

Transforming a classroom course into an online course

A concept for an adaptation of a course in Teamcenter on pedagogic grounds

Master of Science thesis in Learning and Leadership

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Abstract

E-learning is a rapidly growing field in the professional education and training area. Although it has existed for some time now, e-learning is a new and fairly unexplored discipline if you put it in perspective and compare it to more classic forms of education. This study aimed to investigate how a traditional classroom course can be transformed into an e-learning course without losing, and preferably gaining, pedagogical quality. The specific course is used for new employees at Volvo. To achieve the aim, four research questions were created, which consisted of one main question and three sub questions: (1) How can a classroom course be transformed into e-learning with preserved or higher pedagogical quality? (1.1) Which are the most important factors to create a well-functioning online course? (1.2) What are the learning objectives of the Volvo course and how does the current teaching support the learning of these? (1.3) What can be gained or lost from an educational view through the change from physical to virtual learning environment?

The study was performed with a qualitative approach with some elements of design research. The main sources of data were interviews, course observation, document study, self-completion questionnaire and a focus group discussion. Based on the theory and the collected data, with a framework combining constructive alignment and the 5E model, a concept for transformation from classroom course into e-learning was created. This concept works as an instruction, explaining and suggesting, for how to transform the course using existing course material, with a new pedagogical approach and some additions, like new assessment tasks.

Key words: bloom's taxonomy, constructive alignment, e-learning, professional education, the 5E model, course design.

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Table of contents

Acknowledgementsii1. Introduction11.1 Background11.2 Aim11.2 Aim11.3 Research questions11.4 Delimitations21.5 Thesis outline22. Theoretical framework42.1 Grand learning theories42.1 1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism132.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	Abstract	i
1. Introduction 1 1.1 Background 1 1.2 Aim 1 1.3 Research questions 1 1.4 Delimitations 2 1.5 Thesis outline 2 2. Theoretical framework 4 2.1 Grand learning theories 4 2.1.1 Behaviorism 4 2.1.2 Cognitivism 5 2.1.3 Constructivism 6 2.2 Framework for analysis 6 2.2.1 Bloom's taxonomy, the cognitive domain 6 2.2.2 Constructive alignment 9 2.3 E-learning 10 2.3.1 Definition of e-learning 10 2.3.2 Critical success factors for e-learning 10 2.4.1 Cognitivism 12 2.4.2 Constructivism 13 2.4.3 The 5E model 13 2.4.4 Zone of proximal development 15 3.1 Approach 17 3.1 Direct observation of the course in Teamcenter 17 3.3.1 Direct observation of the course in Teamcenter 17 3.3.2 Course teacher interviews 19 3.3.4 Course participant survey 20 3	Acknowledgements	ii
1.1 Background 1 1.2 Aim 1 1.3 Rescarch questions 1 1.4 Delimitations 2 1.5 Thesis outline 2 2. Theoretical framework 4 2.1 Grand learning theories 4 2.1.1 Behaviorism 4 2.1.2 Cognitivism 5 2.1.3 Constructivism 6 2.2. Framework for analysis 6 2.2. I Bloom's taxonomy, the cognitive domain 6 2.2.1 Bloom's taxonomy, the cognitive domain 6 2.2.2 Constructive alignment 9 2.3 E-learning 10 2.3.1 Definition of e-learning 10 2.3.2 Critical success factors for e-learning 10 2.4.1 Cognitivism 12 2.4.2 Constructivism 12 2.4.2 Constructivism 13 2.4.3 The 5E model 13 2.4.4 Zone of proximal development 15 3. Methodology 17 3.1 Direct observation of the course in Teamcenter 17 3.3.1 Direct observation of the course in Teamcenter 17 3.3.4 Course participant survey 20 <td>1. Introduction</td> <td>1</td>	1. Introduction	1
1.2 Aim 1 1.3 Research questions 1 1.4 Delimitations 2 1.5 Thesis outline 2 2. Theoretical framework 4 2.1 Grand learning theories 4 2.1.1 Behaviorism 4 2.1.2 Cognitivism 5 2.1.3 Constructivism 6 2.2 Framework for analysis 6 2.2.1 Bloom's taxonomy, the cognitive domain 6 2.2.2 Constructive alignment 9 2.3 E-learning 10 2.3.1 Definition of c-learning 10 2.3.2 Critical success factors for e-learning 10 2.4 Applications of learning theories 12 2.4.1 Cognitivism 12 2.4.2 Constructives 13 2.4.3 The SE model 13 2.4.4 Zone of proximal development 15 3. Methodology 17 3.1 Direct observation of the course in Teamcenter 17 3.3 Document study of course exercise book and teacher manual 18 3.3 Course teacher interviews 19 3.3 Course teacher interviews 19 3.4 Course participant survey	1.1 Background	1
1.3 Research questions 1 1.4 Delimitations 2 1.5 Thesis outline 2 2. Theoretical framework 4 2.1 Grand learning theories 4 2.1.1 Behaviorism 4 2.1.2 Cognitivism 5 2.1.3 Constructivism 6 2.2 Framework for analysis 6 2.2.1 Bloom's taxonomy, the cognitive domain 6 2.2.2 Constructive alignment 9 2.3 E-learning 10 2.3.1 Definition of e-learning 10 2.3.2 Critical success factors for e-learning 10 2.3.2 Critical success factors for e-learning 10 2.4.4 Cognitivism 12 2.4.2 Constructivism 13 2.4.3 The 5E model 13 2.4.4 Zone of proximal development 15 3. Methodology 17 3.1 Approach 17 3.2 Literature study 17 3.3 Data collection 17 3.3 Course teacher interviews 19 3.4 Course participant survey 20 3.3.5 Focus group 21 3.4 Course participant su	1.2 Aim	1
1.4 Delimitations21.5 Thesis outline22. Theoretical framework42.1 Grand learning theories42.1.1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Direct observation of the course in Teamcenter173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	1.3 Research questions	1
1.5 Thesis outline22. Theoretical framework42.1 Grand learning theories42.1.1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2 Framework for analysis62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3 Course teacher interviews193.4 Course participant survey203.5 Focus group213.4 Analysis223.5 F-learning concept23	1.4 Delimitations	2
2. Theoretical framework42.1 Grand learning theories42.1.1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	1.5 Thesis outline	2
2.1 Grand learning theories42.1.1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Direct observation of the course in Teamcenter173.3.1 Direct observation of the course in Teamcenter173.3 Course teacher interviews193.3.4 Course participant survey203.5 Focus group213.4 Analysis223.5 E-learning concept23	2. Theoretical framework	4
2.1.1 Behaviorism42.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructives132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.3 Data collection173.3 Course teacher interviews193.3 4 Course participant survey203.3 5 Focus group213.4 Analysis223.5 E-learning concept23	2.1 Grand learning theories	4
2.1.2 Cognitivism52.1.3 Constructivism62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3 Course teacher interviews193.3 4 Course participant survey203.3 5 Focus group213.4 Analysis223.5 E-learning concept23	2.1.1 Behaviorism	4
2.1.3 Constructivism.62.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning.102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.1.2 Cognitivism	5
2.2 Framework for analysis62.2.1 Bloom's taxonomy, the cognitive domain62.2.2 Constructive alignment92.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.1.3 Constructivism	6
2.2.1 Bloom's taxonomy, the cognitive domain	2.2 Framework for analysis	6
2.2.2 Constructive alignment92.3 E-learning.102.3.1 Definition of e-learning.102.3.2 Critical success factors for e-learning.102.4 Applications of learning theories.122.4.1 Cognitivism.122.4.2 Constructivism.132.4.3 The 5E model.132.4.4 Zone of proximal development.153. Methodology.173.1 Approach.173.2 Literature study.173.3 Data collection.173.3.1 Direct observation of the course in Teamcenter.173.3.2 Document study of course exercise book and teacher manual.183.3.4 Course participant survey.203.3.5 Focus group.213.4 Analysis.223.5 E-learning concept.23	2.2.1 Bloom's taxonomy, the cognitive domain	6
2.3 E-learning102.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.2.2 Constructive alignment	9
2.3.1 Definition of e-learning102.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.3 E-learning	10
2.3.2 Critical success factors for e-learning102.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.5 Focus group213.4 Analysis223.5 E-learning concept23	2.3.1 Definition of e-learning	10
2.4 Applications of learning theories122.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.3.2 Critical success factors for e-learning	10
2.4.1 Cognitivism122.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.4 Applications of learning theories	12
2.4.2 Constructivism132.4.3 The 5E model132.4.4 Zone of proximal development153. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.4.1 Cognitivism	12
2.4.3 The 5E model.132.4.4 Zone of proximal development.153. Methodology173.1 Approach173.2 Literature study173.3 Data collection.173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.4 Course participant survey203.5 Focus group213.4 Analysis223.5 E-learning concept23	2.4.2 Constructivism	13
2.4.4 Zone of proximal development.153. Methodology173.1 Approach173.2 Literature study173.3 Data collection.173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews.193.4 Course participant survey203.5 Focus group213.4 Analysis.223.5 E-learning concept.23	2.4.3 The 5E model	13
3. Methodology173.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	2.4.4 Zone of proximal development	15
3.1 Approach173.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	3. Methodology	17
3.2 Literature study173.3 Data collection173.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	3.1 Approach	17
3.3 Data collection.173.3.1 Direct observation of the course in Teamcenter.173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews.193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis.223.5 E-learning concept.23	3.2 Literature study	17
3.3.1 Direct observation of the course in Teamcenter173.3.2 Document study of course exercise book and teacher manual183.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	3.3 Data collection	17
3.3.2 Document study of course exercise book and teacher manual.183.3.3 Course teacher interviews.193.3.4 Course participant survey.203.3.5 Focus group.213.4 Analysis.223.5 E-learning concept.23	3.3.1 Direct observation of the course in Teamcenter	17
3.3.3 Course teacher interviews193.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	3.3.2 Document study of course exercise book and teacher manual	
3.3.4 Course participant survey203.3.5 Focus group213.4 Analysis223.5 E-learning concept23	3.3.3 Course teacher interviews	19
3.3.5 Focus group 21 3.4 Analysis 22 3.5 E-learning concept 23	3.3.4 Course participant survey	20
3.4 Analysis223.5 E-learning concept23	3.3.5 Focus group	21
3.5 E-learning concept	3.4 Analysis	22
	3.5 E-learning concept	23

4. Results and analysis	.24
4.1 Teamcenter CAD Viewer and TCVis Basic	.24
4.1.1 Course material	.24
4.1.2 Teacher's manual	.26
4.1.3 Course observation	.27
4.1.4 Course teacher interviews	.28
4.1.5 Course participant survey	.31
4.2 Course analysis	.34
4.3 Concept for transformation of classroom course into e-learning	.38
4.3.1 Course disposition	.38
4.3.2 Constructive alignment of new course concept	.47
4.3.3 Evaluation of the new course design	.49
5. Discussion	.51
5.1 Research questions revisited	.51
5.1.1 RQ1: How can a classroom course be transformed into e-learning with preserved higher pedagogical quality?	or .51
5.1.2 RQ1.1: Which are the most important factors to create a pedagogically well- functioning online course?	.51
5.1.3 RQ1.2: What are the learning objects of this course and how does the current teaching support the learning of these?	.52
5.1.4 RQ1.3: What can be gained or lost from an educational view through the improvements of the course and the change from physical to virtual learning environment?	53
5.2 Limitations and recommendations	.55
6 Conclusion	55
References	.57
Appendix I – Interview guide	i
Appendix II – Course participant survey	. iii

1. Introduction

In this first chapter the subject of the master thesis will be presented, beginning with a background introducing the subject followed by the aim of the study, the research questions and the delimitations for the study. Lastly the outline of the thesis is presented.

1.1 Background

The use of e-learning in professional education is increasing and has multiplied several times during the 21st century (Clark & Mayer, 2016). E-learning can be performed when the employee or learner has time for it, allowing them to still perform their working tasks without being occupied a whole day or week with education. It can also be adjusted to the learner who can spend more time on the parts that he or she needs and less time on parts that is less relevant or easier for the individual. This can save companies time and money, but in order to do that the quality of the education must survive in the transformation to e-learning.

Volvo are using the PLM (product lifecycle management) software Teamcenter to store and share information such as CAD (computer aided design) models, methods, processes and so on. To gain access to the program all new users must participate in a basic course. This course is called *Teamcenter CAD Viewer and TCVis Basic* and gives the participants a viewer access. The course is administered in cooperation between Volvo and Unico, a company specialised in CAD and PLM training.

The group currently working with the course wants to transform the course from a one-day instructor-led classroom training to e-learning in order to unlock both engineer and trainer hours. Also, a classroom course has a required minimum and a maximum number of attendants which can lead to the course being cancelled or booked up and people have to wait to get the course. To ensure the quality of the e-learning, they want a pedagogical groundwork to perform the transformation of the course.

1.2 Aim

The aim of the assignment is to create instructions for transformation of an existing classroom course (Teamcenter CAD Viewer and TCVis Basic) into a web-based course. A pedagogical concept for the transformation will be produced based on the course objectives and the existing course material.

To achieve this, the thesis also aims to investigate how the pedagogical design of a course should be altered when transforming a classroom course into a web course.

1.3 Research questions

To support the thesis aim to develop a pedagogical concept for transforming a classroom course into an online course the following main research question needs to be answered:

• RQ1: How can a classroom course be transformed into e-learning with preserved or higher pedagogical quality?

To answer that question, one needs to answer three additional questions. The first is about important factors in general when transforming a course into online learning:

• RQ1.1: Which are the most important factors to create a pedagogically well-functioning online course?

Knowledge of the specific course is needed to make the necessary adjustments to it, which leads to the question:

• RQ1.2: What are the learning objectives of the Volvo course and how does the current teaching support the learning of these?

At last, to evaluate the impact of the transformation on the pedagogical quality of the course one last question needs to be answered:

• RQ1.3: What can be gained or lost from an educational view through improvements of the course and the change from physical to virtual learning environment?

1.4 Delimitations

This project only focused on the pedagogical arrangement of the course as a web course. There was no production of online course material such as recording of lectures or programming tasks. As a consequence of this, the new course concept could not be applied and tested in a real-life situation, but it was evaluated by a focus group consisting of the course teachers, administrators and the course owner.

1.5 Thesis outline

The thesis outline of the research is divided in six chapters. These chapters and a description of each of them can be seen below.

