Self-regulated Strategies of Employees Toward Learning

Leveling the talent demands of aerospace companies and the learning needs of new employees

Inaugural-Dissertation
zur Erlangung des Doktorgrades der Philosophie
der Ludwig-Maximilians-Universität
München

vorgelegt von

Despoina Pourtoulidou

aus
Giannitsa, Griechenland

2024

Erstgutachter: Prof. Dr. Thomas Eckert
Zweitgutachter: Prof. Dr. Bernhard Schmidt-Hertha
Tag der mündlichen Prüfung: 22.10.2024

Acknowledgment

I would like to express my gratitude to Prof. Dr. Thomas Eckert. His invaluable advice and supervision throughout my PhD have been vital to my academic success. I would also like to thank Prof. Dr. Bernhard Schmidt-Hertha for his time and willingness to review this thesis.

An immense thank you to Prof. Dr. Andreas Frey for his consistent support and guidance during all these years of my research at Ingolstadt University of Applied Sciences (Technische Hochschule Ingolstadt - THI). This research was possible due to the projects IDEA and ASSET-2 that the German Ministry for Economic Affairs and Climate Action funded. At this point, I want to extend my appreciation to all THI colleagues for their continuous support throughout this research.

I would like to express my sincere gratitude to all the great people from different fields and countries with whom I have had the pleasure of meeting and working during this time. My study companions from THI and LMU made this journey truly enjoyable.

A special thank you goes to my friends and, foremostly, my family, my parents, my brother, and particularly my sister, for their unconditional love and for being my greatest supporters. Despite the miles between us, their presence in my life brings me immense joy and love by enriching my life each day.

Finally, I am deeply thankful for the employees who took the time to offer me insights into their learning journey and enabled this research!

Abstract

This study explores the strategies of employees during their attendance at introductory training in aerospace software engineering and the contrast between their needs in entry-level roles and the talent demands of their employers. Specifically, interviews with participants from six different companies show employees' self-regulatory actions during formal and informal learning situations while aiming to fulfill their learning needs. In line with previous research, this study affirms the various individual expressions of adult learning and notices the use of technology flexibly according to their preferences. The results of this study indicate various strategies that new employees use to educate themselves further, with the majority referring to searching for information or solutions independently. Their strategies differ depending on the trigger situation, the goals of the employees, and the available resources. Subsequently, this study recommends adopting a lifelong learning company culture, supporting self-regulation through training, enabling individualization, and ensuring networking, which facilitates help-seeking within the company, to promote employees' learning. Further research regarding the influence of a company's culture on training development and the learning strategies of its employees could support their learning and the company's future.

Zusammenfassung

Das Angebot an akademischen Studienkursen, die online und offline in Präsenz, in Teil- oder Vollzeit absolviert werden können, ist vielfältig. Arbeitnehmende können solche Kurse vor dem Antritt einer neuen Stelle besuchen. Zusätzlich kann dieses Angebot durch die Teilnahme an einer Weiterbildungsschulung beim Eintritt in diese neue Stelle oder ein neues Unternehmen (oder Betrieb) erweitert werden. In den Unternehmen gibt es eine Abteilung, die sich mit der Entwicklung der Weiterbildung befasst, oder externe Dienstleistungsunternehmen, die sich damit befassen und den Arbeitnehmern feste Schulungen anbieten. Die Weiterbildung erfolgt aufgrund einer Vielzahl von Faktoren. Hauptsächlich beziehen sich diese hauptsächlich auf den technologischen Wandel und das Ziel der Arbeitgeber, ihre Mitarbeitende für einen nahtlosen Einstieg zu rüsten. Dies soll dazu beitragen, die Leistung der Mitarbeitenden und die Gewinne der Arbeitgeber zu maximieren. Der Fachkräftemangel wirkt sich ebenfalls darauf aus, da die Arbeitgeber zur Deckung ihres Talentbedarfs Einstellungen aus einem breiteren Bereich in Betracht ziehen und sie anschließend umschulen.

Obwohl es keinen allgemeinen Arbeitskräftemangel gibt, berichten mehrere Branchen über Schwierigkeiten bei der Gewinnung qualifizierter Fachkräfte, insbesondere in Sektoren, in denen hohes Fachwissen gefragt ist, wie in der Luft- und Raumfahrtindustrie (BMWK, n.d.; Kövesi & Csizmadia, 2016; Guo et al., 2022; VDI, 2023a; 2023b). Der Bedarf an Fachkräften in dieser Branche führt dazu, dass Fachkräfte aus den für die Luft- und Raumfahrt relevanten Bereichen angeworben werden und in ihre Weiterbildung investiert wird, um die offenen Stellen zu besetzen. Bei der Entwicklung der Einführungsschulung für neue Mitarbeitende in der Softwareentwicklung in der Luft- und Raumfahrtindustrie in Deutschland konnte dies direkt beobachtet werden. Der Hintergrund der Schulungsentwicklung war die Bedarfsanalyse aus der Perspektive des Arbeitgebers. Die Hintergrundrecherche erfolgte durch die Sichtung des deutschen Marktes sowie von Bachelor- und Masterabschlüssen und deren Modulen aus Studiengängen in Deutschland. Die Berücksichtigung der Bedürfnisse der Mitarbeitenden bei der Entwicklung dieser speziellen Einführungsschulung ist schwierig. Erstens stehen die Mitarbeitenden noch nicht zur Verfügung, da sie nicht zum Unternehmen gehören. Zweitens variiert ihr Bildungshintergrund über die im Rahmen der Bedarfsanalyse durchgeführten Recherchen hinaus. Diese beiden Faktoren bestärken die Überzeugung,

dass weitere Forschungen über die Bedürfnisse des Einzelnen beim Eintritt in eine neue Rolle und ihre Lernaktivitäten im Rahmen der Berufsausbildung erforderlich sind.

Arbeitgeber bereiten Schulungen für ihre Mitarbeitende vor, unabhängig davon, ob es sich um neue Mitarbeitende handelt oder nicht, um sicherzustellen, dass sie zu ihrem Unternehmen passen und kompetent sind, um die Anforderungen zu erfüllen (Guest, 2006; Institute of Continuing Professional Development, 2009; Molloy & Noe, 2010). Verschiedene Onboarding-Prozesse gehen auf diese Herausforderung ein, indem sie neue Mitarbeitende in ihre Aufgaben einführen. Onboarding unterscheidet sich je nach Art des Arbeitsumfelds und der Organisationskultur (Permats & Östman Ellison, 2021; Gomes & Sousa, 2023). Onboarding-Schulungen werden mit Blick auf die Marktanforderungen und Trends der Unternehmen entwickelt. Dennoch gibt es eine Diskrepanz zwischen den Lernbedürfnissen neuer Mitarbeitende und dem Talentbedarf von Luft- und Raumfahrtunternehmen (Kövesi & Csizmedia, 2016; Guo et al., 2022).

Um diese Diskrepanzen zu beheben und die Wirksamkeit von Schulungsprogrammen zu verbessern, ist es wichtig, die Theorien und Methoden zu berücksichtigen, die der Entwicklung von Schulungskursen zugrunde liegen. Theorien zur Entwicklung von Schulungskursen im beruflichen Umfeld beginnen mit einer Bedarfsanalyse, um die Bedürfnisse zu ermitteln, die ein Schulungskurs abdecken sollte. Studien zeigen, dass solche standardisierten und einheitlichen Schulungen dem Prinzip "one-size-fit-all" folgen und die individuellen Lernbedürfnisse der Mitarbeitenden nicht erfüllen (Kövesi & Csizmedia, 2016; Zitat). Dafür sind lernerzentrierte Ansätze entstanden. Der Bereich der Schulungsentwicklung konzentrierte sich auf die individuellen Bedürfnisse der Mitarbeitenden, wobei grundlegende Merkmale aus bekannten Theorien zum Lernen Erwachsener wie der Andragogik von Knowles übernommen wurden. Nach 2000 unterstützten Lernansätze, die auf adaptivem Lernen beruhen, diese Tendenz, und heutzutage bieten sie, einschließlich Computeralgorithmen, maßgeschneiderte Ressourcen und Lernaktivitäten für jeden Lernenden (Kaplan, 2021; Brusilovsky & Peylo, 2003).

Es ist nur wenig darüber bekannt, wie Arbeitnehmer lernen und wie sie dies in formellen und informellen Lernsituationen während ihrer Arbeitspraxis regeln. Anhand von Interviews mit Mitarbeitenden, die gerade in ein Unternehmen der Luft- und Raumfahrtindustrie eingetreten sind und an zwei Einführungskursen teilgenommen

haben, wird in dieser Studie untersucht, wie die Mitarbeitenden mit dem Lernen umgehen. Zu wissen, ob und wie neue Mitarbeitende ihr Lernen im Arbeitsalltag selbst regulieren, kann für Arbeitgeber und Schulungsentwickler hilfreich sein, die sich auf die Steigerung des Lernens der Mitarbeitenden konzentrieren. Die Untersuchung der Bedürfnisse von Arbeitnehmern und ihres spezifischen Lernverhaltens hat das Potenzial, allen an der beruflichen Entwicklung Beteiligten wertvolle Perspektiven zu bieten: Arbeitgebern, Bildungsentwicklern und Arbeitnehmern. Gleichzeitig können Informationen über die Bedürfnisse von Mitarbeitenden mit unterschiedlichem Hintergrund einen realistischen Blick auf die Kluft zwischen Anforderungen und Bedürfnissen und dem, was Mitarbeitende tatsächlich brauchen, bieten, um die Mitarbeitendenbindung zu erleichtern. Dieser Vorteil lässt sich auch auf andere Branchen außerhalb der Luft- und Raumfahrt übertragen, die ebenfalls Schwierigkeiten bei der Gewinnung von Mitarbeitenden haben und auf die Weiterbildung von Mitarbeitenden angewiesen sind, die in anderen Fachrichtungen studiert haben. Empfehlungen zu den Lernstrategien der Mitarbeitende können es ermöglichen, diese Strategien bei der beruflichen Weiterbildung und insgesamt im Unternehmen zu unterstützen.

In den folgenden Kapiteln gibt diese Arbeit zunächst einen Überblick über den theoretischen Rahmen in Kapitel 2, gefolgt von einer Analyse der Forschungsmethodik in Kapitel 3. Anschließend werden in Kapitel 4 die Ergebnisse der mit den Schulungsteilnehmern geführten Interviews, der von ihnen beantworteten Fragebögen und der Bedarfsanalyse im Rahmen der beiden Projekte vorgestellt. In Kapitel 5 werden die Implikationen dieser Ergebnisse erörtert und Vorschläge für die künftige Forschung gemacht. Kapitel 6 schließlich ist die Schlussfolgerung dieser Arbeit.

Table of Contents

Acknowledgment I
Abstract II
Zusammenfassung III
Table of Contents VI
List of Tables IX
List of Figures X
1. Introduction 1
2. Literature Review 4
2.1. Society: Continuing Education 4
2.1.1. Purposes & Aspects 6
2.1.2. Funding 8
2.2. Employers: Companies 9
2.2.1. Onboarding Process 10
2.2.2. Workplace Learning 12
2.2.3. Training Development 21
2.2.3.1. Training Demands and Needs 22
2.2.3.2. Training Needs Analysis 26
2.2.3.3. Training Development Models 27
2.3. Employees: Individuals 29
2.3.1. Adult Learning Theories 29
2.3.2. Self-Regulated Learning 32
2.3.3. Employees' Learning 35
2.3.3.1 Learning Strategies 35
2.3.3.2 Learning Styles 36
2.3.3.3 Learning Patterns 38
2.3.3.4 Learning Paths 39
2.3.3.5 Learning Behaviors 40
2.3.4. Self-regulated Strategies of Employees 41
2.4. Summary of Literature & Research Questions 49
2.5. Projects' Framework 51
2.5.1. First Project (ASSET-2) 52
2.5.2. Second Project (IDEA) 54

3. Methodology 57
3.1. Sampling 57
3.2. Data Collection 58
3.3. Data Analysis 61
4. Results 65
4.1. Learning Approach 66
4.1.1. Learning Preferences 67
4.1.2. Problem-solving 69
4.1.3. Work Approach 71
4.1.4. Step-by-step Description 73
4.1.5. Beliefs about Learning 74
4.2. Self-Regulated Learning 74
4.2.1. Reactions to Inadequate Training Courses 74
4.2.2. Engagement with the Training Courses 76
4.3. Learning Needs of New Employees 77
4.3.1. Learning Needs of Employees entering ASD 77
4.3.2. Evaluation of the First Training Course 79
4.3.3. Evaluation of the Second Training Course 81
4.3.4. Suggestions for the First Training Course 83
4.3.5. Suggestions for the Second Training Course 85
4.3.6. Gain 87
4.4. Differences among New Employees 88
4.4.1. Differences among Employees entering ASD 88
4.4.2. Other / Motivation 92
4.4.3. Experience with Training 93
4.5. Companies' Demands and Employees' Needs 94
4.6. Summary 96
5. Discussion 104
5.1 Self-Regulated Strategies of Employees toward Learning 105
5.2 Differences among Employees 108
5.3 Demands vs. Needs 112
5.4 Recommendations for Practice 113
5.5 Recommendations for Future Research 117
6. Conclusion 119
References 121

Appendices 146
A. Transcription Guidelines 146
B. Data Consent Form I 147
C. Data Consent Form II - German 148
D. Data Consent Form II - English 149
E. Prior-Training Questionnaire - I 150
F. Post-Training Questionnaire - I 153
G. Interview Guidelines - I 156
H. Prior-Training Questionnaire - II 159
I. Post-Training Questionnaire - II 163
J. Interview Guidelines German - II 166
K. Interview Guidelines English - II 168
L. Code System 170

List of Tables

Table 1. Collection of Strategies 46
Table 2. Thematic Qualitative Text Analysis: Implementation 63
Table 3. Main categories of Code System 66
Table 4. Main category 1. Learning preferences 67
Table 5. Main category 2. Problem-solving 70
Table 6. Main category 3. Work approach 72
Table 7. Main category 16. Reactions to inadequate training courses 75
Table 8. Main category 17. Engagement with the training courses 76
Table 9. Main category 6. Learning needs of employees entering Aerospace Software Development 78
Table 10. Category 8.1. Pros - Evaluation of the first Training Course 80
Table 11. Category 8.2. Cons - Evaluation of the first Training Course 81
Table 12. Category 9.1 Pros - Evaluation of the second Training Course 82
Table 13. Category 9.2 Cons - Evaluation of the second Training Course 83
Table 14. Main category 10. Suggestions for the first training course 84
Table 15. Answers to Question 4 of Post-Training Questionnaire I 85
Table 16. Main category 11. Suggestions for the second training course 85
Table 17. Main category 12. Gain 87
Table 18. Main category 7. Differences among employees entering ASD 89
Table 19. Category 14.4 Motivation 92
Table 20. Main Category 15. Experience with training 93
Table 21. Talent demands of companies 95
Table 22. Learning needs of employees 96

List of Figures

Figure 1. Triangle of Learning 4
Figure 2. Combination of different terms about Workplace learning 20
Figure 3. Maslow's Needs Pyramid 23
Figure 4. Combination of different terms related to needs 25
Figure 5. Timeline of first Training Course 54
Figure 6. Timeline of second Training Course 56
Figure 7. How familiar are you with the following topics? First Training Course 90
Figure 8. How familiar are you with the following topics? Second Training Course 90
Figure 9. Participants' academic background 91
Figure 10. Code System - Partial screenshot 97
Figure 11. Summary of Main Category 1. Learning preferences 99
Figure 12. Summary of Main Category 3. Work Approach 101
Figure 13. Summary of Main Category 2. Problem-solving 103
Figure 14. Important for Training course development 115

1. Introduction

The range of academic study courses, available online and offline, part or full-time, that an employee may have attended before starting a job position may be enhanced by taking further training when entering this new job position or a new company. Either a sector within companies is devoted to training development or external service provider companies deal with this and offer standardized training to employees. Continuing education occurs due to a multitude of factors that mainly relate to technological changes and the employers' goal to equip their employees for a seamless onboarding in order to maximize their performance and the employers' profits. Shortages of skilled workers also influence this because employers consider hires from a broader field to cover their talent demand and re-train them afterward.

Although there is no overall workforce shortage, several industries report difficulties in acquiring skilled professionals, especially in sectors where high expertise is demanded, such as the aerospace industry (BMWK, n.d.; Kövesi & Csizmadia, 2016; Guo et al., 2022; VDI, 2023a; 2023b). The demand for specialized employees in this industry leads to acquiring professionals from fields pertinent to aerospace and investing in further educating them to match their open positions. During the development of introductory training for new employees entering the aerospace software development industry in Germany, this could be directly observed. The background of the training development addressed the needs analysis from the employer's perspective. Background research was conducted by reviewing the German marketplace, as well as bachelor's and master's degrees and their modules from study courses in Germany. Considering the employees' needs during the development of this particular introductory training is difficult because, at first, the employees are not yet available as they do not belong to the company, and second, their educational background varies beyond the research conducted during the needs analysis. These two factors enhance the opinion that further research is needed about the individuals' needs when entering a new role and their learning actions within professional training.

Employers prepare training for their employees, whether new hires or not, to ensure they match their organization and are competent to cover their demands (Guest, 2006; Molloy & Noe, 2010). Diverse onboarding processes address this challenge by introducing new employees to their tasks. Onboarding differs according to the nature of the workplace

environment and the organizational culture (Permats & Östman Ellison, 2021; Gomes & Sousa, 2023). Onboarding training courses are being developed focusing on companies' market demands and trends. Despite this, there is a mismatch between the learning needs of new employees and the talent demands of aerospace companies (Kövesi & Csizmedia, 2016; Guo et al., 2022).

To address these mismatches and enhance the effectiveness of training, it is essential to consider the theories and methods behind training course development. Training course development theories in professional environments begin with a needs analysis to address the needs that a training course ought to cover. Studies show that such standardized training follows the principle of "one-size-fits-all" and fails to meet the individual learning needs of the employees (Kövesi & Csizmedia, 2016). Learner-centered approaches emerged, and the training development field focused on employees' individual needs, adopting basic characteristics from known adult learning theories such as Knowles' Andragogy theory. After 2000, learning approaches based on adaptive learning supported this tendency, and nowadays, including computer algorithms, offer customized resources and learning activities for each learner (A. Kaplan, 2021; Brusilovsky & Peylo, 2003).

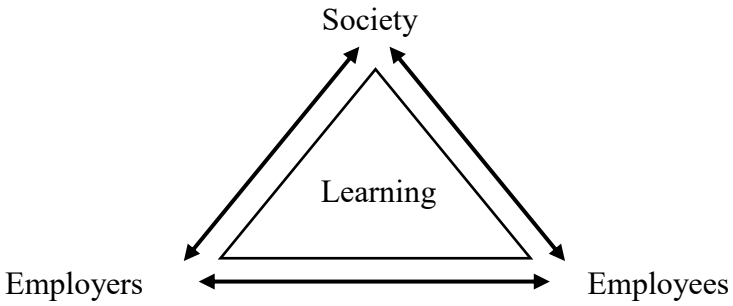
Little is known about employees' learning and how they regulate it in formal and informal learning situations during their work realities. Using interviews with employees who had just entered aerospace companies and participated in two introductory training courses, this study explores the actions of employees toward learning. Knowing if and how new employees self-regulate their learning in everyday work conditions can be helpful for employers and training developers who focus on increasing employees' learning. The investigation of employees' needs and their specific learning actions has the potential to offer valuable perspectives to all contributors in professional development: employers, training developers, and employees. Simultaneously, information about the needs of employees with diverse backgrounds can offer a realistic view of the gap between demands and needs and what employees actually need to facilitate employee retention. This advantage can be transmitted to other industries outside aerospace that also experience difficulties in acquiring employees and rely on further training employees who have pursued different fields of study. Recommendations regarding employees' learning strategies can enable the endorsement of these strategies during professional training and overall, across the company.

