12: Haaga-Helia's lecturers' knowledge of LbD before the study module

Haaga-Helia lecturers	No prior knowledge	Basic understanding	Good knowledge	In-depth knowledge
Lecturer 1	X			
Lecturer 2	X			
Lecturer 3	X			
Lecturer 4	X			

Haaga-Helia lecturers' answers to questions 2 (*How well does the LbD model fit your organisation, in your opinion?)* and question 6 *(How well does the LbD fit into the study module you teach, in your opinion?)* can be seen in Table 13. Lecturers answered that LbD fits well in Haaga-Helia, depending on the context. According to the lecturers, LbD is well suited to the project-based studies of final-stage students because the students get to collaborate with project clients. Students also gain practical experience working on life-oriented projects, deepening their knowledge. One teacher answered, *"I think LbD is the only correct and natural way in that study module"*.

Table 13: Haaga-Helia's lecturers' answers to questions 2 and 6

Question		Fits well	Fits very well	Fits perfectly
How well do you think the LbD model fits in your organisation?	Lecturer 1		X	
	Lecturer 2		X	
	Lecturer 3		X	
	Lecturer 4		X	
How well do you think LbD fit into the study module you teach?	Lecturer 1			X
	Lecturer 2			X
	Lecturer 3		X	
	Lecturer 4		X	

Regarding question 3 *(Do you think the LbD model is suitable for all study modules?)*, the Haaga-Helia lecturers answered that LbD is unsuitable for all study modules. To question 4 *(What studies or situations is the LbD best suited for, in your opinion?)*, the Haaga-Helia lecturers answered that LbD is best suited for project-based teaching or modules involving an external stakeholder group. The Haaga-Helia lecturer's answers to question 5 *(What were your roles in this study module implementation in which you were involved?)*, which were related to their roles during the study module, can be seen in Table 14.

Table 14: Haaga-Helia lecturers' roles in the study module

Lecturers roles	Haaga-Helia lecturer 1	Haaga-Helia lecturer 2	Haaga-Helia lecturer 3	Haaga-Helia lecturer 3
Teacher	X	X	X	X
Mentor	X	X	X	X
Organisator	X		X	X
Designer		X		
Preparer	X	X		X
Implementer				X
Evaluator	X		X	X
Enabler			X	
Learner	X			
Participant		X		

All the lecturers answered that they had played the role of teacher and mentor. Three lecturers answered that they had also played the organiser, preparer and evaluator roles. Other roles of individual lecturers were planner, enabler, learner and participant. The answers show that in teaching, according to LbD pedagogy, lecturers have and can have several different roles, which also vary from client to project.

Haaga-Helia lecturers' answers to questions 7 *(What strengths do you think the LbD model has?),* question 8 *(What are the weaknesses or shortcomings of the LbD model, in your opinion?)*, question 9 *(What are the opportunities in the LbD model, in your opinion?)*, and question 10 *(What kind of threats do you think the LbD mole includes?)* are compiled in a SWOT analysis table (Figure 77).

SWOT ANALYSIS

<table>
<tr>
<td>

STRENGTHS
- It is work-life-oriented and development based
- The students learn to tolerate uncertainty and notice that the project can nevertheless be successful
- Students get to develop real, concrete things during the study module and find out the problems related to them

</td>
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WEAKNESSES
- If all parties are not committed, this might cause problems
- If students do not have sufficient prerequisites or skills to perform the task given to them, it can cause problems

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OPPORTUNITIES
- Allow real working-life projects
- Get students a better understanding of the company's good practices
- Uses professional procedures that students need when they are transitioning to working life

</td>
<td>

THREATS
- Poor customer engagement
- Poor motivation of students
- If only the LbD model is used, it may not be a good thing
- Poor commitment

</td>
</tr>
</table>

Figure 77: Haaga-Helia lecturers' SWOT analysis

Haaga-Helia's lecturers saw LbD's strength as its working life orientation and development-based nature. It was also seen as a strength that students learn to tolerate uncertainty and develop a real concrete working life project during their studies. The lecturers saw it as a weakness that if all parties are not committed to the project, it might cause problems. It was also seen as a challenge that if the students do not have the necessary skills before the customer project starts, then it can be a problem. The opportunity was seen to enable real working-life projects, students' better understanding of the good practices of companies and the use of professional procedures, which are needed when transitioning to working life. It was seen as a threat if the parties' commitment was not exemplary or the students had lousy motivation. It was also seen as a threat that if the LbD model is misused, it can cause problems.

Regarding question 11 *(Do you have something in mind that should be developed in the LbD model to make it work better?)*, two Haaga-Helia lecturers could not think of any suggestions for improvement. One lecturer answered that a clear structure, good instructions, and practical examples would help bring added value. One lecturer

suggested that if the students were to receive continuous feedback on developing their skills, they could immediately do corrective activities in the right direction.

In question 12 *(How well did the students' skills develop during the study module?)*, the lecturers were asked how well the students' skills developed during the study module. In the opinion of the lecturers, the students' skills developed well, and the project clients were satisfied. The skills of more active students developed better than those who were not as active. One lecturer mentioned that the students' competence increased in many different areas, and in addition to the technical skills, the students' soft skills also developed. One lecturer said the students' skills developed well, but the results could have been even better.

4.4.5 Students' Experience

The study also collected Haaga-Helia computer science students' experiences of LbD-based learning, examined the development of the student's competence during the study module and asked what students' experiences of participating in the study module were according to the LbD model. The research material was collected from Haaga-Helia students using an electronic Google Forms questionnaire (Appendix C). The survey was completed after completing the study module, and the research material was collected from Haaga-Helia's computer science students in the spring of 2022. The subject of the study module was the Software Development Project, and client projects were implemented during the study module. The total number of students in the study module was 24. The language of the study module was English and Finnish. The students were told about this study at the start of the study module. In addition, they were told that the end-of-study module questionnaire would be used to collect research material. The students were also introduced to the LbD approach at the start of the study module so that they understood the basics of LbD and their role in it and would know how to act accordingly.

54.2% of students answered the survey. The survey background was the same as earlier, and it related to developing higher education students' skills in general working life skills. Laurea's 2030 strategy, in addition to the defined and identified general skills of the degree, also strongly considers the competence needs of working life, which are perceived as increasingly essential skills for those who have completed a degree from a University of Applied Sciences. These common and general working life skills for all degrees consist of six competencies: self-management and entrepreneurial attitude,

critical thinking and problem-solving skills, foresight and innovation skills, communication and interaction skills, global skills and responsibility skills. According to the research plan, the survey of Haaga-Helia students was the same as that of Laurea and RGU students, so that a comparison could be made based on the results.

Students evaluate their competence development in these six areas with a survey, where each area of competence contains three or four questions (Appendix C). There were six areas of expertise and a total of 20 questions. These questions are referred to in the text by number and letter abbreviations. For example, the first question of the first competence area is 1a, and the second is 1b. The self-assessment questions of the survey by competence areas can also be seen in Appendix C, starting with number 7. The students self-assess their competence level before and at the end of the study module on the topics of each sub-area. It is the student's self-assessment which must be taken into account in the interpretation of the answers and presented as a limitation of the reliability of the results.

Analysis of Students' Classified Questions

The first area of expertise was self-management and an entrepreneurial attitude. The first question (1a) was about 'life management and well-being'. Students rated their competence on a scale of 1 ("no competence") to 5 ("expert"). The results are shown in Figure 78. At the start of the module, the students' competence score was M = 2.92 and SD = 1.188. At the end of the module, the students' competence had increased by M = 3.54, SD = 0.967. The students' skill level increased by an average of 0.62 percentage

points, and the students' answers were slightly more consistent. The results are statistically significant (t(12) = 2.551, p = 0.025).
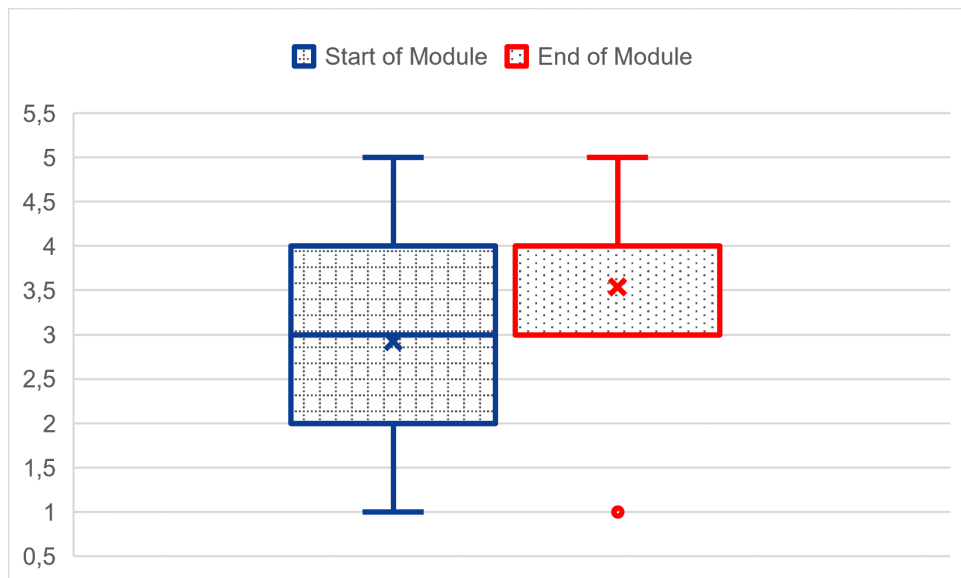
Figure 78: Haaga-Helia students' survey results for 'life management and well-being'

The next question (1b) was about the students' 'own skills and skills for continuous learning'. The results are shown in Figure 79. M = 2.69, SD = 1.032 at the start of the module and M = 3.69, SD = 0.480 at the end. The mean value increased by 1.00 percentage points. At the end of the module, the students' competence levels were either 3 or 4. The results are statistically significant (t(12) = 5.099, p < 0.001).
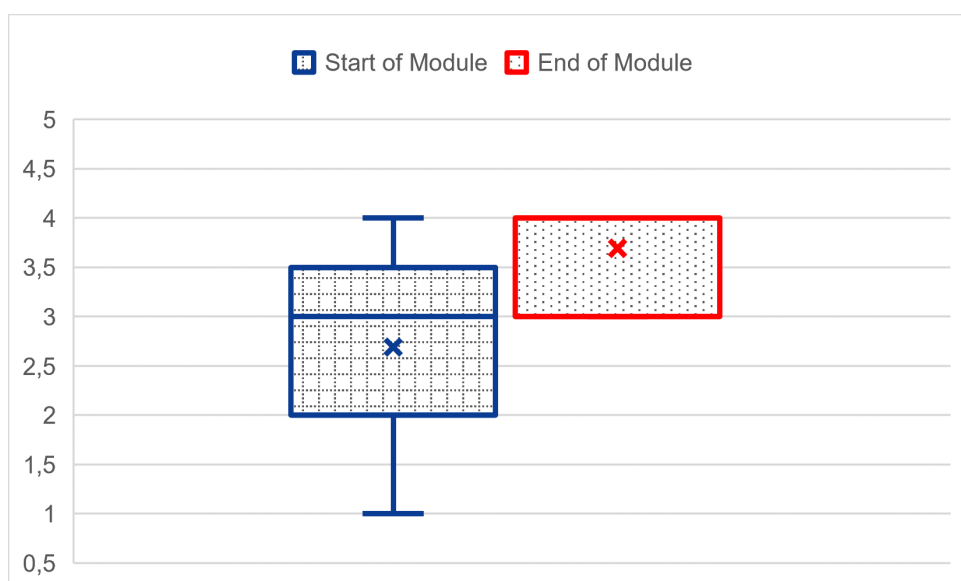
The first competence area's third question (1c) was about the students' 'sales skills' (Figure 80). Sales skills are not mentioned in the competence objectives of the study module, yet seven students estimated that their sales skills had developed. At the start of the module, M = 2.00, SD = 1.000 in this competence area, which is relatively low and rose to M = 2.92 SD = 0.954 at the end. The results are statistically significant (t(12) = 3.207, p = 0.008).
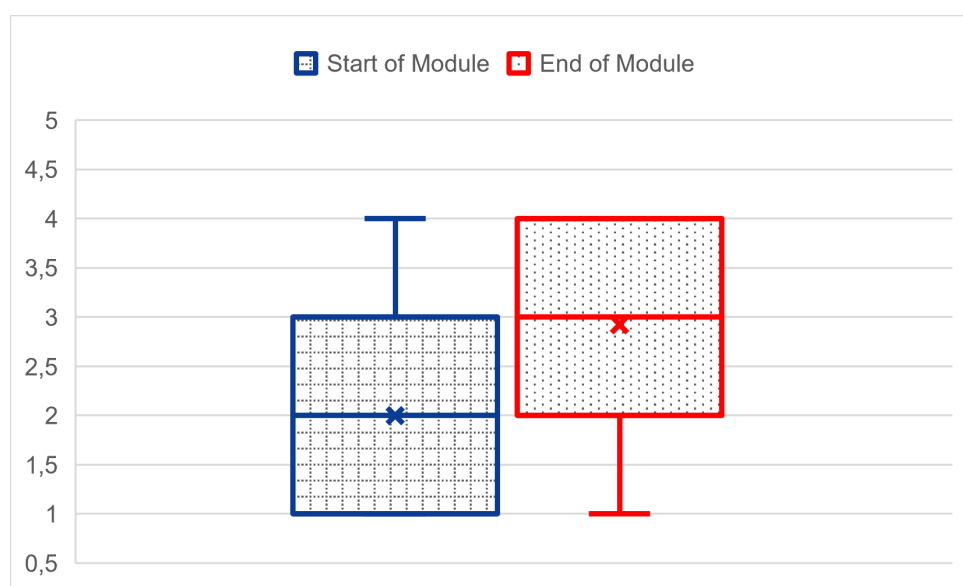
Figure 80: Haaga-Helia students' survey results for 'sales skills'

The second competence area of the students' survey was related to 'critical thinking and problem-solving skills' (Figure 81). This sub-area's first question (2a) was related to 'critical information acquisition, evaluation and utilisation'. At the start of the study module, M = 3.08, SD = 0.760; at the end, M = 3.69, SD = 0.855. The results are statistically significant (t(12) = 3.411, p = 0.005). None of the students' levels was one, and seven students' competence levels increased during the study module.
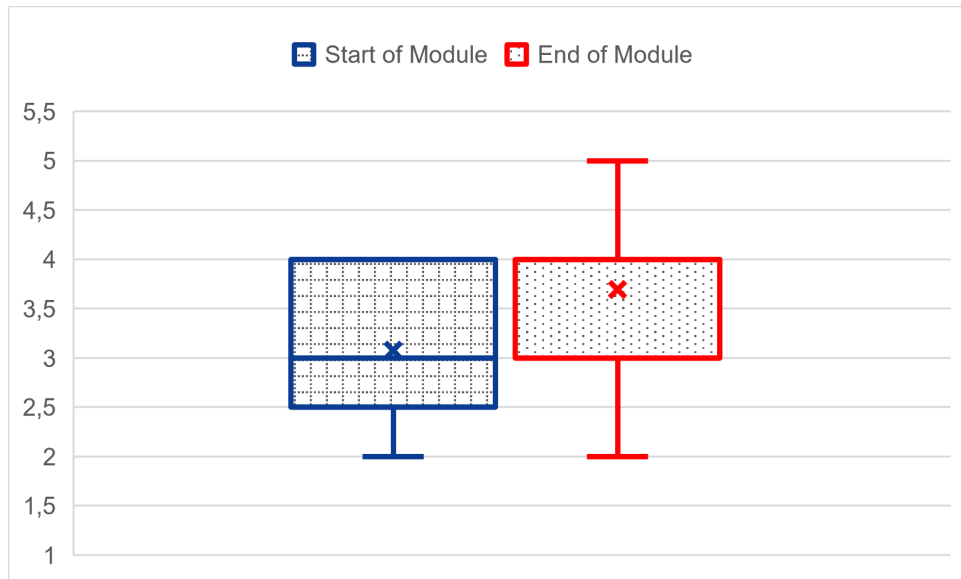
Figure 81: Haaga-Helia students' survey results for 'critical knowledge, evaluation, and utilisation'