1. Introduction

In this first chapter the subject of the master thesis will be presented, beginning with a background introducing the subject followed by the aim of the study, the research questions and the delimitations for the study. Lastly the outline of the thesis is presented.

2. Theoretical framework

This chapter focuses on previous research concerning the pedagogical aspects of e-learning and educational development. The main focus is to investigate how to create an e-learning course that facilitates learning and to identify the pedagogic differences between classroom and online education.

3. Methodology

The methodology chapter presents how the research study was done. First, the approach of the study is explained. The sections following that include: the methods for how data was collected, the analysis of the current course and a description of how the e-learning concept was created.

4. Results and analysis

This chapter contains the results from the data collection. It starts with the data from the observation of the Teamcenter course. The next section contains data from the interviews with the course teachers and the section after that shows the data from the poll given to the course students. Finally, a concept for the transformation of the classroom course into e-learning, based on the collected data in addition to the theoretical framework in chapter two, is presented.

5. Discussion

In this chapter, the results of the study will be discussed. The research questions will be examined, followed by a discussion of the limitations of the study and recommendations for future work.

6. Conclusion

The last chapter contains a presentation of the connection between the aim and what the research has led to. Also, the research questions are answered.

2. Theoretical framework

The objective of this chapter is to create a theoretical framework to build further work on. Therefore, the focus of the chapter is on previous research about the pedagogical aspects of e-learning and educational development. The main focus is to investigate how to create an e-learning course that facilitate learning and to identify the pedagogic differences between classroom and online education.

2.1 Grand learning theories

By definition, e-learning doesn't have to be more than just course material presented online. To effectively support the participants learning it must be designed in a way that enhances learning. When designing an online course, it is therefore preferred that one is aware of different learning theories and how they can be used to support the learning process. In the following sections, different learning theories are presented to give necessary background to the pedagogical design of a course.

2.1.1 Behaviorism

Behaviorism focus on how to acquire new behaviours, in contrast to previous theories by Platon and Locke, where obtaining knowledge was the focus (Phillips & Soltis, 2014). Therefore, behaviourists are interested in how learners execute tasks, e.g. like how well a football player can pass the ball to another player or if a student can use the formula for the area of the circle. The internal mental processes are not of interest according to the behaviourist theory (Boghossian, 2006). Instead, behaviorism is about the relation between what someone do and the stimuli they get when performing that act. Boghossian (2006) describes that valid knowledge is knowledge that is publicly observable. According to behaviourists, learning is about change of behaviour. Boghossian (2006) describes it in this way:

For example, in the hypothetical karate class, if students do not form straight lines they are punched in the shoulder (stimuli), after a few people get out of line, and get punched, the line becomes noticeably straighter (behavioral response).

(p. 716)

So, stimuli lead to a change of behaviour, a behavioural response. When this happens, behaviorists think that one has learned something. As stated above, this is about observable behaviour. Boghossian (2006) explains that for topics of a non-practical character, like many subjects in school, behaviorists suggest that the verbal response works as a substitute to the behavioural response. Therefore, he means that behaviorists think that the learner is not reflective. Learning is just about a physical behavior or a verbal response. Further, he expresses that behaviorism does not explains how one gets information, how one uses it and how one understands it.

Around year 1970 thoughts about the self, motivation and things concerning the brain started to interest social psychologists. Because of the behaviorism's lack of answers regarding language, memory and mental issues, the theory of cognitivism begun to grow (Ashworth,

Brennan, Egan, Hamilton & Sáenz, 2004; Leary & Tangney, 2011). Since then, behaviorism has declined in popularity (Leary & Tangney, 2011).

2.1.2 Cognitivism

Things like memory, thinking, motivation, reflection and metacognition are parts of a cognitivist view of learning (Ally, 2004). Cognitivist psychologists were interested in human thinking and focused on observations and tests of human memory, problem-solving and learning to understand the thoughts (Ashman & Conway, 1997). These psychologists described the learning and change of behaviour in the way of mental structures and processes (Yilmaz, 2011). He also states that cognitivist psychologists focus on making sense of knowledge and helping learners place and sort new information according to already existing knowledge in their memory, therefore instructions should be based on the subject's previous knowledge and mental structures. Further, Yilmaz (2011) describes that the individual cognitive movement, based on studies from Piaget, and the sociocultural trend deriving from Vygotskij, is the foundation of cognitivism.

Jean Piaget describes that when one's internal view of reality no longer fits with the "real" reality, there will be an imbalance that leads to new cognitive structures and learning (Phillips & Soltis, 2014). When this happens, the cognitive structures are modified to fit the new experiences and regain balance. This strive to get balance in our cognitive structures is comparable to more physical parts of our body, like the body temperature control mechanism which helps us maintain a constant body temperature. Therefore, Phillips and Soltis (2014) suggest that every learning experience stems from a change in our cognitive structures.

According to Ally (2004), cognitivists think that the learner activates different memories in the learning process, which are needed to learn something from when the senses get sensations collected in the sensory store. Further, Ally (2004) writes that the sensations last for less than one second and must be transferred from the working memory during this time to not get lost. In short, this means that information comes from the senses, gets stored in the sensory store, whereupon, if the working memory take care of it, it ends up in the short-term memory and perhaps also in the long-term memory. How well this process goes depends on how much attention the learner gives to the information (Ally, 2004).

Deep processing in working memory leads to new information in long-term memory, which either is assimilated or accommodated (Ally, 2004). Assimilation is when the new information is changed to fit the existing cognitive structures or knowledge, and accommodation happens when the existing cognitive structures changes to integrate the new information (Yilmaz, 2011). If there is some contradiction between the existing cognitive structure and the new information, there are three different types of accommodation according to Fosnot and Perry (1996): (1) existing cognitive structures do not change, the new information fits the structure even though there are contradictions about the new information, (2) the contradiction is interpreted as a separate or specific case and therefore the new information lays as a parallel theory in the structure, and (3) a new modified theory forms to explain and answer what previous was a contradiction.

2.1.3 Constructivism

According to constructivism, learners should be active rather than passive in the learning process. The basic principle of constructivism is that knowledge is constructed within the learner and not just passively received and stored (von Glasersfeld, 1989). This means that the teacher must focus on the learner and the cognitive processes within that person instead of just focusing on what is being taught (Hein, 1991). According to the constructivist theory, learning is not about understanding the truth about things or remembering facts and theories. Instead learning is about the learner constructing a meaning and understanding of the taught subject in the context of the persons prior knowledge. This means that the learner should be active, and the teacher should play an advising and facilitating role (Ally, 2004).

2.2 Framework for analysis

This section is divided into two parts, each containing a method that can be used to analyse a course. First, the cognitive domain of Bloom's taxonomy is described and also how it can be used as a tool for analysis. Second, the same is presented for the theory of constructive alignment.

2.2.1 Bloom's taxonomy, the cognitive domain

Bloom's taxonomy is a framework of three domains: the cognitive, the affective and the psychomotor (Forehand, 2010). The taxonomy was first published as *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain* in 1956 by Benjamin Bloom with co-workers and treated the cognitive domain (Krathwohl, 2002). This domain is knowledge based and describes how student learning can be arranged in a hierarchical manner from simple to complex learning and that you have to master the simple ones before you can master the more complex (Forehand, 2010; Huitt, 2011). Bloom, Engelhart, Furst, Hill and Krathwohl (1956) ordered the learning levels as follows, starting with the simplest and ending with the most complex: knowledge, comprehension, application, analysis, synthesis and evaluation. This means that a student has to master the levels knowledge and comprehension before the application level can be mastered and also that many teachers want their students to master as many levels as possible (Forehand, 2010). Bloom et al. (1956) also created subcategories to all the levels, with the exception of application. On the next page, there is a simplified table of these categories and some describing examples of each one of them:

Level	Definition
Knowledge	Repetition of a definition or
	principle. Recalls and recognize
	information.
Comprehension	Understands with own words.
	Explains the definition, gives
	examples of how to use the
	definition. Interprets and
	comprehends information based
	on previous learning.
Application	Uses the knowledge in a context.
	Uses data and principles to solve
	a problem.
Analysis	Separates facts from assumptions
	in principles. Separates,
	classifies and compares
	components to understand the
	structure.
Synthesis	Compiles new structures and
	patterns from different
	principles. Creates and designs
	ideas into a proposal that is new.
Evaluation	Assessment due to some criteria.
	Evaluate and judge the use of for
	example a new strategy.

Table 1. Table with each level in Bloom's taxonomy and definitions of them (Bloom et al. 1956).

One of the most common ways the original taxonomy has been used is to classify educational goals and test items to visualize the deepness or lack of deepness in the goals and items according to the categories (Krathwohl, 2002). He argues that these analyses most frequently have shown that the focus of the goals are on recalls of information, thus goals in the knowledge level. Further he says that goals involving understanding and use of knowledge are the level a teacher or an educator usually want their students to reach. Therefore, analysis with Bloom's taxonomy has often led to the fact that teaching, course content and tests moved towards this.

The taxonomy was revised around 45 years later by Lorin Anderson and David Krathwohl (2001). They shifted the terminology of six categories in the original taxonomy from nouns to verbs. This was done because verbs usually are used in objectives and therefore the verb form makes the model more user friendly (Krathwohl, 2002). Also, the lowest level in the taxonomy changed name from knowledge to remember and the levels comprehension and synthesis were renamed to understand and create. Anderson and Krathwohl (2001) also switched the order of the two highest categories. This means that the revised taxonomy has the following categories from the lowest to the highest level, added with some words describing what each category is about:

- *Remember* Define, describe, choose, retrieve, recognize, recall name, find, bullet pointing, list
- Understand Categorize, explain, defend, separate, develop, generalize, use, sum up
- *Apply* Calculate, prove, discover, modify, execute, anticipate, prepare, produce, relate, show, solve, use, outline
- *Analyse* Identify, distinguish, illustrate, point out, relate, choose, separate, divide, sort, differentiate, outline, specify, critical processing
- *Evaluate* Evaluate, compare, reach, contrast, criticize, explain, motivate, prove, determine, relate, sum up, support, defend, propose, take a stand
- *Create* Categorize, combine, compile, develop, create, figure out, construct, explain, produce, modify, organize, plan, reconstruct, relate, sum up

The original cognitive domain of Bloom's taxonomy embodied three different knowledge dimensions, *Knowledge of specifics, Knowledge of ways and means of dealing with specifics* and *Knowledge of universals and abstractions in a field* (Krathwohl, 2002). These were subcategories to the knowledge level seen in *Table 1*. In the revised taxonomy these knowledge dimensions were changed and one more dimension was added. The new knowledge dimensions became factual, conceptual, procedural and metacognitive knowledge (Anderson & Krathwohl, 2001). The following is a description of each of them.

- *Factual Knowledge* The basic elements that students must know to be acquainted with a discipline or solve problems in it.
- *Conceptual Knowledge* The interrelationships among the basic elements within a larger structure that enable them to function together.
- *Procedural Knowledge* How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.
- *Metacognitive Knowledge* Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

(Krathwohl, 2002, p. 214)

The change of name for the first cognitive level from knowledge to remember, and the new four knowledge dimensions means that the one-dimensional original taxonomy became a two-dimensional model. How these two dimensions intersect can been seen in *Table 2*. Krathwohl (2002) explains how the taxonomy can be used "to classify objectives, activities, and assessments provides a clear, concise, visual representation of a particular course or unit." (p.

218). Further, he means that this can be used to improve the content in a course and the instructions. Forehand (2010) states that the two-dimensional table "offers teachers an even more powerful tool to help design their lesson plans." (p. 5-6).

		(Cognitive D	imensions		
Knowledge Dimensions	l. Remember	2. Understand	3. Apply	4. Analyse	5. Evaluate	6. Create
A. Factual						
B. Conceptual						
C. Procedural						
D. Metacognitive						

Table 2. Illustration of how the knowledge and cognitive dimensions are connected to each other in the revised taxonomy.

2.2.2 Constructive alignment

Constructive alignment is a theory created by John Biggs (1996) to enhance teaching in higher education. According to the theory one should not just try to add new better methods or curriculum to enhance the teaching. Instead one should look at the bigger picture and always try to connect the learning activities and the examination to the learning objectives.

As the name implies the theory is based upon the two concepts "constructive" and "alignment". The constructive part of the theory comes from constructive learning theory. A central concept of this is that the learner's activities and former knowledge creates meaning to the information (Biggs, 1996). It means that the learning is dependent on what the students are doing. The second part, alignment, derives from instructional design which emphasise alignment between course objectives and tasks for student assessment.

The constructive alignment theory combines these two concepts into a framework suited to design (or evaluate) both teaching methods and assessments with the course objectives as starting point and with the student activities as the centre of attention. It means that the teaching methods and the examination tasks must align with the objectives so that the activities actually are linked to what the students are supposed to learn. For example, one cannot use a multiple-choice question to examine a complex course objective. When deciding suitable tasks for assessment, Biggs (1996) states that the following issues should be considered:

1. What qualities of learning are we looking for; what performances need to be confirmed in the assessment? This question should already be answered in the curriculum objectives and the teaching activities.

2. Should the assessment be decontextualized or situated? The answer here depends on the nature of the knowledge; procedural knowledge clearly requires enactment in context, while declarative knowledge may or may not, depending on why it is being taught.

3. Who should set the criteria for learning, provide the evidence, and assess how well the evidence addresses the objectives? All three issues could be addressed by teacher, by peers, by the student, or by all collaboratively.

(p. 358)

The theory is widely spread and used in higher education course design and there are several studies (Thota & Whitfield, 2010; Wang, Su, Cheung, Wong, & Kwong, 2012) that implicate that the use of constructive alignment has positive impact on students learning. There exists some critique against the theory, though. Millar and Bester (2008) suggests in a conference paper that the course objectives can be highly subjective and therefore it is not certain that the learning will be improved using constructive alignment. Although, if the course objectives are clear and one are convinced that they are the objectives best suited for a specific course, the constructive alignment is a great tool to use when developing a course.

2.3 E-learning

In this section a definition of e-learning is presented, and different types of e-learning are described. Furthermore, critical success factors for e-learning are described, or in other words, what is important to consider when creating an e-learning course.

2.3.1 Definition of e-learning

In the book "E-Learning and the Science of Instruction" the authors Clark and Mayer (2016, p. 8) defines e-learning as "instruction delivered on a digital device (such as a desktop computer, laptop computer, tablet or smart phone) that is intended to support learning".