In the following chapters, this thesis will first provide an overview of the theoretical framework in Chapter 2, followed by an analysis of the research methodology in Chapter 3. Subsequently, Chapter 4 will present the results from the interviews conducted with the training course participants, the questionnaires they answered, and the needs analysis within the two projects. Chapter 5 will discuss the implications of these results and offer suggestions for future research. Finally, Chapter 6 is the conclusion of this thesis.

2. Literature Review

In a work environment, learning is constantly influenced by society, employers, and employees (see Figure 1). The trend to attend training after primary academic studies when starting a new position is not new. It has been the subject of continuing education for many reasons, which will be presented in the following chapter. The influence of society within the field of continuing education and how this takes place will be presented first, followed by the employers' and the employees' perspectives. Continuing education is of great interest to employers who plan the onboarding process to introduce new employees entering a job position, and they encourage employees' learning by offering training and other learning opportunities to ensure further upskilling. The protagonist in every training is each employee who participates in it, but their learning occurs within and outside of training or their job role. Therefore, adult learning theories will be analyzed afterward by examining the self-regulation in the learning process and the employees' strategies toward learning. Finally, this chapter concludes with the focus of this research by analyzing the research questions and the framework within these sought to be answered.

Figure 1. Triangle of Learning



Note. Own figure.

2.1. Society: Continuing Education

„Γηράσκω δ' αἰεί πολλά διδασκόμενος."
(As I grow old, I learn continually many things)
Plato, Lovers 133c in Morgan (2015, p.131)

Continuing education refers to organized learning programs beyond undergraduate courses (Kirby et al., 2009; KMK, 2001). In particular, continuing professional education refers to such programs that provide employees with job-related knowledge, methods,

and approaches used widely in professional practice, and aims to anchor them with existing experience (Müskens & Lübben, 2015; Coady, 2021). The relation of continuing education to professionalism exists undeniably due to its origins, which is why people with a degree or any qualification need to educate themselves further. Scientific evolution in every field and technological changes are inevitable. This has been recognized several times in the past. UNESCO officially used the term lifelong learning more than 30 years ago to serve the economy's and society's development (Faure, 1972; Delors, 1996). The term lifelong learning is broader than continuing education. It refers to a personal process that indicates that humans continue learning through every stage of their existence, and it derives from their motives to learn, which come from personal decisions (Fischer, 2000; Department of Education and Science, 2000; COM, 2006).

The influence of lifelong learning is inevitably high for a person's professional life. Therefore, this is promoted so that professionals can keep up with career challenges and continue to evolve (Commission of the European Communities, 2001; Coady, 2016). The Institute of Continuing Professional Development recognized this and defined the term continuing professional development, which refers to systematically maintaining, improving, broadening knowledge, and further developing personal qualities due to the requirements of professional tasks in a role (Guest, 2006). Molloy & Noe (2010) specifically defined continuing learning as "*a career-related acquisition of knowledge, skills, and abilities, occurring as a result of either systematic planning or chance events, which may facilitate adaptation to talent market dynamics*." (p.334). Their continuous learning model illustrates the sequence of employees' learning influenced by their network diversity and size, organizational structure and demands, and individual differences related to their interests and competencies (Molloy & Noe, 2010). They also acknowledged that individuals restart and go through this model numerous times due to personal interests, competitiveness, or financial crises, which potentially leads them to acquire a lower or higher professional status (Molloy & Noe, 2010). Lately, different terms are used to refer to further educating the workforce:

- Redeploy refers to changes in the job roles to new and different roles requiring maybe similar skills.
- Reskilling refers to cases where a skills gap was notable, and employees needed to learn an entirely new skill(s) for a different or notably evolving role. Retraining is more general and includes enhancing their knowledge and competencies.

- Upskilling refers to changes that raise one person's knowledge and skills beyond their current level (Fenton et al., 2021).

Due to technological evolution, especially the fourth industrial revolution, upskilling seems more critical than reskilling or retraining (Harish, 2022). However, according to the latest report of the World Economic Forum, all have been and are still relevant (Illeris, 2003; World Economic Forum, 2023).

2.1.1. Purposes & Aspects

The European Union aims to promote continuing education via particular projects with content relevant to the basic skills of the population, like reading, writing, and IT skills, to reduce the low-skilled workforce (European Commission, 2015). In the briefing note from a European opinion survey from CEDEFOP, it is mentioned that even before the COVID-19 pandemic, over 45% of the adult population in the EU did not have enough skills and possibly needed reskilling (CEDEFOP, 2020). At the beginning of 2020, the World Economic Forum announced that the need to reskill employees would concern more than one billion people based on data from the Organisation for Economic Co-operation and Development and described the current situation as a reskilling emergency (Zahidi, 2020). There have been numerous occasions where lifelong learning and continuing education have been suggested as solutions to problems. The benefits of continuing education for both employers and employees have been reported by different authors (Yolles, 2009; Dosi et al., 2022). An international comparison of ten countries in 1999 showed a higher possibility of attending training after completing their primary education when a person is already employed (O'Connell, 1999). According to this study, training relevant to job subjects is more often than training related to other purposes (O'Connell, 1999). The demographic change in the workforce and technological evolution were the main reasons for continuing education at the beginning of 2000 (Zimmermann, 2009; OECD, 2007; Pfeiffer et al., 2019). The suggestion of continuing education is always relevant because it offers a chance for adults to cover any educational gaps from their youth (Schiersmann, 2007). However, it becomes essential for employees after socio-financial changes like the migration of population or, for example, the financial crisis starting in 2007, followed by another great resignation after the global COVID-19 pandemic that influenced every local economy (BMBF, 2022; Cohen, 2021; J. Kaplan, 2021; BMAS, 2022; Guo et al., 2022). In 2020, the German Federal Statistical Office reported the highest participation rate in continuing internal education to date, in

which 52% of staff in enterprises in Germany attended training (Destatis, 2022). This press release also mentioned that the time spent on continuing education has increased. Referring to the consequences of the pandemic is perplexing because it is an ongoing economic trend, and its consequences remain to reform the global marketplace. Incidents and societal changes affect job conditions and stir the marketplace, leading to new trends such as the current great resignation and various job changers (J. Kaplan, 2021). In particular, knowledge acquired through academic studies no longer offers job safety and may be outdated for the current job role of an individual (Schiersmann, 2007; Sze-yeng & Hussain, 2010; Bierema, 2016). Without the urge to acquire new knowledge to maintain or find a job, there are also financial motives for employees to achieve a better pay rate or job position. Moreover, the job conditions and work environment may also be subject to improvement (Poell & Van Der Krogt, 2016). In addition to these reasons regarding personal preferences, which affect changes in the interests of the individual, studies show that employees choose to resign from their current job for another position in their present profession or another new field (Morgan, 2023). The reasons why employees want to change their careers differ. The so-called career changers may desire better salaries and, in general, better work conditions, for example, explicitly looking for remote working opportunities (Dunlap & Grabinger, 2003). Beyond objectively acquiring new knowledge and skills, participating in continuing education offers new contacts and networking among participants and trainers.

Continuing education also relates to labor shortages, particularly to the lack of specialized employees (Kövesi & Csizmadia, 2016; Guo et al., 2022). According to current publications of *Bundesministerium für Wirtschaft und Klimaschutz*, “BMWK” (Federal Ministry for Economic Affairs and Climate Action of Germany), there is no general labor shortage in Germany. In STEM sectors, it is difficult for employers to acquire appropriate professionals (BMWK, n.d.). Other specific industries, e.g., health, social sciences, and education, clearly have Germany's highest shortage of qualified employees (Janson, 2022). The latest data from the Association of German Engineers (VDI) and the German Institute of Finances (IW) shows that in 2023, from all engineering professions, the sectors of energy and electrical engineering and construction and building technology face the most vacancies (VDI, 2023a; 2023b).

Today's and future marketplace for skilled individuals is constantly shifting (Molloy & Noe, 2010). Sarma et al. (2020) commented on the changes the workforce was obligated

to adjust to after the COVID pandemic when *"1.6 billion students were displaced in the spring of 2020 as COVID-19 forced social distancing"* and many employees had no other choice but to participate in training, meetings and any other activity through the internet (UNESCO, 2020, p. 3). The workforce training development and the workforce environment after COVID-19 changed considerably, wherein the online learning environments complement the workforce's growing needs (Sarma et al., 2020; Whiting, 2020). This pandemic accelerated the ongoing trend of increasing the use of online platforms and virtual environments for training, meetings, lessons, and generally for learning (Bell & Kozlowski, 2008; Sarma et al., 2020; Mikolajczyk, 2021). It directly affected the kind of knowledge transmission and, indirectly, the whole learning process. As previously noted, continuing education serves companies and their goals. The mechanisms that facilitate this process remain to be analyzed as follows. Training, seminars, workshops, webinars, etc., are organized by the employer or another company responsible for training. There are official academic courses from universities offered online or offline, nationally or internationally, as bachelor's, master's degrees, or Ph.D. or as partial certificates. Employees may choose individually from the plethora of available continuing education options. The art of the learning process within the training from the employer's perspective will be analyzed further in Chapter 2.2.2 and then from the employees' perspective in Chapter 2.3.

2.1.2. Funding

The options for continuing education for the learner are multiple, and the prices differ. Financing professional training concerns individuals, companies, organizations, continuing education institutions, the public sector, the government, and every industry that aims to upskill the workforce (Reglin, 2009). Information from the Federal Association of German Employers' Associations (BDA) shows that the funding for continuing education is covered by employers up to 56% and the rest privately by employees (Pfeiffer et al., 2019). An example for 2022 is that Federal Employment Agency (*Bundesagentur für Arbeit*) amounted to Euro 2.79 billion, from which around Euro 346 million were aimed for the acquisition of a vocational qualification, more than Euro 1.5 billion for continuing education measures coming from the continuing training budget, and more than Euro 1.3 billion were devoted to unemployment benefits for continuing vocational training (Eurydice, n.d.). If the individuals participate in training at their own cost, they may receive tax relief depending on the land and their income.

The development of human capital can strategically benefit both employers and individuals (Dosi et al., 2022). The following chapter presents the employer's perspective on retraining and upskilling employees.

2.2. Employers: Companies

> *„Den Wert eines Unternehmens machen nicht Gebäude und Maschinen und auch nicht seine Bankkonten aus. Wertvoll an einem Unternehmen sind nur die Menschen, die dafür arbeiten, und der Geist, in dem sie es tun."*[1]
> H. Nordhoff, ex-chairman of the board of VW
> (in Kühnlein, 1999, p.1, Hans-Böckler Stiftung)

The value of employees within a company or a company transcends that of its buildings, machines, or bank accounts and statements (Nonaka & Takeuchi, 1995; Kühnlein, 1999). In a professional working environment, the learner is an employee, and the employer inevitably affects the learning process (Billet, 2006; Smith & Kelly, 2016). The employer varies from a private company, an enterprise, or a small or medium organization, which may be nationally or internationally active, up to a federal government, and affects the learning process of its employees. According to the third version of Business Analysis Body of Knowledge (BABoK), an enterprise, a corporation, a company, and a company are terms used for business entities that differ in their professional activities, size, scope of operations, and financial resources (IIBA, 2015). Organization is the more extensive term and may comprise several companies (Vahs, 2023). Companies prioritize profit through commercial business activities, and therefore, this will be used in this research as an equivalent for the employer, whether it refers to a company, a company, or an enterprise (Busse von Colbe et al., 2021; Vahs, 2023). Every employer aims to create, share, and integrate knowledge for the optimization of its work processes to stay competitive in an ever-changing, challenging environment (Galy & LeMaster, 2006; Argote, 2013; Boahin & Hofman, 2014; Gil et al., 2015; Paruzel et al., 2020). For these purposes, the employer organizes training through the human resources department or an external service provider, depending on the company's size (Dosi et al., 2022).

Organizational training is a form of training derived, planned, or carried out by the employer within the company. It aims to transfer knowledge and skills internally to boost

[1] The value of a company is not determined by its buildings and machines, nor by its bank accounts. The only thing that is valuable about a company is the people who work for it and the spirit in which they do it.

employee performance (Gil et al., 2015; Ford, 2009). During organizational settings, learning takes place in various forms; therefore, different terminology is used to describe the learning. This has been named corporate or workplace learning, autonomous learning in the workplace, and formal or informal learning. Different criteria and components, such as the level of structure, the intentionality, the sources of validation, control, and stimulus within the learning process, justify the terms mentioned earlier related to employees' learning (Segers et al., 2018). How this takes place within a company will be explained in the following subchapters, beginning with the onboarding process of new employees, the definition of workplace learning, and finally, the fundamentals of training development.

2.2.1. Onboarding Process

Academic studies seem insufficient for direct engagement in the workplace as new employees need to keep educating themselves after formal studies (Chegg & Harris, 2013; Kövesi & Csizmadia, 2016; Molinsky & Pisman, 2019; Bennet & Ananthram, 2021). Researchers have identified a gap between the skills and competencies that the workforce possesses and the ones companies need (Chegg & Harris, 2013; Kövesi & Csizmadia, 2016; European Commission, 2020; Guo et al., 2022). Entering a job position and simultaneously a company predicates acquiring new knowledge. This automatically results in becoming acquainted with a new professional environment within the individual's up-to-date educational and professional background or outside. In either case, employees entering a new company are subjected to a process to inform them about the latest trends and the new company's formalities, restrictions, and policies to be able to perform their roles efficiently and quickly (Smith, 1984; Snell, 2006; Bauer, 2010; Dessler, 2024). This is called onboarding or, in earlier literature, employee orientation and intends to offer employees fundamental information about their position and company (Derven, 2008). The new employees may be called entry-level professionals, novices, beginners, or newcomers/ new hires. New employees undergo onboarding, which includes specific welcoming events and training, particularly intending to introduce them to their new company and its infrastructure, department, team, and position. With or without former work experience, the new hires learn the company's structure and processes and become acquainted with being socially integrated into their new environment (Klein & Weaver, 2000; Becker & Bish, 2021). Research on onboarding and socialization models covers the content the new employees need to

acquire and/or the socialization to ensure newcomers integrate efficiently into their new environment (Van Maanen & Schein, 1979; Becker & Bish, 2021; Klein & Heuser, 2008). The socialization model of Van Maanen & Schein (1979) distinguished the socialization process regarding the art of participation, formalities, sequence, cohesion, structure, and investment from the side of employees and employers (Van Maanen & Schein, 1979). Based on another socialization model of Chao and colleagues (1994), Klein and Heuser (2008) developed a socialization model with twelve dimensions that influenced onboarding and highlighted the importance of the kind of knowledge implementation. These twelve dimensions are *Language, History, Task Proficiency, Working Relationships, Social Relationships, Structure, Politics, Goals and Strategy, Culture and Values, Rules and Policies, Navigation, and Inducements* (Klein & Heuser, 2008). More recent models, such as the 4Cs model by Bauer (2010), describe the onboarding process more precisely according to four levels: *compliance, clarification, culture*, and *connection* (Bauer, 2010). These have been widely used in onboarding development for the last two decades, remain relevant for virtual onboarding, and are acknowledged by the Society for Human Resource Management (Maurer, 2022). *Compliance* includes fundamentals about the tasks that the new employees will manage, *clarification* includes information about the role and future performance expectations, *culture* includes the company's values and norms, formal as well as informal, and *connection* refers to building networks and being linked to colleagues (Bauer, 2010).

Onboarding may last several months for new hires, depending on their position and the company, and learning continuously plays a vital role in every employee's orientation (Becker & Bisch, 2021; Klein & Heuser, 2008). This orientation process starts in the pre-boarding phase before the employees' first working day. The orientation phase follows beginning the first working day until approximately the third month, which in some models includes the training phase. Finally, the onboarding ends with the integration phase from the third to roughly the sixth month (Chang et al., 2004). The critical period of onboarding lasts approximately 90 days, wherein research on nursing onboarding may include milestones of 30 and 60 days and may last until the first six months (Ellis et al., 2017; Kurnat-Thoma et al., 2017; Lynch & Buckner-Hayden, 2010; Rollag et al., 2005). Onboarding practices during this period concern centralized processes deriving from human resources, direct engagement of the manager with the new employees, and further informal activities to support their acclimation and socialization in the company (Snell,

2006; Lynch & Buckner-Hayden, 2010). Other processes that may be included in the onboarding phase of an employee are, for example, mentoring and coaching. Mentoring refers to having another more qualified and experienced employee offer advice and guidance generally regarding the employee's career (Zerzan et al., 2009; Dessler, 2024). Coaching is more specific and refers to instructing somebody on how to do something, usually everyday tasks related to the job position and performance of an employee (Dessler, 2024).

2.2.2. Workplace Learning

Companies aim to promote learning due to the valuable relationship between working and learning, which influences personal and organizational processes (Barnett, 1999; Jacobs & Park, 2009;). The terms organizational, corporate, professional, work-related, or workplace learning attempt to describe and define this learning from different perspectives.

From an organizational perspective, organizational learning refers to producing knowledge collectively beyond individual learning and distributing it by communicating over different channels within a company (Kim, 1998; McManus & Snyder, 2003; Gangopadhyay & Huang, 2004; Galy & LeMmaster, 2006). Kozlowski and colleagues (2010) described organizational learning in their multilevel approach as a mix of informal and formal processes that encourage acquiring knowledge and attempting to distribute it (Kozlowski et al., 2010, p.364). Basten and Haamann (2018) defined organizational learning as the approaches that companies use to constantly upgrade the development of knowledge and its implementation, aiming at a company's competitive advantage. Specifically, "*organizational learning can be perceived as a management task that involves controlling and planning. Its areas of focus include organizational strategic creation, capture, and internalization of knowledge"* (Basten & Haamann, 2018, p.2). The three most commonly used and cited theories in organizational learning research are the *single-loop* and *double-loop learning theory* of Argyris & Schön (1996), the *organizational knowledge creation theory* of Nonaka (1991), and the *five building blocks theory* of Garvin (1993). Implementing one of these theories in a company can support organizational learning but confines their validity depending on the organizational environment and structures (Basten & Haamann, 2018). Therefore, numerous practical approaches have arisen since the publication of these theories, with the most relevant being the *communities of practice* by Wenger (1998) and the role of a *chief knowledge*

officer (Jones et al., 2003), who aim at facilitating knowledge creation and transfer within the company informally (Dewhurst & Cegarra-Navarro, 2004; Jones et al., 2003; Li et al., 2009). The term *"corporate learning"* is used similarly in the managerial literature to describe the company's ability to gain, utilize, and disseminate knowledge to discover innovative solutions and leverage them to enhance efficiency and gain a competitive edge (Dunphy et al., 1997). Essential elements for organizational learning are becoming, according to Erpenbeck & Sauter (2013), workplace learning, learning with others (social learning), and self-regulation (Arnold, 2021; Coady, 2021). Reich et al. (2015) attempted to engineers' professional learning and identified common practices of engineers in the construction industry, which seemed to be centered on the practice. They emphasized that continuing professional learning for engineers occurs *"through practice about practice"*, particularly site walk practice and review meetings that track the project progress (Reich et al., 2015, p.376).