The second question in this sub-area (2b) was 'entity management and systematics' (Figure 82). In this question, the students' M = 2.62, SD = 0.870 at the start and end of the study module M = 2.77, SD = 0.832. The results are not statistically significant ($t(12)$ = 1.477, p = 0.165).
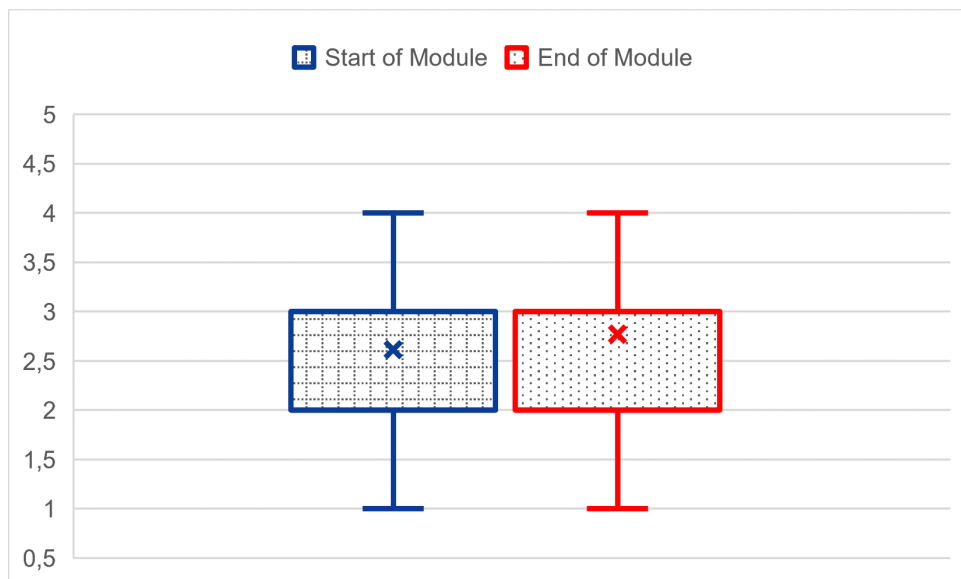
Figure 82: Haaga-Helia students' survey results for 'entity management and systematics'

This sub-area's third question (2c) concerns 'analytical thinking and argumentation' (Figure 83). At the start of the study module, M = 2.92, SD = 0.862; at the end, M = 3.54, SD = 0.776. The results are statistically significant (t(12) = 4.382, p < 0.001). 61.5% of students evaluated their competence increases in this area during the study module. One student answered that the competence level was one at the start, i.e. no competence at all, and at the end of the study module, the level was two.
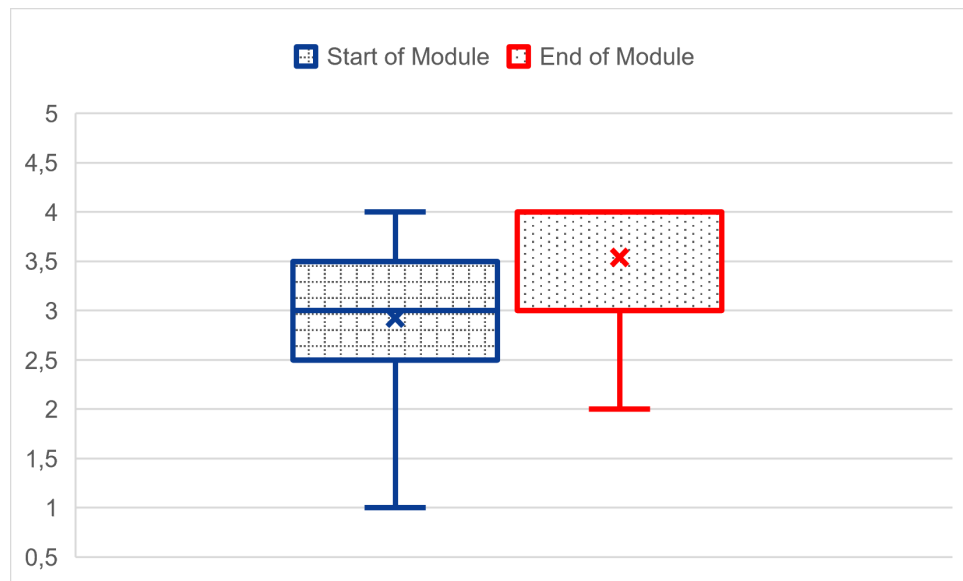
Figure 83: Haaga-Helia students' survey results for 'analytical thinking and argumentation'

The third competence area was 'foresight and innovation skills'. The first question concerned 'creativity and initiative' (3a) (Figure 84). The students' M = 2.92, SD = 0.862 at the start of the study module. The Mean value increased during the study module and M = 3.38, SD = 0.870 at the end. The results are statistically significant t(12) = 3.207, p = 0.008). 46.2% of students assessed that their level of competence increased during the study module.
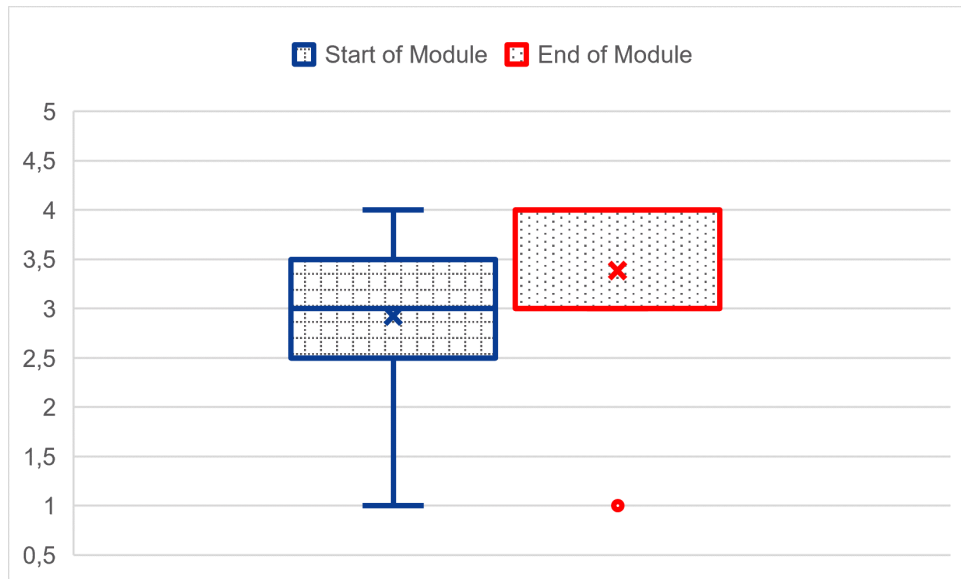
Figure 84: Haaga-Helia students' survey results for 'creativity and initiative'

This competence area's second question (3b) was about 'co-development and service design skills' (Figure 85). M = 2.38m SD = 1.044 at the start of the module and M = 3.62, SD = 0.650 at the end, i.e. a Mean rise of 1.24%. The results are statistically significant (t(12) = 5.333, p < 0.001).
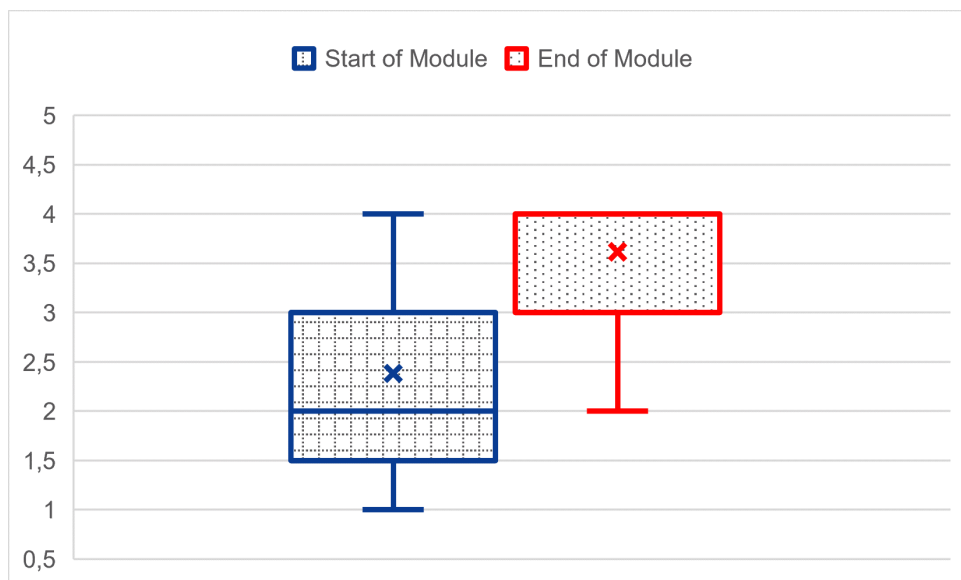
Figure 85: Haaga-Helia students' survey results for 'co-development and service design skills'

The third question (3c) was about 'technology and digital competence' (Figure 86). M = 3.08, SD = 0.954 at the start of the module and M = 3.92, SD = 0.494 at the end. The results are statistically significant (t(12) = 4.430, p < 0.001).
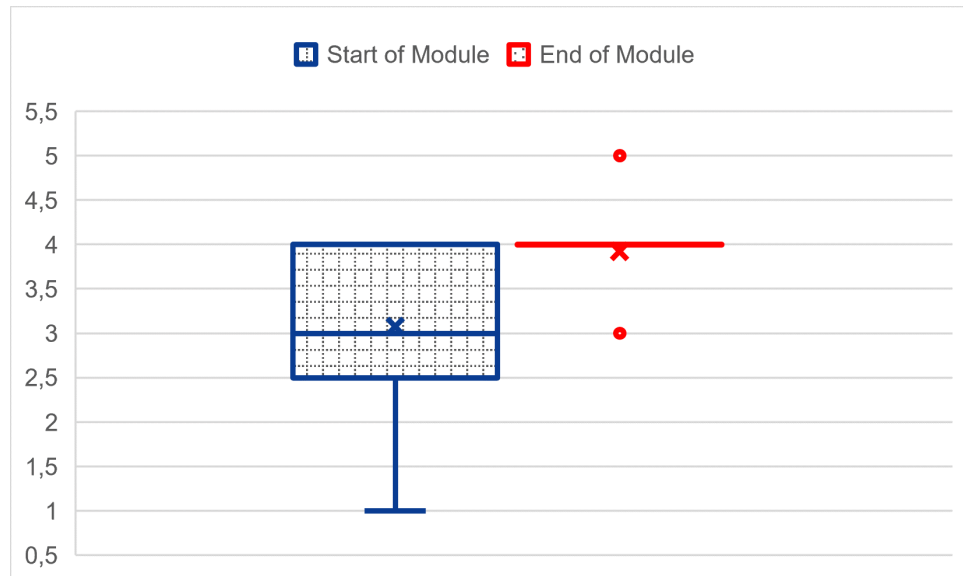
Figure 86: Haaga-Helia students' survey results for 'technology and digital competence'

The fourth question (3d) was about 'the ability to change' (Figure 87). At the start of the module, M = 3.23, SD = 1.013. At the end of the module, the Mean increased to M = 3.77, SD = 1.166. The results are statistically significant (t(12) = 2.941, p < 0.012).
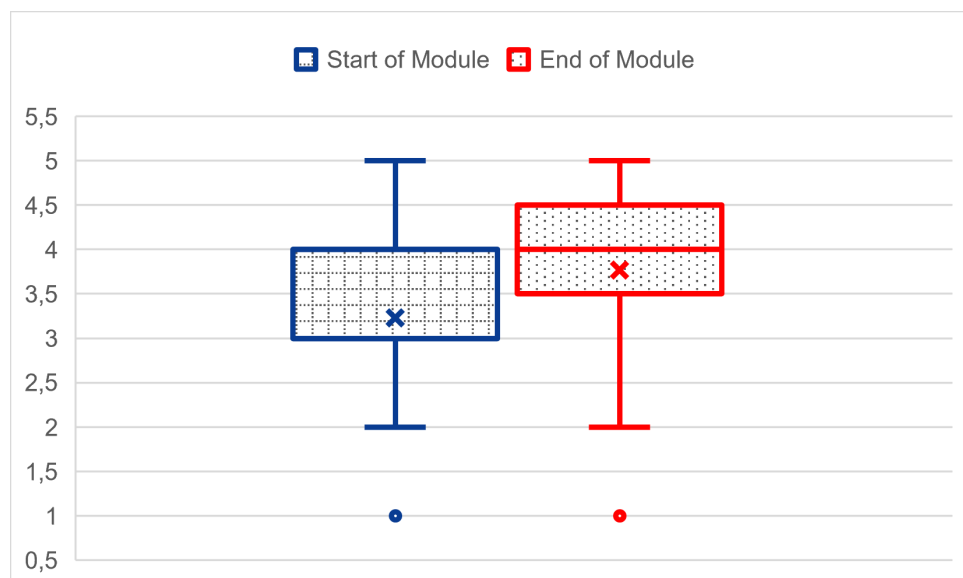
Figure 87: Haaga-Helia students' survey results for 'the ability to change'

The fourth competence area was 'communication and interaction skills'. The first question of this competence area (4a) was about 'effective oral and written communication skills (including language skills)' (Figure 88). At the start of the module, M = 3.08, SD = 0.862. Five students estimated their competence increased from three to four during the study module. In the end, M = 3.46, SD = 0.967. The results are statistically significant (t(12) = 2.739, p = 0.018).
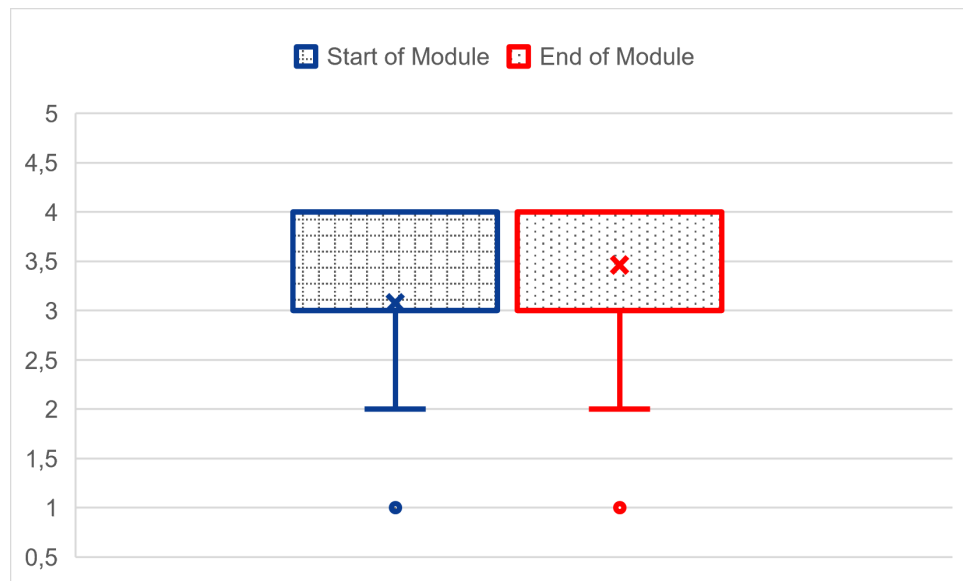
Figure 88: Haaga-Helia students' survey results for 'impressive oral and written communication skills (including language skills)'

The second question in this competence area was related to 'networking skills' (4b) (Figure 89). M = 2.82, SD = 0.768 at the start of the module. At the end of the module, M = 3.46, SD = 0.776. The results are statistically significant (t(12) = 4.430, p < 0.001). 69.2% of students rated their competence level increased during the study module, and none of the students' competence levels was at level one.
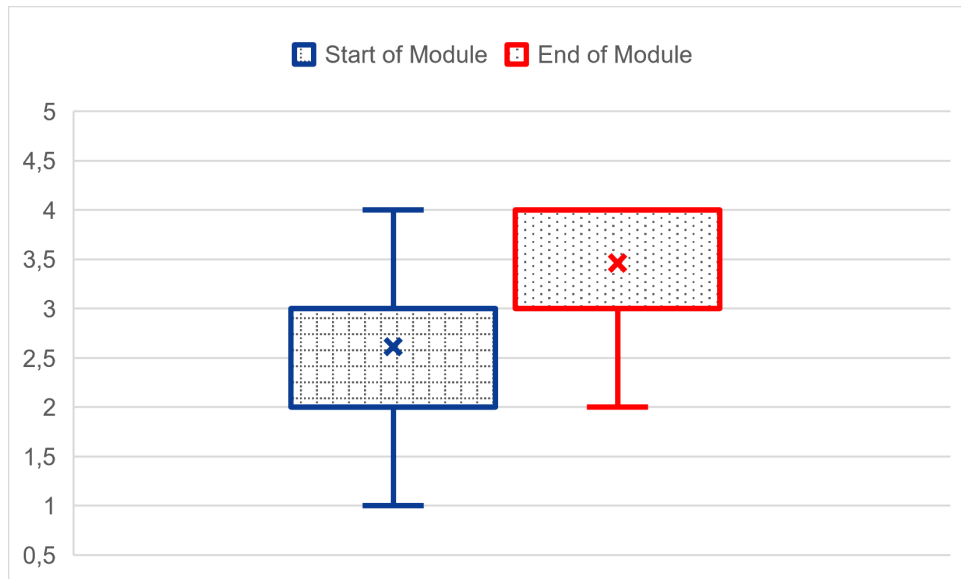
Figure 89: Haaga-Helia students' survey results for 'networking skills'