This definition includes different types of e-learning such as *asynchronous e-learning*, designed to facilitate self-study on demand, and *synchronous e-learning* which is more like traditional classroom education with an instructor presenting the course at a fixed time, although through digital media. Among these two forms of e-learning Clark and Mayer (2016) also make a distinction between *inform courses*, designed to supply information, and *perform courses*, designed to develop specific work-skills.

Common to these different types of e-learning is that they include both content, which is some kind of information, and methods to help the students to learn the content. The courses are all delivered through digital media such as written or spoken word, images, illustrations or videos. Interaction between students or student-teacher can take place via message boards, conference calls, email and so on. Many educators combine different ways of teaching like real time instructor-led sessions, self-paced self-study sessions and collaborative work in what is called blending learning solutions (Clark & Mayer, 2016).

2.3.2 Critical success factors for e-learning

Bullen and Rockart (1981, p. 7) define critical success factors (CSFs) as "the few key areas where "things must go right" for the business to flourish and for the manager's goals to be attained." That definition can with a little modification be used on learning instead of business. CSFs for learning can be defined as key areas that have to be done right to enhance learning

and for learning goals to be attained. Freund (1988) agrees with Bullen and Rockart that CSFs are factors that are few and important to achieve goals and objectives. Freund adds to the definition that CSFs should be expressed as things that must be done and that they also should be measurable and controllable. These requirements can also be applied to suit learning goals and objectives instead of corporate ones.

Selim (2007) classifies the critical success factors for e-learning into four different categories. The first CSF according to Selim is IT. (1) To enable successful e-learning one must ensure that the IT infrastructure is good enough to let the learning process run smoothly. The concept of IT here includes network issues such as bandwidth, security and accessibility, multimedia services, videoconferencing etcetera. Next CSF according to Selim is the course instructor. (2) The instructor's teaching style, attitude and mindset are important factors to motivate the students and help them learn. It's also important that the instructor has the right IT competence. (3) The student's characteristics are another CSF. Their IT experience is important along with their discipline and time management. If the students are motivated enough, e-learning allows them to learn when and where they want. The last CSF according to Selim is (4) technical support from the university or education department which also has shown to be of importance for e-learning success.

According to Basak, Bélanger and Wotto (2016) there are eight categories of CSFs. Technological factors (1) include for instance infrastructure planning, software, hardware, technical support for both teacher and learner, internet speed and interface design. Institutional factors (2) includes technical infrastructure but also soft values such as leadership strategy, learning culture and management support for training. Another category is pedagogical factors (3) that includes attitudes towards students, organisation, learning strategies and constructive feedback to learners. Academic background and professional training in education/professional development is also considered to be important pedagogical factors (5) which involves different management and ethical issues such as cultural and diversity issues, time management, efficiency etcetera. Course evaluation, learning assessment and content development are all examples of evaluation factors (6). Factors such as financial support and computer availability are defined as resources factors (7). The last one is described as social interaction factors (8) and as the name implies include social interaction as well as cultural interaction, isolation and motivation.

Cheawjindakarn, Suwannatthachote and Theeraroungchaisri (2012) are grouping the different critical success factors found in the literature into five main factors: (1) institutional management, (2) learning environment, (3) instructional design, (4) services support, (5) course evaluation. (1) institutional management includes factors such as market research, program framework, operational plan and cost effectiveness. These are all factors that focuses on organisational issues and the authors states that it's important to pay close attention to the planning of an e-learning course with respect to business administration. The second factor is the learning environment that refers to the locations and systems that the students use to access course information, lectures, tasks, tutoring and receive assessment. The technical

infrastructure and interface design is considered to be important parts of the learning environment and also the possibility to interactive learning. The third factor defined by Cheawjindakarn et al., instructional design, includes clarification of objectives, content quality, learning strategies, psychology of learning and learning assessment. It's important that the course objectives are clear for the students and that the course content meets acceptable standards. Further the instructors should be prepared with different learning strategies to help different students. The fourth factor is defined as services support and includes training, communication tools to facilitate communication between students and teachers, and finally a help desk to assist students. The fifth and last factor for successful e-learning according to Cheawjindakarn et al. is course evaluation to ensure the quality of the online learning.

2.4 Applications of learning theories

In the following sections it will be accounted for how the grand learning theories affect e-learning. The application of some smaller learning theories, derived from the grand theories, are also accounted for. These theories are: *The 5E Model, Zone of proximal development* and *Spacing*. Due to the declined popularity and usage of behaviorism nowadays in learning (Leary & Tangney, 2011), there is no section about e-learning regarding behaviorism.

2.4.1 Cognitivism

Ally (2004) claims that online learning, according to cognitive learning theory and the fact that the human memory is limited, needs to divide and organise the information in a proper size to make efficient cognitive processing possible. Further, he state that cognitive psychologists describe the stored information in long-term memory as a network system, like an information map, therefore it is important to highlight the major concepts and the relation between them in online learning. Furthermore, Ally (2004) give suggestions for online learning, which are listed below:

- Focus on giving the learner the right amount of sensations, too few will not give the learner enough to make efficient processing and too many can be counterproductive, because the learner can get problem with sorting out the important information.
- Use strategies to help the learner get relations with the new information and prior knowledge stored in long-term memory.
- Information should be divided into different clusters, using some sort of information map. Divide the clusters into subcategories and visualize the information map. Present between five and nine objects on the screen at one time to make the processing in working memory efficient.
- Deep processing in working memory can also be achieved by letting the learner apply, analyse, synthesise and evaluate information.
- Different learners prefer different types of learning styles, therefore, include different activities.
- Present information in more than one way, for example in both text format and verbally and perhaps, if it is possible, visually. Different ways of presenting the information gives better processing possibilities.
- Use both internal and external motivation strategies to get the learners motivated.

- Make it possible for the learners to get feedback, for example using self-check questions.
- Refer to real-life situations in order to make the information relevant for the learners.

2.4.2 Constructivism

According to the constructivist learning theory the learner should be in focus. The major implications of the constructivist learning theory for online learning is:

- Learners should be given control over their own learning process (Ally, 2004). The instructor can help the learners by guiding them through the course material, but for them to construct their own knowledge, the learners should discover things in their own way.
- The learners should be kept active as much as possible in order to get them to construct their own knowledge instead of just accepting and memorizing the instructor's views on the subject. One way to activate learners during lectures is to use quizzes, which improves performance relative to lectures without quizzes (McDaniel, Anderson, Derbish & Morrisette, 2007).

2.4.3 The 5E model

The 5E model is a tool that can be used to plan and design effective learning situations for students. The model is created by science educator Roger Bybee and his colleagues at BSCS and is built upon a mix of cognitive science, psychology and science education (Tanner, 2010). Bybee and colleagues has taken to account decades of research, with a starting point in the theory of learning suggested by Johann Herbart, via John Dewey's "complete act of thought", to the learning cycle proposed in the 1960s by Atkin and Karplus (Bybee et al., 2006). Herbart meant that the best pedagogy first allows the student to discover relationships between their experiences. The next step is direct instructions from the teacher that explains ideas that the student can't be expected to discover by themselves and the final step is to give the student the opportunity to demonstrate their new knowledge. Dewey's "complete act of thought" led to an instructional model that included the following steps: sense a perplexing situation, clarify the problem, formulate a hypothesis, test the hypothesis, revise tests, and act on solutions (Bybee et al., 2006). Inspired by Herbart and Dewey the 5E model is a direct descendant of the learning cycle proposed by Atkin and Karplus which used the terms *exploration*, term introduction and concept application. The BSCS 5E instructional model added to this learning cycle an initial phase to engage the learner's prior knowledge. Further, a final phase was added to evaluate the student's new understanding of the studied subject. Hence, the 5E model suggests that an effective lesson should consist of the following key elements:

- 1. Engagement (Engage)
- 2. Exploration (Explore)
- 3. Explanation (Explain)
- 4. Elaboration (Elaborate)
- 5. Evaluation (Evaluate)

The 5E model has a strong scientific foundation, an example of this is the following quotation from the National Research Council (NRC) report *How People Learn*:

An alternative to simply progressing through a series of exercises that derive from a scope and sequence chart is to expose students to the major features of a subject domain as they arise naturally in problem situations. Activities can be structured so that students are able to explore, explain, extend, and evaluate their progress. Ideas are best introduced when students see a need or a reason for their use—this helps them see relevant uses of knowledge to make sense of what they are learning.

(National Research Council, 2000, p. 139)

This quote motivates all five elements of the 5E model. It states that ideas are best introduces when students see a need or reason for their use. In other words, the students thinking should be engaged to the new ideas. Then, the NRC states that the students should be given the opportunity to explore, explain, extend (which equals elaborate in the 5E model) and evaluate their learning. Below, a short explanation are given of each one of the five phases according to Bybee (2009).

Engagement (Engage)

The first step of the model is supposed to get the learner engaged to the subject. This is achieved using a short activity that promotes curiosity and connects the subject to the learners' prior knowledge and conceptions. In addition to getting the learner engaged to the subject this activity also helps the learner start making connections to past experiences and organize the news knowledge into their existing cognitive structures.

Exploration (Explore)

Exploration activities should be concrete and form a common foundation for all students to build their new skills and knowledge upon. This phase lets the learners' explore new situations and procedures or get familiarized with new technologies or tasks. The teacher's role is to guide or coach the students' in this activity and let them investigate the new area of study from their own point of view based on their previous experience and ideas on the subject.

Explanation (Explain)

This phase aims to give the learners a deeper understanding of the subject. The teacher here directs the students' attention to specific aspects of the previous phases. The explanation is supposed to give the student and the teacher a common language for the experiences from the exploration and to help the student to understand the concept. The teachers presenting of the concept or skills should be brief, simple, clear, direct and connected to the students' experiences from the first two phases. Once the students' have an explanation for the subject it's important to get on to the next phase to let them use their new knowledge.

Elaboration (Elaborate)

The elaboration gives the learners the opportunity to apply, extend or elaborate their new knowledge. To achieve this the teacher should challenge the students with new activities that requires them to use their newfound explanations or skills. To support the transfer of learning and the generalization of concepts or skills the activities also can be similar but slightly different from previously explained or completed activities.

Evaluation (Evaluate)

In this phase is supposed to give the students feedback on their newfound knowledge and abilities. This phase also gives the teacher the opportunity to determine the student's understanding of the subject and to evaluate the progress toward educational objectives.

2.4.4 Zone of proximal development

The Soviet psychologist Lev Vygotskij accepted the different stadium of development suggested by Piaget but was more interested in children learning potential. Vygotskij created a model which he called Zone of Proximal Development (ZPD). The model distinguishes between what a person is able to do without help and what they can do with help (Phillips & Soltis, 2014). Further, Phillips and Soltis (2014) reports that ZPD states that when a person does something that they cannot do by their own, but get some help to understand, the learning for that person gets the highest efficiency. Vygotskij claimed that two different children can have the same intelligence quotient but despite that have totally different potential of learning development, due to the environment surrounding them (Phillips & Soltis, 2014). Vygotskij (1978, p.86) defines the ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." Thus, he describes two developmental levels. The first is the actual level, which is about what you can do by your own right now, and the second is the potential level, describing what you are capable to do with help by any means.

Recently, there have been made some instructions for e-learning according to Vygotskij's thoughts about ZPD and the learning potential of the learner. Hung and Chen (2001) have created some points about how to do e-learning based on the learning theories Vygotskij formed. The major implications for e-learning are listed below:

- The course content should be personalized, so that the learner feels meaningfulness about it.
- It should be possible to use tools for communicating and collaborating.
- There should be a scaffolding structure which includes words and expressions normally used in the community.
- There should be a structure where the learner needs support of more knowledgeable persons, like in the zone of proximal development.
- E-learning should have a continual growth and interaction between the different tools and tasks.

• The e-learning environment should be portable in order to make the learner doing it in his or her right context.

3. Methodology

The methodology chapter presents how the research study was done. First, the approach of the study is explained. In the sections following that, the execution of the data collection, the analysis of the current course and how the e-learning concept was created are described.

3.1 Approach

The research approach was of a qualitative nature with some elements of design research. Design research can be used to test and improve teaching practices by observations and prior research (Collins, Joseph & Bielaczyc, 2004). The transformation from classroom course to e-learning began with observations of the current course and prior pedagogical research, things that are incorporated in design research. Qualitative research involves analysis of sources such as documents, interviews, questionnaires and observations. The analysis performed in qualitative research is focused on words and meaning instead of numbers as in quantitative research (Bryman, 2012). Qualitative research is typically used to answer questions of why and how, rather than what and when (Hennink, Hutter & Bailey, 2011). Further, the study was performed in an inductive way. This means that observations or findings leads to a conclusion or a theory (Bryman, 2012). In this case the literature study and the analysis of the course lay as a groundwork for the proposed concept for the e-learning course.

3.2 Literature study

To obtain relevant literature about pedagogical theories, educational development and elearning, mainly Google Scholar and the search engine Summon, available at Chalmers library webpage, were used. The words and phrases searched for were: *behaviorism, bloom's taxonomy, cognitivism, constructive alignment, constructive alignment criticism, constructivism, critical success factors, design research, e-learning, e-learning critical success factors, e-learning development, the 5E model, spacing* and *zone of proximal development.* Further references were also found through the articles. Mainly the literature study was done in the beginning phase, but some additions were made throughout the work. The purpose of the literature study was to obtain knowledge and information in order to primarily answer RQ1.1 but in some manner also RQ1.3. Further, it provides a theoretical base for the development of the e-learning course.

3.3 Data collection

The data collection was made in five different ways; direct observation of the course, document study of course related documents, interviews with course teachers, course participants survey and a focus group session with people involved in the course administration. Each one of these are presented in the following six sections with a description of the general data collection method and how they were performed in this study.

3.3.1 Direct observation of the course in Teamcenter

To get information and knowledge about the Teamcenter course, both according to the pedagogically construction like processes and methods, and to obtain general insights about the course, a direct observation was made. Observations have the strength of being a data collector where the researcher actually is present when something happens (Esaiasson, Gilljam,

Oscarsson, Towns & Wängnerud, 2017). Therefore, researchers using this method do not have to trust others because they can see and hear with their own eyes and ears. Esaiasson et al. (2017) write that observations are a sharp tool when it is difficult to describe something with words, for example when studying structures or processes. Observations are commonly used when studying pedagogically situations, for instance when researching about what happens in a classroom situation. Further, they list four different reasons for doing observations, which are:

- 1. When the studied object is so obvious for the people being asked in interviews that they do not even think of it and therefore do not tell anything about it.
- 2. When there are reasons for thinking that the answers from the interviewees do not fit in with what they actually do, a difference in what they say and what they do.
- 3. When focus is on people who have difficulties with expressing orally, like children for example.
- 4. When the research is of a sensitive or controversial nature, meaning that the interviewees do not want to talk about it.