From a training development and psychological perspective, professional, work-related, or workplace learning is initially defined according to its location. These seem self-explanatory for someone irrelevant from their expertise by analyzing the terms' vocabulary as the learning related to work or the learning that takes place at work. Such simplified definitions appear inadequate when further questions about the learning conditions, the role of the learner, or the available resources arise. Besides the location where the learning occurs, the terms refer to learning activities taking place toward the growth of work-related competencies (Kyndt & Baert, 2013; Manuti et al., 2015; Grosemans et al., 2020). The meaning of this term has been a great subject of recent literature, and since its importance is undeniable for companies, it is necessary to elaborate more on it (Jacobs, 2003; Clarke, 2005).

To commence with, Smith (2003) offered an extensive review of conceptualizations of the workplace learning of the past century, wherein the three forms of learning of Billett (1993) and the Job Competence Model of Mansfield and Mitchell (1996), along with the conclusions of Levy (1987) and Cunningham (1998) about the connection between learning and workplace activity, and the social interaction during workplace learning, respectively, distinguish (Smith, 2003). In particular, the Job Competence Model focused on the skills the learner may acquire and described these in four aspects of competence (Mansfield, 1991, 2004). These four aspects refer to technical, task management, contingency management, and role and environment skills (Mansfield & Mitchell, 1996).

These examine the skills as learning outcomes related to planning, making decisions, prioritizing tasks, managing events during their work, and comprehending and performing within the company (Mansfield & Mitchell, 1996). Billett (1993) differentiated the knowledge about a topic between the knowledge of how to acquire the topic and the values and attitudes during workplace learning as three forms of learning, respectively named *propositional, procedural,* and *dispositional*. He also recognized that in workplace learning, the learners receive support or guidance from someone who has already acquired the knowledge or skill they seek to learn (Smith, 2003; Billett, 1993). Levy (1987) drew a connection between learning and workplace activity regarding how learning in the workplace is structured if proper learning opportunities are offered directly on and off the job (Levy, 1987). Another memorable conceptualization is the one from Cunningham, who described workplace learning as informal social interactions among people within a company (Cunningham, 1998). No matter the employees' level, they engage in such interactions to help other employees and spread knowledge (Cunningham, 1998). Smith (2003) concludes with the similarity of the examined conceptualizations of workplace learning: the social construct of knowledge and learners' preference for social interaction when learning.

Workplace learning blends with other terms, such as formal, informal, non-formal, autonomous, self-regulated, or sovereign learning, which focus on different characteristics of the learning process. **Formal learning** describes the learning during programs, courses, and events developed and organized by an employer or a company(Eraut, 2000; Noe et al., 2014; Manuti et al., 2015; Kawalilak & Groen, 2021). These organized courses and events aim to convey knowledge, skills, abilities, and other resources to the employees as part of the formal training that may occur inside or outside the company (Eraut, 2000; Noe et al., 2014). In formal settings, an assigned trainer, instructor, or coach is present and guides or supports the learners, and the content and goals are externally determined (Eraut, 2000; Tannenbaum et al. (2010). Events related to formal training include classroom instruction, online training, mentoring, and academic degrees that the employer may have initiated, ordered to be developed by another training development company, and supported financially (Noe & Ellingson, 2017). Mentoring refers to a level of guided learning that includes an employee with more experience, which shows and supports an employee with less experience (Cohen & Galbraith, 1995; Billett, 2000).

Mandl et al. (2004) sum up the following methods to support workplace learning and the further qualification of employees: project work, learning place, quality circle, learning island, simulations, open-space-conference, coaching, and mentoring. Formal learning remains the primary learning strategy within companies but lies behind informal learning, which exceeds 70 percent of learning in the workplace and is sometimes considered more helpful than formal learning (Queeney, 2000; Bear et al., 2008; Cunningham & Hillier, 2013; Tynjälä, 2013, Cerasoli et al., 2018). Earlier studies on managerial informal learning showed that only 20% takes place in the classroom, and the majority takes place during interactions with colleagues and work-related experiences (Zemke, 1985).

A simple definition of **informal learning** is derived from a comparison to formal learning. It explains that informal learning refers to all learning processes and outcomes apart from formal learning, even if it is difficult to separate it from work (Marsick & Watkins, 1990; Colley et al., 2002; Cross, 2007). As formal learning is strongly associated with the classroom, informal learning is said to be outside of the classroom (Malcolm et al., 2003). The basic characteristic of informal learning is the employers' lack of formal company and structure (Coombs, 1985). Instead, it occurs "*wherever people have the need, motivation, and opportunity for learning"* (Marsick & Watkins, 2001, p.28). This implies that intentionality is not always present and spontaneity is a characteristic of informal learning as it may occur during daily tasks or social interactions (Tjepkema et al., 2002; Malcolm et al., 2003). Therefore, under the umbrella of informal learning, incidental learning refers to outcomes or side-effects of activities with other intentions or no intention to learn (Watkins & Marsick, 1992). Another essential element of informal learning is the importance of social interactions with other colleagues, managers, or generally people they may meet daily and discuss work (Marsick & Watkins, 1990). This refers to Dewey's experiential learning, wherein the role of experience in formal and informal learning settings was analyzed (Dewey, 1938).

At the beginning of 2000, the terms dedicated to workplace learning were controversial as the distinction between formal and informal learning was inadequate regarding further learning characteristics. Billett (2004) was opposed to distinguishing workplace learning into formal and informal because this may misleadingly lead to conclusions that employees' learning is unstructured and poor while it is shaped by the company's dynamics and employees' interests (Billett, 2004). The employees' engagement in

learning practices in the workplace is critical for the succession of the practices. The workplace participatory practices of Billett (2004) highlight the interdependence between daily engagement in work activities and purposely structured workplace-related learning processes under the fundamental role of individuals who determine what they will gain from these. Numerous authors such as Watkins & Marsick (1992), Hodkinson & Hodkinson (2004), and Elkjaer & Wahlgren (2006) exceeded this partition and described workplace learning based on elements related to the learner's intentions. Watkins & Marsick (1992) and Elkjaer & Wahlgren (2006) used the terms "incidental" and Hodkinson & Hodkinson (2004) "intentional" learning to distinguish workplace learning according to the background motives of the learner if they exist. Otherwise, the learning may be an outcome of an activity wherein the learner participated with no intention to learn.

Jacobs and Park (2009) proposed a conceptual framework of workplace learning beyond the polarization between formal and informal learning up to this period. They marked the term workforce learning as more inclusive but agree with the aforementioned definitions of workplace learning as *"the process used by individuals when engaged in training programs, education and development courses or some type of experiential learning activity for the purpose of acquiring the competence necessary to meet current and future work requirements"* (Jacobs & Park, 2009, p. 134). Workplace learning has grown in the last two decades, and researchers have attempted to describe it by including more elements related to learning conditions. Kyndt & Beausaert (2017) described workplace learning as influenced by five dimensions, including a dimension about informal or formal learning and on- or off-the-job learning. The other three dimensions refer to the roles of the actors in a learning process, which are the role of learner, the role of facilitator, and the role of peers by distinguishing, for example, the extent of being an active learner, being coached and offering feedback, and cooperating with others (Kyndt & Beausaert, 2017). Similarly, Segers and colleagues considered formal and informal learning according to five elements of learning: the level of structure, the intentionality, the sources of validation, the control, and the stimulus (Segers et al., 2018). These five elements also influenced Poell, who suggested a framework regarding the learning process in companies, highlighted the importance of the employee's role, and divided learning into implicit, self-directed, and guided learning (Poell, 2005). From a psychological perspective, Röhr-Sendlmeier and Käser (2012) distinguished informal learning into three

modes: explicit, implicit, and incidental. They contrasted these three modes under the criteria of self-consciousness, attention, intentionality, and verbalization of knowledge. The first mode describes a situation wherein the learner self-consciously is occupied and pays attention to the content and the learning goals (Röhr-Sendlmeier & Käser, 2012). The second mode of implicit learning refers to learning wherein the learner participates in a learning process but learns something different from the learning goals and content. Finally, the third mode of incidental learning refers to situations where the learner has no intention to learn anything, but learning happens unexpectedly (Williamson, 1998; Röhr-Sendlmeier & Käser, 2012). Nevertheless, this topic is subject to debate, with some researchers presenting opposing perspectives. In case the learner has no intention to learn, Bilger et al. (2012) consider that there is no learning taking place.

The significant relevance of the individuals' intentionality regarding workplace learning also concerned Tannenbaum and his colleagues (2010), who developed a dynamic model of informal learning. The intent to learn, the experience and the actions individuals encounter, the feedback they receive, and the reflection they show are the four components of the dynamic model of informal learning (Tannenbaum et al., 2010). According to this model, the learning process occurs dynamically and foresees that learners experience all four components even multiple times with no solid flow (Decius et al., 2019). This implies the existence of triggers surfacing by chance that afterward (may) lead to a learning process (Cerasoli et al., 2018; Marsick & Volpe, 1999; Elkjaer & Wahlgren, 2006; Watkins & Marsick, 1992). Decius et al. (2019) further expanded this dynamic model while trying to offer a specific operationalization of informal workplace learning by adding subcomponents to the existing four components. Without meaning that this component necessarily starts a learning process that can explained with this model, the intent to learn has a critical role in workplace theories as it is also a component that distinguishes formal and informal learning (Eraut, 2000; Tannenbaum et al., 2010). This component was subdivided into intrinsic and extrinsic intent to learn depending on the source of learning motives (Decius et al., 2019). For example, if professional promotions affect the intention to learn and acquire new knowledge, it is an extrinsic intent to learn (Decius et al., 2019). The component experience/action, which refers to how individuals engage, was subdivided into trying & applying their own ideas and model learning, which refers to learning that derives from the individual and learning from other colleagues (Tannenbaum et al., 2010; Decius et al., 2019). The component feedback,

which arises either from a task itself or from other people, was subdivided into direct and vicarious feedback, which depends on former own acts or comes from information shared by colleagues. The fourth component, reflection, refers to the thinking about experiences or actions that occurred in the past or may occur in the future (Tannenbaum et al., 2010; Decius et al., 2019). This was divided into anticipatory or subsequent reflection (Decius et al., 2019).

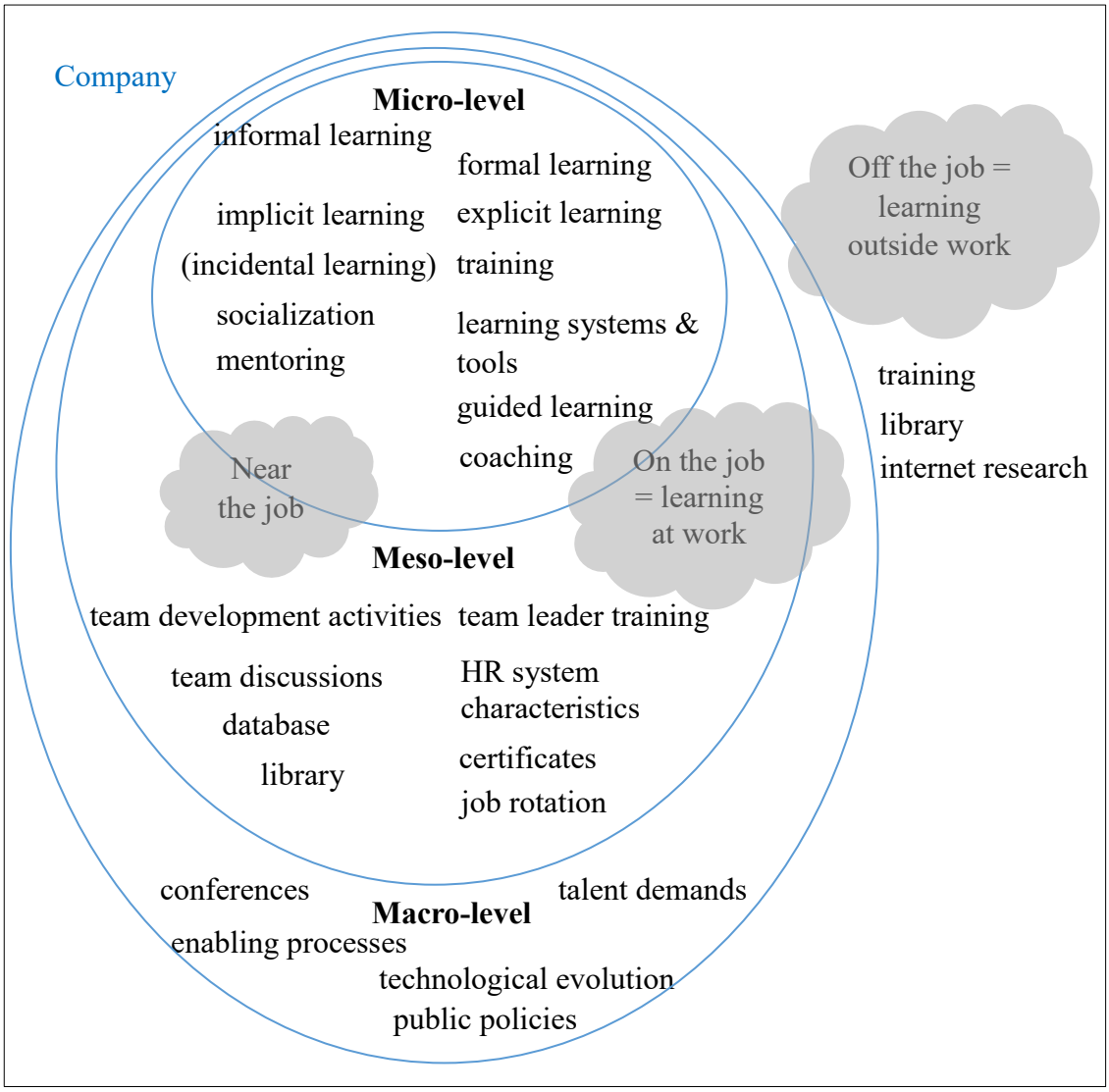
Other authors used another element to clarify workplace learning, and this is the location of the learning. The first distinction is between *learning at work* and *learning in work*. The first one refers to organized learning processes that take place during training and other structured courses. In contrast, the second relates to learning that occurs parallel to other work activities and has an informal character (Sambrook, 2005). When learning is entirely unrelated to the work environment, the term *learning outside work* is used (Sambrook, 2005). A similar distinction uses the terms *on the job, near the job,* and *off the job* (Baitsch, 1998, p.306). *Off the job* refers to learning outside work, which can be training the learner chooses to attend individually without the employer's involvement or events outside typical working hours (Baitsch 1998). Learning *on the job* refers to *learning at work,* as described above, and *learning near the job* refers to learning within meetings or training with content not directly related to the individual's work tasks (Arnold, 2021).

Pennings et al. (2020), in a vignette study with Dutch military personnel, judged informal learning interventions and concluded that the two most preferable were *informal mentorship* and *safe learning environment*. Coetzer et al. (2017) state two beneficial factors within informal learning in small businesses: short decision paths and social proximity. Research about informal learning in other fields has also shown the importance of general interaction and engaging with colleagues (Cuyvers et al., 2016). Cuyers et al. described co-occurrences of learning activities such as observing and interacting (2016). In the meta-analysis of Cerasoli et al. (2018), engagement in informal learning behaviors indicated a connection to employees' attitudes, skill acquisition, and performance. Marsick & Neaman (2018) related informal learning to the reactions of individuals to a problem or knowledge deficit at work, which is challenging and requires further qualification. Informal learning has been established in workplace research as Welk et al. (2023) acknowledged the existence of informal learning in continuing education as a tool to strengthen the workforce and how feedback can cultivate this. Decius et al. (2021)

consider informal workplace learning the dominant form of learning, particularly in small and medium-sized companies. However, healthy affiliations between formal and informal learning can continuously support workplace learning (Arnold, 2021; Kittel & Seufert, 2023b).

Figure 2 summarizes the terms and characteristics that are mentioned in the literature about workplace learning up to this point. This occurs within three levels: Micro-level, Meso-level, and Macro-level, inspired by the multilevel foundation and infrastructure for organizational learning by Kozlowski et al. (2010). The micro-level refers to the learning occurring in small sections, task-related, that can be formally designed by the organization, aiming also at the socialization of individuals within the company (Kozlowski et al., 2010). Meso-level, one level higher in the organizational processes, refers to knowledge building within a team and generally aims at promoting team learning, relations, and development (Kozlowski et al., 2010). The Macro-level covers learning to a larger extent, concerns broader measures, and is influenced by technological evolution in society (Kozlowski et al., 2010). Employees learn outside of their organization; therefore, Figure 2 includes activities for learning that take place outside of the work environment. For example, employees may attend training outside of the work hours of their own interest or search the internet or in a library for information.

Figure 2. Combination of different terms about Workplace learning



Note. Own figure inspired by Figure 12 in Arnold (2012), p.88, Figure 11.3 in Kozlowski & Salas (2010), p.377, and Figure 1.5 in Sammet & Wolf (2019), p. 14.

Furthermore, the literature emphasizes the importance of self-directness in workplace learning (Smith, 2003; Pennings et al., 2020). In 2022, Decius and Decius proposed an integrated process model of sovereign workplace learning, which combined self-regulated learning and informal learning in the workplace. Their model offers a holistic analysis of employees' learning pathways by considering the up-to-date psychological and educational research background (Decius & Decius, 2022). The connection between informal and, generally, workplace learning and self-directed learning and self-regulation is derived from examining individuals' intentions. This will be further analyzed from the individual's perspective in Chapter 2.3.4 after self-regulation theories are presented.

2.2.3. Training Development

Companies' attempts to structure workplace and organizational learning address training development with specific goals and content and the relevant knowledge and skills the employees need to acquire and develop. The consequences of training closely and positively affect the organizational performance of employees (Garavan et al., 2020). Formal learning occurs mainly during training that employers organize in-house or externally for employees (Eraut, 2000; Noe et al., 2014; Manuti et al., 2015). Such training serves the employers' goals and obtains external validation and stimulus for learning with mostly high structure, wherein a trainer proves the learning outcome (Eraut, 2000; Noe et al., 2014). This chapter will analyze the concept of training development and present widely used models of developing training aiming to demonstrate the environment wherein formal learning takes place and opportunities for informal learning arise within a company and the constraints.

Training is an organized period that aims to equip employees with knowledge, skills, abilities, and other resources (Goldstein & Gessner, 1988; Noe et al., 2014). Training may be called professional, corporate, or formal in professional work-related settings. In a recent article about skills and training in the EU, Eurofound defines training as *"the process of enhancing employees' skills, attitudes, and knowledge to improve competence levels"* (Eurofound, n.d.). In the same article about the European Qualifications Framework, the term "skills" refers to the employees' abilities to apply knowledge to carry out their assignments and resolve any problems (Eurofound, n.d.). Professional training development addresses this challenge by achieving specific employee performance goals. A separate department internally or an external company, which is a training provider, undertakes this task and offers training as educational courses to provide the employees with the required knowledge, skills, or information.

Nowadays, training is either solely face-to-face training, virtual training, or hybrid training. The use of hybrid or blended training was accelerated through the COVID-19 global pandemic (Fake & Dabbagh, 2020; McGuire, 2021). However, Bonk et al. predicted already in 2005 that blended learning would thrive and be extensively employed in the workplace (Bonk et al., 2005).