The third question in this competence area (4c) was related to 'social impact' (Figure 90). M = 2.62, SD = 0.768 at the start of the module, and the end, M = 3.15, SD = 0.899. The results are statistically significant (t(12) = 3.742, p = 0.003). 54.8% of students estimate that their competence level increased in this competence area during the study module.
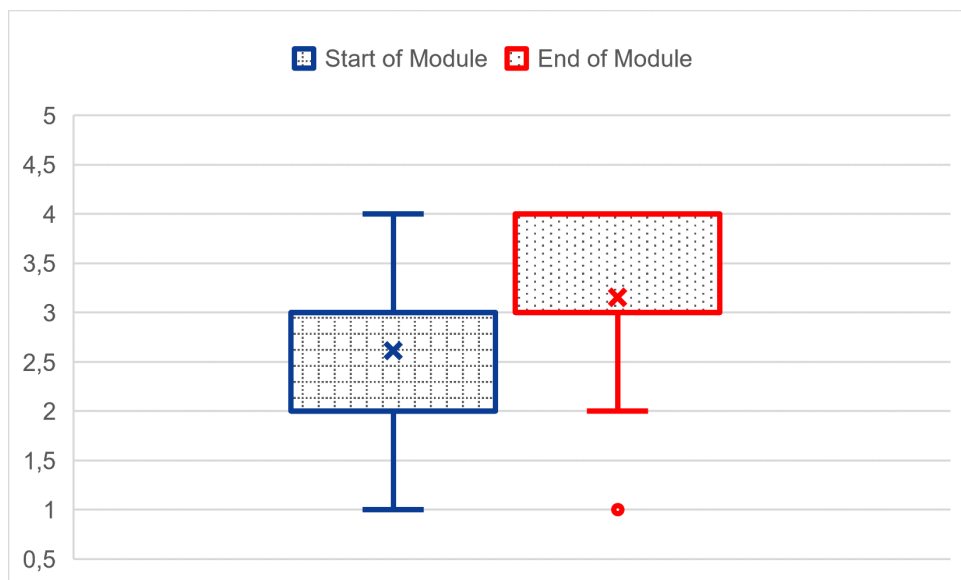
Figure 90: Haaga-Helia students' survey results for 'social impact'

The fourth question in this competence area (4d) was related to 'customer understanding and knowledge' (Figure 91). M = 2.45, SD = 0.776 at the start of the module, and at the end, M = 3.38, SD = 0.961. The results are statistically significant (t(12) = 3.860, p =

0.002). 69.2% of students estimated that their level of competence had increased, one even from level one to level four and one from level two to level four. At the start of the study module, one student rated the competence level as one and assessed that the competence level did not increase at all.
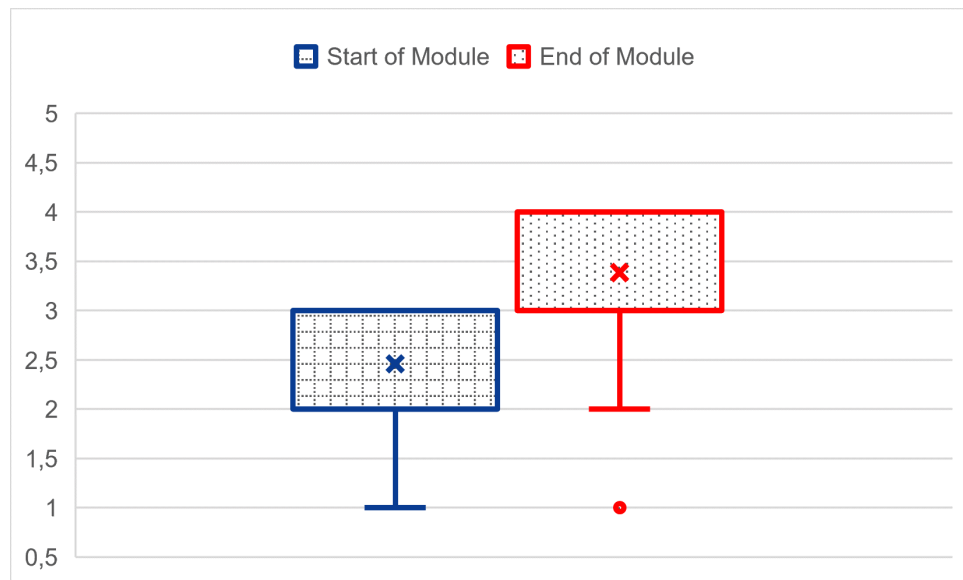
Figure 91: Haaga-Helia students' survey results for 'customer understanding and customer knowledge'

The fifth competence area was 'global expertise', whose first question (5a) concerned 'international capabilities' (Figure 92). M = 2.54, SD = 1.127 at the start of the module. At the end of the module, M = 3.00, SD = 1.155. The results are statistically significant (t(12) = 2.521, p = 0.027). 38.5% of students assessed that their level of competence increased during the study module.
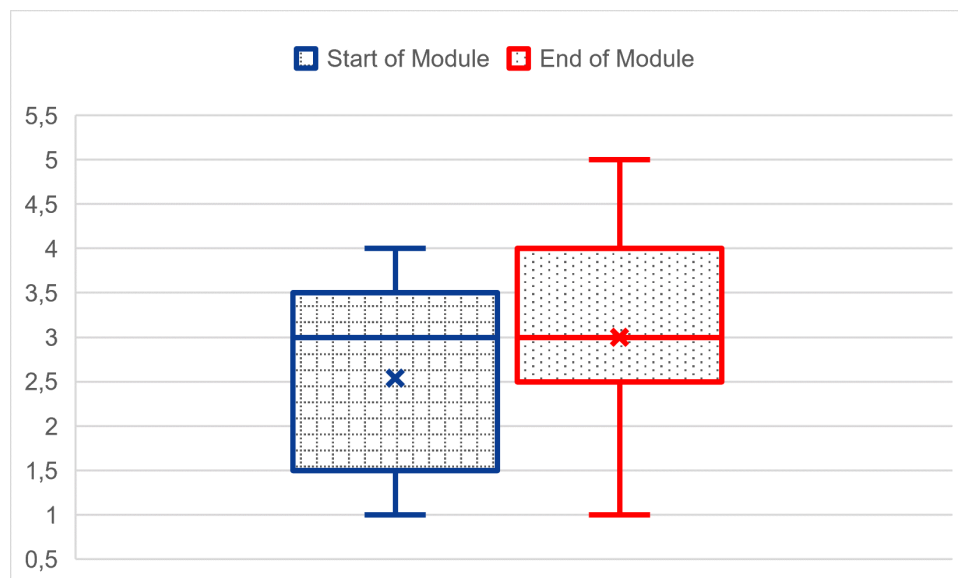
Figure 92: Haaga-Helia students' survey results for 'international capacities'

The second question of the fifth competence area (5b) was 'understanding cultural meanings' (Figure 93). M = 2.85, SD = 0.987 at the start of the module. At the end of the module, M = 3.08, SD = 1.188. The results are not statistically significant ($t(12) = 1.897$, $p = 0.082$). 23.0% of students estimate that their competence level increased during the study module.
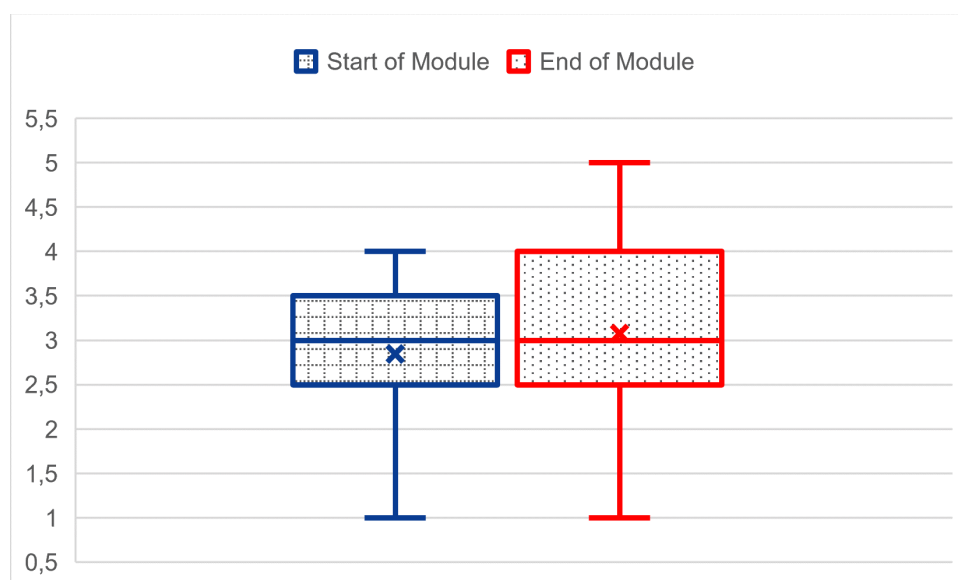
Figure 93: Haaga-Helia students' survey results for 'understanding the cultural meaning'

The third question (5c) was related to 'ethical engagement in the global media and technology environment' (Figure 94). M = 2.77, SD = 0.927 at the start of the module, and M = 2.85, SD = 0.899 at the end. Whilst there is a slight increase in the Mean, these results are not statistically significant t(12) = 1.000, p = 0.337).
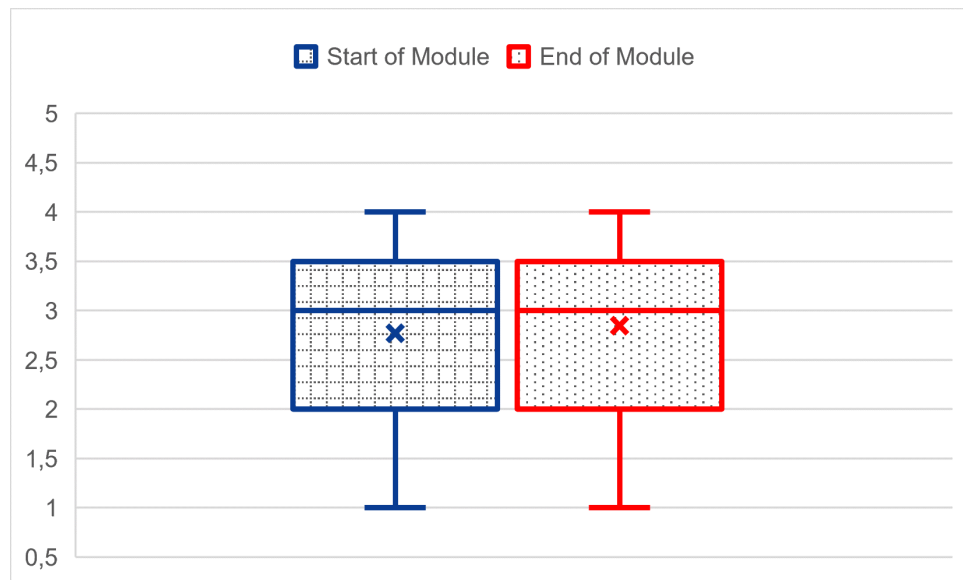
Figure 94: Haaga-Helia students' survey results for 'ethical engagement in a global media and technology environment'

The sixth competence area was 'responsibility competence'. The first question (6a) was about 'ethics and empathy' (Figure 95). M = 3.15, SD = 0.987 at the start of the study module, and at the end, M = 3.38, SD = 0.961. The results are not statistically significant (t(12) = 1.897, p = 0.082). In this competence area, only one student assessed that his competence increased during the study module.
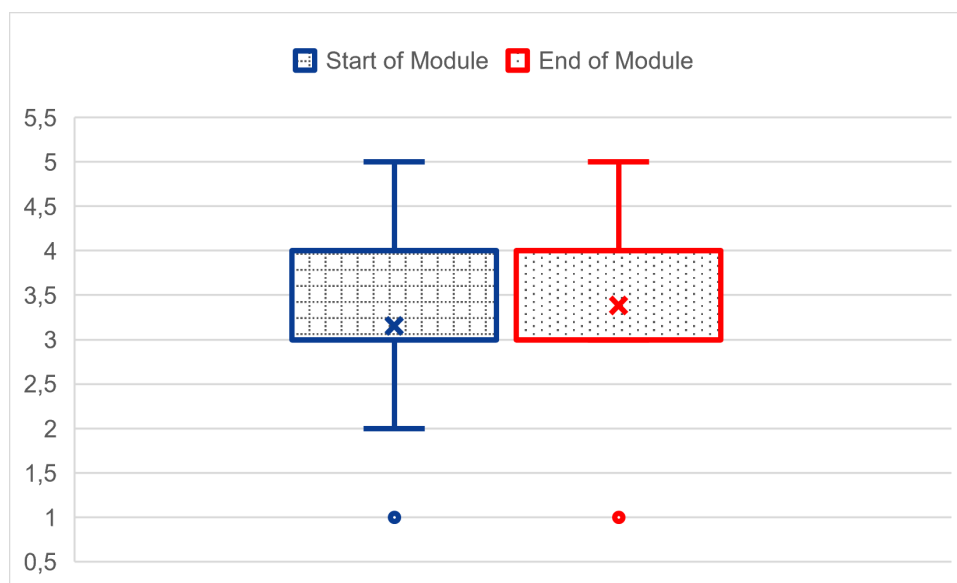
The second question (6b) was about 'equality and justice' (Figure 96). The students' M

Figure 95: Haaga-Helia students' survey results for 'ethics and empathy'

= 3.31, SD =0.947 at the start of the module and M = 3.46, SD = 0.967 at the end. The results are not statistically significant (t(12) = 1.477, p = 0.165). Only one student estimated that his skills had increased in this competence area.
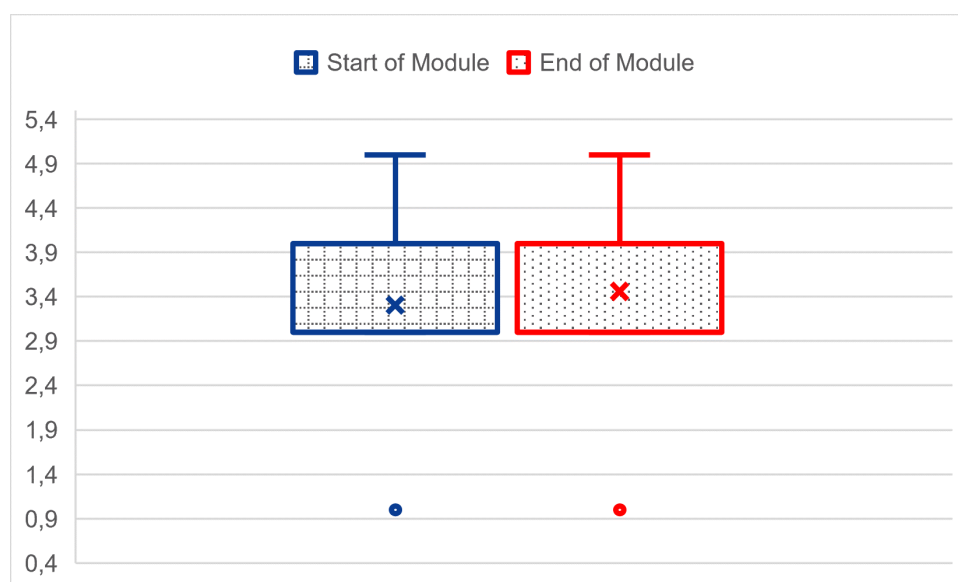
Figure 96: Haaga-Helia students' survey results for 'equality and justice'

This competence area's third and last question (6c) was related to 'ecological, social and economically sustainable development' (Figure 97). M = 2.92, SD = 0.954 at the start of the module, and M = 3.08, SD = 1.115 at the end. The results are not statistically

significant (t(12) = 1.477, p = 0.165). Two students evaluated their increased competence level increased during the study module.
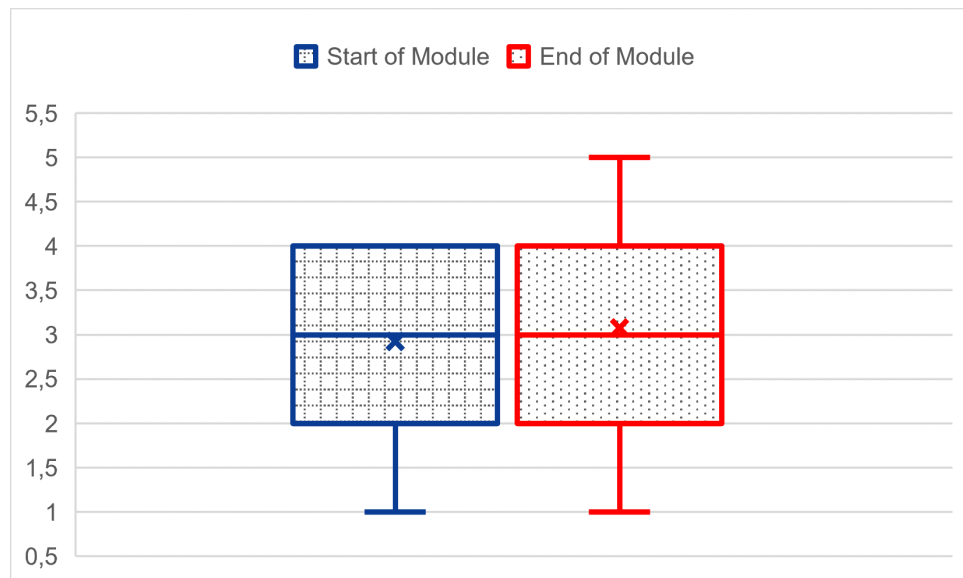
Figure 97: Haaga-Helia students' survey results for 'ecological, social and economic sustainable development'

Analysis of Students' free-form questions

Students were asked to freely answer what new things or skills they learned during the study module. The students' free-form answers have been classified using content analysis (Table 15). Table 15 contains the answers to question 7. Table 15 shows students' competence development in teamwork, working with client projects, and technical skills. In addition to these, the personal skills of many students grew or deepened, such as never giving up, better knowledge of working life coding and many other skills which one should acquire as part of a university degree.