Additionally, Esaiasson et al. (2017) write about some different moments where it is not a good choice to use observations, these are:

- 1. When the researcher wants to know the intentions behind what is going on or which assumptions one does in different situations.
- 2. When the purpose is to make notations of feelings or sensations.

Number (1) and (2) in the first list of the two above are two of the reasons why a direct observation was made. Also, as stated above, when the research is about teaching situations direct observations are recommended. Therefore, there was an extra reason to use direct observation. The aim of the direct observation was get information regarding RQ1.2. During the observation notes were written down and audio was recorded to enable going back and listen to things that may had been forgotten.

The existing classroom course was attended at Volvo in Torslanda. There were two main goals with this activity. The first one was to get some knowledge in Teamcenter and understand how the software work. The second goal was to create a picture of how the classroom course is constructed and in which ways the participating learners are supposed to understand and learn the course material. Therefore, at the time when the classroom course was attended, focus was both on following the teacher and the learners and do what they did, but also, trying to make notations of how the material was pedagogically explained.

3.3.2 Document study of course exercise book and teacher manual

The document study of the course exercise book and the teacher manual was conducted as a qualitative analysis, which means that the content was studied in the form of its structure, procedures and what it is about. Esaiasson et al. (2017) describes qualitative text analysis as a method to get out the important information from a text by thoroughly reading the different parts of the text, the text as a whole and the context of the text. They write that generally this

method suits researchers who are interested in the meaning of the text and processes within it. Further, text analysis often serves as a function for answering questions in the form what, which and how, but typically not why. Esaiasson et al. (2017) distinguish between two types of qualitative text analysis, systemised and critical reviewing. The first one is about clarifying what the text is about thematic and systematic. For example, it can include deciding what aspects in a text that are of importance. The latter goes one step longer and has the purpose of, as the name of it implies, critically review the text and create ideas around them.

The book is given to the course participants in the beginning of the course occasion. The book was thoroughly read, and the main content was summed up in order to get a grip of it, like a systemised qualitative text analysis. After this, the content was also analysed according to the theories constructive alignment and Bloom's taxonomy.

As for the course book, the teacher manual was thoroughly read, and the main parts were summed up. The purpose of the document study was to obtain knowledge regarding the course and answer RQ1.2.

3.3.3 Course teacher interviews

The qualitative interviews were an important source of data in this study. Interviews are probably the most common source of data in qualitative research according to Bryman (2012). One of the big advantages with interviews is the possibility of follow-up questions (Esaiasson et al., 2017). That means the connection between the researcher and the interviewe are bigger in interviews than in surveys. Esaiasson et al. (2017) describe that interviews often are about a phenomenon, how something is and looks like and not as much about frequency, like in surveys usually. Further, they list different areas where it is a good choice to use interviews. "When we want to know how people themselves perceive its own world" (Esaiasson et al., 2017, p. 262, translated from Swedish) are one of them, and this one of the reasons why interviews were performed in this study. The authors also make a distinction between respondent interviews and informant interviews. When talking about informant interviews, the interviewees work as a witness and gives information about something they know, for example how the coffee break procedure at their work looks like.

The interviews conducted in this study were of semi-structured character, with predefined questions but still room for spontaneous and follow-up questions. The interview template can be seen in Appendix I. The interviews were held in a separate room at the interviewees workplace to not get disturbed. Notes were taken during the interviews to catch the interviewees main point of view. The interviews were also recorded to ensure that no information was missed and to get correct quotations from the interviews. Participation in the interviews was voluntary, the participants was aware of the purpose of the interviews and all approved that they would be recorded.

The three interviewees are all teachers that hold the course regularly. One of them is a senior trainer and group leader for the training group. The other two are newer to the profession and

to this specific course. It's valuable to have the different point of views from different teachers with different experience of the course.

The purpose of the interviews was mainly to answer RQ1.2 and also to some extent RQ1.3. The first group of questions were asked to gain a better understanding of the course planning and the objectives of the course. In the later parts of the interviews, questions were asked regarding the transformation of the course to e-learning. This was done do get the teachers opinion on what material and methods that can be used in a similar way in both classroom and e-learning environment. The purpose was also to get their view on what might be difficult when the course change from classroom to online. Because of this dividing, the interviews were of both informant and respondent character. The first part was of informant character when the interviewees answered questions about the current course. The later part of the interviews shifted character to a respondent interview, when the interviewees were asked about the e-learning transformation.

3.3.4 Course participant survey

Like interviews, self-completion questionnaires or surveys are typically one of the main data collection sources in research projects (Bryman, 2012). Typically, the questionnaire is sent out to the respondents by post or e-mail. Bryman (2012) describes that the most obvious difference between structured interviews and surveys is that the researcher is not there and asks the questions, instead the respondent needs to read and answer the questions by their own. This means that every participant in the survey have the same questions to answer, and follow-up questions are not possible. Bryman (2012) list some pros and cons with surveys related by interviews. The pros are that surveys are cheaper and more convenient than interviews, more time efficient and have no dependence of who performs the interview. On the other side the respondent has no possibility to ask for help or get an explanation if needed, the interviewer cannot twist and turn the questions in order to get out more information from the respondent. Further, if the questions are salient to the respondent or if the survey has to many open questions the respondent may not complete the survey.

A survey was created with the tool Google Forms, which is an online tool for making surveys. The survey in whole, including responses, can been seen in Appendix II. The link to the survey was sent to the three teachers in the Teamcenter course by e-mail, and they distributed it to previous course participants by e-mail. The survey was sent to 90 persons and was answered by one third of the respondents. All answers were anonymous and participation in the survey was voluntary.

In the beginning of the survey there was an introductory text, consisting of a presentation of the researchers and their work, the aim with the survey, expected time to answer the survey and thanks for participating in the survey. The introductory text is of importance to create trust and confidence and also to inform about the purpose of the survey (Esaiasson et al., 2017).

Since the survey was distributed by the teachers in the course, the researchers had to rely on them and trust that they would distribute the survey to the course participants. An advantage of

handing out the survey in this way was that the participants, in addition to the researcher's justification, also were asked by the teachers of the course to participate.

The purpose of the survey was to get input from the participants of the course regarding learning methods used, course content and possible room for improvement. Also, to some extent, the purpose was to get information regarding RQ1.2.

The topics of the course evaluation survey were *Purpose and course objectives*, *Prerequisites*, *Learning methods*, *Course content* and *Overall view*. The survey consisted of 15 questions in total. Four of these questions had the character of a five level Likert scale. A Likert scale is a "multiple-indicator or multiple-item measure of a set of attitudes relating to a particular area." (Bryman, 2012, p. 166) For example, this means that a statement is followed by the answer alternatives strongly disagree, disagree, neither agree nor disagree, agree and strongly agree and the respondent must to choose one of these alternatives. Each of these four questions were followed by some lines to enable a comment according to the selected answer.

Two of the remaining questions were multiple choice questions, were the respondent had to choose just one of the alternatives. Also, these two questions had one open follow-up question each. The three questions remained were of an open character. Totally there were 30 persons who participated in the survey.

3.3.5 Focus group

Esaiasson et al. (2017, p. 330, translated from Swedish) write that "An advantage [...] with focus groups compared with interviews are that they reduce the directive role of the interviewer. The point with focus groups is that the participants shall get started a conversation where they address different questions or statements to each other." Further, when there is a discussion it is possible that ideas are generated by the participants and also the researcher may get an understanding about the interpretations that are made by the participants. This means that a focus group was a suitable method for getting response about the e-learning concept and therefore the method was used to answer RQ1.3.

The focus group discussion was conducted by five persons, including the course owner, one person working with questions regarding Teamcenter, two of the course trainers and one person working with testing of Teamcenter and questions about the program. One of the researcher was designated as a leader for the conversation, trying to keep the conversation in the right direction. By right direction means that the conversation had a specific focus, decided beforehand, and the leader had the role of guiding the focus group towards that focus. The other one of the two researchers were taken notes during the conversation and the dialogue were recorded. The focus group had the purpose of getting opinions about the concept for the

e-learning course, by letting the participants discuss it with each other. This is in line with Esaiasson et al. (2017), the focus group should have a conversation leader, a purpose of the composed group and a specific theme.

The focus group were conducted at Volvo in Torslanda in a typically classroom with a projector and whiteboard for presentation. In order to get a better discussion there is, according to Esaiasson et al. (2017), an advantage of conducting the focus group sitting around a round table. Therefore, the tables and chairs were reordered in that way. Also, they were placed in front of the whiteboard, making it easy for everyone to see the presentation.

Before the session started, the participants were informed about the purpose of the session and approved that they would be recorded. The focus group leader began with a short presentation of the research work performed and then shifted focus to the concept for the transformation of the course. Primarily, *Module 4* (see chapter 4.3.1) was presented, but also a short look of the other modules was done. This because *Module 4* involves most of the things that exists in the rest of the modules. The researchers and the participants of the group were familiar with each other due to a previous meeting and therefore, no presentation or introduction questions were made.

After the presentation, the discussion regarding the new e-learning course concept was started. The discussion was divided into the three questions; (1) Does the concept meet your expectations? (2) What do you think about the possibility to implement the course concept? (3) Do you have any further comments regarding the concept? The analysis was done in the same way as for the qualitative interviews. Thus, different areas according to the three questions were created and interesting answers concerning these areas were described and strengthen by some quotations.

3.4 Analysis

In addition to the direct observation of one course occasion and the document study of the course material, the course was analysed. This analysis was mainly done by using the theory constructive alignment and to some extent also Bloom's revised taxonomy.

Constructive alignment can be used both as a framework for course design, but also as a tool to analyse an existing course. To analyse the course through constructive alignment theory one can focus on the three issues proposed by John Biggs (1996), accounted for in section 2.2.2.

The first step (1) is to ask the question; "what qualities of learning are we looking for; what performances need to be confirmed in the assessment?" (Biggs, 1996). The next step (2) is to look at the assessment. What knowledge or abilities are tested? Does it test the desired learning outcomes? Another important issue to examine if the assessment tasks and the learning objectives are at the same level of understanding. If the course objectives for instance are on level five of Bloom's taxonomy, *evaluate*, then the assessment task must be on the same level. If the assessment is on a lower level than the course objective, it cannot be used to evaluate whether the objectives are fulfilled or not. The last step (3) is to examine the teaching or learning activities. Do the learning activities help the students to reach the learning objectives?

In order to analyse the results from the interviews, the information gathered was divided into three different areas; *Understanding of the course objectives and planning*, *Transformation of the classroom course to e-learning* and *Opinions regarding difficulties when changing from classroom course to e-learning*. At first, the notes taken during the interviews was used to start

sorting the answers. When the answers were sorted into the different areas, the recordings were used to transcribe the answers that was relevant to the research questions.

Regarding the survey, Google Forms own tool for analysis was used to summarize the result, especially the questions of a non-open character were summed up in this way. The survey was of a qualitative nature, meaning that no statistical approaches were made. Therefore, the percentage of the respondents was enough to get input for the purpose stated in 3.3.4. Common answers were noticed to get a grip of the main parts and to create patterns of how the current course has been experienced by the learners. In order to get an overview of the answers to the open questions, they were divided in different clusters depending on how they were related to each other. For example, quotes about the teachers and quotes about the division of learning activities, etc.

3.5 E-learning concept

The e-learning concept is the result of the research study. The concept is a recommendation of how to best use and change the materials in order to get a well-functioning e-learning course in an easy way. The concept is based on the literature presented in the theoretical framework chapter, the results gathered from the different data collections and by using a combination of constructive alignment and Bloom's revised taxonomy to analyse the existing course and to aid the design of the new course.

The e-learning course concept was created with respect to the different learning theories accounted for in chapter 2 and the implication of these for e-learning. For example, the new course disposition is made of several learning modules to help the learners to organise the material into smaller parts. To form the new course concept, constructive alignment was used as a framework to ensure that the course objectives, learning activities and assessment were connected to each other. Another theory that was used to construct the new course disposition is the 5E model. The model is not used strictly, but rather as a framework to use as much as possible when designing the course modules. Every module follows the 5E model to some extent, depending on the amount of content and the topic of each module.

Since the e-learning course is a transformation of the current classroom course, the objectives are taken from the current course material. The exercises from the existing course can be used in online course, but with more focus on learner activity. The recommendations of different learning activities are based on the literature study, the result of the interviews and the self-completion questionnaire.

4. Results and analysis

This chapter contains the results from the data collection. It starts with the data from the observation of the Teamcenter course. The next section contains data from the interviews with the course teachers and the section after that shows the data from the survey to the course students. Finally, a concept for the transformation of the classroom course into e-learning, based on the theoretical framework established in chapter two and the data collected during the study, is presented.

4.1 Teamcenter CAD Viewer and TCVis Basic

This section contains data about the course, *Teamcenter CAD Viewer and TCVis Basic*, collected from the course material and through course observation.

4.1.1 Course material

The course material given to the learners are an exercise book. The following are information originated from that book. The name of the course is *Teamcenter CAD Viewer and TCVis Basic* and it's supplied by Volvo Cars Corporation. The course type is classroom training, the duration is one day, and it grants the participator the access level *viewer* in the Teamcenter software. The target group is employees that need to search for documents and information and to visualize models in Teamcenter. The main focus is on people that need to view CAD documentation. No prior knowledge is needed, although it's recommended that the participants has attended the course "Green card product documentation" before this course.

The purpose of the course is presented to the students as follows:

"The course participant will learn how to search and find documents and how to find information regarding these. They will also learn how to filter out a virtual car from the Teamcenter structure. The training will also give knowledge regarding how to use the Product Visualization webpage to find a virtual car and load it to Teamcenter Visualization (TCVis). Participants will learn how to use some of the basic tools in TCVis."