2.2.3.1. Training Demands and Needs

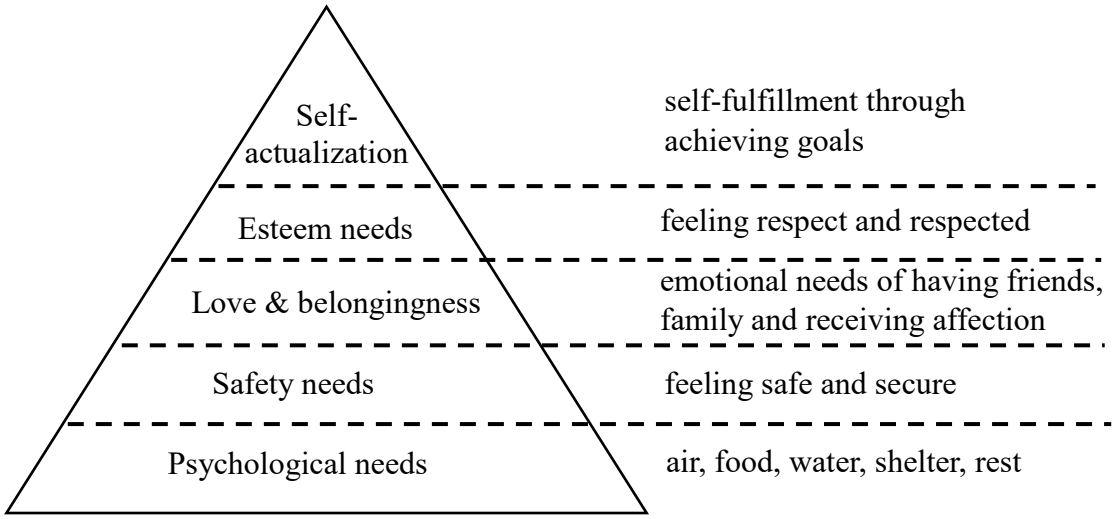
The aims of training concern a kind of improvement of the skills and knowledge of the employees, which postulates a primary existing and desired status of knowledge and skills. The differences between the primary and desired status form a knowledge and/or skills gap (Chegg & Harris, 2013; Kövesi & Csizmadia, 2016; European Commission, 2020; Guo et al., 2022). Depending on who defines this desired status of knowledge and skills, different terms such as needs, demands, requirements, and wants are used to describe, explain, and determine this gap. As Sava (2012) mentioned, different perspectives recognize different conditions between the existing and the desirable status of the learner.

In training development, the term *"demands"* is used to address a social gap, which contains socially recognized differences in the state of knowledge and skills of a group of people (Gieseke, 2008; Sava, 2012). Demands refer to objective needs highly influenced by society, technology, and law changes (Gieseke, 2008). These are translated from companies and are also mentioned as organizational development or business needs (Smith, 2003; Sava, 2012). Organizational needs will hereafter be mentioned in this research as demands that refer to the company itself and aim to benefit the organization's goals. This distinction between demands and needs is attributed in German with two different terms; first, the term "Bedarfe" refers to needs that have objective origins, and the term "Bedürfnisse" originates subjectively from participants (Gieseke, 2008, p. 29). Both terms are used to describe needs related to education and training needs.

The first thing that comes to mind of people working in training development and other psychologically relevant fields when hearing the word "needs" is Maslow's hierarchy of needs in his motivational theory, wherein he divided human needs into five levels (see Figure 3) (Wahba & Bridwell, 1973; Geller, 1982; Maslow, 1987). His pyramid refers to five levels of needs, beginning with the first level of *physiological needs* and counting up from the bottom. The needs for food, water, shelter, and sleep belong to the first level (Maslow, 1987, p. 15). The second level includes the needs of humans to feel *safe and secure* by, for example, being employed and healthy (Maslow, 1987, p. 18). The third level of *love and belongingness* refers to the emotional needs to have friends and family and receive affection (Maslow, 1987, p. 20). The fourth level of *esteem* relates to the respect of others and by others an individual feels (Maslow, 1987, p. 21). The final and most challenging level of Maslow's pyramid is *self-actualization*, which refers to self-

fulfillment and differs among people due to their different goals and experiences (Maslow, 1987, p. 22). Maslow first supported the idea that lower needs must be fulfilled before all higher levels of needs due to their importance for human well-being (Sava, 2012, p.31). In the later refinements of his theory due to criticism, he added that the order of the needs may vary among individuals, and higher and lower needs can simultaneously motivate a person (Wahba & Bridwell, 1973; Geller, 1982).

Figure 3. Maslow's Needs Pyramid



Note. Own figure according to Maslow (1987, p. 15-22).

Another classification of needs, according to Bradshaw (1972, 1994), with a sociological background includes *normative, felt, expressed,* and *comparative needs* (Bradshaw, 1994). A similar classification by Kettner et al. (1999) refers to *normative, perceived, expressed,* and *relative needs*. The normative needs are needs distinguished by professionals in the field (Bradshaw, 1972; Kettner et al., 1999). The felt or perceived needs are the needs of the individuals' perspective who experience such wants or wishes in this situation (Bradshaw, 1972; Kettner et al., 1999). The word "felt" describes these needs from the learners' perspective, and the word "perceived" encloses the experts' perspective (Berwick, 1989). Expressed are the needs exhibited by people who seek and participate in training or services. Finally, the comparative or relative needs are concluded by comparing people with similar characteristics but in different geographic areas (Bradshaw, 1972; Kettner et al., 1999).

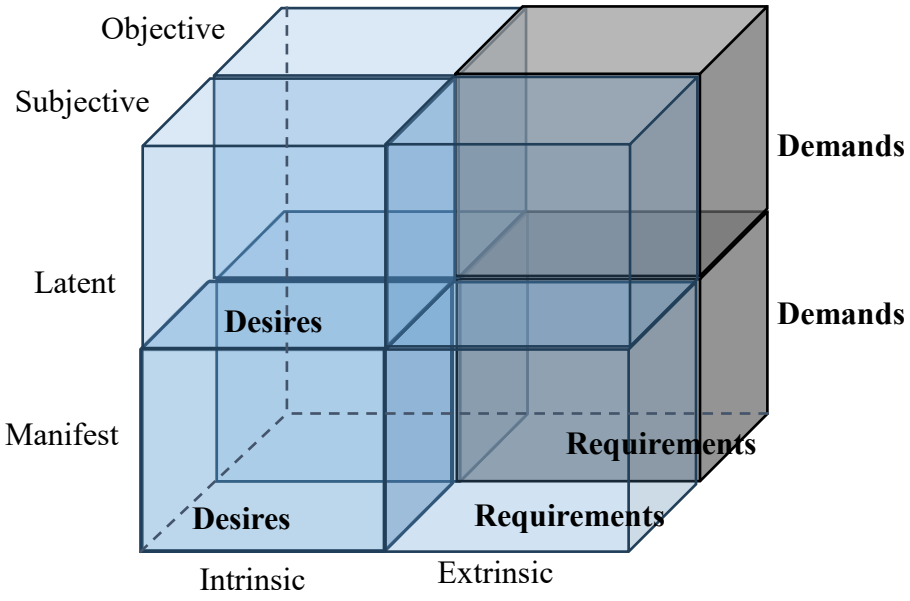
In a similar context to Maslow's pyramid, McClusky (1971) described four categories of educational needs of an adult. In McClusky's hierarchy, coping needs are placed at the bottom, referring to decisions about shelter, free time, health, finances, and family relationships (Merriam et al., 2007). Expressive needs contain talents that have not been expressed but can be developed. Contributive needs refer to the desire to give and help others. Finally, influence needs *"are those needs of adults to affect the quality and direction of their own lives"* (Mazmanian, 1977, p. 5).

While these classifications seem adequate at a first general level, there are further interesting distinctions about individual needs. Subjective needs derive from the individual, differ according to the individual's perceptions and interpretations, and change often (Sava, 2012; Kaewpet, 2009). Similar to the distinction between demands and needs, objective needs are formulated from the market and are similar to demands and normative needs. These needs are common for a group of people, e.g., company employees, and arise from occupational standards (Sava, 2012). A different concrete distinction between objective and subjective needs within training development comes from Brindley (1989), who states that objective needs are explored before a training course, while subjective needs are addressed while the course is underway (Brindley, 1989). Besides these, Sava (2012) included two additional needs classifications in her cube dimensions of needs. The difference between intrinsic and extrinsic refers to the origin of the need; intrinsic needs come from the inside, and extrinsic needs come from the outside of a person or a company (Sava, 2012. The needs of employees working at a company may emanate from their interests, so they have an intrinsic origin or from requirements given by their employers (Sava, 2012). The third important classification of needs refers to whether they are expressed. Manifest needs are the ones individuals express by searching and organizing their learning process to cover these (Sava, 2012). Latent needs are individuals' needs that are not expressed or recognized. These needs are also subdivided into unformulated or unperceived needs (Horvat & Kailer, 1989).

The needs' dimensions cube of Sava (2012) shows that the dimensions interact with each other and are not permanently attached to a need. As Sava (2012) explained, a latent need becomes manifest if, e.g., employees find training to support their interests, which until then remained unexpressed (Sava, 2012, p.17). Attempting to present collectively all relevant terms, Figure 4 collects all terms about demands and needs mentioned until now.

Desires may be expressed or not and have an internal origin and subjective validity (O'Reilly, 1973; Maslow, 1987). Finally, in human resources, requirements describe specific information about knowledge or skills necessary for a job role to fulfill the employers' demands (Sava, 2012, p.56). According to the International Institute of Business Analysis, a requirement is *"a condition or capability needed by a stakeholder to solve a problem or achieve an objective"* (IIBA, 2009, p.4). Hence, the cube dimensions of needs of Sava is adapted in Figure 4 by including all terms. While all dimensions of the cube can be called needs, in this research, needs refer to differences in the individual's state of knowledge and skills, which may be expressed or not and are subjective as they differ among employees. Demands refer to the gap described as objective, extrinsic, latent, or manifest, depending on the situation (See grey cuboids in Figure 4).

Figure 4. Combination of different terms related to needs



Note. Own figure adapted from Figure 1: *"The cube dimensions of needs"* from Sava, 2012, p.17 in *Needs Analysis and Programme Planning in Adult Education*, by Sava, 2012, Barbara Budrich Publishers.

Before analyzing in Chapter 2.3 how an individual, especially an employee, covers these needs and how adults learn, it is interesting to discuss the organizational perspective of how companies aim to cover these needs within training, how training needs analysis identifies needs and demands before developing training and how training development takes place.

2.2.3.2. Training Needs Analysis

The process of "needs analysis" is the first step of training development, which examines a situation to identify the needs of a group of people to achieve the desired outcomes (Altschuld & Witkin, 2000; Boydell, 1976; Gould et al., 2003). This step is presented here before training development models because it takes place initially to investigate if training is necessary. Who can answer the question of what the needs of a group of people are? Within an organization, employees of different departments and levels may have needs. As mentioned in 2.3.3.1, the demands are externally identified from a higher level in the organization, and the needs are derived from individuals. This requires an analysis that begins at the organizational level, continues with the operational, and ends with the individuals (McGee & Thayer, 1961; Morano, 1973). Representatives of the organizational level are required to provide information regarding an company's goals, investment, and strategic planning, which also depend on marketplace demands (Leat & Lovell, 1997). The operational or task level is visible through job descriptions and specifications, which contain information about the standards, knowledge, and skills necessary for one position (Leat & Lovell, 1997). This relates both to the company's and employees' needs. The third level refers to individuals' needs regarding their skills, interests, participation in training, and every other aspect that bothers them or their job role (Leat & Lovell, 1997). Chiu et al. (1997), in their literature review regarding training needs analysis approaches, concluded that companies' demands were emphatically prioritized and the individual needs of employees were neglected. Controversies about individuals' capability to identify their own needs exist in parallel with the importance of asking them about their opinions (O'Reilly, 1973; Morano, 1973). Therefore, a complete needs analysis must examine different actors within an organization. An exemplary training analysis by Gould et al. (2004) in nursing education concluded that micro-level needs analysis tends to cover the stakeholders' perspective and indicates a positive influence on training outcomes. The methods used in the training needs analysis of the discussed literature were questionnaires, surveys, focus groups, group discussions, and interviews with the stakeholders, who, in this case, were nurses and managers (Gould et al., 2004). Lately, analyzing training needs differentiates whether it refers to new or current employees; the task analysis explores the needs of new employees and the performance analysis of current employees (Dessler, 2024). The difference lies in the fact that a task analysis studies job descriptions and specifications to determine specific skills

and responsibilities of a position, while a performance analysis evaluates the performance of current employees to reveal whether potential gaps could be covered with training or by other means (Stetar, 2005; Dessler, 2024). The sovereignty of the one-size-fits-all approach began to decline, and the focus shifted to flexibility and individualization to adjust the training to the trainee (Salas & Kozlowski, 2012; Salas et al., 2012; Cannon-Bowers & Bowers, 2012; Bell & Kozlowski, 2012; Ferreira & Abbad, 2013; Mikolajczyk, 2021). Salas et al. (2012) highlighted the significance of how training is structured and distributed. Therefore, the following subchapter analyses how training is developed.

2.2.3.3. Training Development Models

A training development model includes every step of creating training for a target group (Robbins & Judge, 2023). The field of instructional design is dedicated to analyzing all steps of this process to make it as efficient as possible (Robbins & Judge, 2023). Trainers have used numerous different training development models in the last fifty years. This sector has boomed and is explicitly referred to as instructional design. In the 1950s, Bloom and colleagues published the taxonomy of skills, which classified six levels of cognitive function and learning and was revised in 2001 (Bloom et al., 1956; Anderson et al., 2001). This taxonomy greatly influenced the training development by focusing on the types of knowledge learners can reach (Anderson et al., 2001). In the 1960s, Gagne introduced a systematic approach based on the Nine Events of Instructions, which aims to attract learners' interests and then engage them in the application of learning (Gagne, 1985). These nine events describe the whole learning process starting with *(1) getting the attention of the learners, (2) informing them about the learning objectives, (3) stimulating recall of prior knowledge,* continues with *(4) presenting the content, (5) providing guidance, (6) offering practice opportunities* and *(7) feedback, assessing their performance,* and finally *(9) increase retention and transfer of the* knowledge in real-world situations (Gagne, 1985; Gagne et al., 1992).

In the 1970s, a team from The Centre of Educational Technology at Florida State University developed the ADDIE model, which describes a linear approach to developing training (Gustafson & Branch, 2002; Branch, 2009; Salas, 2013). The ADDIE model was the primary training development model for many years, named after the five steps trainers follow to develop training: analyze, design, develop, implement, and evaluate (Allen, 2006; Dessler, 2024). This model begins with analyzing the goals of the training to be developed and who should participate in it (Allen, 2006). This step is equal to the

needs analysis described in 2.2.3.2. The next step is establishing the learning strategies to fulfill the training goals and designing the desired outcome (Blanchard & Thacker, 2010). The third step is the training development, including training materials, place, and other necessary resources (Allen, 2006). The fourth step is implementing the training with participants (Allen, 2006). The final step is the evaluation of the training according to the company's goals, which may offer suggestions for further improvements of the training (Allen, 2006).

In 2012, the educational psychologist M. Allen initiated the Successive Approximations Model (SAM), aiming to create "*meaningful, memorable, and motivational learning experiences that drive measurable gains and performance"* (Allen & Sites, 2012). The difference between this and other training development models lies in the agile process, including repeated small steps during the three development phases: preparation phase, iterative design phase, and iterative development phase (Allen & Sites, 2012). This enables fast and real-time adjustments to potential mistakes and flexibility during development.

Apart from the above-mentioned training development models, there are known instructional design approaches such as Merrill's 5 Principles of Instruction, which are practical Instructional Design approaches that guide a training developer on how to design training (Merrill, 2002; Merrill et al., 1992). Merrill (2002), influenced by adult learning theories, introduced his five principles, focusing on solving real-world problems that may trigger prior knowledge. Similar to the nine events of Gagne, Merrill's five principles consider that true learning begins with a problem, then the learner's prior knowledge is activated, afterward educators show a process or step of it, the learners apply the new information, and at last, they integrate it in their reservoir (Merrill, 2002). The Cognitive Load Theory of Sweller (1988) suggests that adults can absorb a specific amount of knowledge, and instructional designers should consider the three types of cognitive load to develop successful training (Sweller, 1988). The intrinsic load refers to the difficulties of learning a topic by deriving from the topic itself, the extraneous load from the cognitive load due to the instructional transmission, and the germane load from the schematical presentation of the content flow (Sweller, 1988).

2.3. Employees: Individuals

> *"As employees have come to take more ownership in their professional development in recent years, it is becoming increasingly important to examine employees' professional development strategies from the perspective of individual learning paths."*
> Poell et al. (2018, p.317)

Up to this point, this literature review considered learning from the perspectives of employers and companies. Lately, the research on training and development has taken a turn toward the learner and the specific characteristics of the training (Bell et al., 2017). Human resource development professionals responsible for staff development and training could more effectively reach organizational goals by considering that employees act strategically concerning their professional development and that these strategies may vary from the professional development strategies that managers and educators intend for them (Nolan et al., 2000; Poell, 2017; Munro, 2008). Therefore, this chapter presents the learning process from the employees' perspective, beginning with the fundamentals of adult learning theories, followed by self-regulated learning theories and relevant literature about employees' strategies toward learning.

2.3.1. Adult Learning Theories

The analysis of employees' learning requires an examination of the existing learning theories that refer to adults. The necessity to differentiate learning theories for adults can be traced back to ancient times and to the 1700s with the influence of Comenius, but started officially in the early 1900s (Savicevic, 1999; Götz, 2011; Knowles et al., 2020). The term andragogy started appearing in European and American literature in the early 1970s, and in 1973, Knowles used the term explicitly referring to how adults learn (Knowles et al., 2020). An adult is a person who, after completing compulsory education, enters the adult world and is able to perform adult roles such as worker, parent, spouse, and voting citizen and to direct their own life (Knowles et al., 2020). The first version of Knowles' Andragogy theory started with four assumptions about adults' learning, which were extended to six assumptions afterward (Knowles, 1973; Knowles et al., 2020). Contrary to pedagogy and learning theories about children, adults want to be aware of why they (need to) learn something in advance (Illeris, 2003; Knowles et al., 2020). Facilitators should contribute by helping adults become aware of potential gaps and their *need to know* (Knowles et al., 2020). This relates to adults' self-concept, which influences

their learning as they dislike being dependent and obliged to learn what others decide they need to learn (Knowles, 1973). Adults evolve into *self-directing learners* and carry their own experiences, which greatly defines them (Knowles et al., 2020). This requires that adult educators consider and acknowledge adult learners' existing experiences, attempt to shed light on these, and engage with them to enrich them by potentially overcoming biases (Knowles et al., 2020). The fourth and fifth assumptions of the latest Andragogy model are readiness to learn and the orientation to learning, which relate significantly to the first assumption, the need to know (Knowles et al., 2020). The readiness to learn refers to the suitable timing of learning a subject because learning something that an adult does not need at the present moment is not beneficial as the reason to learn it is missing (Knowles, 1973). Similarly, the orientation to learning of adults is problem-centered, which implies that adults learn what they need according to their current life circumstances (Illeris, 2002; Knowles et al., 2020). Knowles' last assumption is that internal motives drive adults to a greater extent than external motives (Knowles et al., 2020). The critique of Knowles' theory focused on the lack of consideration of the obstacles to adult learning resulting from social and organizational conditions (Grace, 1996). Further objections to Knowles' Andragogy described adults' need for self-direction as excessive and the differences between pedagogy and andragogy as vague (Hartree, 1984; Tennant, 1986).