Table 15: Haaga-Helia students' competence development during the study module

What new things or skills did you learn during the study module?			
Technical skills	**Team work skills**	**Working with the customers**	**Development of personal skills**
New technologies for both front and back end development	Teamwork, sustaining productive direction when doing projects	Working with a real company	Never give up: keep trying until find the solution
Better coding skills	Working with different kind of people	Account for customer requirements and needs	A lot of skills which should learn in university degree
Better understanding Scrum	Better teamwork		Better knowledge of working life coding
More about configuration of different technologies			
Technology			

The students were also asked about their roles during the project (Question 8). The ready-made roles were project manager, developer, designer, tester, participant and researcher. Students were also asked to rate their level of competence in these roles on a scale of 1-5. Figure 106 shows the students' answers about their different roles during the study module and their self-assessment of their level of competence in each role. The value 0, in Figure 106, means that the student had not chosen this role in question in the survey. Therefore, those students did not act in that role during the study module.

Students were also asked to evaluate their level of competence in how well they thought they had understood what LbD means in practice (Question 9) (Figure 98). 23.1% of Laurea's students estimated they do not understand the LbD. 15.4% of students rated their level of understanding at three and fifteen at level four. 46.2% of students estimated that their understanding of LbD was level two. 23.1% of students estimated that their level of understanding was three, and 30.8% of students estimated that understanding was level four. This self-assessment question also included an answer point where students were asked to describe in their own words what LbD means in practice (Question 10).

The free-form answers are well aligned with the numerical estimate. Two students did not answer this, and one answered that he had no idea. Students who rated their level of understanding of LbD as four could explain relatively well what LbD meant, although one answered that it is learned by doing.
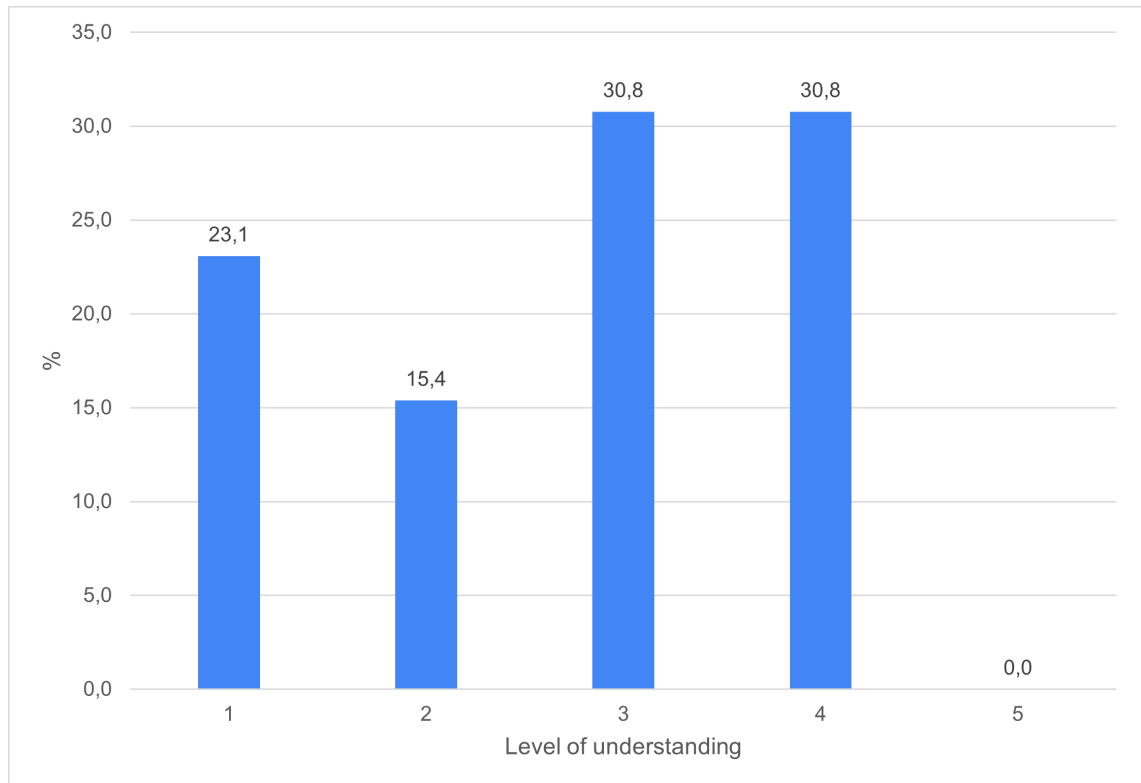
Figure 98: Haaga-Helia students' understanding of what the LbD mean in practice (1 = no understanding, 0 = high understanding)

The students were also asked how well LbD fitted into computer science studies in general (Question 11). The majority of students thought it fitted either very well (six students) or well (three students) (Figure 99). Three students estimated the suitability level to be three. One student chose level one, meaning not a fit at all. This student was one of those who did not understand the meaning of LbD at all. The precise answer of this student: *"I literally have no clue what is going on."*
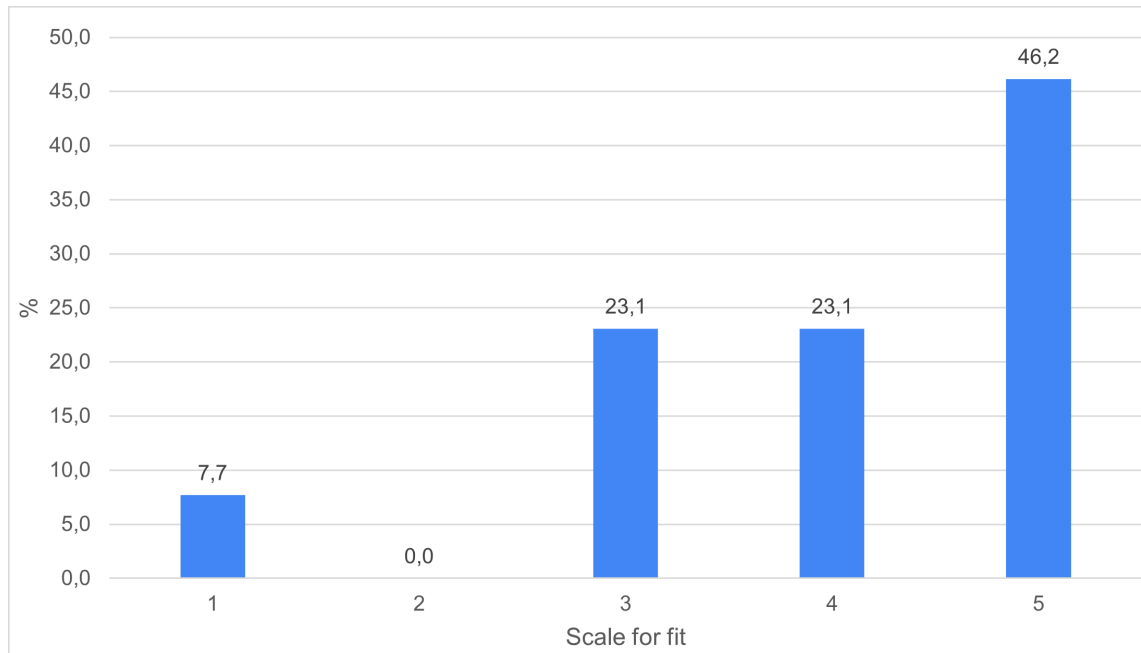
Figure 99: How well does the LbD Action Model fit into studying computing science studies (1 = no understanding, 0 = high understanding)

Students were also asked to evaluate the suitability of LbD for the study module they attended (Question 13). It can be seen from Figure 100 that the students' answers to this question differed a bit in how they thought LbD fitted into computer science studies. These two questions differ because a few students found the projects technically tricky and would have liked more support from lecturers and project clients.
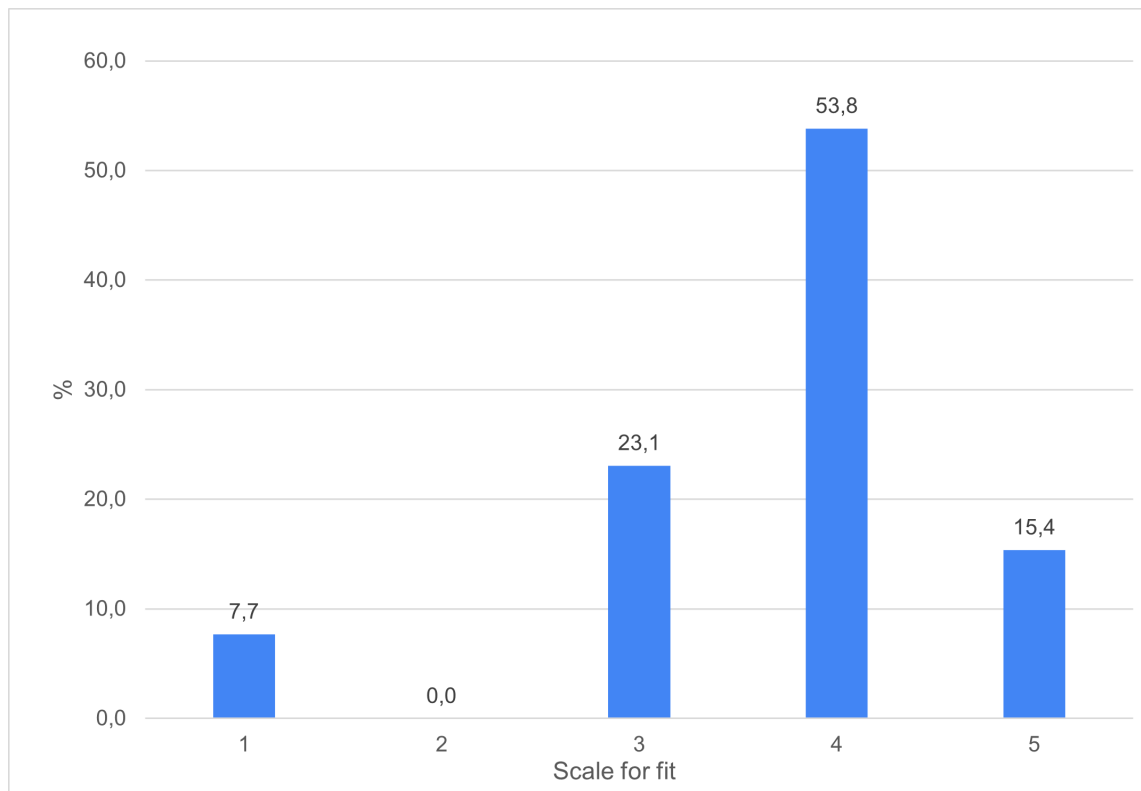
Figure 100: How well LbD fits the study module where students' attended (1 = no understanding, 0 = high understanding)

In the answers to question 14 *(Describe in your own words your opinion on the suitability of LbD for that study module)*, 61.5% of the students thought that LbD is a suitable and functional model for students' project-based studies. 30.7% of the students had not answered this question, and only one had an opposing view. Attached are some students' authentic answers. *"It should be the main one. Classroom teaching is outdated and risky, as the teacher has a high probability of not adapting to many of the students' learning styles. Instead, if you jump into the action directly and are given enough incentives actually to work and get better, you will naturally learn in your own way, which is infinitely better than someone forcing their learning style upon you (with peer support, of course, as learning alone is very demoralising."* (Haaga-Helia, student 1). *"LbD was a fitting conclusion to software development studies, as it was more enhanced than what we had done before: year by year, we had taken more demanding projects, but they were usually based on our own ideas. I cannot imagine a better target for the last course than an outsider client who gives the project's objectives"* (Haaga-Helia, student 2). *"Very suitable. In addition to helping with learning the technologies, the method makes it so*

that the group members are more likely to rely on each other and thus help with working in a group." (Haaga-Helia, student 9).

One student's authentic answers to question 14 were critical*: "We had to pick up a completely new technology with limited documentation, which made it hard to do and test things when you do not know how to do anything. There was barely any actual programming/coding involved in this project."* (Haaga-Helia, student 5).

The students were also asked to evaluate how well they thought the project clients had internalised the meaning of LbD (Question 15). It can be seen from Figure 101 that one student thought that the project client did not understand the purpose of LbD. One student chose level two. Three students chose level three, six chose level four, and one chose level one. The student who chose the estimation of clients' understanding at level five thought: *"I believe they have understood the main idea of the model: even though they are ordering a product from us, they acknowledge our priority - learning by doing, not automatically creating outstanding or professional results."*
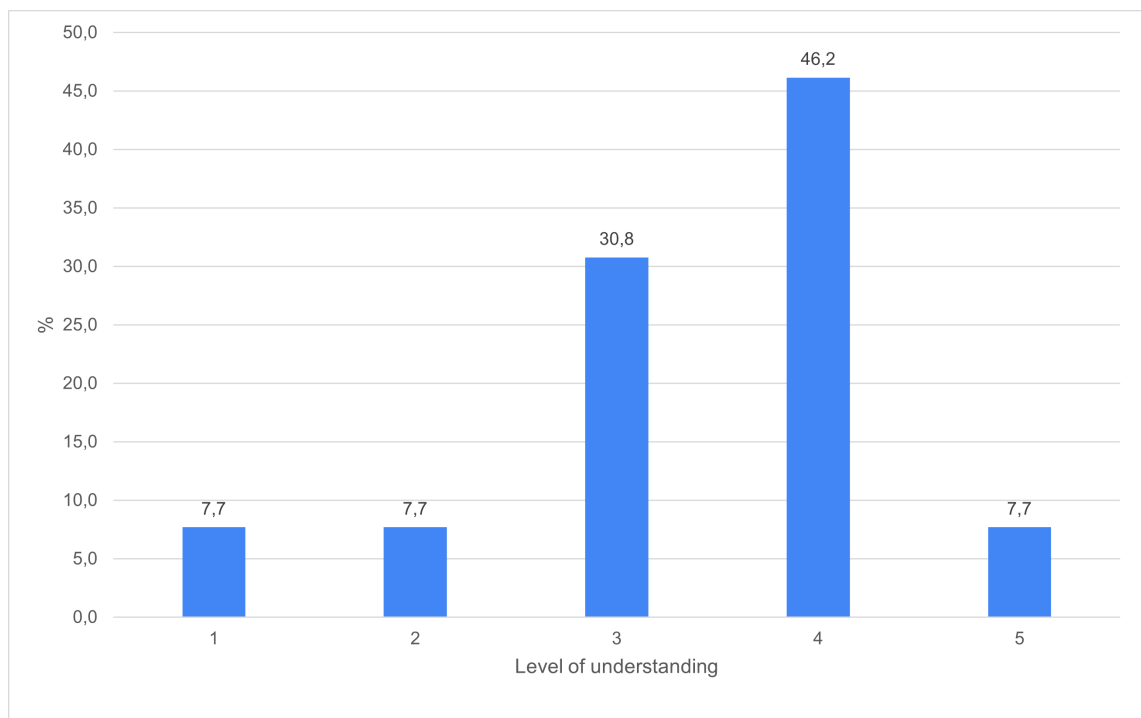
Figure 101: Students' assessment of project clients' level of understanding of the LbD
(1 = no understanding, 0 = high understanding)

The students were also asked whether introducing the LbD model at the start of the study module was sufficient and whether they understood the LbD model (Question 17). 46.2%

of respondents thought that the familiarisation with the LbD model was sufficient; based on that, they understood the basic principles of LbD. According to two students, the introduction to the LbD model could have been more in-depth. The student did understand the basics but would have liked more information about the LbD model. Three students did not answer this question, and one was quite confused about the LbD. One student, who was not involved in the initial orientation, thought that the knowledge about LbD was minimal before the survey.

Regarding survey question 18 *(What was the role of the lecturers, and was it in line with the LbD Action Model?)* of whether the lecturers' roles aligned according to the LbD model, four students chose not to respond. According to two students, the lecturer's role was very much in line with the principles of LbD. One student said the lecturer's role was relatively good but not commendable. Five students said the lecturers did not play a huge role during the study module. The lecturers were very involved at the start of the study module and during the evaluation phase, but otherwise, the lecturers were more in the role of an observer, but they could help if needed. One student answered: *"What lecturers?"* (Haaga-Helia, student 1).