The teaching activities exist of the 11 different exercises in the exercise book. In fact, the whole course is based on that exercises. Both when the teacher instructs and shows how to do and when the learners work on their own, the exercises in the book are used. Beyond that, the teacher also presents the learning material in a more traditional way with Powerpoint slides, but these moment always end up with one or more exercises in the book.

The named exercises are all constructed in a similar way. Typically, an exercise is divided in several steps, named with a number followed by one or several describing words. Each of these are subdivided into some points. These points are usually directives for the reader or learner of what to do. In addition to this, pictures are often integrated under the subdivided points. The pictures are screenshots from the program and visualize where to click or write in the program. The following is a typical example of how this looks like in the exercise book, see *Figure 1* and *Figure 2*.

Star	t Exercis	e 5					
1. Op	pen Docum	ent Portal					
	Click Docu	umentPorta	Applicatio	on.			
	 My Te Docur Struct Design 	eamcenter mentPortal A ture Manager nContext	pplication				
2. Sea	arch						
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•	Click Add to	Part.					VM2251
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	💆 Add to part: (GEAN-PROD-3338	8892/006(3338389 Part GEAN-PROD-333	92-01/6) Connections for 183892/006(3338)	3892-01/6)		
	Part Number	Part Version	Part Issue	Rank	Part Name	Part Status	
	31094287	AA	3	Primary	CARRIER RH	PREL	

Figure 1. Example of exercise 5 in the course book, first part.

	In Document Portal, click Pa	art Connect	tions.		
	Search for part number 3169	4287.			
	Select the part version you fo	und.			
	Check the bottom field to view	w if any doc	uments are connecte	ed to the	
	part.				
	Disconnect/Copy Part Documents			8	
	Part Number: 31694287		Copy Documents to	another Part?	
	Select part below to view connected documents Part Number Part Version	Part Issue	Part Name Part S	tatus	
	31694287 AA	3	CARRIER RH PREL		
	Document Connections for selected part Rank Status Doctype Subtype Doc N.	Sheet Doc Re	Doc Ti TCE Ite TCE Ite T	CE Ite User ID	
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Figure 2. Example of exercise 5 in the course book, second part.

Notably, the words the learner have to click on are marked with bold letters. Also, the instructions are in the type of a verb followed by the "learning objective". Frequently used verbs are click, go to, select, open, change, write and so on. The "learning objective" differs depending on the exercise the learner is doing.

4.1.2 Teacher's manual

In addition to the exercise book, the teachers have a manual for the course. The teacher's manual is a document distributed to all teachers on the course. The document contains instructions for the teacher to follow before and during the course. First, there are instructions for how and when to contact the course participants before the course, and what information they should receive. Then, there are instructions for how to perform the teaching. It is stated when to show Powerpoint slides and when to perform the exercises. There are also some notes about things that are important to show or explain to the participants, both during lecturing and exercises.

4.1.3 Course observation

Below are some hard facts from the attended course:

- One teacher (always one single teacher).
- Seven learners in total with an age interval between about 25 to 65 years old.
- Start time of the day was at 9 am and the end was around 3 pm.
- One hour break between 12 am and 1 pm for lunch.
- Two coffee breaks, one before lunch and one after.
- Every learner got one computer each with two screens and one exercise book with instructions of how to do the exercises.
- The teacher had one whiteboard used for Powerpoint presentation and a desk beside the whiteboard for the computer.
- The language that was used were English, both in Powerpoint presentations, the exercise book and in Teamcenter.

These facts were of course easy to recognise, just by being in the classroom and keeping the eyes and ears open. To get a grip of the different learning activities and how they were cooperated with each other were harder. To understand the course, the method of identification was to divide the whole course into different learning activities, for example could the different chapters in the exercise book be such type of separating. One observation from the course was that there was actually no clear dividing in the learning activities, which made it difficult to separate the observations in the described kind of clusters above.

Three different types of learning activities were used in the classroom course. (1) the teacher spoke to a Powerpoint presentation. It was typically explanations of how different things in Teamcenter looks like, how the program is used at Volvo and why Volvo uses it. (2) the teacher did exercises on her computer, which was connected to a projector in order to show the learners the exercises she did. The learners did the same exercises as the teacher did, step by step, like the game Simon Says. For every step the teacher made, she also described verbally what she did, making it possible for the learners to both listen to her and see on the whiteboard what she did. (3) the learners followed the exercise book. The book was constructed in the same way as the way the teacher showed and described how to perform the exercises, in the same way as explained in point (2). The difference was, of course, that instead of hearing the teacher's verbal instructions, the learners had to read the instructions in the book. In addition to the text, screenshots from Teamcenter were attached in the book, showing the learners where to click in order to solve the exercises.

The points (1), (2) and (3) were mixed with each other, especially the second and third point. Sometimes when going from one chapter to another in the exercise book, the teacher begun with (1) followed by the points (2) and (3). But, other times it was just the points (2) and (3) that were used or (1) and (3). It was not clear why and in which situations the different set-ups were used. Nor was it always easy to keep in mind where in the exercise book the current learning sequence were and at the same time hang on with the teacher's instruction, for example in which specific chapter in the book the learning sequence belonged. Sometimes the teacher said something like "go to exercise XX on page YY in the exercise book". Then, of course, it was easy to know in which phase the current learning moment where in the book and the course. At other times, it was harder to know where in the book the present learning belonged, but then following the teacher was easy.

4.1.4 Course teacher interviews

Three interviews where held, one with each of the trainers in the Teamcenter course. First a short description of each of these is presented and then the result from the interviews follows. In order to not expose who of the interviewees who said what, their name is replaced by the letters *A*, *B* and *C*. The result is divided in three different categories: *Understanding of the course objectives and planning, Transformation of the course to e-learning* and finally *Opinions regarding difficulties when changing from classroom course to e-learning*. Also, the result is presented as a summary of the answers and supported by quotes from the interviews. The interviews were conducted in Swedish, therefore the quotes are translated to English.

Description of the interviewees

Interviewee A has been working with the course for about three to four years and has worked with Teamcenter since year 1999, as user, super user and as a trainer/teacher. A is mainly working as team leader for the group of teachers, which means that A works with the planning of the course.

Interviewee B works as a PLM trainer, which involve teaching in the Teamcenter course. Also, B has a supporting role regarding the programs linked to Teamcenter. This is the first job after completed studies with a double Master of Science, both in education and in engineering. B has been employed by Unico for about eight months.

Interviewee C works as a PLM trainer, which involve teaching in the Teamcenter course. Also, C has a supporting role regarding the programs linked to Teamcenter. C has a Bachelor of Science in Engineering and has also studied some courses in rhetoric. C has been worked as an employee at Unico for about six months.

Understanding of the course objectives and planning

The answers regarding the purpose of the course where quite the same for the three interviewees. All three said that the purpose is to get an introduction and get familiarized with Teamcenter. It is about basic knowledge like knowing where and how to find information and how to search in the program.

"Find information, know where to find the information, how do you find the virtual car? How do you find what you seek in the best way? [...] That's the overall function really." -A
Additionally, they were talking about the Teamcenter visualization program TCVis.

"One should familiarize yourself with Teamcenter and also circumvention visualization programs. In this case, it is TCVis." -**B**

They were also talking about how to find and use different workbenches, like methods and processes.

"The second purpose is the methods and processes [...] thus how to use Volvo's internal net in order to find help and knowing how to serve yourself when you get problem with things." -**B**

About the arrangement of the order of the different parts of the course, A explained that the order is shifted occasionally:

"That has shifted periodically, so it doesn't have to be specific this or that. For a while, we start with Teamcenter, for a while we start with visualization, a different period we start by talking about who uses this around and which around features is needed. So, we have shifted this, depending on how we feel. [...] You cannot always do the same, you must change it [the course]. Otherwise you will get tired of it." -A

All interviews confirmed that there is no assessment to determine if the participators reach the course objectives. The motivation for this was that it's up to the course participators themselves to learn what they need. Also, they only get a viewer access after the course and will not be able to edit things in Teamcenter, only view them.

"We don't need to control it [the learning objectives] because they [the learners] only get a viewer access, they can never create something in Teamcenter. They can only search for information, but they can never create something, so they can't cause any damage in Teamcenter. So, it's really up to them, if they want to learn anything or not." –A

Transformation of the classroom course to e-learning

The interviewees were asked what they think is important to think about when transforming the course into e-learning. The answers can be categorized into two main themes, learner participation and learning assessment. About the learner participation, A stated:

"To get them [the learners] involved, I think that's the hardest and most difficult part. To bring them along, get them to understand why this is important to them [...] so they don't sit and just let it [the course] roll past them." -A Both **B** and **C** talked about the need of some sort of learning assessment to ensure that the learners are doing the exercises and learning something.

"I think that some kind of control is needed to have an e-learning course, [...] it doesn't have to be a strict scenario exercise [...] it can be that one has finished some steps and successfully produced something that can be regarded as a validation." -**B**

"That they [the learners] really do the exercises. The e-learning I have seen have been like just reading and almost just skipping through it so make sure that they really do the exercises. Then finish with some kind of scenario to make sure they have understood and to make it more interesting." -C

All three of the interviewed thought that much of the course material can be used in a similar way in the e-learning course.

"The exercises definitely, they can definitely be used, [...] a short demo first and then they [the learners] can do the exercise on their own." -A

"Everything [the course material] I think. Or what can't be used?" -C

Even though they all think that much of the material can be used, both B and C stressed the importance of how the material and exercises are presented.

"You can use many of the exercises to learn by yourself. Maybe they need to be rephrased a little bit since I'm explaining certain steps as it is now. [...] They are based on methods, all the exercises, so every step that you do in an exercise have a connection to a method on the intranet. And these methods are in the margins of the exercises, [...] I'm pretty sure that you could wade through the course by using the exercise book and these methods, but I haven't tried so I don't know." -B

"The engineering portal, and when you show them the DMU-garage and explain what all parts represent, if you have that in text no-one will read it. [...] I don't think that it [e-learning] will work if it's much text. You notice that people don't like to read, especially when it's much text, then no-one read." -C

Opinions regarding difficulties when changing from classroom course to e-learning The main difficulty with changing from classroom course to e-learning according to the interviewees was that the participants in the course do not have the possibility to ask questions during the course. Or in other words, there are no trainer present who can answer questions.

"[...] especially if they [the learners] have questions is it difficult to answer them when you are not there." -C B and C also talked about how the trainer can adapt the teaching depending on which background or work role the participants have. They said that in a traditional classroom course it is possible to describe something in different ways to reach a better understanding, something that is hard in an e-learning course.

"To have someone who is there to help you, who can give you some tips and tricks and explain in three [...] ways. You cannot do that in e-learning. [...] An advantage with trainers is that they can twist and turn formulations and adapt them along the learners they have and also adapt the materials [...], if they have a hum about what they are doing. I think that you are more flexible in a classroom than you are online." -**B**

Interviewee *A* was talking about a solution according to that problem.

"Perhaps there may be some information in the end [of the e-learning] telling that the learners can contact us if they have any reflections or questions. Then, I think you get the backup that may be important." -A

4.1.5 Course participant survey

The result from the survey is presented both with pictures of diagram and in text form with quotations from the open questions to strengthen the result.

Course content

When looking at the result of the question regarding the division of different learning activities, most of the respondents are divided into two different ways, see *Figure 3*. One group, around two fifths, thinks that the division between the different ways of working was not so well balanced and one group, also around two fifths, thinks that it was well balanced. Although there is a small part who neither agree nor disagree. It is notably that the label "Somewhat agree" was missing among the possible answer alternatives for this question, instead the label "Somewhat disagree" existed twice, see Appendix II. That could mean that some of the respondents who chose the labels "Strongly agree" or "Neither agree nor disagree" would have chosen the missing label instead. It is also possible that some of the respondents happened to choose "Somewhat disagree" when they were intended to choose "Somewhat agree". The question to answer is what do the respondents want more of in order to get the different working ways more well balanced in the course?

The division between the different ways of working (theory, exercise, group work, discussion) was well balanced.

30 responses



Figure 3. The division between different ways of working (theory, exercise, group work, discussion) according to the respondents.

The answer to that question can be seen in the pie chart, *Figure 4*. Around two thirds of the respondents in the survey would have liked more exercises, when they pointed out which of theory, exercise, group work or discussion they would have liked more of. Basically, the rest think that the current division is good as it is, which is relatively in line with the result from the previous question. Though it seems like some of the respondents who think the division was good (see the result in *Figure 3* above), have wanted some change in the division according to the answers in this other question.



Figure 4. Response distribution of which of the working ways theory, exercise, group work and discussion the respondents would have wanted more of.

To further investigate witch areas that can be improved, the respondents were asked if something was missing or if something should be added in the course. They were also asked to list the three things they liked most about the course and the three things they thought could be

improved. The answers from these questions are divided in the five categories *Practice*, *Theory*, *Teacher*, *Course length* and *Adaption to the learner's job* and is presented below.

Practice

One of the most common answers concerned the exercises in one way or another. A lot of the respondents thought that the exercises was good and that exercises and practice done by themselves was positive for the learning experience. Many respondents asked for more and/or better exercises, for example more hands-on exercises.

"More "real" cases would be nice."

It was also stated that some sort of follow up activity would be good for the learning result:

"[...] if you really should learn everything in the course I think it would be good with a follow up session or some exercises to do after the course."

In order to get a more individual touch of the course and the exercises one respondent stated this:

"Ask the education participants prior to the education what they will use the programs for and include some exercises into the education. They could have more exercises and let the participants select the exercises that are more suited for their type of use of the program"

Beyond the exercises, it seems like the course book provided in the beginning of the course was appreciated. Both to have for taking notes during the course and afterwards when in need of help the book could be used. Some respondents answered that the instructions in the course book were easy to follow.

Theory

The survey showed that there were different meanings regarding the course theory. For example, learning more about a specific topic like how to use revisions and versions, was the wish of one respondent while other respondents expressed other opinions regarding the content. There were also different opinions regarding the amount of theory. Some respondents wanted more theory while others thought it was too much.

Adaption to the learner's job

Some of the respondents think that the course could be better adapted to the learner's job. One respondent stated it like this:

"The course could better focus on the need of the use related to the job function. Some parts are not interested [sic] for some people and some are very useful. If the trainer focus on the need I think more of my other colleagues would enjoy it more as well." One suggestion regarding this was:

"Option to tailor to each participants [sic] respective need in his/her department"

Course length

There were different meanings regarding the length of the course. Some respondents thought that the course was well balanced, and some that it was not enough time to go through the whole content properly and to understand. One respondent stated that the learners experience before attending the course affects how much time is needed.