Kolb (1984) enhanced the third assumption of Knowles about the importance of experience in adult learning by continuing the experiential learning theory introduced by Dewey (1938) and Piaget (1970) that defines learning as *"the process whereby knowledge is created through the transformation of experience"* (Kolb, 1984, p.38). Engaging in a *concrete experience* is the first stage of Kolb's four-stage cycle of learning that might have already happened or be a new experience (Kolb, 1984). Afterward, the learners reflect on this experience during the second stage of *reflective observation*. Here, intrinsic thoughts and discussion with others enable a clear understanding of the experience and their perspective (Kolb, 1984). In the third stage of *abstract conceptualization*, learners form conclusions based on their experience and prior knowledge to explain and understand what they experienced (Kolb, 1984). Finally, the fourth stage of *active experimentation* involves applying the conclusions of stage three to new experiences to test these in practical situations (Kolb, 1984). The critique of Kolb's experiential learning model focuses on the lack of theoretical and empirical foundations (Miettinen, 2000), the vague definition of a *concrete experience* (Morris, 2019; Bergsteiner et al., 2010), and

the exaggerating concept of learning styles, which have been debunked in the meantime and are analyzed in 2.3.3.2 (Pashler et al., 2008; Furey, 2020). Despite these oppositions, Kolb's experiential learning model contributed to shifting adult learning to adults' experiences and practical implications of knowledge (Morris, 2019). Similarly emphasized in Jarvis' model of the learning process is the value of experience and the subsequent reflection of it with the addition of motivation, context, and individual characteristics (Jarvis, 2006). In this model, the learners are perceived, including their past and emotions, which contribute significantly to learning because these, complemented by reflection, lead to change, and the person becomes more experienced (Jarvis, 2006). This changed person encounters another experience, which triggers a learning cycle again (Jarvis, 2006; Merriam et al., 2007).

Another thought-provoking adult learning theory that shares common elements with Kolb's theory is Mezirow's Transformational Learning Theory (1997). Mezirow's theory also highlights the role of experiences and the reflection of these on adults' personal growth (Mezirow, 1997). In this theory, the learning process is triggered by a disorienting dilemma, which causes uncomfortable feelings, which adults need to examine and lead them to reevaluate their perspectives (Mezirow, 1994). A central element of this theory is critical thinking, in which adults need to be inclined to be open toward discourses to overcome any constraints (Mezirow, 1994). Contrary to Knowles' and Kolb's learning theories, Mezirow emphasizes the social aspect of learning as adult learners participate in society and professional social settings (Mezirow, 1994). This was inadequate to withhold his critics from commenting that Mezirow's theory has an individualistic focus and suggests, as Kolb's does, a linear learning process (Tennant, 1993; Taylor, 2000; Collard & Law, 1989; Hoggan & Hoggan-Kloubert, 2023).

There are learning theories that specifically emphasize the influence the environment and other people have on one's learning and, in general, on behavior, such as Bandura's social learning theory, which supports that learning occurs through observation, imitation, and modeling others (Bandura, 1971). Exceeding behavioristic theories, he proposed that a mediational process occurs before adults start observing something, leading them to pay attention to observing (Bandura, 1971). The interactions between learners, their behavior, other humans[2], and the environment occur dynamically, including the element of self-

[2] Humans are referred to as "models" in Bandura's theory (Bandura, 1991).

efficacy (Bandura, 1991; Lent et al., 1994). The value of collaboration and cooperation within learning was also an issue examined by Johnson and Johnson (1999) and is evident in *communities of practice*, wherein the learners have common goals and experience positive interdependence (Wenger, 1998; Johnson & Johnson, 1999; Wenger-Trayner et al. 2015;). The communities of practice are deliberately created, align with the members' needs, and include resources that the members use (Wenger, 1998). Cooperative learning exceeds beyond communities of practice and occurs additionally in formal or informal settings, wherever individuals have the chance to *"work together to maximize their own and each other's learning"* (Johnson & Johnson, 1999, p.73).

2.3.2. Self-Regulated Learning

During the 1970s, there was a notable increase in scholarly interest surrounding the concept of self-regulation. However, some individual elements of learning regulation can be traced back to older learning theories of Comenius and Montessori as Götz (2011) also commented. After the middle of the 20th century, researchers such as Bandura (1971) mentioned the importance of paying attention and distinguished that learning through observation, for example, does not occur passively. Knowles (1975) also underlined the value of self-directed learning before, during, or after the learning process. Approximately a decade later, Deci & Ryan (1987) analyzed in their Self-Determination Theory the influence of the interaction between the person and their environment on the person's motivation from a psychological perspective. They focused on the need for autonomy, competencies, and embeddedness of learners (Ryan & Deci, 2000). Self-regulated learning is a broader concept than self-directed or self-determined learning due to the possibility of external guidance in self-directed learning (Pilling-Cormick & Garrison, 2007; Fontana et al., 2015). Self-regulated learning focuses on the *internal processes* (Fontana et al., 2015, p.34). Many researchers define self-regulated learning similarly by describing it as *"a form of learning in which the person self-determinates one or more self-management measures, depending on the type of learning motivation (intrinsic or extrinsic), cognition, metacognition, volition, and behavior, and supervises the progress of the learning process itself"* (Schiefele & Pekrun, 1996, p.258). Another definition describes it as *"a form of acquiring knowledge and skills in which the learners are independent and self-motivated. Learners independently choose their own goals and learning strategies that will lead to achieving those goals. It is through evaluating the effectiveness of one's learning strategies – comparing one's current state with the target*

state – that learning can be modified and optimized." (Götz et al., 2013, p.126). Summing up similar definitions, Sitzmann & Ely concluded that "*self-regulated learning refers to the modulation of affective, cognitive, and behavioral processes throughout a learning experience to reach a desired level of achievement.*" (Sitzman & Ely, 2011, p. 421).

By 2000, research about self-regulated learning became more prominent with the development of different self-regulated learning models. These models are distinguished into hierarchical and process models, with the most famous being the Three-Layered Model of Self-Regulated Learning by Boekaerts (1999), the Process Model of Self-Regulation by Schmitz (2001), the General Framework for SRL (self-regulated learning) of Pintrich (2000) and the Social-Cognitive Model of Self-Regulation by Zimmerman (1989). Zimmerman's (1989) and Schmitz and Wiese's (2006) models examined the learning process as a dynamic cycle. They divided it into three phases: *forethought* or *preaction, performance* or *action,* and *self-reflection* or *postaction* phase. The first phase contains the learners' planning regarding the solution of a problem or the way to achieve their goal (Zimmerman, 2002; Schmitz & Wiese, 2006). The second phase is the implementation of the strategies the learners chose and simultaneously observing these strategies, which may include asking for help (Zimmerman, 2002; Schmitz & Wiese, 2006). The third phase refers to reflecting on the outcomes wherein the learners judge if they are satisfied, which may lead to further adjustments of their learning strategies and process (Zimmerman, 2002; Schmitz & Wiese, 2006). Pintrich's (2000) model is subdivided into hierarchical models, but its four phases resemble the three abovementioned models. Its four phases are *forethought, monitoring, control,* and *reflection*, which he thoroughly analyzed into areas for regulation: cognition, motivation and affect, behavior, and context (Pintrich, 2000). This distinguishes Pintrich's model from other models of self-regulated learning due to the analysis of motivation in self-regulated learning (Puustinen & Pulkkinen, 2001; Panadero, 2017). Based on his SRL model, he developed the Motivated Strategies for Learning Questionnaire (MSLQ), which measures self-regulated learning and self-efficacy and is most frequently utilized by researchers on these topics (Panadero, 2017; Roth et al., 2016; Honicke & Broadbent, 2016).

Contrary to process models, Boekaerts (1999) described the three-layered model of self-regulated learning, which is hierarchically structured based on the three layers of

learning, *regulation*, and *self*. The first layer, *learning*, focuses on regulating information processing, which refers to the selection and coordination of cognitive learning strategies. The second layer, *regulation*, refers to the regulation of the learning process, which supports the regulation of learning through metacognitive knowledge. Learning strategies considered necessary for this are planning, observing, evaluating, and correcting. The reasons for regulation can be internal, external, or even mixed since the selection of cognitive learning strategies can also occur with external support. The third layer is of great importance because the regulation of this level concerns the *self*, which deals with the selection of personal goals and resources and depends on learners' motivation. This last layer influences the whole learning process (Boekaerts, 1999; Otto et al., 2011).

As Puustinen & Pulkkinen concluded in their literature review about self-regulated learning models, the common element of the models of Boekaerts (1999), Zimmerman (1989), and Pintrich (1999) is their interpretation of self-regulated learning *"as a goal-oriented process"* (Puustinen & Pulkkinen, 2001, p.280). According to these models, cognitive, motivational, emotional, and social elements are considered within self-regulated learning (Puustinen & Pulkkinen, 2001). On the contrary, the models of Borkowski et al. (2000) and Winne (1996) emphasized metacognition during the learning process that matches *"cognitive strategies to tasks"* (Puustinen & Pulkkinen, 2001, p.280). Panadero (2017), in his more recent review of self-regulated learning models, compared newer self-regulated models, such as Efklides (2011) and Hadwin et al. (2011, 2018), to the models mentioned above and noticed that the newer models were influenced by the previous self-regulated models of Zimmerman (2000), Winne & Hadwin (1998), and Pintrich (2000). He concluded that the variety of these self-regulated models serves the research because researchers and trainers can choose a model that suits their learning conditions and population accordingly (Panadero, 2017). Finally, it is interesting to comment on the collaboration aspect of regulation that Hadwin et al. (2018) emphasized and analyzed apart from self-regulated learning, also into co-regulated learning and socially shared regulation of learning. They implied that the conditions influence the individual self-regulation of learners when they are part of a group, either strongly in the case of co-regulation or in terms of group interactions in shared regulation (Hadwin et al., 2018).

2.3.3. Employees' Learning

Attempting to understand the learner during the learning process extensively, this subchapter further elucidates employees' learning by exploring the different terms used to describe individuals' actions, methods, or techniques to enhance their learning. The different relevant terms vary from cognitive and metacognitive learning strategies to learning styles in the workplace, learning patterns in companies, learning paths, and learning behaviors (Perkins, 1992; Witkin et al., 1977; Kolb, 1984; Riding & Cheema, 1991; Govaerts & Baert, 2011; Poell et al., 2000; Poell et al., 2018; Cerasoli et al., 2018; Kittel & Seufert, 2023a).

2.3.3.1 Learning Strategies

The use of learning strategies has been connected to the success in the learning process and the categorization of learners (Pintrich & De Groot, 1990; Weinstein et al., 2000). Weinstein and her colleagues claim that: *"Learning strategies include any thoughts, behaviors, beliefs, or emotions that facilitate the acquisition, understanding, or later transfer of new knowledge and skills."* (Weinstein et al., 2000, p.727). Götz et al. (2013) similarly defined learning strategies as *"thoughts and actions that are used to control the learning process either directly or indirectly, and may be knowingly used by individuals to optimize their learning experience"* (Götz et al., 2013, p.127). They mentioned that learning strategies could be categorized into *"cognitive, metacognitive, and resource-based strategies, or general, subject-specific, and self-control strategies"* (Götz et al., 2013, p.127). The first categorization in cognitive strategies is well-founded in psychological and learning theories, while the second group of categories has hardly gathered research affirmation (Pashler et al., 2008). In particular:

- Cognitive strategies *"involve the intentional manipulation of information by the learner through processes such as rehearsal, elaboration, and organization of the material"* (Weinstein et al., 2000, p.729). The rehearsal learning strategies include copying material, notetaking, and underlying text segments (Weinstein et al., 2000). The learning strategies related to elaboration create connections between the new information and the preexisting knowledge. This occurs through paraphrasing, summarizing, questioning the material, and teaching something to somebody else (Weinstein et al., 2000). Third, the company includes strategies such as creating diagrams and outlining the material (Weinstein et al., 2000). The

cognitive learning strategies focus on achieving objectives and are deliberately provocative (Weinstein & Meyer, 1991).

- Metacognitive strategies aim to monitor comprehension during the learning process (Pintrich et al., 2000). According to Zimmerman (2002), planning, monitoring, and regulation are metacognitive strategies, which involve choosing cognitive strategies, checking if the chosen strategies are appropriate, and changing cognitive strategies if they do not lead to the desired outcome. Metacognition[3] is, after all, defined *"as the awareness of and knowledge about one's own thinking"* (Zimmerman, 2002, p.65).
- Resource management strategies concern internal and external resources, tools, materials, and the learning environment, which learners use to achieve their goals (Boekaerts, 1999; Pintrich, 1999).

2.3.3.2 Learning Styles

Learning styles emerged at the beginning of the 20th century during educators' attempts to explain students' low performance and achievements and to further support them by customizing the learning process according to the preferences of the learners (Coffield, 2004). This term also refers to specific traits, behaviors, and skills related to learning (English & English, 1958; Coffield, 2004). The main argument was that learning styles differ due to the individual preferences of learners and generally how they act when they want to learn something, solve a problem, or find themselves in similar situations (Gully & Chen, 2012; Knowles et al., 2020).

One frequently cited approach is Kolb's, who, except for describing his Experiential Learning Theory (See 2.3.1), defined four learning styles that learners use to acquire knowledge (Kolb, 1984). Kolb's inventory aimed to measure how much an individual moves toward his four stages of learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation. He named the four learning styles converger, diverger, assimilator, and accommodator, which he later changed to converging, diverging, assimilating, and accommodating style to overcome criticism about assigning a permanent learning style to individuals (Kolb, 1984; Coffield, 2004).

[3] Perkins (1992) identified four levels of metacognition in elementary students, according to how aware they are of their metacognitive knowledge. These levels divide learners into tacit, aware, strategic, and reflective. Tacit learners lack metacognition, the aware learners acknowledge some of it, the strategic learners structure the thinking process, and the reflective learners are also able to reflect on this while using metacognitive strategies (Perkins, 1992).

The converging style shows a preference for technical problems rather than communicating with people and an advantaged competence for problem-solving, decision-making, and implementing ideas in practice (Kolb, 1984). Contrary to this, the diverging learning style excels in creating alternative ideas and applications through observing concrete situations, acknowledging meanings and values, and simultaneously being inventive (Kolb, 1984). The assimilating style aims at logically forming theoretical models and focuses on this rather than people (Kolb, 1984). Finally, the accommodating style demonstrates that people want to engage with new experiences and solve problems intuitively by trying different solutions and changing their approach accordingly (Kolb, 1984).

Witkin (1962) distinguished a dipole differentiating field-dependent and independent learners. His theory indicated that the learners influenced by the environment around them are called dependent, and the learners who stay uninfluenced by their surroundings are called field-independent (Witkin, 1962; Witkin et al., 1977). This theory examined how the surroundings can support or disturb learners during learning, with the latter being more skilled in situations needing change or reorganization (Witkin & Goodenough, 1981). Influenced by the work of Witkin and his colleagues (1977), Riding & Cheema (1991) created their model based on four groups of learning styles, which refer to how learners organize information, holist or analyst learning style, and how they represent information, verbalizer or imager (Riding & Cheema, 1991). While this model has not been sufficiently validated, it indicates similarities with other models, such as Dunn & Dunn's model, which identified five stimuli (environmental, emotional, sociological, psychological, and physiological) and investigated the preferences of learners (Dunn & Dunn, 1979). Particularly, the physiological aspect, which is further analyzed into visual, auditory, kinesthetic, and tactile (Dunn & Dunn, 1979), has gained the most attention and has been significantly used by other researchers (Bissell et al., 1971; Barbe et al., 1979; Coffield, 2004). The learning styles have been repeatedly debunked as being inconsistent for adults & training conditions. Pashler et al. (2008) highlighted the controversial literature and deficient evidence on learning styles and debunked the famous learning styles approach. Rogowski et al. (2014) agreed with these findings in their study on verbal comprehension and learning using digital tools that did not verify a relationship between learning styles and learning comprehension. Notwithstanding, many educators, trainers,

and instructional designers have attempted to analyze learning styles further in the last decades, aiming to increase training effectiveness (Pashler et al., 2008; Furey, 2020).

2.3.3.3 Learning Patterns

From the perspective of human resources development, Govaerts & Baert (2011) researched the existence of learning patterns in companies and developed a typology of basic learning patterns and their variations of employees within companies. They investigated *"existing configurations of learning opportunities"* that appear formal or informal when employees engage in workplace learning (Govaerts & Baert, 2011, p.545). These repeatedly used learning opportunities may solidify and form learning patterns over time, which are influenced by multiple factors that differentiate an organization, such as the organizational culture, structure, work routines and activities, job characteristics, and the team employees belong to (Govaerts & Baert, 2011). It is noteworthy to mention that they considered the importance of communities of practice by Wenger (1998) due to the common challenges, practices, and characteristics of employees of the same community (Govaerts & Baert, 2011). Their exploratory study interviewed employees and managers of four different sectors and succeeded in constructing a typology of five basic learning patterns, which are analyzed as follows (Govaerts & Baert, 2011):

- The Olympic learning pattern was mainly found in the social sector and referred to formal learning opportunities, where the structures for learning were relatively strong, and management strongly monitors these.
- The Helpdesk learning pattern referred to informal learning through a system and included constant updates of employees' knowledge.
- The Agora learning pattern was very popular and mainly found in the employment service sector. Learning occurs here within the social environment of the employees, e.g., by asking colleagues questions, discussing problems, asking and offering feedback, and generally through meetings and communicating with fellow employees.
- The Job performance learning pattern described the negative influence of job characteristics on learning due to the restriction of learning opportunities and the pressure for improvement in this situation.
- The Entrepreneurial learning pattern showed a degree of freedom in choosing the learning activities and less pressure toward learning (Govaerts & Baert, 2011).

The abovementioned learning patterns were also further analyzed in variations depending on the intensity of how strong the characteristics of the learning pattern appeared. Despite this, this study showed the parallel existence of different learning patterns within companies. The different learning patterns seemed to be related to the company's type, the structure within a working environment, and each community of practice (Govaerts & Baert, 2011). Finally, Govaerts & Baert (2011) underlined that the higher percentage of the agora learning pattern could be due to the value of learning from peers and seeking advice from colleagues or managers and added the multifactor influence of organizational and personal elements and preferences may be within workplace learning. This is slightly related to the learning styles mentioned in 2.3.3.2.