For question 19 *(What is good about LbD, and what is the best about it?),* the students' answers were analysed using material-based content analysis. The answers were categorised and classified, and answers were grouped into three main categories: a new way to develop competencies, practical learning and customer cooperation. The students' answers were very similar, and it can be seen from Figure 102 what kind of issues the students highlighted as the good or best aspects of LbD.
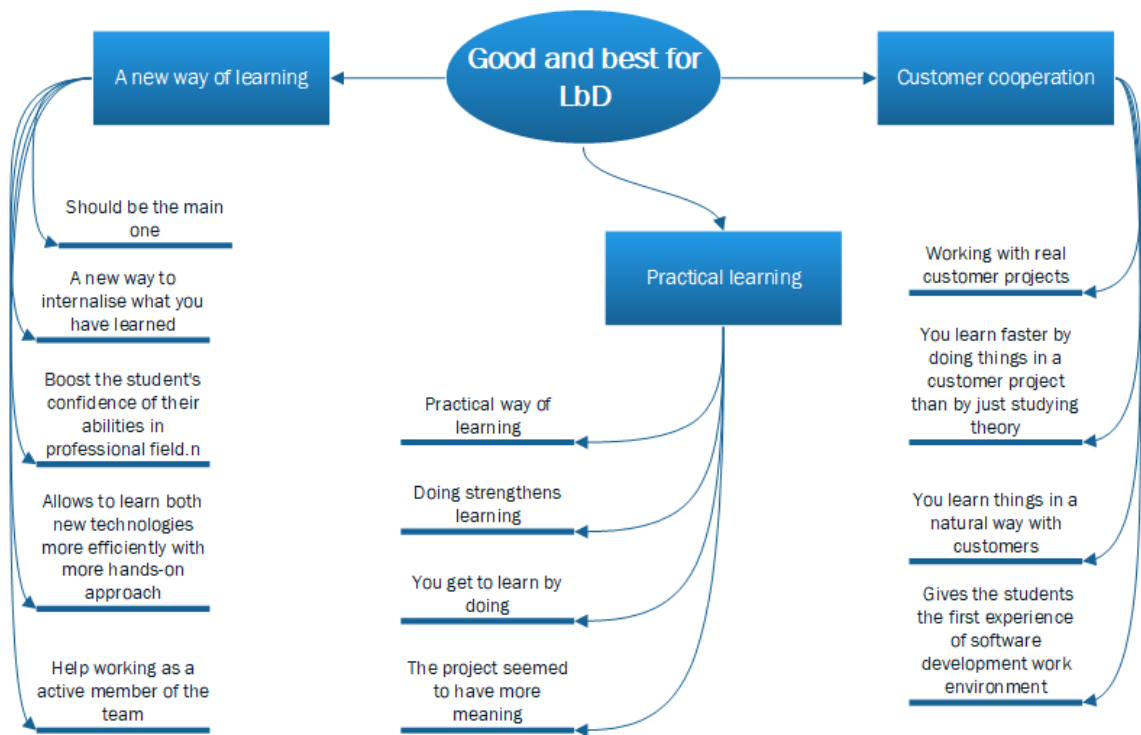
Figure 102: Good and best aspects of LbD model in the opinion of Haaga-Helia students

Students' answers to question 20 *(What weaknesses do you see in the LbD-based study?)* were also classified using data-based content analysis, and, based on that, the answers were classified into four categories: project clients, learning methods, teamwork and students. Figure 103 shows that weaknesses related to project clients may be because the client is not sufficiently committed to cooperation or the documentation is limited. Weaknesses related to learning methods may be due to some students preferring a more theoretical way of learning. It was seen that teamwork could sometimes be complex, especially if there were a weak composition within the team. The fact that the LbD model is not necessarily suitable for all students was also seen as a weakness. Some students can become discouraged because the LbD requires a lot of passion and self-initiated work. It can also be a problem if there are not enough resources available.
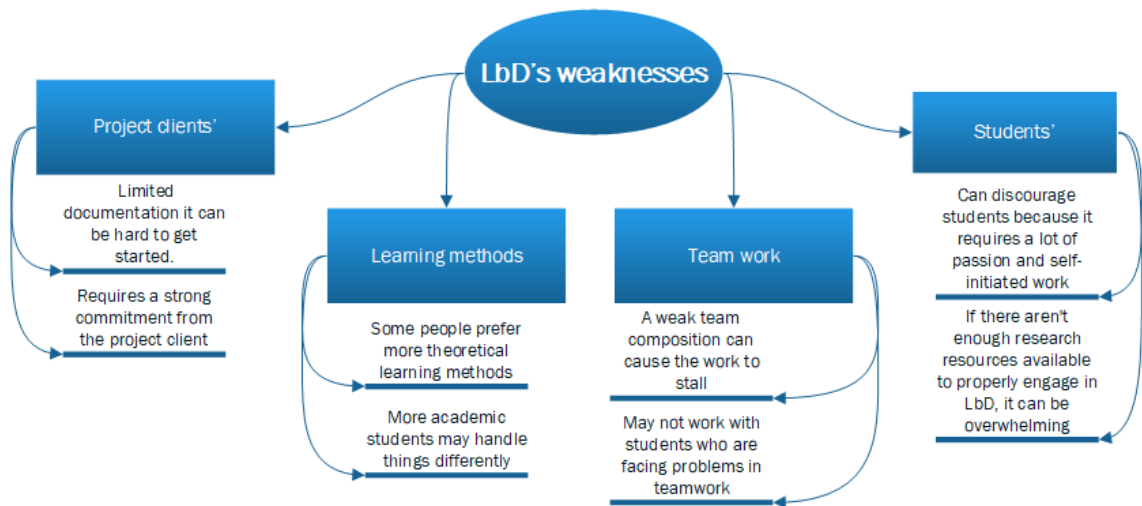
Figure 103: LbD's weaknesses in the opinion of Haaga-Helia students

In question 21 *(How do you think the LbD Action Model should be developed?),* the students were asked how they thought the LbD model should be developed. Six of the thirteen students did not answer this question, and one had no ideas. One of the students thought getting more peer support and creating a community where students could study things together would be good. In addition to project work, one student wanted to practice some basics or learn something new together. Three students needed more familiarisation and literature about LbD. One student thought the current direction was good.

In question 22 *(What kind of learning situation do you think is the best suited for the LbD Action Model?)*, the students were asked what kind of study situations they thought the LbD model best suited. To this question, the students answered that LbD is well suited to client projects in students' final year studies, where client projects are carried out. The students also saw LbD as a good fit for practising programming, especially if they could practice it simultaneously. One student answered: *"The best situation where LbD fits is when the customer project has a clear goal, but you are not sure how to approach it correctly, i.e. how to put the pieces together. This allows the user to understand better problem-solving in the future"* (Haaga-Helia, student 2).

4.4.6   Project Client Experience

Research data was also collected from the project clients who participated in the study module to obtain information from all parties involved in the study module implementation according to the LbD model. There were project clients from four different organisations;

everyone had a different project, and their needs varied. Three project clients participated in the research, and the researcher introduced them to the principles of LbD and went through the research questions the clients had received in advance. At the start of the study module, the clients went through the topics of the projects with their student groups, after which they jointly agreed on work methods, schedules, and tools to be used.

Haaga-Helia's students were divided into four groups, all of whom had their project in which they were involved. There were 11 interview questions for project clients (Appendix D). The project clients were interviewed remotely, after which the interviews were transcribed for analysis. Data-based content and narrative analysis were used to analyse the research results.

Table 16 shows the customers' classified answers to question 1. The answers were categorised into weak, satisfactory, well and excellent. All Haaga-Helia project clients estimated that students succeeded well in the projects.

Table 16: Haaga-Helia project clients' assessment of the projects' results

Haaga-Helia projects'	Weak	Satisfactory	Well	Excellent
Client 1			X	
Client 2			X	
Client 3			X	

Regarding question 2 (*How well do you think the cooperation between students and teachers worked?*), the project's clients did not have much visibility, but they felt it went well and was positive and immediate. Question 3 *(Did everyone have clear roles during the project?),* authentic answers are as follows. *"To some extent, the roles were agreed upon at the beginning of the project, but they became clearer as the project progressed"* (Haaga-Helia, client 1). *"Roles were intentionally changed during the project, but yes, they were quite clear"* (Haaga-Helia, client 2). *"The roles became clearer along the way. At the beginning, there was a bit of ambiguity, also on the client's side".* (Haaga-Helia, client 3).

Question 4 *(Were the project goals mutually agreed upon, and were they clear?)*, the project clients answered: *"Yes, the goals were clear, and the goals were agreed upon in writing"* (Haaga-Helia, client 1). *"Yes, yes, they were clear, but the goals were not very*

precisely defined at the beginning; they became clearer as the project progressed" (Haaga-Helia, client 2). *"At the beginning, our own goals were a bit unclear, but they became clearer along the way"* (Haaga-Helia, client 3).

To question 5 *(How well did the practical matters related to the project go?)*, all project clients answered that the practical matters went well, there were no significant problems, and the use of all tools went smoothly. To question 6 *(Were there any challenges or problems during the project, and if so, were they resolved, and if so, how?)*, one customer answered that there were some technical challenges, but they were solved well. According to other customers, the only challenge was that some students dropped out, slightly changing their roles. One customer said they had some minor problems with the schedule, but everything was resolved.

Questions 7 *(How well were the goals achieved?)* and 8 *(How beneficial was the result of the project for your organisation?)* are closely related, and the answers to them were very similar, so the answers are presented here combined. The answers to questions 7 and 8 are also relatively consistent with how they evaluate the students' success in the projects. Client 1 replied that the goals were achieved quite well, and only a few small things were missing. Client 1 thought that the project's output was useful, but it still needed to be further developed because they were not yet ready to put it into use. Client 2 thought the goals were achieved well, and the students gained useful new information. Client 2 also estimated that the project's outcome would likely benefit them, but their innovation unit continuously evaluated all new products that came into production. Client 3 also thought that the students achieved the project's goals well, but due to the client's schedule challenges, not all goals were achieved during the study module. However, Client 3 stated that this was not the reason for the students. Client 3 estimated that the project's outputs could be used in similar projects, and the development would continue.

Another representative of the project's client 1 said he did not know LbD before, while another said he had participated in a similar study module during his studies. Client 2 answered that he only knew the LbD model to the extent that it was discussed with him at the start of the study module. The representatives of Client 3 answered that they were unfamiliar with the LbD model.

The authentic answers for question 11 *(What do you think about collaboration according to the LbD model, and do you think it is suitable for such student customer projects?)* were: *"Yes, we think it suits well and certainly a meaningful way for students to learn*

when they get to do customer projects" (Haaga-Helia, client 1). *"Yes, I feel that this is a good way"* (Haaga-Helia, client 2): *"It is suitable if the project is suitable and the schedules can also be arranged to suit"* (Haaga-Helia, client 3)*.*

According to the project clients, the LbD model is well suited for such projects implemented in cooperation with the client. LbD helps students deepen what they have learned in practice. In addition, students can already get to know real-life projects during their studies. However, LbD pedagogy requires independent work, initiative and good interaction skills, but these are skills students can learn at the same time.

4.4.7   Reflection

The fourth research cycle was carried out in Haaga-Helia. Haaga-Helia's pedagogy staff was interviewed to get information about Haaga-Helia's pedagogical background factors. The answers of Haaga-Helia's pedagogy staff have been analysed using narrative analysis since there was only one respondent. According to the pedagogy staff at Haaga-Helia, several pedagogical methods are used. Lecturers can use the pedagogical model they want with the study modules. Haaga-Helia's pedagogy staff noted that the LbD model used at Laurea is also very familiar to Haaga-Helia. Haaga-Helia also has a vocational teacher training college; students can learn about different pedagogical models, including LbD. Haaga-Helia's pedagogy staff said that Haaga-Helia's master's degree mainly uses an exploratory and developmental learning model. According to the pedagogy staff, there is no obstacle to using LbD in Haaga-Helia, and many lecturers probably use it there, too. However, at Haaga-Helia, there is not only one pedagogical model which has been chosen, but the lecturers have been given the freedom to use the model they deem best for each study module. The pedagogy staff also does not see any cultural or social obstacles to using the LbD model, but if a model were to be adopted as the primary pedagogical model, it would require that the organisation's structures and processes support it. Haaga-Helia has a strong network with companies called a partner model. A strong network with companies makes it possible to use the LbD model in teaching. According to the pedagogy staff, LbD is unsuitable for all teaching but best suited to working life-oriented studies that include exploratory and developmental problem-solving.

Based on the analysis of the lecturers' answers, LbD fits well as a teaching and learning method at Haaga-Helia and the project-based study module of computer science that is the subject of the study. One lecturer replied that, in his opinion, it is the only right way

for such a working life-oriented study module. During the study module, the lecturers acted in several roles, which is typical in LbD pedagogy. Haaga-Helia's lecturers were unfamiliar with the name LbD, but development-based learning was familiar to everyone. The lecturers saw many strengths in LbD. Strengths included the students' working-life cooperation during the studies, the implementation of real working-life projects, and the increase in the tolerance of uncertainty during the project. The lecturers saw it as a weakness and a threat that if all parties are not adequately committed to the project, it can cause problems. It can also cause problems if the students do not have sufficient basic knowledge to perform the projects. Opportunities were seen to be participation in real working-life projects, the deepening of students' knowledge of the best practices of companies and understanding what skills are needed when moving into working life.

54.2% of students responded to the students' survey. The response rate was not as good as Laurea's students, but more than half of the participants answered the survey. The students' answers provided valuable information about how the students experienced the use of LbD in Haaga-Helia. Students' competence increased in each competence area. The students' competence increased the most in the competence areas 'co-development and service design skills' (1.23 %), 'own skills and the skills for continuous learning' (1.00 %), 'customer understanding and customer knowledge' (0.92 %) and 'sales skills' (0.92%). Competence grew the least in the competence areas 'ethical engagement in a global media and technology environment' (0.08%), 'equality and justice' (0.15%), 'ecological, social and economic sustainable development' (0.15%) and 'entity management and systematics' (0.15%). In the competence area, 'technology and digital competence', competence increased by 0.85%. At the end of the study, the level of competence in this area was the highest, i.e. 3.92%.

The students also learned much new technology during the study module, and their teamwork and personal skills developed. In addition, students learned to work with the customer and to understand the customer's requirements and needs better. During the study module, students also acted in many different roles, as is part of the principles of LbD. Three Haaga-Helia students answered that they did not understand what LbD meant in practice, but all these students were absent when the LbD orientation was held. In the future, it must be ensured that all students participating in the study module know the LbD principles and that everyone understands what it means. Only one student thought that LbD was not suitable for computer science studies, nor for the study module that was the subject of the research. The student who gave this answer was one of the

respondents who did not understand the meaning of LbD. According to the students, the best thing about LbD is a new way of learning, a practical and meaningful way of working and working in cooperation with the client. According to the students, a weakness can be if the client is not committed enough or if there is not enough documentation available at the beginning of the project. Challenges can also be caused by students who do not commit to teamwork or if there is a bad team spirit. Students also answered that LbD is not necessarily suitable for students used to more theoretical and academic studies. It may also be a problem if the students are not used to working independently or if insufficient resources are available.

According to all project clients who participated in Haaga-Helia's study module, the projects were successful. The project's clients were not familiar with the LbD model before, but they thought it to be a meaningful way of learning and well-suited to studies that included a client project. According to the customers, the roles were clear at the beginning of the project, but some changes took place during the project. The roles also became clearer as the project progressed. According to the customers, the project's goals were clear and mutually agreed upon at the beginning of the project. Since the development took place with the help of an agile method, the goals also changed somewhat during the project. According to the customers, the cooperation and practical matters went well, and the outputs were helpful from the customer's point of view. Some project outputs are such that they can be taken to production after further development. According to customers, the so-called proof of concept tasks best suit such projects in collaboration with students.

4.5 Conclusions

This action research aimed to determine the suitability of LbD for computer science students' project-based studies in working life cooperation. The research was conducted in four cycles from 2019 to 2022. The research was started in Finland at Laurea, where the LbD action model was developed. In the first phase of the research, information about the backgrounds of LbD was collected from the literature and Laurea's pedagogical staff. The mapping of the background factors was an essential step in the research because action research was chosen as the research strategy. In action research, knowing the initial situation is vital because its goal is to develop and renew the organisation's operating methods.

According to background theory and the pedagogy staff at Laurea, three main reasons can be identified as being behind the development of LbD. The first reason was the 2003 legal reform in Finland, where Universities of Applied Sciences were given three tasks: regional development, RDI activities and teaching. The second underlying reason was a change in the pedagogical paradigm, and the third was working life cooperation and the development of working life. Together, these contributed to Laurea developing a new pedagogical model named LbD.

After discovering the background factors, the next step was implementing the planned research in Laurea's Service Design Study Module in the fall of 2019. Laurea's students were surveyed, and lecturers and project clients participated in thematic interviews. The results of these studies are presented in Chapter 4 in sections 4.2.5, 4.2.6, 4.2.7 and 4.2.8.