"Don't think 1 whole day is necessary for this course (if you have some experience before)."

Some other respondents also mentioned solutions according to that.

"Participants with the same skill level would perhaps be more efficient."

"Merge participants with similar background/needs."

Teachers

One of the things that was characteristic for the answers was that the respondents think that the teacher did a good job. This was expressed in different ways, such as the teacher was well prepared, relaxed and focused and knowledgeable. But also, they answered that it was good to have the ability to ask questions to the teacher and the teacher was good at explaining difficult things.

4.2 Course analysis

The analysis is a combination of Bloom's revised taxonomy and a constructive alignment framework, see *Table 3*. Both the overall aim of the course and the course objectives are stated in the course material. They were also explained by the course teachers during the interviews. When it comes to the assessment, the teachers explained that they don't use any assessment since the course only give the participants viewer access to Teamcenter. At last, the learning activities are described by the teachers as mainly lecturing and exercises. The lecturing has been observed during the course and the content is also listed in the teacher's manual. The exercises are listed in the course material.

In order to analyse the course by Bloom's revised taxonomy the course outcomes were divided into Bloom's six different key objectives. Each of the six key objectives remember, understand, apply, analyse, evaluate and create, were numbered from 1 to 6. The revised taxonomy also includes a second dimension, the knowledge dimension. The four knowledge categories are marked with the letters A, B, C or D. The course objectives in the Teamcenter course are listed in *Table 3* below and in brackets are the related number (1-6) and letter (A-D) belonging from the key objectives according to Bloom's taxonomy. In other words, a course objective is followed by a bracket including a combination a number and letter, for example (1B), which

means that the objective relates to the key objective remember and has the knowledge dimension conceptual.

According to Bloom's taxonomy the six different key objectives describe different levels of learning, from the lowest level, remember, to the highest level, create. By this, the different course objectives are distributed between the three lowest learning levels remember, understand and apply. The knowledge dimensions are represented by factual, conceptual and procedural knowledge, but not the metacognitive one.

According to the result of both the survey and the interviews, the exercises are well functioning. Although, it seems that the course participants often get to little time to actively work with the exercises in the current course disposition. The teachers all thought that the exercises could be used in a similar way online, and that's in line with our own conclusions regarding the course material. To enhance the learning, the learners must get much more engaged and activated during the course. As one can see in *Table 3*, the learners often get the information or instructions for how to perform a task but according to the findings in the study there isn't enough time for them to try the things for themselves. To achieve active learning, the learners must get time to perform the exercises by their own. The table also shows that there is a lack of assessment in the course which should be added in the online course.

Objectives (Bloom's level of learning)	Learning activities	Assess- ment	Comments	Implications for online learning
Learn how to find (1A), and use (2C, 3C), supportive documents.	Teacher demonstrate exercise 1, learners follow instructions and try for themselves.	-	Learners get enough information for (<i>1A</i>), although assessment of (<i>2C</i>) and (<i>3C</i>) is missing.	Can be done in a similar way online with addition of some assessment.

Table 3. Course analysis of the classroom course including objectives, learning activities, assessment, comments and implication for online learning.

Learn how to use	Teacher lectures	-	Learners get	The lectures and
(2B, 3B) some	about the basics		information about	exercises can be
basic tools in	in Teamcenter		the basic tools but	used online.
Teamcenter.	and then		little time to	Although the
	demonstrates		practice it and no	lecturing need to be
	exercise 2 3 and		assessment of	short and concise
	4 The learners		(2R) and $(3R)$	and the learners
Learn how to find	follow the	_	Learners get	should be engaged
(1A) information	exercises on their		enough	more The
about an item and	own computers		information for	exercises work to
how to visualize	own computers.		(14) and get to try	fulfil the
<i>(3A)</i> it.			(IA) and get to try (2A) but there is	abiactives but the
			(<i>SA</i>), but there is	loornors nood to got
				realities need to get
T 1 /			II.	more time to
Learn now to $parform(2.4)$ on		-	Learners get	
advanced search			instructions on	own. Assessment
auvaneeu searen.			how to perform	of the objectives is
			(3A), and a	also needed.
			chance to try it	
			but there is not	
			much practice and	
			no assessment.	
Learn how to	Teacher lectures	-	Learners get	The lecture and
search $(3A)$ in	about the		instructions for	exercise can be
document	Document portal		how to do the	used online,
portal and view $(3R)$ connections	and demonstrates		things $(3A)$ stated	although with more
(<i>SD</i>) connections	exercise 5. The		in the objectives	focus on learner
documents.	learners follow		but little time to	practise and
	the exercise on		practice it and no	complemented with
	their own		assessment.	assessment of the
	computers.			objectives.
Learn how to	Teacher lectures	-	Learners get	The material can be
open $(3A)$ the car	about the		instructions for	used online, but
structure in	structure in		how to do the	with more focus on
Teamcenter and	Teamcenter,		things (3A) stated	practice and with
(34) where in a	revision and		in the objectives	addition of
structure DI is	variant rules.		but not much	assessment of the
used.	Exercise 6 and 7		practice and no	objectives.
	is demonstrated		assessment.	-
Learn how to	and the learners	-	Learners get	
open (3A) a	follow the		instructions for	
specific car	exercise on their		how to do the	
variant	own computers.		things $(3A)$ stated	

in Structure Mana			in the objectives	
ger.			but not much	
			practice and no	
			assessment.	
Get familiarized	Teacher lectures	_	Learners get	The instructions
(1B) with the	about the Product		instructions and	and exercises can
Product	Visualization		time to get	be used online. To
Visualization	webpage and		familiarized (1B)	make the learners
webpage.	TCVis basics		with the subject	more active in the
Get familiarized	Exercise 8 and 9		Learners get	learning process
(1B) with	are demonstrated		instructions and	exercise 8 can be
the basic tools	sten by sten with		time to get	done with less
of TCVis.	time for the		fomiliarized (1P)	instructions
	learners to do the		with the subject	Assessment of
	avaraisas by them		with the subject.	Assessment of
	calf between the			exercise furniment
	demonstrations			call be belieffcial
L come h orre to	Tagahan laaturaa		L company ant	Omme.
Learn now to $apply (3C)$ a	l eacher lectures	-	Learners get	Can be done in a
Volume filter and	about Design		instructions and	similar way online,
save the result as	context and		time to learn the	but with addition of
a Design Context	demonstrate		things (3C) stated	assessment of the
item.	exercise 10. The		in the objectives.	objectives.
	learners then get		Assessment of	
	time to do the		objective	
	exercise by them		fulfilment is	
	self.		missing.	
Understand (2BC)	Teacher lectures	-	Learners get the	The lecture and
the purpose of	about BOM/CAD		information	exercise can be
BOM/CAD	alignment and		needed to	used online, but
how to use the	demonstrate		understand (2BC)	with more learner
tool.	exercise 11. The		the subject but	activity.
	learners follow		assessment of	Assessment of the
	the exercise on		how to use the	objectives should
	their own		tool is missing.	be added.
	computers and get			
	to read an			
	informative			
	document about			
	the subject.			

4.3 Concept for transformation of classroom course into e-learning

In this section, the new course concept is first presented and explained. This is followed by a constructive alignment analysis of the concept and the focus group evaluation.

4.3.1 Course disposition

In this section, the course disposition will be presented. It's based on the already existing course material, such as exercises, lecture slides and the teacher's manual. Although, the new configuration is made in view of the research work carried out. The new course design is made through constructive alignment to ensure that there is a connection between the objectives, the learning activities and the assessment. Another learning theory that had particularly big impact on the design is the 5E model, described in section 2.4.3.

The course is divided into modules to make it possible for the participants to adjust the training to their work schedule. In every module, the 5E model is used to enhance the learning. The learners are in focus thanks to the constructivist perspective. As an implication of the zone of proximal development theory, the course is organized so the learners get more help and support to perform the exercises in the beginning than in the end of the course.

Course introduction (Engage)

The course starts with a course introduction module. This module is intended to get the learners engaged to the course and explain the course disposition and give them necessary and valuable information. The introduction starts with a form where the participant is asked about their work role, previous Teamcenter experience and expectations on the course. Then follows information about course purpose and objectives, and the learners gets to see examples of what they will be able to do after completing the course. Also, the course disposition is explained, and the participants are informed about how they can reach the course teachers if they have any questions during the course. A quiz with a small number of multiple choice questions regarding the information given is used to increase the participants engagement and also highlight the bullet points of the module.

- Pre-course form
 - Name, role, Teamcenter experience, expectations on course.
- Video
 - State course purpose, aims and objectives.
 - Show examples of what the learner will be able to do after completed course.
 - Explain course disposition.
 - Important information (for example about teacher support, where to find it)
 - Inform about Exter V3, what is this and why is it important?
- Text
 - State course purpose, aims and objectives.
 - List examples of what the learner will be able to do after completed course.

- Explain course disposition.
- Important information (for example about teacher support, where to find it)
- Inform about Exter V3, what is this and why is it important?
- Quiz
 - One to three multiple-choice questions regarding the information given in the video and text. The questions need to be answered correctly before the module is completed.

Module 1: PLM methods and support

The first learning module treats the subject *PLM methods and support*. The purpose is to give the learners knowledge about how to find and use supportive documents. Due to the nature of the topic which is quite simple (more or less use a search tool to find support documents), the 5E model is not used in its whole in this module, but in a slightly compressed manner. In the first part, the objectives of the module are stated, followed by a short lecture about the subject. Also, information is given about further reading available about the topic. This is supposed to engage the learners and provide explanation of how to use the PLM methods and support. This is followed by a task that gives the learners opportunity to explore the subject and elaborate their understanding by themselves. To assess if the learner is able to find a specific support document, the module ends with a question about information in a specified document.

Objectives:

• Learn how to find, and use, supportive documents.

Learning activities:

- Video (Engage/Explain)
 - State objectives
 - Lecture slides with spoken explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)

• Text (Engage/Explain)

- State objectives
- Lecture slides with written explanation
- Further reading (show where to find more information about this topic, for example where you find it in PLM methods)

• Task (Explore/Elaborate)

• The learner follows the instructions in Exercise 1 from the course book

Assessment:

- Task (Evaluate)
 - Answer a short text question about a specified PLM method.

Module 2: Introduction to Teamcenter / Teamcenter basics

The second module gives the participants an introduction to Teamcenter. They will learn how to use some basic tools in Teamcenter, how to search for information and how to visualize an item. The module follows the 5E model and starts with a video intended to engage the learners. In this video, the objectives of the module are stated, and the teacher shows an example of what the participants will be able to do after completing the module to get them engaged. This is followed by a short lecture about Teamcenter basics and at last further reading is recommended. All information given in the video is also available in writing for those who prefer to read rather than to watch a video. To get the learners more engaged, and also to increase the retention of the learning, a short quiz follows the video/text section. After the quiz, the learners get to explore the Teamcenter basic tools by themselves through an easy exercise. The exercise is followed by video examples of the next two exercises and some useful tips and tricks from the teacher. The exercise instructions are also available in writing and images. The final part of the module is a task similar to the example exercises. This task is intended to let the learner elaborate the skills and knowledge obtained in the module. To complete the module and evaluate the learning outcome a question shall be answered with information obtained through the exercise.

Objectives:

- Learn how to use some basic tools in Teamcenter.
- Learn how to find information about an item and how to visualize it.
- Learn how to perform an advanced search.

Learning activities:

- Video (Engage)
 - State objectives
 - Show what the learner will be able to do when he or she have the requested knowledge
 - Lecture slides with spoken explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- Text (Engage)
 - State objectives
 - Lecture slides with written explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)

- Quiz (Engage)
 - One to three multiple-choice or short answer questions regarding the information given in the video and text. If the answer is wrong, correct answer is displayed to the learner. The questions can be done again and need to be answered correctly before the module is completed.
- Task (Explore)
 - Learner try the exercise on their own
 - Easy, for example Exercise 2 from the course book
 - Step by step instructions available upon request
- Text + Images + Video (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Exercise example (Exercise 3)
 - Exercise example (Exercise 4)
 - The trainer gives tips and tricks, why are we doing things in a certain way?

Assessment:

- *Task* (Elaborate/Evaluate)
 - Similar to example exercise but without step by step instructions.
 - Answer a question with information obtained through the task to complete the module.

Module 3: Document portal

The third module is quite short and treats the subject *Document portal*. The participants are supposed to learn how to find information about an item and how to visualize it. Like module one, the use of 5E is slightly compressed simply because the material/task in this module is rather short and straight forward. Therefore, the first part is supposed to both engage the learners and provide them with an explanation of the subject. Both video and written material is available for this. Then follows further explanation in the form of an exercise example, both in video and text form. The module is finished with an assessment task similar to the example exercise. This exercise is, apart from the assessment, also intended to let the learners both explore the subject and to elaborate their skills.

Objectives:

• Learn how to find information about an item and how to visualize it.

Learning activities:

• Video (Engage/Explain)

- State objectives
- Lecture slides with spoken explanation
- Further reading (show where to find more information about this topic, for example where you find it in PLM methods)

• Text (Engage/Explain)

- State objectives
- Lecture slides with written explanation
- Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- Text + Images + Video (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Exercise example (Exercise 5)

Assessment:

- Task (Explore/Elaborate)
 - Similar to example exercise but without step by step instructions.
 - Answer a question with information obtained through the task to complete the module.

Module 4: View structure

The fourth module is called *View structure* and deals with the subject of how to open and view specific cars in Teamcenter. Like the other modules it starts with a video (and text) supposed to engage the participants to the subject. In the video the objectives of the module are stated along with an example of what the participants will be able to do after completing the module. This is followed by a short lecture and recommendations for further reading. To explore the subject, the learners get an easy task to try for themselves without too much instructions. Then follows two exercise examples, where the teacher explains the exercises in a video with written instructions as a complement. The module is finished with one or two tasks, similar to the example exercises. To assess if the objectives are met, a question must be answered with some information obtained through the exercise before completing the module.

Objectives:

- Learn how to open the car structure in Teamcenter and also how to view where in a structure DI is used.
- Learn how to open a specific car variant in Structure Manager.