2.3.3.4 Learning Paths

Poell (2005) and Van Der Krogt (1998) examined what employees do and plan within learning networks to develop professionally. In 2016, they described the employees' strategies, which derive from the individuals' learning-action theories, may differ during their work life, and are influenced by their values (Poell & Van Der Krogt, 2016). The individual learning-action theories are categorized into four groups according to the interests that drive an employee: the profession-driven, the person-driven, the work-driven, and the socially-driven learning-action theory (Poell & Van Der Krogt, 2016). Within their theory of learning network, Poell & Van Der Krogt (2016) established the *learning-path cycle* to describe in detail how employees interact with other actors within their work environment, gain experience, and coordinate this experience to thrive professionally (Poell & Van Der Krogt, 2016). One option is that employees *follow existing structures and actors* either mechanically or deliberately according to the existing company's structures or behaviors of colleagues, which may be employed at a different company from theirs (Poell & Van Der Krogt, 2016). A second option is the *aspect-based strategic operation*, which indicates that employees create learning paths by engaging actors along the way, by strategically deploying experiences during their job role or programs offered by human resources, and by planning themselves these learning plans and expanding these further while working (Poell & Van Der Krogt, 2016). Finally, employees may follow an integrated strategic operation by creating and implementing a personal and specific strategy (Poell & Van Der Krogt, 2016). A study by Lisman et al. (2007) discovered four types of learning paths among nursing staff and the significant role of social interactions and the learning environment. Starting from the most popular

learning path among the respondents, the *formal-external learning path* indicates learning within formal learning settings; the *self-managed learning path* stands for the personal company and the manager's support; the *social-emotional learning path* shows value in contact with the patients for counseling, and the fourth, the *information-oriented learning path* distinguishes learning through reflection after discussing with experts (Lisman et al., 2007). A study by Gajadhar (2007) with teachers identified similar learning paths to the ones mentioned: *self-reflecting, formal subject-didactic, private-focused,* and *innovation-oriented learning path*. In a different field, a study with probation officers discovered the following five learning paths: *practice-based, knowledge-oriented, task-oriented, social, and person-oriented* (Khaled, 2008; Sloots, 2008). Poell & Van Der Krogt (2016) concluded that employees tend to follow available structures in the learning network of their organization, wherein the individual learning-action theory affects their learning paths and future development. To move beyond existing structures within learning networks and personal learning paths, an external contribution is helpful to other experts or actors (Poell & Van Der Krogt, 2016).

2.3.3.5 Learning Behaviors

The term "learning behaviors" is included in the definition of learning strategies by Weinstein et al. (2000), as mentioned in 2.3.3.1. Some scientists use this term to refer to learning strategies focused on one topic, e.g., Milligan et al. (2015), who explored self-regulated learning behaviors within the finance industry; Cerasoli et al. (2018) and Smet et al. (2022), who analyzed informal learning behaviors, and Kittel and Seufert (2023a), who examined the relation between these two. The differences rely on the difference of the regulation during learning, but the learning behaviors resemble the learning strategies. For example, Smet et al. (2022), in their literature review regarding informal work-related learning behaviors, concluded that such behaviors exceed the work environment and refer to *"changes in knowledge, skills, and attitudes, individuals' and organizations' professional achievement, and sustaining a future development"* (Smet et al., 2022, p.11). Kittel and Seufert (2023a), in their study about self-regulated learning in informal workplace learning, concluded that *"informal learning behaviors of reflection, keeping up-to-date, feedback-seeking, and knowledge-sharing are strongly related to the metacognitive self-regulated learning strategies of monitoring and regulation"* (Kittel & Seufert, 2023a, p.16). They discovered that informal learning behaviors lack the deep-processing strategies of elaboration and company and the resource strategies of help-

seeking and effort regulation (Kittel & Seufert, 2023a). Therefore, they suggested that employees could benefit from training about learning strategies and encouragement of the organizational learning culture (Kittel & Seufert, 2023a). A review of new employees' information-seeking behavior concluded that *"both organizational context and newcomer individual characteristics"* affect this behavior and drew attention to the need to support this group of employees in their further workplace learning (Vu et al., 2023, p.223).

2.3.4. Self-regulated Strategies of Employees

This subchapter presents and analyzes the recent literature regarding the emergence and implementation of self-regulated learning in the contemporary workplace in various new settings. The value of self-regulation for adult learning has been non-negotiable and officially acknowledged for employees since the beginning of the 2000s and continues to grow for training developers (Porath & Bateman, 2006; Sitzmann & Ely, 2011; Vancouver et al., 2017). The Dobrovolny model illustrated how adults learn during a self-paced and technology-based online corporate training course and concluded that *"learning starts with, and is sustained by, metacognition"* (Dobrovolny, 2006, p.167). The findings of Rotgans & Schmidt's (2009) study with engineering students supported the idea that self-regulated learning is not subject-dependent for learners, while Milligan et al. (2015) discovered a correlation between workplace learning context, workplace learning activity, and self-regulated learning. The findings of Sitzmann & Ely (2011), who examined self-regulated learning in professional development in the last thirty years (1981-2011), indicated powerful connections among 16 basic self-regulated learning constructs, specifically a parallel coverage between self-regulated strategies and motivation and self-efficacy, and a positive connection of goal, level, persistence, effort, and self-efficacy to profitable learning outcomes. Although employees have little available time to (re-)act, important metacognitive strategies have to be engaged during work, such as interpreting the situation as a learning affordance, reflecting on past experiences, choosing strategies, and evaluating the effects of actions (Tynjälä, 2013).

Margaryan et al. (2012) highlighted the importance of workplace learning through another publication regarding a typology of what employees learn through work. They found out that new employees concentrate on technical and procedural knowledge and getting to know a new company (Margaryan et al., 2012). In the energy sector, Margaryan et al. (2013) looked for similarities and differences in learning among novices, mid-

career, and experienced professionals. They concluded that self-regulated learning in the workplace occurs iteratively and lacks reflection but is socially related among professional employees (Margaryan et al., 2013). It is also important to mention their conclusion about the employee's learning goals, whose management depends significantly on their supervisors (Margaryan et al., 2013). Milligan et al. (2015) concluded that self-regulation in workplace learning is essential for individuals to be able to plan autonomously their everyday work and, generally, their careers. Therefore, they suggested that employers should support individuals to lead them in an effective work direction (Milligan et al., 2015). The same group continued their research, and in 2015, Fontana and her colleagues developed an instrument to measure self-regulated learning behavior at work, following Zimmerman's and Pintrich's models. They tested it with employees from different roles in the finance industry (Fontana et al., 2015). Their findings indicate a connection between the opportunities to engage with learning and the actual learning that takes place, which are mostly affected by the interest in a task, the strategies used to undertake a task, and the self-evaluation of the learners (Milligan et al., 2015). They concluded that professionals capable of self-regulating consider this type of learning to be *"long-term, personalized self-improvement"* (Littlejohn et al., 2016, p. 223).

Van Houten-Schat et al. (2018) discovered that self-regulated learning among actors in clinical contexts differs and aims at *goal setting and monitoring* of learning by implementing *coaching, learning plans, and supportive tools*. They concluded that medical students and residents have difficulties assessing their progress while aiming at achieving their goals. Therefore, they suggest enhancing the learners' abilities to self-regulate apart from ensuring a good self-regulating environment at work with the support of a mentor or a coach.

The role of technology in the last years is evident in the literature, wherein specific elements such as web-based, add, or mobile learning have been investigated. Lin et al. (2018) examined the influence of self-regulated learning on job characteristics regarding web-based continuing learning with employees of an Asian airline company. They confirmed the beneficial role of self-regulated learning at work. Their results indicated a positive relation between self-regulated learning and job control, which refers to what employees can control in their professional work environment (Willemse et al., 2012; Lin et al., 2018). Furthermore, they highlighted the importance of social support for self-

regulated learning and, respectively, attitudes toward *web-based continuing learning* (Lin et al., 2018). A systematic review of the relationship between mobile learning and self-regulated learning at different educational levels revealed the vice-versa of support within this relationship. It underlined the need for skilled trainers to integrate mobile learning into formal learning (Palalas & Wark, 2020). Van Laer & Elen (2020) explored self-regulated behaviors in blended learning environments in their study of learners in second-chance education, which they in advance considered non-typical adult learners because of the potential lack of self-regulation. They recognized learners who are able to self-regulate, those who are not able to self-regulate, and those who use external sources to regulate their learning (Van Laer & Elen, 2020). Their conclusion about internal and external self-regulation corresponds to the Model of Self-Regulation by Butler and Winne (1995), which described the different processes according to the source of feedback on their performance. Finally, regarding blended learning environments, their results confirmed that when self-regulatory design features are provided, the number of learners with poor self-regulation skills decreases (Van Laer & Elen, 2020). This was also implied by Kellenberg et al. (2017) and Panadero (2017), in general, that teachers and trainers need to start applying these different self-regulation models and theories to enhance learners' learning and self-regulatory skills.

Regarding new work forms, Margaryan (2019) compared the self-regulated strategies of crowdworkers[4] and traditional employees and concluded that all use similar strategies except for clearly defining a plan in advance to achieve learning goals. In subsequent research, Margaryan et al. (2022) confirmed again that crowdworkers are highly self-regulated and added that they mostly use *"deliberate practice"* to learn, afterward social learning and, to a minor degree, *"self-initiated formal learning"* (Margaryan et al., 2022, p.511). They also commented that contrary to Zimmerman's self-regulated model, their findings support that self-regulation among crowdworkers occurs in all phases (Margaryan et al., 2022). The unique element of crowdworking is the necessary planning in advance, especially the *"planning ahead for the application of newly acquired skills in future jobs"* (Margaryan et al., 2022, p.512).

Cuyvers et al. (2020) focused on their review specifically on the self-regulation of professional learning and concluded that some clear metacognitive self-regulatory

[4] Crowdwork is *"a type of online platform labor in which a global pool of workers are matched with clients through digital platforms to carry out remunerated tasks."* (Margaryan et al., 2022, p.495).

strategies in professional learning involve *"the responsibility for detecting and interpreting learning affordances and needs, and initiating learning during job performance (which) lies with the learner – the employer"* (Cuyvers et al., 2020, p.298). They summarized that this metacognition occurs everywhere, continuously emerging during original professional situations, which may not necessarily maintain certain learning goals or structure (Eraut, 2000; Cuyvers et al., 2020; Tynjälä, 2013). Further research on professional self-regulated learning that Cuyvers et al. (2020) mentioned as desirable and necessary arose lately. The contributions of Kittel et al. (2021), Decius & Decius (2022), Kittel & Seufert (2023a), and Jain et al. (2023) correspond to Cuyvers' et al. (2020) suggestions and are presented as follows.

Kittel et al. (2021) examined self-regulation in informal workplace learning among employees from various industries. They concluded that three metacognitive strategies *(planning, monitoring, and regulation),* two resource strategies *(help-seeking and effort regulation),* and one deep processing strategy *(elaboration)* were the strategies associated with self-efficacy and specifically with two job characteristics, autonomy and feedback. Jain et al. (2023) agreed with this in their review about metacognition's relation to workplace cognitive competencies and performance, wherein they identified that metacognition affects problem-solving, decision-making, innovations, and knowledge acquisition. Concluding Kittel et al. (2021) highlighted the role of motivation in informal learning - and particularly the factor mastery-approach learning goal orientation and self-efficacy - and suggested further research on the diversity of informal workplace learning, which excels compared to cognitive formal learning activities. In subsequent research with a bigger group of employees, Kittel & Seufert (2023a) correlated clearly metacognitive self-regulated strategies *(monitoring and regulation)* with informal learning behaviors *(reflection, keeping-up-to-date, feedback-seeking, and knowledge-sharing)* but recognized the lack of deep-processing and resource strategies in informal learning behaviors. In their conclusions, Kittel and Seufert (2023a) advised supporting self-regulating learning to enhance their own development during work.

Decius & Decius (2022) combined the perspectives of self-regulated and informal learning and developed an Integrative Process Model of Sovereign Workplace Learning. The similarities between self-regulated and informal learning rely on the role of individuals. In the former, individuals regulate their learning process, while in the latter, they reflect on their learning during each job task (Decius & Decius, 2022). Therefore,

they united these within the term *"sovereign workplace learning",* defined as *"work-related learning that takes place autonomously and independently of formal structures in organizations, putting the learner in charge of the learning process"* (Decius & Decius, 2022, p.1). This model recognizes three stages: stimulus, intention, and spontaneity of learning, and it begins with a work. The following steps of the learning process depend on the kind of stimulus within a work task because if this impulse is internal and creates an intention to learn something, it takes the self-regulated road but may turn to informal workplace learning depending on the spontaneity of choosing how to act (Decius & Decius, 2022). So, the conscious action belongs to the self-regulated path. At the same time, there is the possibility that the learners' path shifts to informal workplace learning if the learners are going with the flow after intending to learn but waiting for a suitable opportunity to form a strategy (Decius & Decius, 2022). With this important feature of this model, the diverse nature of workplace learning is illustrated and the mercurial changes during learning are acknowledged, which were also described in Chapter 2.2.2. According to this model, external stimuli lead to informal workplace learning because they emerge during work and urge the employee to act or react to, for example, solve a problem (Decius & Decius, 2022). Either way, the end of this model is that the employees have learned something.

Table 1 consolidates all strategies mentioned in this literature review to provide a comprehensive overview. From older publications like the Learning and Study Strategies Inventory (LASSI) by Weinstein et al. (1987), the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich & De Groot (1990), Pintrich et al. (1991), Zimmerman (1998), up to more recent, e.g., Sitzmann & Ely (2011), who underlined that metacognition overlies on the learning strategies and vice versa. Column A, the first from the left, states the name of the strategy. Columns B, C, and D stand for the kind of strategy, e.g., if the strategy was named a self-regulated strategy, there is a mark (x) on the second column. Column E shows to which phase of Zimmerman's model of self-regulated learning each strategy would be implemented by learners. These data are derived from Zimmerman (2002), Fontana et al. (2015), and Kittel & Seufert (2023a). The letters stand for the three phases of Zimmerman's model: F = Forethought, P = Performance, and SR = Self-reflection. Column F contains the literature reference, wherein each strategy was mentioned.

Table 1. Collection of Strategies

	A	B	C	D	E	F
N.		Self-regulated strategies	Informal learning strategies	Learning strategies	Phase	References
1.	Anxiety reduction	x			F/SR	Sitzmann & Ely (2011)
2.	Control of learners' beliefs[5]	x			F/SR	Pintrich et al. (1991)
3.	Decision making	x		x	F/P/SR	Jain et al. (2023), Vancouver et al. (2017)[6]
4.	Detecting learning needs	x			SR	Cuyvers et al. (2020)
5.	Discussions with colleagues		x		P	Sitzmann & Ely (2011)
6.	Elaboration	x		x	P	Weinstein et al. (2000), Pintrich et al. (1991), Kittel & Seufert (2023a)[7]
7.	Emotion control	x			F/SR	Sitzmann & Ely (2011)
8.	Environmental structuring	x		x	P	Sitzmann & Ely (2011), Zimmerman (1998)
9.	Error detection	x			SR	Weinstein et al. (2000)
10.	Feedback-seeking		x		P	Bednall & Sanders (2017), Kittel & Seufert (2023a)
11.	Goal setting	x		x	F	Zimmerman (1998)
12.	Help-seeking	x			P	Sitzmann & Ely (2011), Zimmerman (1998), Kittel & Seufert (2023a)
13.	Identifying learning opportunities	x			SR	Cuyvers et al. (2020)

[5] *"Control of learning refers to students' beliefs that their efforts to learn will result in positive outcome. It concerns the belief that outcomes are contingent on one's own effort, in contrast to external factors such as the teacher. If students believe that their efforts to study make a difference in their learning, they should be more likely to study more strategically and effectively. That is, if the student feels that she can control her academic performance, she is more likely to put forth what is needed strategically to effect the desired changes."* Pintrich et al., 1991, p. 12.

[6] Both references mentioned decision-making both as a learning strategy and a self-regulated strategy.

[7] Only Kittel & Seufert (2023a) mentioned "Elaboration" as a self-regulated strategy.

14.	Imagery			x	P	Zimmerman (1998)
15.	Innovative behavior		x		P	Bednall & Sanders (2017), Kittel & Seufert (2023a)
16.	Internet research (looking up information online)	x	x		P	Kittel & Seufert (2023a), Sitzmann & Ely (2011)[8], Zimmerman (2002)
17.	Keeping up-to-date		x		F	Bednall & Sanders (2017), Kittel & Seufert (2023a)
18.	Knowledge sharing		x	x	P	Bednall & Sanders (2017), Kittel & Seufert (2023a)[9]
19.	Motivation	x			F	Weinstein et al. (2000), Pintrich et al. (1991)
20.	Note-taking			x	P	Weinstein et al. (2000)
21.	Observation		x	x	P	Grosemans et al. (2020)
22.	Problem-solving	x		x	P	Jain et al. (2023)
23.	Repetition			x	P	Weinstein et al. (2000)
24.	Paraphrase			x	P	Weinstein et al. (2000), Pintrich et al. (1991)
25.	Persistence	x			F	Pintrich et al. (1991), Sitzmann & Ely (2011)
26.	Planning	x			F	Sitzmann & Ely (2011), Kittel & Seufert (2023a)
27.	Positive self-talk	x			F/SR	Sitzmann & Ely (2011)
28.	Practice tests	x			SR	Van Laer & Elen (2020)
29.	Reflection		x			Kittel & Seufert (2023a)
30.	Resource strategies	x			SR	Weinstein et al. (2000), Sitzmann & Ely (2011)

[8] Sitzmann & Ely (2011) mentioned this as an informal learning strategy, while the other two references call it a self-regulated strategy.
[9] Kittel & Seufert (2023a) categorized this as an informal strategy, while Bednall & Sanders (2017) as a learning strategy.

31.	Self-instruction	x			P	Zimmerman (1998, p.76)
32.	Self-monitoring	x			P	Kittel & Seufert (2023a)[10], Van Laer & Elen (2020), Zimmerman (1998)
33.	Self-efficacy[11]	x			F	Sitzmann & Ely (2011)
34.	Self-evaluation	x			SR	Zimmerman (1998, p.76), Weinstein et al. (1987) Vancouver et al. (2017), Van Laer & Elen (2020)
35.	Summarize			x	P	Van Laer & Elen (2020)
36.	Task strategies	x		x	P	Zimmerman (1998)
37.	Teach to somebody			x	F/SR	Weinstein et al. (2000)
38.	Time management	x		x	P	Sitzmann & Ely (2011), Weinstein et al. (2000), Zimmerman (1998)[12]
39.	Trial-error		x		P	Sitzmann & Ely (2011)

Note. Column E shows to which phase of Zimmerman's model of self-regulated learning each strategy would be implemented by learners. These data are derived from Zimmerman (2002), Fontana et al. (2015), and Kittel & Seufert (2023a). The letters stand for the three phases of Zimmerman's model: F = Forethought, P = Performance, and SR =Self-reflection.

[10] They distinguish SRL strategies between cognitive and metacognitive. Monitoring "whether the gathered information might be sufficient to reach the goal to find a satisfying solution is a metacognitive SRL strategy" (Kittel & Seufert, 2023, p. 2).

[11] *"Refers to trainees' beliefs regarding their capability to succeed in training and perform training-related tasks"* (Bandura, 1997 in Sitzmann & Ely, 2011, p.426).

[12] Sitzmann & Ely (2011) mentioned this strategy both as a learning strategy and a self-regulated strategy. Weinstein et al. (2000) and Zimmerman (1998) called this directly a self-regulated strategy.