According to the plan, the following research cycle was carried out at RGU in the spring/summer of 2020. To find out the pedagogical background of RGU, one RGU pedagogy staff was interviewed. After this, a student survey was carried out at RGU. In addition, one study module lecturer and project client were interviewed. Only one of RGU's 12 students answered the survey, so the research plan was changed, and the researcher decided to implement a new research cycle at RGU in autumn 2021. The student surveys were carried out using Google forms (Appendix C). All students in the autumn of 2021 answered the survey, but only five students participated in the study module. The research cycle two and three results carried out by RGU's pedagogical staff, lecturer and project client at RGU in spring/summer 2020 and autumn 2021 have been compiled and discussed in Chapter 4, sections 4.2.5, 4.2.6, 4.2.7 and 4.2.8.

After cycle three, the researcher changed the plan because more research material was wanted. One more University of Applied Sciences, Haaga-Helia, from Finland, was included as a research target.

The fourth research cycle was carried out in the spring of 2022 in Haaga-Helia. There was also one Haaga-Helia pedagogy staff who was interviewed. The pedagogy staff interview was essential to discovering Haaga-Helia's pedagogical background. Haaga-Helia's students participated in the same survey as in previous research cycles. Haaga-Helia's lecturers and project clients participated in a thematic interview. The results of the fourth research cycle have been discussed in Chapter 4 in sections 4.3.5, 4.3.6, 4.4.7 and 4.3.8.

It is typical for action research to change as the research progresses, as in this case. The research plan was changed as the research progressed in the reflection phase of the research cycle. At RGU, two research cycles were carried out in two consecutive years because only one student answered a spring/summer 2020 survey. During the reflection phase of the third research cycle, the research plan was changed once again, and a new research target, Haaga-Helia, was included in the research because there was a need to get even more research material from the students. The research perspective also changed slightly simultaneously because Laurea and Haaga-Helia are both Finnish Universities of Applied Sciences, so that a better comparison can be made regarding them. RGU's role in the research is still important because the study also aims to get information on whether LbD would be suitable as a pedagogical model in a context other than the Finnish University of Applied Sciences.

Chapter 5 compares and summarises the participants from different institutions. A comparison cannot be made directly for all the entities that participated in the study because the background factors in all institutions are different. The comparison has been made of selected meaningful and suitable items to compare with each other.

Chapter 5:   Discussion

5.1 Key Findings

In this chapter, the results of all three higher education institutions will be compiled and compared where possible. The background factors of all three institutions are slightly different, so a direct comparison cannot be made, but some individual comparisons and summaries can be made.

Qualitative research focuses on the meanings of people's actions or the implications they give to their inner experiences. The people whose actions or experiences are studied are vital to understanding these meanings. In qualitative research, the reliability of research data is essential, and the researcher's reflexivity affects the analysis. Therefore, the researchers must be clear about their pre-commitments and preconceptions related to the research and the matter under study, and the researcher must ask and tell about them. In this study, the students' qualitative research material was collected from the students' free-form answers to the questionnaire. The students' survey free-form answers have been carefully recorded, and the research results have presented summaries and direct quotes from the students' answers. Direct quotations increase research results' reliability and can be checked afterwards. The survey was conducted using GoogleForms, and all survey results are genuine and authentic student responses derived directly from GoogleForms. All students' answers have also been kept as original answers without changing them. The research results contain samples of students' authentic answers. The student survey was carried out in three higher education institutions, and although the starting points and sample sizes of the target groups were different, similarities can also be seen in the results, which increases the reliability of the research. In the study at Laurea, the researcher was a lecturer in the study module. Still, concerning the study, the researcher ensured that the students' answers could not be identified to any specific student, but the information was analysed entirely anonymously. In the same way, the research materials of RGU and Haaga-Helia students have been analysed anonymously. The researcher did not previously know the students of RGU and Haaga-Helia personally because the researcher did not work as a lecturer in these study modules.

Through interviews, research data was collected from pedagogy staff, lecturers and project clients. For all participants in the study, the interview questions were sent in advance, and participants were able to prepare for them in advance. During the interviews, the researcher made sure that the researcher's opinions or perceptions did not influence the interviewees' answers. All interviews conducted in the study have been recorded and transcribed. Both the recorded interview and the transcribed text have been carefully recorded. The interview material is, therefore, utterly authentic research material according to the answers to be studied. The recordings can be listened to afterwards and compared with the transcribed text if necessary. The interviews were transcribed in the analysis phase of the research results, and the interviewees' answers were compiled and classified. Based on the classifications, similar answers were gathered into their category without changing their meaning. The researcher has brought out the thoughts and opinions of the interviewees as they have given them without letting the researcher's interpretations influence them. Reliability is also increased because some interviewees' answers are presented as direct quotes in the research results. In addition, the reliability of the research results is also increased by the fact that the research was carried out in three higher education institutes, and there is a lot of similarity in the responses of the lecturers and the project clients. In qualitative research, the researcher does not have to be wholly outside and neutral but must strive to act as objectively as possible, morally correct, and according to good research practice. In this study, the researcher has actively and consciously acted throughout the research so that the researcher's attitudes and beliefs do not affect the analysis too much. The researcher's relationship with the interviewees was based on mutual trust. The researcher knew some interviewees better than others, but all were treated impartially and confidentially, and their anonymity was ensured in the research.

5.2 Staff Experience

Staff from all three institutions were involved. In the study, thematic interviews were conducted with both pedagogy staff and lecturers. The findings of pedagogy staff and lecturers are described in more detail in the following subsections, 5.2.1 and 5.2.2.

5.2.1   Experience of the Pedagogy Staff

As such, the findings of pedagogy staff cannot be directly compared because LbD was developed at Laurea. The interview with Laurea's pedagogy staff aimed to get more information about the backgrounds of LbD, the reasons for its implementation at Laurea

and the experiences of those using it. The interviews with pedagogy staff from RGU and Haaga-Helia aimed to obtain background information about the pedagogical models used in these institutions. Regarding the RGU and Haaga-Helia, the study sought the pedagogy staff's answers on whether LbD would be suitable as a pedagogical model. In addition, the pedagogy staff from the RGU and Haaga-Helia wanted to know which studies and what kinds of situations LbD was best suited for and whether there would be any obstacles to introducing LbD in these institutions.

The answers of RGU and Haaga-Helia pedagogy staff about which studies and what kind of situations LbD fitted were consistent. The pedagogy staff from both institutions thought LbD is well suited to working life-oriented project-based studies but perhaps not so well with more theoretical subjects. The answers of Laurea's pedagogy staff were also very much in line with these answers. According to RGU's pedagogy staff, LbD could be well suited as one of the pedagogical methods there, but it would require strong management and staff commitment. In addition, it would require systematic coordination of business cooperation to include enough suitable client projects for the study modules. According to Haaga-Helia's pedagogy staff, LbD can be used as a pedagogical method in Haaga-Helia, and its use has no obstacles. Haaga-Helia already has a good business cooperation model, making getting suitable client projects easy. However, Haaga-Helia does not want to choose only one primary pedagogical method; the lecturers can use the one that best suits their study modules. Adopting one model as the primary method would require strong management and staff commitment and sufficient training and orientation.

5.2.2   Lecturers Experience

Comparing the results of Laurea, RGU and Haaga-Helia lecturers can be done somewhat better than comparing pedagogy staff answers. For all three institutions, the students were computer science students, although the study modules differed in all places. However, all study modules involved clients' IT projects, and agile methods were used in the software projects.

The lecturers' opinions on how well they think LbD fits into computer science studies and the study module they were teaching are summarised in Table 17. Table 17 shows that

everyone thinks it fits at least well, and three lecturers thought it fits perfectly in the study module they were teaching.

Table 17: Lecturers' opinion on how well LbD fits their areas of studies

Question		Fits well	Fits very well	Fits perfectly
How well do you think the LbD model fits in your organisation?	Laurea lecturer 1		X	
	Laurea lecturer 2			X
	Laurea lecturer 3	X		
	RGU lecturer		X	
	Haaga-Helia lecturer 1		X	
	Haaga-Helia lecturer 2		X	
	Haaga-Helia lecturer 3		X	
	Haaga-Helia lecturer 4		X	
How well do you think LbD fit into the study module you teach?	Laurea lecturer 1		X	
	Laurea lecturer 2			X
	Laurea lecturer 3	X		
	RGU lecturer		X	
	Haaga-Helia lecturer 1			X
	Haaga-Helia lecturer 2			X
	Haaga-Helia lecturer 3		X	
	Haaga-Helia lecturer 4		X	

The lecturers' answers to questions 7, 8, 9 and 10 (Appendix B) have been compiled into a SWOT analysis (Figure 104). Among other things, the strengths were a better understanding of working life, better motivation of students, working life cooperation during studies and cooperation between all parties. The possibilities were in the same direction; for example, students' connection to working life, the deepening of competence in customer projects, learning new skills needed in working life, challenging students to do their best and students' better understanding of how they should learn. The possibility of misunderstanding was seen as a threat if LbD was not well known. In addition, it was seen as a threat that if all parties do not commit sufficiently well to the project, then the goals will not be achieved. If students have poor motivation, that can also cause problems. If the projects fail, a possible bad reputation for the institution is also seen as one threat. Weaknesses are seen if the participants do not have sufficient knowledge of LbD principles, whereby results might not meet expectations. The commitment of all parties and a precise definition of the evaluation criteria are needed. The students also need to know how their competencies are evaluated. A good and concrete tool for using

LbD was hoped for, which could ensure a sufficient understanding of the LbD principles by all parties.

SWOT ANALYSIS

STRENGTHS
- Students' and lecturers' better understanding and knowledge of working life and students' better motivation
- Working life contacts during studies
- Brings competitiveness compared to others
- Puts pressure on everyone to perform as well as possible
- Teaches responsibility and independence
- Requires cooperation and professionalism from all stakeholders
- Work life-oriented and development based
- The students learn to tolerate uncertainty and notice that the project can nevertheless be successful

WEAKNESSES
- Needs for more precise instructions and lack of practical tools for participants
- Needs for well-understood evaluation criteria
- Need to understand LbD pedagogy and use it correctly. Otherwise, the results are not useful
- If all parties are not committed, this might cause problems
- If students do not have sufficient prerequisites or skills to perform the task given to them, it can cause problems

OPPORTUNITIES
- Students' better connection with working life
- Deepening students' skills in clients' projects
- Allow real working-life projects
- Students' learn new things which needed in working life
- Help students better understand how they should learn
- Challenge students to do their best with others
- Get students a better understanding of the company's good practices
- Uses professional procedures that students need when they are transitioning to working life

THREATS
- Misunderstanding, if the principles of LbD are not known
- Challenge how to ensure all competence goals
- A lousy reputation for education institutions if the project goals are not achieved and clients are not satisfied
- Poor customer engagement
- Poor motivation of students
- If only the LbD model is used, it may not be a good thing
- Poor commitment

Figure 104: Combined SWOT Analysis

As improvement proposals, the lecturers hoped for clear and reasonable instructions for each party, i.e. lecturers, students and project clients. The instructions should be very concrete, practical, and easy to use. Instructions were requested for different situations because client projects are often very different, and the study modules and subjects differ. Examples of good practice cases and best practices were also requested.

The lecturers thought that the skills of all students developed well during the study module. The skills of some active students developed excellently. The lecturers answered that most project clients were also satisfied with the student's results. A few lecturers answered that the students' competence could have developed even better in some projects, but they were still satisfied with the development of the student's competence as a whole. The students' skills developed in many competence areas, which was positive in the opinion of the lecturers.

5.3 Students Experience

Based on the students' self-assessment in all three higher education institutions, the competence increased the most in the competence area 'co-development and service design skills'. The research results of all three institutions' students in this competence area are statistically significant. The students' competence did not increase so much in the competence area 'technology and digital competence', but in all three institutions, the level of competence in that area was the highest at the end of the study module. The research results of RGU students in this competence area were not statistically significant, but it is also affected by the fact that the number of respondents was smaller than Laurea and Haaga-Helia.

There were many differences in the research results of Laurea, RGU and Haaga-Helia students. The research result is influenced by the fact that the number of students who responded to the survey at RGU and Haaga-Helia was smaller than at Laurea. At Laurea, 29 students answered the survey. There were only six respondents in RGU and thirteen in Haaga-Helia. The smaller sample size affects the statistical significance of the results in the t-test and p-value. As the sample size increases, smaller and smaller effect sizes and differences reach statistical significance, while a small sample size has the opposite effect. Therefore, the results of Laurea, RGU and Haaga-Helia cannot be directly compared to each other as such.

Statistically significant results all three higher education institutions were statistically significant in the following areas: 'life management and well-being'; 'critical knowledge acquisition, evaluation and utilisation'; 'analytical thinking and argumentation'; 'co-development and service design skills'; and 'impressive oral and written communication skills'. The results of Laurea's students' self-assessment questionnaire were statistically significant in all other answers except for the 'ethics and empathy'. RGU students' results were statistically significant in the 'entity management and systematics'. In other questions, the results of RGU students were not statistically significant. The results of Haaga-Helia's students' answers were statistically significant in all other sub-areas but not in 'entity management and systematics'; 'understanding cultural meanings'; 'ethical engagement in a global media and technology environment'; 'ethics and empathy'; 'equality and justice'; and 'ecological, social and economic sustainable development'.

The different background factors of the three higher education institutions under study also impacted the results. The LbD model was already familiar to most of Laurea's

students, while at RGU, it was a new pedagogical method. Haaga-Helia's students were unfamiliar with LbD as a concept, even though the same type of development-based learning has been used in their teaching. The fact that RGU's study modules were implemented as online learning due to COVID-19 also impacted the research results.

Even though the background factors were different, the competence of all students developed in many different competence areas in all three higher educational institutions. In addition to technical skills, the students' competence was developed in soft skills, such as teamwork, communication skills, customer understanding and personal competence. Most students also believed that LbD fits well with computer science studies and the study module in which they participated. According to some students, the best thing about LbD pedagogy is that it allows students to participate in working life projects during their studies, which can deepen their knowledge of real customer projects. A few students thought that LbD was not a good pedagogical model and that more traditional teaching methods would have been better. Indeed, LbD requires students to be independent and take a more active approach to developing their skills.

5.4 Project Clients Experience

All institutions had a different number of clients and projects. The projects were all slightly different, but all were concerned with software development. All project clients were satisfied with the work done by the students, and the project outputs were also good or satisfactory. According to all project clients, the LbD model is very suitable for such projects in cooperation with students. There were no significant problems during the projects, and even minor problems were solved during the project. Some customers reported minor scheduling issues, but the reasons were due to the customer and not the students. A few project clients would have liked to have received additional information about students' previous competence before the project started to understand better what they could expect from the students and their level of competence, for example, in different technologies.

One essential issue in the LbD is the development of working life; students usually have many fresh ideas for development. In the opinion of a few project clients, the best thing about collaborating with students was that they got a new perspective on many things and a lot of new ideas that they would not have thought of themselves. Some customers regretted not having enough time to be involved in the project, which made the project's progress somewhat tricky.

5.5 Discussion

This study's first research question (Q1) was, *'Why and for what purpose has the LbD model been developed?'*. This question has been answered in the background theory in Chapter 2 and Laurea's pedagogy staff answers in Chapter 4.

Research question Q2 seeks an answer to the question about the suitability of LbD for project-based studies in computer science at higher education institutions. The lecturers and computer science students of all three higher education institutions have sought answers to this question. The responses of lecturers and students have been analysed in Chapter 4. A summary of the findings is located in Chapter 6.

Project clients' experiences of cooperation according to the LbD model (research question Q3) have been collected from clients through thematic interviews, and answers to these can be found in Chapter 4. Answers to research question Q4 have been sought mainly from RGU and Haaga-Helia pedagogy staff. The pedagogy staff answers can be found in Chapter 4.

The last research question (Q5) aimed to collect information on improving the LbD action model. Answers to this question have been collected from all participants' responses in the study. Some of the improvements have already begun as a part of the continuous development of LbD. The research has also found many things that still need to be developed in the LbD model. Most improvement needs relate to more precise and concrete instructions and a new practical tool with instructions for lecturers, students and project clients. Developing a new practical tool has already started, but it is still in the planning phase.

Chapter 6:   Conclusions

This thesis aimed to study the use of LbD in computer science students' project-based studies in collaboration with project clients. This chapter begins by summarising the findings of this thesis and how these answer the research questions presented in Chapter 1. Second, it shows the implications of the findings for LbD and its development work. Third, it discusses the main strengths and limitations of the study. In addition, this chapter suggests opportunities for future work.

6.1 Summary of Findings

The thesis results are considered and reviewed through the original research questions. Each research question is considered in the context of the related knowledge.

Chapters 2 and 4 answer the first research question, *"Why and for what purpose has the LbD model been developed?"*. Answers to this question have been searched for and found in the literature, Chapter 2, and in interviews with Laurea's pedagogical staff, Chapter 4. In summary of the research findings, it can be stated that there were three main reasons behind the development of the LbD action model: the reform of the law in Finnish higher education, a change in the pedagogical paradigm, and working life cooperation and working life development.