Learning activities:

- Video (Engage)
 - State objectives

- Show what the learner will be able to do when he or she have the requested knowledge
- Lecture slides with spoken explanation
- Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- Text (Engage)
 - State objectives
 - Lecture slides with written explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- *Quiz* (Engage)
 - One to three multiple-choice or short answer questions regarding the information given in the video and text. If the answer is wrong, correct answer is displayed to the learner. The questions can be done again and need to be answered correctly before the module is completed.
- Task (Explore)
 - \circ The learner tries a simple task without too much instructions
 - Very easy (for example open a program node)
 - Step by step instructions available upon request
- *Text* + *images* + *video* (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Exercise example (Exercise 6)
 - Exercise example (Exercise 7)

Assessment:

- Task (Elaborate/Evaluate)
 - Similar to example exercises but without step by step instructions.
 - Answer a question with information obtained through the task to complete the module.

Module 5: Product visualization

The topic of this module is product visualization. After completing the module, the participants should have got familiarized with the product visualization webpage and the basic tools of TCVis. The disposition of the module is very much like the disposition of the fourth one. It starts with information about objectives and a quick example of an exercise. This information is given both in video and text form. The video/text is followed by a quiz to make the learners more engaged. To explore the subject in their own way, the learners gets to do an exercise

without detailed instructions. After the exercise further explanation of the subject is provided through a video and text example exercise. The module is then finished with an exercise that assess if the learning objectives are met.

Objectives:

- Get familiarized with the Product Visualization webpage.
- Get familiarized with the basic tools of TCVis.

Activities:

- Video (Engage)
 - State objectives
 - Show what the learner will be able to do when he or she have the requested knowledge
 - Lecture slides with spoken explanation
 - Quick example of exercise 8
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- Text (Engage)
 - State objectives
 - Lecture slides with written explanation
 - Instructions for exercise 8
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)

• Quiz (Engage)

• One to three multiple-choice or short answer questions regarding the information given in the video and text. If the answer is wrong, correct answer is displayed to the learner. The questions can be done again and need to be answered correctly before the module is completed.

• Task (Explore)

- The learner does exercise 8 on their own
- Step by step instructions available upon request
- Text + Images + Video (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Exercise example (Exercise 9)
 - The trainer gives tips and tricks, why are we doing things in a certain way?

Assessment:

- Task (Elaborate/Evaluate)
 - o Exercise 9
 - Upload screenshot after step 1-6
 - Upload created snapshot after step 9
 - o Upload saved session file to complete module, step 13

Module 6: Design context

This module deals with the subject *Design context*. The participants should learn how to apply a volume filter and save the result as a Design context item. First, the objectives and some lecture slides are presented in both video and text. After that, another video provides further explanation and an example exercise demonstration by the teacher. This exercise example is also available in writing and images for those that prefer to read the instructions. The participants then get to do the exercise by themselves. To complete the module, and assess whether the learning objective is met, the participants must upload a file created in the exercise.

Objectives:

• Learn how to apply a Volume filter and save the result as a Design Context item.

Learning activities:

- Video (Engage)
 - State objectives
 - Show what the learner will be able to do when he or she have the requested knowledge
 - Lecture slides with spoken explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- *Text* (Engage)
 - State objectives
 - Lecture slides with written explanation
 - Further reading (show where to find more information about this topic, for example where you find it in PLM methods)
- Text + Images + Video (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Exercise example (Exercise 10)
 - Tips and tricks, why are we doing things in a certain way?

Assessment:

- Task (Explore/Elaborate)
 - Exercise 10
 - Upload screenshot/file obtained through the task to complete module.

Module 7: BOM/CAD alignment

The last of the learning modules deals with the subject BOM/CAD alignment. The learners should after completing the module understand the purpose of BOM/CAD alignment and how to use the tool. The learning activities follow the same pattern as the other modules with lecture slides presented in a video and in text. The learners then get to explore the subject through the first part of an exercise. The rest of the exercise is then explained in a video, complemented by text instructions and the module is then finished with an assessment exercise.

Objectives:

• Understand the purpose of BOM/CAD alignment and how to use the tool.

Learning activities:

- Video (Engage)
 - State objectives
 - Lecture slides with spoken explanation
 - Explain why this is important
- Text (Engage)
 - State objectives
 - Lecture slides with written explanation
 - Explain why this is important
- Task (Explore)
 - Exercise 11, step 1
 - Follow instructions and read document "Show description of errors and how to correct them"
- Text + Images + Video (Explain)
 - \circ Text + Images = Course book
 - Video = Trainer doing exercise
 - Example exercise (Exercise 11)
 - The trainer gives tips and tricks, why are we doing things in a certain way?

Assessment:

- Task (Elaborate)
 - o Exercise 11
 - Upload excel file obtained through the task to complete module.

Course assessment/evaluation

To evaluate what the participants have learned during the course, there is an assessment module. In this module, the learners get a couple of case tasks, where each one of the cases require that the participants have fulfilled several learning objectives. If a person can't complete a case task, they can go back to previous modules and watch the instructions and explanations again. The purpose of this assessment is to let the learners use their new knowledge in a different context to see if they meet the learning objectives. This is also an opportunity for them to repeat what they have learnt, perhaps some time after completing the earliest modules.

After the assessment, the participants get to fill out a course evaluation form. This is partly to develop the course, but also to let the participants reflect on their own learning during the course.

Assessment:

- Tasks (Evaluate)
 - Cases built on several exercises
 - For each case the connected exercises are stated
 - Upload files/screenshots to complete the tasks

Evaluation:

- *Course evaluation form* (Evaluate)
 - Questions regarding the course and the learning
 - Connect to Pre-course form
 - 0

4.3.2 Constructive alignment of new course concept

Table 4 below and in the next pages, shows the constructive alignment for the new concept described in section 4.3.2.

	Constructive alignment for new course concept			
Module	Learning objectives	Learning activities	Assessment	
1	Learn how to find, and use,	Video lecture.	Answer a multiple-	
	supportive documents.	Text.	choice question with	
		Exercise.	information from a	
			specified supportive	
			document.	

Table 4. The e-learning concept presented by a constructive alignment framework.

2	Learn how to use some basic tools	Video lecture.	Complete exercises
	in Teamcenter.	Text.	in module 2 and
		Quiz.	answer questions
		Exploring exercise.	with information
		Exercise.	obtained through the
	Learn how to find information	Video lecture.	exercises.
	about an item and how to	Text.	
	visualize it.	Quiz.	
		Exploring exercise.	
		Exercise	
		demonstration.	
		Exercise.	
	Learn how to perform an	Video lecture.	
	advanced search.	Text.	
		Quiz.	
		Exploring exercise.	
		Exercise	
		demonstration.	
		Exercise.	
3	Learn how to search in document	Video lecture.	Complete exercise in
	portal and view connections	Text.	module 3 and
	between parts and documents.	Exercise	answer questions
		demonstration.	with information
		Exercise.	obtained through the
			exercise.
4	Learn how to open the car	Video lecture.	Complete exercises
	structure in Teamcenter and	Text.	in module 4 and
	also how to view where in a attracture DL is used	Quiz.	answer questions
	structure DTTs used.	Exploring exercise.	with information
		Exercise	obtained in the
		demonstration.	exercises.
		Exercise.	
	Learn how to open a specific car	Video lecture.	
	variant in Structure Manager.	Text.	
		Quiz.	
		Exploring exercise.	
		Exercise	
		demonstration.	
		Exercise.	

5	Get familiarized with the Product	Video lecture.	Complete exercise in
	Visualization webpage.	Text.	module 5 and upload
		Quiz.	screenshot and
		Exploring exercise.	session file from the
	Get familiarized with the basic	Video lecture.	exercise.
	tools of TCVis.	Text.	
		Quiz.	
		Exploring exercise.	
		Exercise	
		demonstration.	
		Exercise.	
6	Learn how to apply a Volume	Video lecture.	Complete exercise in
	filter and save the result as	Text.	module 6 and upload
	a Design Context item.	Exercise	a file obtained
		demonstration.	though the exercise.
		Exercise.	
7	Understand the purpose of	Video lecture.	Complete exercise in
	BOM/CAD alignment and how to	Text.	module 7 and upload
	use the tool.	Exploring exercise.	a file obtained
		Exercise	though the exercise.
		demonstration.	
		Exercise.	

4.3.3 Evaluation of the new course design

To evaluate the new course concept, the course owner, administrators and teachers gathered in a focus group. In this section, the participators of the session are presented, followed by a summary of the discussion.

Description of the participators in the focus group

As for the interviewees in the qualitative interviews, the participants in the focus group are shortly presented below and their names are replaced by the letters A to E in order to not expose which respondent said what.

A is the owner of the course. **B** and **C** works as trainers for the course and with support regarding the programs linked to Teamcenter. **D** is working with different questions regarding Teamcenter and lastly, **E** is working with testing of Teamcenter and with questions regarding the program.

Discussion about the course concept

The new course concept was discussed by the group after a short presentation of the disposition and the theories behind it. The general response was very positive, one of the group members expressed that:

"I feel that this is exactly what we needed as an instruction for how to build our courses, [...] I'm very satisfied." -A One of the teachers were already familiar with the 5E model and expressed that it's a good model to use for a course like this.

"The 5E model is working well, it's a good model to do stuff like this. [...] to think about engage, to have the different stages to engage them [the learners] to the subject. [...] This is as it's made for Articulate Storyline [education software], all of this will be very easy, [...] one will have to work a little bit, but we really have the tools to execute this." -**B**

The short lectures in the online course concept was a concern that were discussed. In the existing course there are some long sections of theoretical lecturing.

"Many times, when we hold the course, it's a very long theoretical part before the learner start doing anything. One has to reach a certain level to understand something that one does." -D

As a response to this, two other persons in the group said:

"I think that the Teamcenter part can be processed pretty quick." -B

"Especially when one [the learner] has the possibility to return to it [the video lectures]." -A

There were a lot of talking about the implementation of the new course. Different issues were discussed, for example what should happen if the learners give the wrong answer on a question, how the more advanced case/scenario exercises in the assessment module can be created, if only certain modules should be required and the possibility to use a course management software.

5. Discussion

In this chapter, the results of the study will be discussed. The research questions will be examined followed by a discussion of the limitations of the study and recommendations for future work.

5.1 Research questions revisited

In this section, the results will be discussed in relation to the research questions.

5.1.1 RQ1: How can a classroom course be transformed into e-learning with preserved or higher pedagogical quality?

The aim of the assignment was to create a pedagogical concept for how to transform an existing classroom course (Teamcenter CAD Viewer and TCVis Basic) into a web-based course. To achieve this, the study needed to answer RQ1: How can a classroom course be transformed into e-learning with preserved or higher pedagogical quality? To answer that question, three additional research questions were formulated. Therefore, instead of discussing RQ1 explicitly, we will discuss each one of the sub questions RQ1.1-RQ1.3.

5.1.2 RQ1.1: Which are the most important factors to create a pedagogically well-functioning online course?

The literature study involved a section about critical success factors (CSFs) for e-learning. Different articles and different authors are naming many different CSFs. The definition of CSF states that they should be few in number, and by just listing all factors suggested by different authors make it more than just a few CSF. However, most of the CSF listed in section 2.3.2 can be categorized into five factors that according to the literature are critical for successful e-learning. These five factors are:

- technological factors
- institutional management
- technical support
- pedagogical factors
- evaluation

This study focused on *pedagogical factors* since the task requested by the company regarded pedagogical aspects of the transformation of the course.

Through the literature, we identified several aspects to consider when creating an e-learning course. When designing the course, we tried to use much of the cognitivist and constructivist views on learning. To help the learners divide and organize the material, we used modules to build the course. It's also important that the information inside each module is divided into smaller parts, because too much information at one time can be harder for the learner to process. To suit different learning styles, it's important that information is distributed in different modes, for example both through video lecture and in text form. Further, cognitivism stresses the importance of getting the learners engaged to the subject, something that the course teachers also expressed in the interviews. Therefore, we effectively applied the 5E model when creating

the modules. The use of the 5E model also served the purpose of putting the learner and their activities in focus. Both the course survey and - to some extent - the interviews with the teachers pointed out the need for more learner activation. To activate the learners is also one of the most important implications of the constructivism.

Another CSF for e-learning is *evaluation*. This can involve both course evaluation and evaluation of the knowledge or skill level of the learners. Course evaluation is important to determine whether the course is functioning in the way it's supposed to do. As part the course evaluation, it is important to get insights about the course from a student perspective. The other part of the evaluation factor is evaluation of the learning and what knowledge or skill the learners has achieved through the course. To have some kind of assessment is essential to determine if the course objective is met. The assessment has also a role to play in the learning process, because it can give feedback to the learner on which areas they master and which areas they might need to repeat.

When designing a course, it is important to think about the relationship between the learning objectives, the learning activities and the assessment. Constructive alignment can be used as a tool to do that in a systematic way. The first question to answer is: what should the participants learn in this course? The learning objectives can then be formulated from the answer to that question. When the objectives are determined, the learning activities and the assessment should be constructed with the objectives in mind. If the assessment is constructed with no or little connection to the objectives, it will be impossible to tell if the course participants meet the objectives. Therefore, it is of great importance that the assessment tests the learners on the same level as the objectives are formulated.

5.1.3 RQ1.2: What are the learning objects of this course and how does the current teaching support the learning of these?

The learning objectives are stated in the course exercise book, both on the level of the whole course in the beginning of the book and with different objectives for each of the exercises. The purpose and the objectives can be seen in section 4.1.1 and in *Table 3* and *Table 4*. They provide the basis for the development of the concept for the transformation of the current course into e-learning. They remained the same for the new concept as for the classroom course.

An analysis of the classroom course was made using Bloom's revised taxonomy to classify the objectives, and we applied a constructive alignment approach to see how these objectives were related to the learning activities and the assessment of them. The learning activities were identified through different methods: the observation of the course, the survey answers, interviews with the teachers and by studying the course materials. A challenge for the analysis was to categorise the objectives according to Bloom's revised taxonomy and to understand if the current teaching leads to an objective improvement for the learners. Although the theories are understandable and plausible in principle, we experienced cases which were hard to categorise in a clear and well-defined way. Though, comparing data from different sources made it possible to identify parts of the course that were not aligned.

An example of these aspects was *practice*. The course observation showed that there was little space for learners to practice. Most of the time was spent on lecturing and exercise demonstration. The survey showed that many respondents thought that the teacher was good at this. Although, the teaching methods make the learners passive which has a negative effect on the learning. During many of the exercises, the learners simply repeated what the teacher showed them, leading to learning at a very low level according to Bloom.