2.4. Summary of Literature & Research Questions

"Which knowledge – a belief, tactic, or a fact –
a learner chooses to apply when working
on a task represents the psychology
of the way learners make things."
Winne (2011, p.29)

This literature review shows that researchers have studied employees' learning as they keep educating themselves after their first academic studies. The gap between the level of skills, knowledge, and competencies that (soon to be) employees possess, and the level that the employers require is evident and continuously changing, if not increasing, due to societal and technological changes (Reich et al., 2014; Kövesi & Csizmadia, 2016; Paruzel et al., 2020; Grosemans et al., 2020; Guo, 2022; Harish, 2022). During employees' further development, elements such as the work environment, context, and organizational structures influence their learning (Molloy & Noe, 2010). Within this multifactor learning process, the individuals try to meander to cover their needs and simultaneously succeed professionally. Employees nowadays learn by attending obligatory and non-obligatory training, through colleagues, or by chance somewhere in, near, or out of their workplace according to their interests, needs, motivation, or other various non-controllable factors (Kozlowski et al., 2010; Noe et al., 2014; Kawalilak & Groen, 2021). The strategies gathered in Table 1 attempted to demonstrate what different theories imply regarding employees' specific actions during workplace learning. Nevertheless, educators, trainers, and employers still lack information on how employees learn during their diverse everyday work lives due to the research being conducted with university students as respondents or with employees in limited fields, such as finance, energy, and health sectors. The field of aerospace engineering faces difficulties in acquiring specialized employees and has not been explored hitherto. In a world where improvement, productivity, and efficiency constantly strive, it is interesting to shed more light on employees' learning (Sitzmann & Ely, 2011). Therefore, the first research question of this study explores:

- **RQ1. What actions do the employees individually take to address their learning needs?**

As employees' everyday environment and workplace are strongly defined by others or affected by factors not controlled by themselves or not even known a priori, what do employees do while participating in on-demand training? This was the case during a

research project among companies in the aerospace industry in 2017 that planned to address their talent demand when looking for qualified Software Engineers but had to introduce them to the Aerospace Software Standards and educate them beyond their formal studies. Like every human being, employees have various needs, as described in 2.2.3.1, but a limitation regarding learning and their job role is the subject of this research.

As the research showed, the role of self-regulation is significant for adult learning, occurs within every stage of learning, and is a sign of competent learners, which can lead to competent employees (Sitzmann & Ely, 2011; Vancouver et al., 2017). As described in 2.2, learning occurs everywhere (Marsick & Watkins, 2001), but it remains insufficiently investigated what employees do when they participate in training, which was made for them and they had to participate. This leads to the second research question, which deals with how self-regulated learning occurs within on-demand training:

- **RQ2. How does self-regulated learning occur within on-demand training for software engineers entering aerospace companies?**

Companies in aerospace software engineering seek workforce from a broad marketplace of employees who might have studied engineering, computer science, or other STEM subjects. Due to the specialized demands of such companies, it is challenging to acquire employees who specifically study aerospace software engineering. Hence, they hire employees with pertinent academic backgrounds and offer training on aerospace fundamentals. New employees' backgrounds, prior experience, knowledge, skills, and competencies are unknown to their managers. The need for individualization based on the needs of society, companies, and individuals has been known since the beginning of 2000 (Illeris, 2003; Knowles et al., 2020). Around that time, Poell (2005) emphasized placing the learner in the foreground by enabling their self-directed learning, which needs to match the interest of the organization. This research, during the training development for Software Engineers entering aerospace companies in Germany, examined the third research question:

- **RQ3. What are the learning needs of new employees entering German Aerospace companies?**

Cerasoli et al. (2018) suggested implementing an informal needs analysis, which would revolve around needs relevant to the informal environment of employees to benefit their

learning skills and, generally, their informal working behavior. The variety of new hires is further explored with the fourth research question:

- **RQ4. What differences exist among new employees entering Aerospace Software Engineering?**

This research also examines the dipole that companies aim to cover in their talent demands when employees have further learning needs. These two terms include continuous change by being influenced by society and technological advancements and the very individual human nature. The fifth research question compares the outcomes of the third research question with the talent demands identified at the beginning of the two projects for the training development of new employees entering aerospace software engineering:

- **RQ5. What are the similarities and differences between companies' talent demands and employees' learning needs entering the field of Aerospace Software Engineering?**

The training development during the two publicly funded projects in which this research took place is thoroughly described in 2.5.

2.5. Projects' Framework

This research is based on data from the aerospace industry, which depends on acquiring employees from other pertinent fields, such as automotive and STEM industries, and is obligated to re-train new employees entering the field (Kövesi & Csizmadia, 2016). It builds on the development, implementation, and evaluation of two training courses for the *Avionic System Software Embedded Technologie* – 2 (ASSET-2) and the *Integrierte Design- und Entwicklungsumgebung für Aerospace* (IDEA) research projects. For clarity, this chapter begins with a short presentation of these two projects' context, aims, and research design and continues with details about the two projects in 2.5.1 and 2.5.2.

The ASSET-2 – from now on referred to as the first project – and IDEA – from now on referred to as the second project – were two research projects funded by the Federal Ministry for Economic Affairs and Climate Action[13]. The predecessor of these projects was the publicly funded research project *Avionic System Software Embedded Technologie*

[13] This ministry was named "Federal Ministry for Economic Affairs and Energy" before January 2022.

(ASSET). During 2015 and 2017, eight companies and academic institutions cooperated within the first project network to optimize the software development processes across companies to reduce future development costs and strengthen the competitiveness of the German aviation industry. The outcome of this project was, apart from the technical results regarding joint cross-disciplinary designs of components and software, the realization of the common demand for further qualification of their workforce entering the field of avionic software engineering. The recruitment process in the aerospace industry draws employees from pertinent fields, e.g., automotive engineering and STEM. Aerospace companies must attract software engineers or architects with various academic and professional backgrounds (Pourtoulidou & Frey, 2020). Afterward, the challenge remains for each company to train the new software engineers or software architects through training courses, which cover the basics for their introduction to aerospace software development, depending on their role.

2.5.1. First Project (ASSET-2)

In 2017, the network started its cooperation aiming at fulfilling this demand by developing a training course for new employees entering the aerospace industry within the first project (Pourtoulidou & Frey, 2021; Alber & Freyer, 2020; Harwardt, 2021; Herpel, 2021; Koal, 2020; Alaoui et al., 2020; Schweiger, 2021; Sutter, 2021; Zoller, 2021). This project aimed to develop one common training course that introduces employees of all different companies of this network to the fundamentals of software engineering in aerospace. The participating companies and institutions operate internationally. Therefore, the training course's language was English, although it concerned employees entering departments in German locations.

The training development started with a needs analysis to identify the training demand. Initially, the researchers from the Ingolstadt University of Applied Sciences (Technische Hochschule Ingolstadt – THI) gathered information during a workshop in January 2017 with the company experts and representatives of the German Aerospace Industries Association (Bundesverband der Deutschen Luft- und Raumfahrtindustrie e.V. - BDLI), (Zoller, 2021). The information collected from this workshop was formed as a questionnaire and distributed to the technical personnel of the network companies to assess the content thoroughly and internally according to their talent demand. Parallel, the researchers examined the module outlines of sixteen study courses that are available in German Universities (e.g., B. Sc. & M. Sc., Informatics, Aviation & Avionics, and

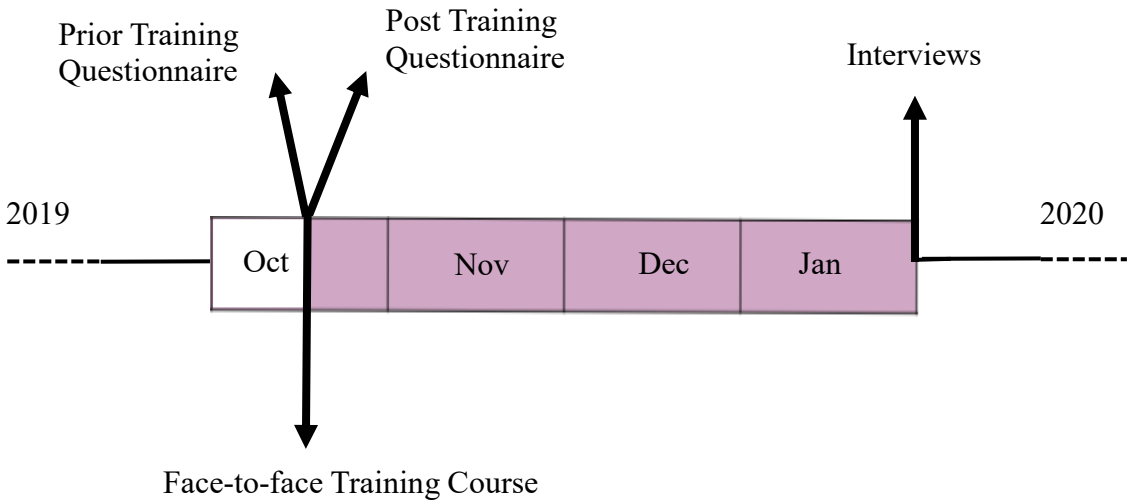
Software System Development) to identify a common basis of knowledge and skills of graduates entering aerospace software development. The selection of German universities was made according to the location of the participating companies. The final step of the needs analysis was the review of the content posted by various engineering associations in Germany, e.g., the Association of German Engineers (*VDI*), Association for Electrical, Electronic and Information Technologies (*VDE*), German Society for Aeronautics and Astronautics (*DGLR*). Information about the aerospace-specific standards, e.g., DO-178C and systems engineering, in conjunction with soft skills for every employee, is fundamental knowledge for aerospace engineers (Kövesi & Csizmadia, 2016; van den Heuvel, 2019; VDI, 2019a). In the wake of Industry 4.0 and before entering Industry 5.0, the role of digitalization, which carried a fear of job positions' elimination, sustainability due to climate change, and artificial intelligence for the future marketplace, also raised issues about the value of continuous learning to adapt to new software (van den Heuvel, 2019; Heckel, 2022). Another known issue is the essential specialization in some engineering sectors that simultaneously reduces the flexibility for changing positions in the future (van den Heuvel, 2019).

This needs analysis identified the companies' demands and the desired job competencies for entering this field. The companies' demands defined the first training course's content and time restrictions. The final selection of the topics favored the thematic breadth instead of the depth to offer new employees a broad spectrum of knowledge (Pourtoulidou & Frey, 2020). Based on these findings, the content covers the following five topics within Aerospace Software Engineering: Process, Requirements Engineering, Verification, Embedded Architecture & Design, and Configuration Management (Pourtoulidou & Frey, 2020). These refer to the standards of Software Engineering and contain information from ISO6262, DO-178B, and DO-178C.

The time limitations for this training were derived from companies' restrictions, so the course had to last a maximum of 56 credit hours, resulting in seven days of face-to-face training. The training material was fully developed, but due to project limitations, parts of it were implemented as a two-day training course and evaluated between October 2019 and February 2020, as shown in Figure 5. Different teaching methods, such as traditional instructor-led teaching, hands-on practical exercises, and expert discussions, were used. The evaluation of this training course took place in three phases, starting with a Prior-Training Questionnaire I (see Appendix E), which the participants filled out directly

before the training course and stated their educational and professional background and their level of knowledge about the training's content. After the training course, the participants completed the Post-Training Questionnaire I (see Appendix F), which assessed the training course overall. The participants answered according to their opinions on the extent to which the materials and teaching methods suit their learning needs and preferences. Interviews with the participants were conducted three months after the implementation of this training course. This qualitative research method was chosen to reflect on the training course, considering the new experiences the participants gained during the three months of working on relevant projects and any further critique about the training course. They were interviewed via telephone while securing their anonymity with code names in the interview transcripts. No video interviews were possible because of the strict confidentiality regulations of each company. More information about the conduction of the interviews and the Interview Guidelines I (see Appendix G) follows in Chapter 3.2.

Figure 5. Timeline of first Training Course



Note. Own figure according to the first project's timeline.

2.5.2. Second Project (IDEA)

The implementation and evaluation of the first training course offered feedback from the participants, which pointed out their need to individualize the training material. The further development continued in the second project, aiming at fulfilling the participants' needs; a blended approach was chosen among other learning approaches to surpass the

limitations of classroom-based training, including various teaching methods and customized content while retaining the face-to-face interaction between the trainer, subject matter experts and participants (Van Laer & Elen, 2020).

The content of the second training course was derived from the first training course and was adjusted to the blended format. This required selecting which topics would be conveyed via the online platform and the face-to-face session and converting the topics that would be distributed via the online platform. The criteria to determine this selection were the subject of the topics, the difficulty level, the pros and cons of each teaching method, and the overall structure and planning of the training. After converting the classroom-based training course (of the first project), the proportion allocated to the online phase was planned to cover approximately 78% of the training's material, resulting in about 22% for the face-to-face (F2F) session (Pourtoulidou & Frey, 2021).

The duration of the training was planned to last seven months in total, during which the face-to-face session would take place, as shown in Figure 6. During the Prior F2F Phase, the participants accessed the videos with the lectures, literature material, quizzes, forums, and virtual meetings over the THI Moodle platform. The average commitment to cover all online material was estimated to be 10 hours. The online modules were staggered in chapters, independent of each other. They contained a summary so the participants could evaluate their knowledge and skip a chapter, video, or parts according to their learning needs. All online material was available from the beginning of the Prior F2F Phase with no limitations other than being unable to download the videos due to license restrictions. Re-watching a video was possible with a working internet connection at any time.

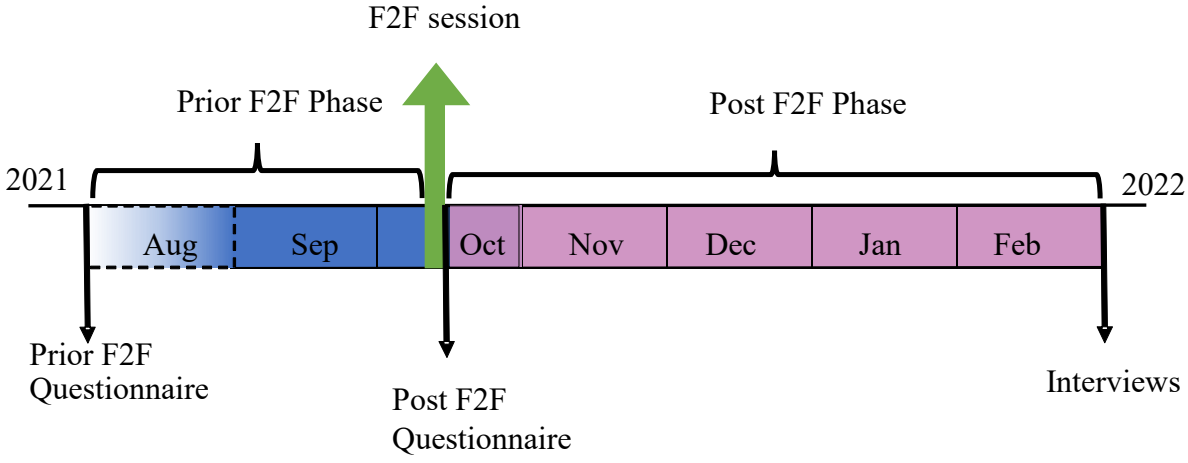
The face-to-face session was initially planned to last five work hours but was extended to one workday equal to eight work hours due to the additional time for discussion and breaks. The desired date for the face-to-face session was planned approximately in the middle of the training so that the participants could simultaneously access the online material before and after the face-to-face session while working on their business projects. This session consisted of multiple parts. It started with a team event to get to know each other the day before the main session. The participants were welcomed and met the trainer and the experts in an informal environment. As part of this session, subject matter experts were invited to offer insights about common problems in the field and advice based on

their experience. Also, the participants engaged in group activities with practical applications.

The COVID-19 restrictions delayed the implementation of this second training. During the COVID-19 restrictions in 2020 and 2021, the availability of the participants for the face-to-face session took time to foresee. Therefore, the second training, "Fundamentals in Avionics Software Development: Verification", occurred in 2021/22. After consultation with the companies to ensure the availability of the participants, the online phase started in August 2021. It ended in February 2022, and the face-to-face session took place in October 2021. 11 employees from five companies participated in this second training. The recruitment of the participants of the second training will be analyzed in 3.2.

The evaluation occurred in three steps: firstly, the participants answered the online Prior-Training Questionnaire II (see Appendix h) before starting the training; secondly, the Post-Training Questionnaire II after participating in the training (see Appendix I); and thirdly, three months after the training, they assessed the training in a semi-structured interview (see Figure 6). The Prior-Training Questionnaire II before the training investigated the learning needs of the participants at the beginning of their onboarding. In Post-Training Questionnaire II, the participants assess the training and at which level the materials of the online and face-to-face sessions and the learning and teaching methods correspond to their needs and learning preferences. The interviews took place three months after the training so that the participants could evaluate the training after gaining relevant experience in their new position. The Interview Guidelines II (see Appendix J and K) are analyzed in Chapter 3.2.

Figure 6. Timeline of second Training Course



Note: The face-to-face session refers to a part of the training course during the second project. Own figure according to second project's timeline, published in Frey et al. (2022, p.41) and Pourtoulidou & Frey (2021, p.1160).

3. Methodology

Chapter 3 describes the course followed in conducting this research during the two projects presented in 2.5.1 and 2.5.2. As mentioned above, the goal of this research is to discover how employees act to address their learning needs while working and participating in training. Qualitative research methods were chosen to gather information about employees' actions and their needs. Such methods as interviews allow a deep exploration of the complexities in the context in which employees operate. First, the sample of this research is explained, followed by the data collection and data analysis according to the Thematic Qualitative Text Analysis by Kuckartz (2014).

3.1. Sampling

The population of this research is new employees entering aerospace companies who recently have started working in avionic software engineering. In particular, this research is interested in employees entering the Aerospace Software and System Engineering field with no or minimum experience. Employees with prior experience in different fields also belong to the population of this research. As such, employees, called career changers *(Quereinsteiger/innen)*, have prior experience in pertinent or irrelevant fields; they need an introduction to Aerospace Software and System Engineering forms and processes.

The project partners made the selection of the participants (sample) for both trainings in agreement with each employee and their manager according to the following guidelines/criteria provided by the researchers of THI:

(1) How long have the employees been working in this field

Both projects targeted employees who enter a company within the project network at this time, do not consider themselves experts in this field, and need to acquire knowledge about Avionic Software and System Engineering.

(2) How long have the employees been working in each company

Both projects targeted employees who entered a company within the project network at this period and are becoming familiar with the procedures and processes of product development.

(3) If the employees plan to work in this field within a short time/ in the near future

Employees who were not working directly in this field for the time period of the projects but were planning to start working in avionic/aerospace projects in the future were also selected. Either project partners and/or managers played a role here, which makes this an externally controlled decision.

(4) If the employees are interested in learning about these topics:

Apart from the criteria mentioned above for selecting participants for the training courses, some employees voluntarily expressed their interest in participating after being informed about the training through the project partners. These were employees who were already working at the network companies and were interested in the topics covered in the training courses.

Each partner company's contact person recruited the participants of the first training course according to the guidelines mentioned above by the researchers, and the participants were then invited via email. Each partner company's contact person also recruited the participants of the second training according to the guidelines mentioned above by the researchers, and the participants were then invited via email. Any questions were clarified in project meetings shortly before the training. In the second project, the researchers developed a video presenting themselves and the training goals, which took place hybrid via the THI Moodle platform and on-site in Ingolstadt. This video was informative and was distributed to the partner companies to inform department leaders about the training.

3.2. Data Collection

As mentioned in 2.5.1 and 2.5.2, semi-structured interviews with the participants were carried out to answer the research questions of this research. Before analyzing the data collection through the interviews, it is essential to describe the overall evaluation of the projects, including participants answering questionnaires.

The participants answered two questionnaires within both projects. At the beginning of each training course, the participants were asked to respond to the "Prior Training Questionnaire I" and the "Prior Training Questionnaire II" (see Appendix E and H). These questionnaires aimed to acquire information about the participants' educational and

professional background and their knowledge regarding the training's content. This offered information for the trainer and the training development regarding the background of the target group. It took place deliberately before the training to avoid the potential influence of the training's content on the participants' state of knowledge. Nevertheless, the information acquired from the questionnaires about the evaluation of the training courses will be partially analyzed here as it offers information about the educational and professional background of the interviewees but primarily serves the goals of the projects and not the research questions of this research.