The second research question was, *"Is the LbD action model a suitable pedagogical method for higher education computing students' project-oriented studies?"*. The answers related to this question have been discussed in Chapters 4 and 5. According to pedagogy staff, LbD is a suitable pedagogical method for working life-oriented project-based studies in higher education institutions. Almost all students also think the LbD model suits computer science students' project-based studies. Only a few students believe the LbD model is not appropriate. Based on the students' self-assessment, their skills developed well in many areas. The students' competencies also developed in many competence areas that were not taught in the study modules that were the subject of the study or were not mentioned in the study module competence objectives. According to all lecturers, LbD is ideally suited to project-based studies carried out in cooperation with working life, and it is a meaningful way from the students' point of view to learn and deepen their learning in practice. Most lecturers think LbD is unsuitable for all learning, such as theoretical subjects. Some lecturers think that LbD is not necessarily suitable for the studies of first-year students either, but that also depends on the context in which it

is used. According to the lecturers, LbD is best suited to such study modules where students have already learned the basic skills and where the skills are deepened in connection with working life in real customer projects.

The third research question was, *"What are the project clients' experiences of LbD model collaboration?".* The project clients' answers have been discussed in Chapters 4 and 5. The project clients' experiences of cooperation, according to the LbD model in the project work related to the study modules, were positive. The project clients felt that the students performed well in the projects, and most of the project outputs were helpful and gave a new perspective.

The fourth research question was, *"Can the LbD action model be implemented successfully in a different institution?".* Answers to this question were sought from pedagogy staff and have been discussed in Chapters 4 and 5. At Laurea, the LbD model has been chosen as the primary pedagogical model, and it has required and requires the entire organisation's commitment and ongoing familiarisation. According to the RGU pedagogy staff, a similar pedagogical model is used at RGU but does not have the same name. At RGU, several pedagogy models are used, and there is no desire to limit these to just one primary model. However, according to the RGU pedagogy staff, the LbD model could also be the primary pedagogical model at RGU, but it would require a firm commitment from the entire organisation and good training, induction and a mentoring model. The biggest obstacle to introducing the LbD model could be the UK's precisely defined academic evaluation criteria. According to Haaga-Helia's pedagogy staff, there is no obstacle to using LbD at Haaga-Helia, but there is no desire to introduce only one primary pedagogical model, with lecturers free to choose the most suitable one.

The study's last and most important research question was, *"What improvement needs are seen in the LbD action model?".* Answers related to this question have been collected from all parties involved in the research. Answers to this question have been discussed in Chapters 4 and 5. Laurea's pedagogy staff had many suggestions regarding improving LbD, especially its use and familiarisation. Many things related to these issues have already been done during this research. The year 2020 was named the LbD theme year, and during 2020 at Laurea, LbD was raised again as an essential part of Laurea's strategy and through this, knowledge was widely shared throughout the organisation. LbD competence badges were also introduced in Laurea, through which LbD pedagogy staff received a certificate. The students hoped for a little more in-depth familiarisation with the LbD model to understand the ideology of LbD better. Many good development

ideas for the LbD model were obtained from the answers of the lecturers. What was most desirable was a good concrete and practical guide and tool to support learning and use of LbD. The lecturers needed continuous training, familiarisation, mentoring and sharing of experiences. The research also yielded a lot of ideas from project clients regarding the improvements of the LbD model and the familiarisation of project clients.

6.2 Implications of Results

The study aims to know whether LbD is a suitable pedagogical method for higher education institutions' computer science students' project-oriented studies. Based on the research results, it can be concluded that LbD is well-suited for this purpose. The research question was whether the LbD model could be successfully implemented in different higher education institutions. Based on the research results, answers were received that implementing LbD in the organisation requires strong support from the organisation's management and staff. Everyone must know the LbD model well and be committed to its implementation. Using LbD also requires that the organisation is progressive and has a competence-based curriculum. In addition, using LbD requires strong business cooperation from the organisation to get client projects suitable for the subject being studied for the study modules. Implementing LbD requires the organisation to have a well-organised model for managing business cooperation. The conclusion that can be drawn from this is that the LbD model can indeed be implemented in different higher education institutions, but its implementation requires much work from the entire organisation and a solid commitment. However, the LbD model does not have to be adopted as the primary pedagogical method in the organisation, but it can be used as one pedagogical model along with others if desired. In this case too, using LbD requires the lecturers who use it to be well acquainted with the LbD model, and for that, it would be good to have excellent and clear instructions and support from the organisation's pedagogical staff. Using LbD in a higher education context other than in Laurea in Finland is possible, but in that case, the organisation must consider many factors related to the cultural and academic background to use LbD successfully.

In chapter 2.1.4, a background on socio-cultural factors essential in higher education studies has been discussed. This study's sociocultural factors are insignificant, although they could be important for an individual student. Foreign exchange students participated in Laurea's study module, whose adaptation to the new cultural and academic environment was tried to ensure that each project group had at least one foreign exchange student and Finnish students to integrate smoothly into the group. Haaga-

Helia included foreign degree students who had already studied in Finland for a few years, so their sociocultural skills were already good. In the Finnish higher education world, all students are treated as equals, and their social class and background do not define them in any way. In Finland, higher education is free for everyone, so economic factors also do not affect the possibility of studying. The Finnish education system is also equal in primary education; thus, everyone should have equal opportunities to apply to higher education. The UK education system is different from Finland's. In England, higher education is paid, but in Scotland, where RGU is located, studying is free for Scots. Previously, before Brexit, studying in Scotland was also free for EU citizens, excluding English citizens.

Students' networks and social capital can influence their opportunities for employment or internships. Laurea and Haaga-Helia have an extensive business partner network through which many students can already network with potential employer companies during their studies. A good business partner network especially helps students who did not have good networks before studying. The Study Module at RGU, which is the subject of the study, was aimed at a group of people studying while working, and therefore they already had their networks. Teachers' biases can also affect student motivation, engagement and performance, but this study did not find that teachers had any biases that affected these. In an interview, the RGU pedagogy staff said that sociocultural factors can play a role in getting an internship or employment after graduation because not all students necessarily have good networks. The RGU pedagogy staff stated that the LbD model could be good in solving this problem because students already cooperate with customers during their studies. It helps students to create a network with customers and can help them find employment more easily after graduation.

One of the goals of this research was to get information from different parties, pedagogy staff, lecturers, students and project clients on what kind of development needs they think LbD has. LbD needs continuous development, like other pedagogical models, to keep it up to date. The most crucial finding in this study was that a clear and practical guide and tool are needed to introduce and use LbD, which makes it easier for all stakeholders to understand their role in pedagogy according to the LbD model. Using LbD in an organisation also requires the entire organisation's commitment and continuous training and familiarisation. Using a mentoring model in the early stages of LbD was a proven method, and it would have been good to have had it continuously.

6.3 Limitations of Work

Although these three higher education institutions were involved in this research, many cycles and materials were collected from various sources. In addition, this thesis has some other limitations.

In Chapter 3, limitations related to the research strategy and the research methods are discussed. The research strategy is action research, which already brings limitations to the reliability of the research. The results of action research are not easily generalisable, reproducible or transferable, but that is not its real purpose. The purpose of action research is to develop the operating methods of the research object or organisation, and the situation constantly changes as the research progresses. In this case, one of the goals was to get information from three different higher education institutions about how LbD pedagogy should be improved and how the operating methods of the organisations that use it can be developed. The reliability of the research is increased by the fact that the initial situations are accurately described. This study describes the initial situations of all three higher education institutions so the reader understands the initial situation. Action research usually uses several different research methods to increase reliability. Using several methods is called triangulation. This study used a questionnaire and interviews to collect the research material. Data analysis methods for qualitative analysis have been used: material-based content analysis, narrative analysis, SWOT analysis, and mean and standard deviation for quantitative analysis.

The students' survey was implemented as a Google Forms online survey, and a limiting factor in the reliability of the answers is that the students answered the survey as a self-assessment. The reliability of the results is affected by how honestly the students have responded to the survey. The response rate of Laurea's students was high, and their responses provided a fairly comprehensive sample of students. At RGU, the survey was carried out twice because the first time, only one student out of twelve answered the survey. The second time, all students answered, but there were only five students at that time, so the number of students as a whole was relatively small. The students' response rate at Haaga-Helia was not as good as at Laurea, but it was still more than 50%. As such, the students' answers cannot be compared very well because the backgrounds of the students and all three higher education institutions are different. At Laurea, LbD has been used for a long time; therefore, LbD was already a familiar pedagogical method for many students. However, to improve the reliability of students' self-evaluation, lecturers and project clients have also been asked to evaluate the development of students' skills.

Pedagogy staff, lecturers and project clients were interviewed, and the reliability of their answers was also based on how honestly they answered the questions. However, the researcher had a slightly better opportunity to observe the respondents in interview situations and the thematic interview was used as the interview format, which was semi-structured. This format helped the researcher ask more detailed questions and allowed the respondents to answer the matter more broadly to obtain more information.

Despite the limitations, the research produced information and results aligned with its goals. The research also produced valuable information about how the LbD model and the organisation's internal operations should be developed and what kind of support staff need in using LbD.

6.4 Future Work

At Laurea, where the LbD model has been widely used since 2006, it is continually being developed. Some improvement proposals that emerged during the research have already been implemented at Laurea. One of LbD's improvement targets has been the changes brought by digitalisation to teaching and pedagogy in general. The changes brought about by digitalisation have been intensely involved in the development of LbD in recent years, and they are intensely involved in improving LbD all the time. COVID-19 significantly increased distance learning worldwide. The spread of distance learning and the increase in the number of its courses must also be considered in improving LbD.

6.4.1   Research Findings Implementation

Laurea published in August 2023 the pedagogical programme for 2023-2025 (Nurkka 2023; 'Pedagogical Programme 2023-2025' 2023). The themes and priorities for the program were chosen from Laurea's strategy, student feedback and the quality audits of the Finnish Education Evaluation Center (FINEEC). The pedagogical program describes and defines Laurea's approach to learning, teaching, competence development and the role of partners. The biggest beneficiary of the pedagogical program is the student, who acts as the leader of the learning process. Laurea's management wants the guidelines of the pedagogical program to be widely internalised throughout Laurea so that it guides the work of every Laurea employee.

Development-based learning, LbD, is Laurea's choice for individual and community learning and generating new knowledge. The role of a student is to be an active learner, experimenter, developer, and researcher both in working life and in the higher education

community. Learning environments are provided by Laurea's R&D projects, key partners and other working life partners. In various learning environments, the student learns critical thinking and applies researched knowledge to the needs of the developing working life and the renewal of society. The task of employees engaged in educational activities is to participate in the implementation of Laurea and educational-level pedagogical policies and choices in their work. To strengthen the student's functionality, the teacher/instructor recognizes his role as a supervisor, coach, promoter and team member in the student's learning process. All Laurea employees promote a communal, learning-friendly culture with their pedagogical solutions, which also increases the well-being of the personnel.

Instead of teaching processes, learning processes are planned at the implementation level. The learning process planning considers the students' backgrounds, skills and goals. Quality criteria are the basis for planning implementations. The teacher plans the course load and learning tasks, enabling student guidance and participation.

The pedagogical manuscript is the basis of the study implementation. The implementations are planned so that the learning process focuses on developing the skills described in the curriculum, including projects, tasks, materials and content. When planning implementations, the general, common working life skills defined by Laurea must also be considered. Competence-oriented assessment guides learning. The teacher's task is to plan a transparent evaluation process so that the evaluation and feedback are aimed at targeted competence and knowledge. In the learning process, the level of competence is assessed at the beginning, in the middle and at the end with the help of common assessment criteria and self-and peer assessment practices. The teacher's task is to guide students in self-assessment and peer assessment and receive feedback. The assessment uses the learning platform's evaluation tools in various ways. Using participatory methods strengthens the student's active role as a learner and supports the student's well-being.

As a rule, projects of key partners and RDI projects serve as learning environments in implementations according to the LbD model. Development work in LbD implementations can also be done with other partners. The teacher guides and, if necessary, helps working life partners evaluate and give feedback following Laurea's policies. Researched knowledge is applied to practice in all implementations, including knowledge produced in RDI projects. The digital content produced in the projects is utilised in the implementations.

As part of Laurea's pedagogical program, the findings of this study will also be included in the development of LbD. At Laurea, during the years 2023-2025, the role of LbD will be more widely considered at the entire organisation level. The pedagogical programme clarifies and unifies pedagogical thinking and management guidelines, and thus, the top management is also firmly committed to innovation work. The pedagogic programme also states the goals of teaching activities in practice, and it defines the way Laurea thinks about learning, teaching, skill development and the role of partners. The pedagogic program helps Laurea's lecturers more deeply internalise the meaning of LbD pedagogy and related practical actions. With this, lecturers can also better open the background of LbD pedagogy to partners. The partners' more profound understanding of LbD pedagogy improves cooperation and possibly also strengthens the partners' commitment. The LbD model is still the cornerstone of Laurea's pedagogy, where the student learns through work-oriented assignments. Laurea's pedagogic orientation is firmly student- and learning-centred, competence-based, and working-life oriented, with guidance and flexibility in the pedagogic programme. The pedagogic programme firmly guides the direction to become even more learner-centred, where learners are encouraged to be active and are increasingly involved in planning their learning process.

Research question 4 asked whether the LbD action model can be successfully implemented in other institutions. According to the research results, implementing LbD in other institutions is possible, but it requires a strong commitment from the entire organisation, an adaptation of operating models, sufficient training and orientation, and a robust business cooperation model.

6.4.2   Development of The New Practical Tool

Digitalisation enables flexible studying even better and has brought new methods to help develop skills. The learning and teaching methods used in innovation pedagogy activate the student and offer different ways of working to promote student skills development. LbD contains the same elements as innovation pedagogy, and one of the development areas of LbD is the utilisation of digitalisation even more in LbD pedagogy. Already in 2020, which was LbD's theme year, Laurea started developing the so-called Digi-LbD (Niinikoski and Marstio 2020).

Through the findings of this research, the idea arose to design and implement a new practical guide and tool to support working life-oriented project studies. Successful working life-oriented project studies require the skills, understanding and prior

knowledge of all parties, students, lecturers and project clients. Through this research, many improvement ideas have been obtained for what the new practical tool to be developed to support working life project studies should contain. Three articles have been written about the topic and idea for doing this (Lintilä and Marstio 2022; Marstio and Lintilä 2022a, 2022b). The background to this idea is to develop a new practical tool based on a modified reference framework from Binkley et al. (Binkley et al. 2012). The purpose of the new tool is to help all three different parties (lecturers, students and project clients) and take into account the particular characteristics of each. The role of lecturers is significant; they must know LbD well and know how to apply it in different contexts. Lecturers must be familiar with the curricula, the competence objectives of the study module being taught, and the related evaluation criteria. In addition, the lecturer must be able to find a client project that fits the competence objectives of the study module and plan in cooperation with the project client to ensure that the competence objectives are met. Furthermore, the lecturer must be able to adapt the study module flexibly and identify whether the achievement of the competence goals requires other learning tasks or methods in addition to the client project. The lecturer must also know how to use a wide range of evaluation criteria to evaluate competencies and how to communicate the evaluation criteria to students and customers in advance.

In terms of developing students' skills, the guide should clearly describe things so that students learn to understand their skills better and recognise what they are learning and how it happens. In project-based learning, students learn many things they do not even know they have acquired. Students also usually do not know their way of learning and how they can best develop their skills. The purpose of the new tool would be to make students more aware of their learning methods and to understand better what and how their skills develop. Better knowledge also helps students reflect on what they have learned and identify their learning process. Table 18 contains a preliminary outline of the learning process of the student's working life-oriented project and related matters related to competence development. A similar description must also be made of the process of the lecturers and the project client. Based on these, the planning for the new tool for all stakeholders' purposes can be started.

Table 18: An outline of the learning process of a work-oriented project (Lintilä and Marstio 2022)

Stages of the learning process	ME (What do I learn and what is critical at each stage)	My Team (teamworking skills)	Project (project working skills)	Working life context (working life skills)
Project kick-off and team grouping	Interaction with different actors Define your own learning goals. How will you reach them as well as the results the working life partner expects?	You get to know your team members and define together the learning objectives for the project	With your team, you will create a thorough project implementation plan You agree on roles and responsibilities within your team Critical: commitment	You get to know the working life partner and investigate backgrounds of the project and the expectations of the project partner
Building the knowledge base and framing the challenge	You learn about information search. Remember source criticism	Leveraging the strengths of different group members Critical: Even division of labour	Skills in project work and project management Critical: Coordination of the teamwork	You improve critical thinking skills
Problem solving and formation of solution (s)	Your problem-solving skills will evolve. You can enhance your creativity	Critical: Reconciliation of different perspectives and aspirations	Your skills in co-development and innovation will develop	You gain ability to apply theoretical knowledge to the working environment of the project partner
Presenting solutions and reflection on the lessons learnt	You reflect your and your team's activities and learning in light of the learning goals You develop your presentation skills	Critical evaluation of the solution to be presented Practicing the presentation	Elaboration of the project report	You are able to speak expertly in questions related to your field of education
Skills and competencies to be developed at all stages	You are able to identify your own competence. Your trust in your competence is strengthened	Development of teamworking skills	Project management skills in practice: how to have meetings, schedule work and agree on things	You gain ability and confidence to work with people from different backgrounds

Project clients are often involved only once in students' working life-oriented projects. With the help of the tool, it would be easier for project clients to open up about the principles of LbD as well as the client's role and related tasks, responsibilities and obligations. In this way, it could be better guaranteed that the customers involved have internalised the matter well and understand that commitment is essential to their responsibility. The roles and tasks of the customers vary a lot from project to project, and the tool would help the lecturer plan the parties' roles during the project. Sometimes, the role of the project client can also be to teach things to the students, for example, if the technology used in the client organisation is unfamiliar to the lecturer of the study module. It is also vital in LbD that everyone understands the equality of the parties. Everyone is an equal project actor, but their roles might differ. Often, the lecturers are also in the role of learner, which can be challenging for some of them.