At the same time, many of the respondents expressed that they liked the exercises, but they wanted more of them. Some respondents also suggested that some type of case exercises would enhance the learning experience. Exercises, where the learner have to think and solve problems by themselves are in line with the cognitivist and the constructivist view of teaching. According to cognitivism, the learner has to process the learning element by the working memory in order to get it into the long-term memory. One way to do this is to let the learners work by themselves or together with exercises forcing them to remember and sort in previous learning. Also, constructivism says that the learner has to construct their own learning and should be active in the learning process.

One notable discovery was that there is no kind of assessment in the current course. According to the interviews, this is due to the fact that the learners participating in the course only get viewer level to the program. The level viewer, means that the person is only allowed to view things in the program, but not to change or create new things. Therefore, a person with this access level cannot disturb anything in the program. However, there could be advantages of having some sort of assessment in the learning experience, not only to check if the learners have achieved what's stated in the objectives, but also to make them more engaged and increase the likelihood that they achieve the learning objectives.

In order to overcome this flaw of the existing course, we used the 5E model as a pedagogical tool for creating lectures or courses. The last element in that model is *evaluate* and was added in all modules in the new concept. Further, through the application of the constructive alignment framework we attempted not only to include some form of assessment, but to align that with the learning objectives and learning activities.

Thus, the different learning theories contributed to the pedagogical design of the new concept that is expected to increase the learner activity and to improve the learning.

5.1.4 RQ1.3: What can be gained or lost from an educational view through the improvements of the course and the change from physical to virtual learning environment?

Face-to-face classroom teaching and pure online education have different advantages and barriers. Transforming a course from one to the other needs to consider those factors. One advantage of online-learning is that the learners get more flexibility and control over their own learning. Instead of listening to lectures and try some exercises at a specific time, they get to do the course in their own pace and when it suites them best. For example, if a person thinks that one module is very easy, they can finish that module quicker and have more time left to another perhaps harder module. With the e-learning concept it will also be possible to perform a module and then apply the new knowledge directly in practice. This will also enhance the learning.

With the new course concept, the learners will be more active than before. Less time will be spent on lectures and instead there will be more time for practice. This will probably lead to higher retention of learning because of the deeper cognitive processing when the learners are more active.

One disadvantage of the online format is the loss of direct contact between the teacher and the learners. In online learning, it can be hard to get the same connection since the participants and the teacher never meet. During the interviews, this was mentioned as a difficult issue for the transformation of the course. Teacher contact will still be available via Skype and e-mail, so the learners will not be without any support. Nevertheless, it is not the same to send an e-mail with a question as to talk directly in the classroom and it is difficult to predict whether learners will use the possibility to contact the teachers or not. But this is the same in a classroom environment, not everybody asks questions even if they wonder about something. In addition, teachers will probably have more time to answer individual questions since they no longer have to lecture and demonstrate the exercises.

5.2 Limitations and recommendations

There are some limitations to the study. One of these is that the concept has not been tested as a complete e-learning course. There is still work left to do regarding the implementation of the course instructions. Thus, the first recommendation is to implement the course concept to a complete e-learning course. Only when the e-learning is fully created is it possible to test and evaluate how it works for real. The strengths are though, that the new course concept is based on accepted pedagogical theories to support the learner in the best possible way. Also, critical aspects regarding e-learning have been taken into account.

Because the concept has not yet been implemented there has not been any sort of evaluation from a learner perspective. Although, the whole concept is built upon a learner perspective which should be positive for the learner experience. To ensure that the new e-learning course works well for the learner, our second recommendation is to evaluate the outcome, at least through a course evaluation at the end of the course. Preferably, a case study could be performed to investigate how the e-learning course works for the learners, and also look at how it has affected the course administration.

6. Conclusion

This, the last chapter, contains a presentation of the connection between the aim and what the research has led to. Also, the research questions are answered.

The aim of the thesis was to create instructions for transformation of an existing classroom course into a web-based course. To achieve this, the thesis also aimed to investigate how the pedagogical design of a course should be altered when transforming a classroom course into an online course. To support the thesis aim to develop a pedagogical concept for the transforming of the course, four research question needed to be answered.

The first question was: How can a classroom course be transformed into e-learning with preserved or higher pedagogical quality? The answer to this question is the new course concept presented in section 4.3. The concept is built on existing pedagogical research, data collected in this study and by the existing course material. To be able to create the new concept and thereby answer the first research question, we needed to answer the three sub-questions RQ1.1-RQ1.3.

The first of the sub-questions, research question 1.1, was about finding out the most important factors to create a pedagogically well-functioning online course. There are of course many factors that are important to consider when designing a course but some of the most important factors according to this study is to:

- Divide and organize the material in smaller parts to make it easier for the learners to process it.
- Give the learners control over their own learning process to allow them to create their own knowledge.
- Present information in different ways to suit different learning styles.
- Keep the learners active to get them to create their own knowledge.
- Give the learners frequent feedback to give them the opportunity to reflect on their learning.

Research question 1.2 was about what the learning objects in the existing course are and how the current teaching support the learning of these. The learning objects can be seen in the first column in *Table 3* in section 4.2. The current teaching lacks assessment, which is not in line with the pedagogical theories that this study is based on. The lack of assessment was also pointed out as a problem by some answers in the survey. Furthermore, the current teaching makes the learner passive, mostly listening to the teacher talking and at most following instructions from teacher or course book. Although, the exercises were found to support the learning, even if the learners had little time to work with them. Also, the teachers themselves were appreciated by many of the course participators. To better support the learning there is a need of more learner activation and assessment.

The fourth research question was to find out what could be gained or lost from an educational view through the improvement of the course and the change from physical to virtual learning environment. Since the new course concept has not yet been implemented, it could not be tested and evaluated. However, the new concept requires the learners to be more active which will improve their learning. Another advantage of the new concept is the possibility for the learners to perform the modules in their own pace, going faster through easier parts and have more time to work with things that are harder or more relevant to the individual. Also, the feedback and assessment parts added to the course will improve the learning. The main downside caused by the change of learning environment is that the connection between the participants and the teachers will be reduced. It is therefore important to encourage the learners to contact the teachers with questions and give them different options to do this to suit different preferences.

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Appendix I – Interview guide

Inledning:

Syftet med den här intervjun är att vi ska få veta mer om kursens upplägg och vad som är syftet med de olika delarna. Dessutom hoppas vi kunna få lite input som kan vara värdefull vid utformningen av det nya kurskonceptet. Vi kommer därför att ställa frågor om syfte och kursmål, kursens upplägg och hur du ser på omvandlingen av kursen till online-format.

Uppvärmning:

Vi börjar med några mer allmänna frågor.

- 1. Vad är din roll, vad gör du på jobbet?
- 2. Vad har du för bakgrund? Utbildning, erfarenhet?
- 3. Hur hamnade du här och hur länge har du jobbat med detta?

Frågor om kursen:

Nu går vi över till frågor som berör kursen mer specifikt.

- 1. Vad är kursens syfte?
 - a. Finns det några kursmål kopplade till kursens syfte?
 - b. Vilka är dessa?
- 2. Hur är kursens upplägg utformat?
 - a. Finns det någon speciell ordning för olika lärsekvenser och lärandeobjekt?
- 3. Vilka olika lärandeaktiviteter används? T ex lecture, exercise osv.
- 4. Hur kontrolleras att deltagarna uppnår målen?
 - a. Hur viktigt är det att veta om deltagarna uppfyller kursmålen efter avslutad kurs?
- 5. Hur har responsen från kursdeltagarna varit?
 - a. Är de generellt sett nöjda/missnöjda?
 - b. Finns det några moment som fungerar bättre/sämre?
- 6. Hur tycker du att kursen skulle kunna förbättras?
- 7. Vid omvandling av kursen till online-format, vad anser du är viktigt att tänka på?
- 8. Vilket av det nuvarande materialet och undervisningen tror du kan användas även till onlinekursen?
- 9. Vilka delar av kursen tror du behöver ändras på?
- 10. Vad tror du kan vinnas respektive förloras vid omvandlingen till online-kurs?

Avslutning: Något som vi borde ha frågat om, något mer du vill tillägga?

Tack för din tid!

Appendix II – Course participant survey



0 responses

No responses yet for this question.



If you have any comments, please enter them here.

50%

1 response

I didn't know the content before and didn't know how I could use it in my job.

The division between the different ways of working (theory, exercise, group work, discussion) was well balanced.

30 responses



If you have any comments, please enter them here.

3 responses

The explanation was too fast and very difficult to follow on the screen in front of the class room. The pointer was hard to see and in the same time you should look to your own screen as well. I didn't feel comfortable with that because you easily miss the information which is explained.

Somewhat agree, think the label is wrong in the question ?!

Poor connection to intranet

Which of the different ways of working (theory, exercise, group work, discussion) would you have liked to have more of?

30 responses



If you have any comments, please enter them here.

0 responses

No responses yet for this question.

Do you think that something was missing in the course and should something be added?

30 responses

No (7)	•
no (2)	
- (2)	
. (2)	
N/A	
Too little time for finding objects, parts. If you don't practice you will not remember.	
No, I would not say that something was missing with the course, although some of the things I have used TC and TCVis for have I learned afterwards.	ľ
The course could better focus on the need of the use related to the job function. Some parts are not interested for some people and some are very useful. If the trainer focus on the need I think more of my other colleagues would enjoy it more as well.	
It was good	
None	
More explanation of the powerpoint-slides / purpose of the team center system and why and when you would use different functions. More "real" cases would be nice.	
ок	
more info on what information that can be found in the different versions of the digital cars, like materials etc	
Option to tailor to each participants respective need in his/her department	
No, if anything the other way around	
Good connection to intranet. Prepared towards our needs	
How TC fits the bigger picture at Volvo	
More on how to use revisions and versions	
Looking at wiring drawings	
Not really	•

Please list the three things you liked most about the course. Please motivate your answer.

30 responses

. (2)	
Ability to ask the teacher questions, exercises	
N/A	
Good teacher.	
What I liked most with the course is the basic knowledge you get about TC and TCVis. I have neverything that I learned in the course, but for the things that I have used and have learnt afterv say that the basic knowledge has been good to have. Another thing that I think is good about the you get to learn what you can do in TC and TCVis, and even if I do not remember exactly how to someone how, or check in the manual that you received at the course how to do it.	ot used /ards, I would le course is that o do it I can ask
Booklet info - clear but very thick booklet. Visualize components in the car - very useful for my job	
good teacher , good mix Theory(Teacher present PPT) an practice , good to have	
Good with exercises, good with small group, good teacher	
I can't remember three things that was better then the rest	
Final test. Exercises. Content.	
Possibility to ask questions during the exercises	
the speed, excercises	
Theory, Practial work, the balance between theory and practical work	
Teacher, Exercises and Duration	
ок	
the teacher was involving, the length of the course was good, size of the group	
working in the system	
 Attending teacher for help and answering questions. 2. practical examples for more understa Handbook that was provided when attending the course, good material to have afterwards 	nding. 3.
Clear on what you learn, easy to follow the "exercises, nice to see the usage of the VCC environ	ment
Timing	
The teacher, he was engaged and nice to listen to. I really liked the "DC Boll" video. The course s	vas important.
 Teacher - very good knowledge of the subject and could easy explain and answer our question. Exercises - always good to try by oneself to understand - more exercises! Training material - clearly pointed out were to find online and handouts at your work station were the class room, but - see point 2 below. 	ns hen entering
How to navigate in visualization module, how to search, how the system is organized.	
The educator/teacher had excellent knowledge of the systems used. The performance of the co had sufficient capacity. The location of the education was near to my office.	mputers used
Time to try things, pedagogic, fun	
The teachers good preparation, the hands-on activities, the course was well organized (time sch units, proper learning material)	edule, content
Good Teacher, relaxed but focused	
*Good mix of information/lecture and exercises (to perform by yourself). It's hard for almost an and actually learn for longer periods. Good that they had planned exercises and/or coffee break was small enough for the teacher to be able to support and answer questions. *I appreciate tha training material. It was given to us in printed form, good to take notes and scribble on during the training material.	yone to listen s. *The group t we got the e training.
Please list three things with the course that can be improved. Please motivate your answer.

30 responses

	. (2)	
	Less theory, less introduction which are given in basically all courses	
	N/A	
	Less topics more in depth. Too short time to cover everything. Participants with the same skill level would perhaps be more efficient.	
	Not really sure on this one. But if you really should learn everything in the course I think it would be good with a follow up session or some exercises to do after the course.	
	Timing was too short, too less time to get thing under control or understand. The screen in front of the class room should be more clear. It was all in all too fast presented.	
	No comments	
	Could put course ppt in hand-out material	
	Could have been divided into two days.	
	Everything was good.	-
	Mana (kattan anana (manainan	
	Mole/better cases/exercises	^
	Nothing	
	Nothing	
	Slå samman deltagare med liknande bakgrund/behov.	
	OK	
	An e-learning course would be great, the facilities were not the best, it should be easier for non P&Q employees to sign up for the course	
	add more time to dig deeper	
	1. The exercises in the handbook would be more helpful as a e-learning than in course. 2. Don't think 1 whole day is necessary for this course (if you have some experience before). 3	
	More versions of the course, what I will do is go into TC, search for an article using search and open + export JT CAD. This information takes around 1 hour to learn and not a complete day. I also had used the software for 2+ years so a certificate or something to bring to new employees (or assignments if you are an consultant) would be good so we don't have to take the course again (since it's so long)	
	Connection to intranet, Stable application,	-
	The terminology used could be explained better. There are a lot of new words. How the different elements fit together could be better explained. Some kind of block diagram or work flow. What information can be found in TC? For instance, how do I find the mass of a sub-system or part?	•
	 Exercises - like exercises, so more of it. Update presentations/training material - some parts are not up to date Working in production database, feels a bit scary - better to have a training database. 	
	More on how to select the correct parts based on revision and version. How to find the correct cars without using the DMU.	
	Ask the education participants prior to the education what they will use the programs for and include some exercises into the education. They could have more exercises and let the participants select the exercises that are more suited for their type of use of the program.	
	To much breaks	



Overall view

How hard do you think the course was?

30 responses



If you have any comments, please enter them here.

2 responses



My expectations for the course have been met.

30 responses



If you have any comments, please enter them here.

1 response

Due to the poor connection to intranet and the unstable application