The prerequisite for developing a new tool is first to find suitable project funding to obtain sufficient resources and funding for the development work. The project's ideation has already been done, but funding is needed to start the more detailed planning of the project. The development process is intended to proceed in three phases. In the first phase, a more precise definition is made using service design methods. As an output of the first phase, it is also intended to have some prototypes made. A digital tool will be built in the second phase based on the first phase's designs, specifications and prototype. In the third phase, the new digital tool is piloted and tested in the organisations involved in the project.

6.5 Final Remarks

This thesis has produced additional information about using LbD in computer science students' work-life-oriented project-based study modules at three higher education institutions. The research was carried out as action research from 2019 to 2022, and the research plan has changed as the research progresses. There were challenges in the implementation of research cycles 2 and 3 at RGU due to COVID-19. That may also be one of the reasons why there were quite a few participants in RGU's study modules. The study took longer than planned because research material from students at RGU did not get as much as planned, and one more Finnish University of Applied Sciences, Haaga-Helia, was added. However, the inclusion of this new institution allowed the research to compare the results of two Finnish Universities of Applied Sciences.

A pedagogical programme has been published at Laurea in August 2023, in connection with which the findings of this study will also be taken into account. The pedagogical program contains several development areas that will be implemented from 2023 to 2025. LbD is still Laurea's core and most crucial pedagogical model, and LbD and related operating models are constantly improving. The findings of this study will be included as part of the pedagogical program. The practical implementation of the pedagogical programme is in the planning phase and will be refined during 2023.

Nevertheless, the most critical finding in this study is that, based on the research results, the need to develop a new practical tool to support working life-oriented project studies has strongly emerged. The development work has already started in the design stage, and the researcher is involved. The tool is intended to be implemented digitally, but it can also be implemented into a physical tool that can be used manually. A new practical tool for work-oriented project studies would be an excellent addition to concretely support

LbD pedagogy practices, considering the perspectives of lecturers, students and students. The new tool could, therefore, be used very well as a practical tool for applying LbD, but it could also be used in other work-oriented project studies. The benefit of a new tool for using LbD in some other higher education institutes in the future would also be that it would bring a concrete and clear tool to help the implementation and users of LbD.

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Appendix A: Laurea pedagogical staff interview questions

Interview questions for the pedagogical staff at Laurea University of Applied Sciences

1. *What are the general background factors for introducing LbD in higher education?*
2. *What were the reasons behind the introduction of LbD at Laurea?*
3. *What are the absolute conditions for using LbD in higher education?*
4. *Is LbD suitable for all teaching, all fields of education, all teachers, all situations, and new students just starting?*
5. *Could you recommend the LbD action model to other universities around the world?*
6. *What kind of effects has LbD had on Laurea's teaching?*
7. *What are your own experiences of using LbD?*
8. *What have the students' experiences been like?*
9. *What have the teachers' experiences been like?*
10. *How to get teachers to use LbD?*
11. *How is the introduction to the LbD action model done?*
12. *How is the use of LbD supported and expertise maintained at Laurea?*
13. *How is the LbD action model developed at Laurea?*

Appendix B: Lecturers' interview questions

Interview questions for lecturers'

1. *Before starting the study module, were you familiar with the Learning by Developing (LbD) action model?*
2. *How well does the LbD model fit your organisation, in your opinion (Laurea/Haaga-Helia/RGU)?*
3. *Do you think the LbD model is suitable for all study modules?*
4. *What studies or situations is the LbD best suited for, in your opinion?*
5. *What were your roles in this study module implementation in which you were involved?*
6. *How well does LbD fit into the study module you teach, in your opinion?*
7. *What strengths do you think the LbD model has?*
8. *What are the weaknesses or shortcomings of the LbD model, in your opinion?*
9. *What are the opportunities in the LbD model, in your opinion?*
10. *What kind of threats do you think the LbD model includes?*
11. *Do you have something in mind that should be developed in the LbD model to make it work better?*
12. *How well did the students' skills develop during the study module?*

Appendix C: Students Survey

LbD research

Survey for students

A. Give your student number *

_____

Your age *

Mark only one oval.

18-25 ⬭

26-30 ⬭

31-35 ⬭

36-40 ⬭

41-> ⬭

Gender *

Mark only one oval.

Female ⬭

Male ⬭

B. Nationality (British, Finnish, French, Swiss, Lithuanian or other) *

Mark only one oval.

British ⬭

Finnish ⬭

French ⬭

Swiss ⬭

Lithuanian ⬭

Other, ⬭ which_____

C. Which year student *

Mark only one oval

First-year

Second-year

Third-year

More

1. Self-management and entrepreneurial attitude

Evaluate your own competence in the following subjects

1a. Life management and well-being

How well you can take care of your own life and your well-being

1a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

⬭	1
⬭	2
⬭	3
⬭	4
⬭	5

Expert Level

1a. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

⬭	1
⬭	2
⬭	3
⬭	4
⬭	5

Expert Level

1b. Describing own skills and the skills for continuous learning

1b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

1b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

1c. Sales skills

1c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

1c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

2. Critical thinking and problem-solving skills

Evaluate your own competence in the following subjects

2a. Critical knowledge acquisition, evaluation and utilisation

2a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

2a. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

2b. Entity management and systematics

2b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

2b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

2c. Analytical thinking and argumentation

2c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

⬭ 1

⬭ 2

⬭ 3

⬭ 4

⬭ 5

Expert Level

2c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

⬭ 1

⬭ 2

⬭ 3

⬭ 4

⬭ 5

Expert Level

3. Foresight and innovation skills

Evaluate your own competence in the following subjects

3a. Creativity and initiative

3a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3a. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3b. Co-development and service design skills

3b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3c. Technology and digital competence

3c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

3d. The ability to change

3d. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

- ⬭ 1
- ⬭ 2
- ⬭ 3
- ⬭ 4
- ⬭ 5

Expert Level

3d. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

- ⬭ 1
- ⬭ 2
- ⬭ 3
- ⬭ 4
- ⬭ 5

Expert Level

4. Communication and interaction skills

Evaluate your own competence in the following subjects

4a. Impressive oral and written communication skills (including language skills)

4a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

4a. Level of knowledge at the of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

4b. Networking skills

4b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

- 1
- 2
- 3
- 4
- 5

Expert Level

4b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

- 1
- 2
- 3
- 4
- 5

Expert Level

4c. Social Impact

4c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

4c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

○ 1

○ 2

○ 3

○ 4

○ 5

Expert Level

4d. Customer understanding and customer knowledge

4d. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

4d. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

5. Global expertise

Evaluate your own competence in the following subjects

5a. International capacities

5a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

⬭ 1

⬭ 2

⬭ 3

⬭ 4

⬭ 5

Expert Level

5a. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

⬭ 1

⬭ 2

⬭ 3

⬭ 4

⬭ 5

Expert Level

5b. Understanding cultural meanings

5b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

5b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

5c. Ethical engagement in a global media and technology environment

5c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

5c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

6. Responsibility expertise

Evaluate your own competence in the following subjects

6a. Ethics and empathy

6a. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

6a. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

1

2

3

4

5

Expert Level

6b. Equality and justice

6b. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

6b. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

Expert Level

6c. Ecological, social and economic sustainable development

6c. Level of knowledge at the beginning of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

6c. Level of knowledge at the end of the study *

Mark only one oval.

No knowledge at all

- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5

Expert Level

7. What new things and/or skills did you learn during the study module? *
    (describe in your own words)

Roles

8. What roles did you have during the study module, and how well do you think they were
    doing?

Evaluate all roles you play during the study module

Project manager

Mark only one oval.

Passable

$\bigcirc$ 1

$\bigcirc$ 2

$\bigcirc$ 3

$\bigcirc$ 4

$\bigcirc$ 5

Excellent

Developer

Mark only one oval.

Passable

$\bigcirc$ 1

$\bigcirc$ 2

$\bigcirc$ 3

$\bigcirc$ 4

$\bigcirc$ 5

Excellent

Designer

Mark only one oval.

Passable

○ 1

○ 2

○ 3

○ 4

○ 5

Excellent

Tester

Mark only one oval.

Passable

○ 1

○ 2

○ 3

○ 4

○ 5

Excellent

Participant *

Mark only one oval.

Passable

○ 1

○ 2

○ 3

○ 4

○ 5

Excellent

Researcher

Mark only one oval.

Passable

○   1

○   2

○   3

○   4

○   5

Excellent

Other roles, what? Give also grades 1 to 5

9. How well have you understood what the LbD Action Model practically mean? *

Mark only one oval.

Poorly

◯   1

◯   2

◯   3

◯   4

◯   5

Very well

10. Describe in your own words what the LbD Action Model practically mean *

_____

11. How well does the LbD Action Model (in your opinion) fit into studying computing science studies? *

Mark only one oval.

Poorly

◯   1

◯   2

◯   3

◯   4

◯   5

Very well

_____

12. Describe in your own words whether LbD is suitable for computing science studies and justify your answer *

_____

13. How well do you think the LbD fit the study module you attended? *

Mark only one oval.

Poorly

○   1

○   2

○   3

○   4

○   5

Very well

Describe in your own words your opinion on the suitability of LbD for that study module
*

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14. How well do you think the customers have understood and internalised the LbD approach? *

Mark only one oval.

Poorly

○   1

○   2

○   3

○   4

○   5

Very well

15. How well do you think the customers internalised the LbD Action Model? *

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16. Was the introduction to the LbD Action Model sufficient, in your opinion? Do you understand the purpose and importance of the LbD model in developing student skills? *

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17. What was the role of the lecturers, and was it in line with the LbD Action Model? *

18. What is good about LbD, and what is the best about it? *

19. What weaknesses do you see in the LbD-based study? *

20. How do you think the LbD Action Model should be developed? *

21. What kind of learning situation do you think is the best suited for the LbD Action Model? *

Thank you for your answers!

Google Forms

Appendix D: Project clients' interview questions

Interview questions for project clients'

1. *How well did the students succeed in the project?*
2. *How well do you think the cooperation between students and teachers worked?*
3. *Did everyone have clear roles during the project?*
4. *Were the project goals mutually agreed upon, and were they clear?*
5. *How well did the practical matters related to the project go?*
6. *Were there any challenges or problems during the project, and if so, were they resolved, and if so, how?*
7. *How well were the goals achieved?*
8. *How beneficial was the result of the project for your organisation?*
9. *Did the project's outcome produce new operating methods or other reforms for your organisation?*
10. *How well did you know the LbD model before starting the study module?*
11. *What do you think about collaboration according to the LbD model, and do you think it is suitable for such student customer projects?*

Appendix E: RGU pedagogical staff interview questions and answers

Interview questions for a pedagogical expert at Robert Gordon University

1. *What pedagogical models do you use to cross the university?*

   Answer: "RGU is a professionally focused university committed to developing students' employability skills during school so that they have good options to get a job and develop their careers after graduating. RGU uses much active pedagogy, where students are active and participate in activities and also in genuine working life cooperation. At RGU, we try to simulate work environments as closely as possible, whether case studies or projects, and many of our courses also use working-life projects from various industrial sectors, including the healthcare sector. At RGU, we want to ensure that when students move to the professional field they are studying, they have sufficient skills for it. Many students do internships in cooperation with companies and advertise them to other students. In addition, RGU has several study modules where the learning is ultimately workplace learning. In these study modules, 80% of students learn at the workplace and are supported to do so. These are so-called mixed learning models, where students are supported to reflect on practical work and academic theory and thus develop their skills and competence. I think this could be called authentic learning."

2. *Do you know the Learning by Developing Action Model used in Laurea?*

   Answer: "I was partially aware of LbD based on our previous discussions, and it was fascinating to read the publications you posted about LbD that opened it up very well. I believe it is very similar to the type of approach we use at RGU, although we do not use to call it by the same name."

3. *Have you used any similar pedagogical model in RGU?*

Answer: "Our study and teaching for some modules is often more theoretical, and they may use a hypothetical case study. Some study modules also include authentic client projects where students work in much the same way. Co-creation is an element we are interested in, and the development-based learning model has pedagogical features that RGU teachers could benefit from. It is not currently part of our formal pedagogical model. A development-based learning model requires commitment from teachers and their understanding that they must be on the same level as students and learn together."

4. **What obstacles could be to implementing the LbD action model in RGU?**

Answer: "One factor that could be an obstacle is that it takes much work to build relationships with industry and their ability to offer jobs and projects. We depend on what happens in the industry. The university has a good relationship with Aberdeen Oil&Gas, but they do not have opportunities to offer projects to students because their operations are embedded. Much work is required from the university to try to involve small and medium-sized companies that could offer opportunities for students to participate in various collaborative projects. Another influential factor that can be an obstacle is that involving an external party in the learning process can cause academic quality problems if external participants are involved in the assessment. In the UK and Scotland, strict academic standards must be followed, where the evaluation criteria have been defined in advance. If an entity outside the university participates in evaluating students' skills, then there must be clearly defined evaluation criteria that everyone must follow to meet the required quality criteria set for universities."

5. **Are there any cultural or societal challenges to using LbD in RGU?**

Answer: "Based on our experience, there has been a discussion about students' social differences in the Scottish sector. Students with a specific social background may perform worse in, for example, internship interviews, and they will not get an internship very easily. This may affect their learning experience. On the other hand, if teaching is integrated by developing a learning model, it could help overcome these challenges because everyone gets the same opportunity."

6. ***What kind of studies or situations do you think would be best suited for the LbD action model?***

    Answer: "I think LbD is suitable for many industries, whether you think of business, healthcare or even education, where innovation has become increasingly important. People have to adapt to new situations and do more with fewer resources. The LbD is well suited to such projects with many challenges that must be solved. The model of learning by development is a more multidisciplinary holistic approach to problems and their solutions. The LbD model is suitable for projects where issues are looked at holistically, work-related problems are helped to be solved, and new things are wanted to be created."

7. ***Do you think there are specific fields of education that are more suited towards this learning style?***

    Answer: "I think LbD can be seen to fit broadly as an equal across all kinds of applied disciplines, be it humanities or extended subjects. LbD is possibly less suitable for very theoretical subjects, for example, theoretical physics or mathematics, but it may be that there are always ways to apply it to them as well. I would say that LbD is generally suitable for fields where practice and theory are applied and can produce added value."

Appendix F: Haaga-Helia pedagogical staff interview questions and answers

Interview questions for a pedagogical staff at Haaga-Helia University of Applied Sciences

1. *What pedagogical models are used in Haaga-Helia?*

Answer: "At Haaga-Helia, we have a pedagogical vision based on continuous learning and continuous investigative learning and development ideology. In Haaga-Helia, there is not only one pedagogical model used, but the lecturers themselves can choose the model that suits each study module. However, the starting point in all of them is competence-based.

2. *Are you aware of the Learning by Developing Action Model used in Laurea?*

Answer: "Yes, I know it. Laurea started to develop it in the early 2000s. The purpose was to think about what a University of Applied Sciences graduate should be able to learn, combine education with working life and include R&D work. At the same time, it was also necessary to reform the competence assessment."

3. *Do you use any similar pedagogical model in Haaga-Helia?*

Answer: "At Haaga-Helia, especially in master's degrees, the exploratory and developmental learning model is widely used."

4. *What obstacles could be to implementing the LbD action model in Haaga-Helia?*

Answer: "In principle, there are no obstacles, but it would require strong staff participation and management commitment, so there was no desire to choose just one pedagogical model for the entire organisation. Lecturers can decide if they want to use LbD pedagogy, but it also requires familiarity with it to be helpful."

*5. **Do you see any cultural or societal challenges to using the LbD in Haaga-Helia?***

Answer: " "I do not see any cultural and social obstacles, but the comprehensive implementation of such a model would require that the organisation's structures and processes support it."

*6. **What kind of studies or situations would be best suited for the LbD action model?***

Answer: "In my opinion, LbD is well suited to working life-oriented studies that include exploratory and developmental problem-solving."

*7. **Do you think there are specific fields of education that are more suited towards this learning style?***

Answer: "It is suitable for many fields, but not everything. In the context of a university of applied sciences, LbD fits well because the teaching there is applied and practical."