Directly after each training course, the participants answered the "Post Training Questionnaire I" and the "Post Training Questionnaire II" to evaluate the content, structure, and teaching methods with Likert scale multiple-choice closed questions and open-ended questions (see Appendix F and I). The results of these two questionnaires served the goals of the projects and will be partially analyzed for topics related to the research questions.

The interviews were conducted via telephone with 10 participants during the first project's evaluation (Jan-Feb 2020) and 11 during the second project's evaluation (Jan-Mar 2022). The participants were informed both when they were invited to participate in the training courses and during the face-to-face meetings that the interviews would take place approximately three months after the face-to-face training course (1st project) and session (2nd project). In this way, they would be able to offer feedback by comparing the training material with their everyday job requirements, considering that these training courses are aimed at newly acquired employees.

Each interview began with an introduction in which the interviewer reminded the participants of the project aims and research purposes and clarified any questions about the consent form and the confidentiality of the research. Before starting the interviews, all participants signed a Data Consent Form (See Appendix B, C, and D). Afterward, if the participant wanted to be reminded, the interviewer summarized the content of the training course.

Interview guidelines of the first project

The development of the Interview Guidelines I was based on the projects' aims and the research questions. The questions of the Interview Guidelines I aimed to get feedback from the participants about the following topics (see Appendix G):

1) Review of the first training course: The first section contained questions about the experience the participants had during the first training, the knowledge and information they acquired, and their opinion about the training overall.

2) Suggestions according to their learning preferences and needs: The second section focused on suggestions for improvement and desired changes in the training according to the participants' individual opinions and wishes.

3) Gain of the first training course: The third section asked about the participants' opinions regarding the gain and the importance of this training for themselves and colleagues. Here, potential differences according to the participants' backgrounds were also questioned.

4) Personal learning needs: The fourth section referred explicitly to the participants' individual learning needs and preferences and their actions to cover these.

This structure and the order of the questions in semi-structured interviews support the interviewer to stimulate the discussion and compare, to some extent, the conversations with the interviewees (Hussy et al., 2013).

These guidelines were tested with one person outside the project participants before the training. It was a person who matched the target group but belonged to another company and was contacted due to being a former colleague of the interviewer. Minor changes were made in the expression of two questions. All participants of the first project expressed their preference for conducting the interview in German. Therefore, the Interview Guidelines I were developed only in German (see Appendix G).

Revision

Due to the short duration of the interviews during the evaluation of the first project, four questions were added to the interview guidelines during the evaluation of the second project. In particular, in the first project interviews: three interviews lasted under 20 minutes, five between 20 and 30, and two between 30 and 40 minutes. Therefore, the

following questions were added to the guidelines for the evaluation of the second project (see Appendix J and K):

- Have you ever participated in a blended training course? If not, in a face-to-face training? What was something that you like about it? (Question 12 in Appendix K and Question 22 in Appendix J)
- What did make a good impression on you in the training course that you have participated in till today? (Question 13 in Appendix K and Question 24 in Appendix J)
- How do you stay informed/updated about the new technology? How do you educate yourself? (Question 25 in Appendix K and Question 26 in Appendix J)
- What do you do when you are participating in a training course and it doesn't cover your learning needs 100%? (Question 30 in Appendix K and Question 30 in Appendix J)

These questions aimed to acquire information about the first research question regarding the actions the employees take to learn by discovering their past actions in experiences with training and their ongoing learning practices/habits for their growth.

The Interview Guidelines II were developed in German (Appendix J) and English (Appendix K). The order of the questions differs and remains flexible and adaptable according to the discussion flow.

3.3. Data Analysis

The data acquired from the interviews were transcribed verbatim without any alterations, following specific transcription guidelines for both the German and English interviews, which are presented in Appendix A. The interviews from the first project were transcribed using Microsoft Word and an audio player, and the ones from the second were directly transcribed in MAXQDA. All words and phrases that could indicate the participants' identities, such as employees', trainers', and companies' names, were replaced with neutral phrases such as for example "Trainer's name" in order to guarantee the anonymity of the participants. The data acquired from the questionnaires were gathered and analyzed in Microsoft Excel.

The data were analyzed using the Thematic Qualitative Text Analysis according to Kuckartz (2014) after inserting all transcripts in MAXQDA software. The process, which

is described in the following paragraph, occurred one time for the interviews of the first project, a second time for the interviews of the second project, and finally, a third time to examine the whole data with the Code System in total.

The qualitative text analysis begins with reading the texts thoroughly and working with the text by considering the research questions. Taking notes and creating codes on the text is part of the process while continuing the reading to build categories. The categories are essential to the Qualitative Text Analysis and may be created before or after engaging with the material. The first case is called a deductive process of creating categories based on existing theories or hypotheses. The second is the inductive process, which enables the building of categories based on the data (Kuckartz, 2014, p. 58-60). The Thematic Qualitative Text Analysis by Kuckartz enables a combination of deductive and inductive construction of categories while coding the material. In this study, the data were collected using semi-structured interviews. There are several categories derived from the interview guidelines, which were based on the research questions, and there are categories added to the category system while coding the material. As presented by Kuckartz (2014), the basic process of Thematic Qualitative Text Analysis contains seven coding steps that may be repeated depending on the material and the research questions. Table 2 presents the process of analyzing the transcripts of the two projects according to the Thematic Qualitative Text Analysis by Kuckartz (2014). Column A of Table 2 contains the steps of Kuckartz (2014), and Column B presents what occurred in order to implement Kuckartz's steps in this research. Although the coding process started by following the sequence of Kuckartz's steps, it was implemented first for the transcripts of the first project and then repeated for the transcripts of the interviews of the second project. This happened due to project requirements to evaluate the first training course and apply any improvement suggestions in the development of the second training course. Finally, Step 6 was repeated after 6 months before starting with the category-based analysis and the presentation of the results.

Table 2. Thematic Qualitative Text Analysis: Implementation

A	B
Thematic Qualitative Text Analysis by Kuckartz (2014, p.70)	Implementation of the Thematic Qualitative Text Analysis in this study
Step 1: Initial work with the text: Highlight important passages, compose memos	The researcher read the transcripts of the first project and highlighted important sequences related to specific topics.
Step 2: Develop main topical categories	Four main categories were developed from the first step. In addition to these, three main categories were derived from the development of the interview guidelines.
Step 3: First coding process: Code the available data using the main categories	All data from the first round of interviews were coded within the seven main categories up to this point.
Step 4: Compile all of the passages assigned to each of the main categories	Here, the passages coded to the same code are collected, reviewed, and organized in detail.
Step 5: Determine sub-categories	After the analysis in Step 4, sub-categories were developed.
Step 6: Second coding process: Code all of the data using the elaborate category system	All data from the first round of interviews were coded using the elaborate category system.
Step 7: Category-based analysis and presentation of results	First results about the research questions were gathered and evaluated, which led to the addition of the four questions presented in Chapter 3.2.
Step 1: Initial work with the text: Highlight important passages, compose memos	Step 1 was implemented again for the transcripts of the interviews of the second project. Three more main categories were added. From this point onwards, all data were entered and edited in MAXQDA.
Step 2: Develop main topical categories	At this point, the main categories were 17.
Step 3: First coding process: Code the available data using the main categories and *Step 4: Compile all of the passages assigned to each of the main categories*	Repeating step 3 for the transcripts of the second interview.
Step 5: Determine sub-categories	Further sub-categories were developed.
Step 6: Second coding process: Code all of the data using the elaborate category system	At this point, all data was coded using the elaborate category system.
Step 6: Second coding process: Code all of the data using the elaborate category system	To validate the research process, this step was repeated after 6 months, combined with data from all the questionnaires and taking into consideration the research questions.

Step 7: Category-based analysis and presentation of results	Step 7 was implemented in the end to evaluate the data and present the results in Chapter 4.

4. Results

This chapter presents the study results from implementing the MAXQDA Thematic Qualitative Text Analysis by Kuckartz (2014). At first, the coding process will be described, and afterward, the results will be presented according to the five research questions mentioned in Chapter 2.4.1. Each category and sub-category presented here is awarded a number according to the order of the coding process and its matching to the research questions e.g., *(1) Learning preferences,* etc. This enumeration is used in Chapters 4 and 5 in the following description to keep the connection to the Code System (see Appendix L) feasible and understandable for the reader. For clarification purposes, the numbers of the categories and sub-categories are written in cursive in brackets.

Based on the development of the interview guidelines, three main categories were deductively created. These categories were based on the research questions RQ1, RQ3, and RQ4 and were: *(1) Learning preferences, (6) Learning Needs (LN) of employees entering Aerospace Software Development (ASD),* and *(7) Differences among employees entering ASD.*

The coding of the interviews during the first project resulted in the addition of the following three categories related to RQ1: *(2) Problem-solving, (3) Work approach,* and *(5) Beliefs about learning.* During this coding step, the inductive development of main categories continued with the categories: *(8) Evaluation of the First training course* with the sub-categories: *(8.1) Pros* and *(8.2) Cons*, *(9) Evaluation of the Second training course* with the sub-categories: *(9.1) Pros* and *(9.2) Cons*, *(12) Gain*, *(13) Recommendation to colleagues, and (14) Other*.

After the revision of the interview guidelines for the second project, the coding continued. During this step, three categories were added to the category system: *(15) experience with training, (16) Reactions to bad training courses,* and *(17) Engagement with the training courses.* The codes of the main categories were further divided into numerous sub-categories in Step 6 of the Thematic Qualitative Text Analysis (see Table 2). In this step, the following categories were added: *(4) Step-by-step description, (10) Suggestions after the First Training Course* with the sub-categories: *(10.1) Content related* and *(10.2) Methods*, and *(11) Suggestions after the Second Training Course* with the sub-categories: *(11.1) Content related* and *(11.2) Methods.*

During the coding process, different colors were used in MAXQDA to distinguish the time of each category's development so the researcher could comment on this later and draw conclusions regarding the interview guidelines. The first three main categories were colored black, the following eight purple, and the last three orange. Furthermore, all sub-categories, which were developed in Step 6, were colored yellow. To sum up, 17 main categories (see Table 3) were created after the Thematic Qualitative Text Analysis and are analyzed in the following subchapters assigned to the five research questions. All categories and sub-categories are visible in the Code System (see Appendix L).

Table 3. Main categories of Code System

Name of the Main Category	Number of codes assigned
1. Learning preferences	262
2. Problem-solving	91
3. Work approach	46
4. Step-by-step description: criteria of selection	10
5. Beliefs about Learning	39
6. LN of employees entering ASD	34
7. Differences among employees entering ASD	51
8. Evaluation of the first training course	81
9. Evaluation of the second training course	142
10. Suggestions for the first training course	39
11. Suggestions for the second training course	42
12. Gain	69
13. Recommendation to colleagues	37
14. Other	72
15. Experience with training	45
16. Reactions to inadequate training courses	38
17. Engagement with the training courses	23

4.1. Learning Approach

The first subchapter includes five categories that answer the first research question: *"What actions do employees individually take to address their learning needs?".* These are the following: *(1) Learning Preferences, (2) Problem-solving, (3) Work approach, (4) Step-by-step description,* and *(5) Beliefs about learning.*

4.1.1. Learning Preferences

With 264 codes, the main category *(1.) Learning Preferences* stands out with descriptions of specific actions that the participants want to follow when they are in the position where they can decide for themselves how they will learn and whether they can freely choose a learning tool or process. It is divided into seven categories, which are alphabetically listed below in Table 4.

Table 4. Main category 1. Learning preferences

Name of the Category	Number of codes assigned
1.Learning preferences	264
1.1 Attend training	38
1.2 Combination of techniques	9
1.3 Depends on	33
1.4 Discuss with colleagues	16
1.5 In a group/collectively	1
1.6 Something on my own	100
1.7 Training Development	67

The *(1.1) Attend training* with 38 codes refers to the participants that state that in order to learn something, they will willingly participate in training, specifically, in either a *(1.1.1) F2F* or *(1.1.2) Online* training.

In the category *(1.2) Combination of techniques*, the participants mentioned explicitly that they follow a combination of actions in order to learn something. They use more than one technique, e.g., they start by reviewing the literature or watching tutorials and then practice the knowledge with exercises or discuss it with other people (#15, §42[14]).

Some participants seemed to have difficulty answering the question of how they would learn if they could choose freely because they answered that it *(1.3) Depends on* some factors. The available time, the content, and their goals are the factors they mentioned that affect their decisions *(1.3.1 – 1.3.3).*

Another action towards learning, which the participants stated to take, is to *(1.4) Discuss with colleagues*. Whether they already know that a colleague is familiar with a subject or

[14] The number of the interview is marked with "#" and the number. The number of the paragraph referred to in each interview is marked with "§" and the number of the paragraph in the MAXQDA file.

an expert at it or not, they choose to discuss a subject with colleagues or ask around (#21, §178). This action helps them get a step closer to what they want to learn.

The category *(1.5) In a group/collectively* was developed because of the experience of one participant, who mentioned that learning within a group was a preferred way of learning while studying.

The largest category is the *(1.6) Something on my own* with 100 codes because the participants mentioned multiple times that they choose individual actions when they want to learn something. The participants described actions which they can implement on their own, such as the following:

- *(1.6.1) Doing exercises,*
- *(1.6.2) Repetition,*
- *(1.6.3) Research & read,*
- *(1.6.4) Trial & error.*

The sub-category *(1.6.1) Doing exercises* refers to when the participants apply the information by implementing practical examples, e.g., solving equations or running a code.

The sub-category *(1.6.2) repetition* encloses three codes, which refer to techniques used in order to learn information through repeatedly reading or writing it and aiming at memorizing it. These are:

- *(1.6.2.1) Flashcards:* the participants use cards as an aid to learning.
- *(1.6.2.2) Re-writing:* the participants write text sequences again and again in order to memorize them.
- *(1.6.2.3) Note-taking/summarizing:* The participants write down important information about something they are reading, watching, or attending and sum up the content.

The sub-category *(1.6.3) research & read* encloses 68 codes which refer to the choice of participants to actively look for information either *(1.6.3.1) in a library* or by searching online in the World Wide Web starting with a *(1.6.3.3) Internet search (Google)* or look for relevant information in *(1.6.3.4) Online forums, (1.6.3.5) Scholarly research,* or in *(1.6.3.6) Social media* or in *(1.6.3.7) Specific websites,* like for example Stack Overflow. They may *(1.6.3.8) Watch tutorials* online either directly on YouTube or on websites of,

for example, the software they use, and finally, they search locally by doing an *(1.6.3.2) internal document retrieval*. Confidential or previous project documents are accessible only within the organization

The sub-category *(1.6.4) Trial & error* refers to when the participants learn something by trying different potential solutions and, through this process, learn the correct way to execute a task. For example, they might try running a code or software, then fail, then try again by changing something in the code, then fail, then try again and maybe at some point succeed *"often at least mathematical things or learning a new programming language, eh, or understanding algorithms is simply for me at least most of "I have to try it out". I have to fall flat on my face*[15]*, have to do it again, have to fall flat on my face again and at some point, there is this "aha moment" that then it is just there and it stays there"* (translated from #21, §162).

Another large category is *(1.7) Training development*, wherein the participants referred numerous times to specific characteristics that a training should have. These preferred characteristics are the use of blended methods, exercises, frequent tests, examples to explain something, and summaries, while they also refer to the learner's and trainer's roles. The interaction among the participants and all contributors within the training (e.g., trainer, subject-matter experts, as well as the offer of a certificate upon completion, were also mentioned *(1.7.1 – 1.7.11).* Particularly for the trainer's role, the participants commented on the way the trainer speaks and moves and whether the trainer is available to answer questions during the online lessons.

4.1.2. Problem-solving

The main category *(2.) Problem-solving,* contains descriptions of the actions that the participants take when they are dealing with a problem within their job role. The 91 codes of this category are divided into nine categories, which are alphabetically listed below in Table 5.

[15] Idiomatic expression which means „to fail" as in German *"Ich muss auf die Nase fallen"* (#21, §162).

Table 5. Main category 2. Problem-solving

Name of the Category	Number of codes assigned
2. Problem-solving	91
2.1 Ask a more experienced colleague - expert	11
2.2 Ask/discuss with colleagues	11
2.3 Ask somebody near me	2
2.4 Database (DO)	1
2.5 Depending on	19
2.6 Give up	1
2.7 Google/search online for literature/solution	35
2.8 Library: search for a book	3
2.9 On my own first	8

The first category encloses eleven codes related to text passages, where the participants stated that if they face a problem at work, they *(2.1) Ask a more experienced colleague/expert* for help. This person could be a known-to-be expert inside the company or a colleague who generally has more experience than themselves or has specifically worked with the subject of their problem.

The second category encloses eleven codes with passages in which the participants stated that they *(2.2) Ask/discuss with colleagues* for help when they face a problem. This differs from the first category because, here, the participants stated that they would generally ask their colleagues for help, e.g., colleagues who are available at the time and/or sitting near them, without specifically choosing an experienced one. Their descriptions refer to a general tactic of searching for answers by soliciting insights from their colleagues or trying to solve an issue together with them.

There is also a small category with two codes *(2.3) Ask sb near me*, in which the respondents specifically mentioned that they would choose the nearest available person without specifying what experience this person has: "*if I have a colleague within reach, I ask him first, otherwise, I continue with the Google search"* (translated from #26, §42).

One person mentioned that looking at the company's (2.4) Database is a solution because there, they can find documents with restricted access, like the DO, which contains Software Considerations in Airborne Systems and Equipment Certification and is used by certification authorities to approve all commercial software-based aerospace systems.

The category *(2.5) Depending on* includes 19 codes where the participants stated that their actions to solve a problem change according to the situation that they are dealing with. Two different kinds of problems could be identified: the *(2.5.1) General problem* and the *(2.5.2) Technical problem*. In *(2.5.1)*, the participants referred to situations where the problem was general, and they needed to begin from zero to acquire knowledge about it, which meant searching online for relevant literature. In *(2.5.2),* the participants talked about specific technical problems that need specialized solutions and literature. This is to be found either online on the specific website of the software they are working with or from the company's internal documents.

One single code was devoted to the sub-category *(2.6) Give-up* since it was stated that on the occasion when all other actions within this main category do not solve the problem, the participants give up trying to solve it.

The category *(2.7) Google/ search online for literature/ solution* encloses 35 codes where the participants stated that they searched online for a solution to their problem. A common start for an online search is using Google, where they can find resources and websites with more specific information. Apart from researching online in general, specific websites with forums e.g., Stack Overflow, are used by the participants because they can find their answers in answered questions from other people. They mentioned that this is a common practice in this field because the multitude of users qualifies for correct answers to a variety of questions on everyday work problems and is time-saving.

Another way to find the necessary information in order to solve a problem is to look for the answer in a book. The three codes related to this topic constitute the last category, which is the *(2.8) Library: search for a book.*

The last category here is *(2.9) On my own first*, which contains codes in which the participants commented on their priority of trying to solve a problem by themselves before contacting somebody to ask for information or generally for help.

4.1.3. Work Approach

The category *(3.) Work approach* contains information about the actions the participants follow to undertake a work task. Here, they describe common work approaches or practices about how things are done that they have adopted from their work environment

or company culture and/or procedures. This category, with 46 codes, is divided into the six following sub-categories, as shown in Table 6 in alphabetical order.

Table 6. Main category 3. Work approach

Name of the Category	Number of codes assigned
3. Work approach	46[16]
3.1 Based on instinct/ intuition	3
3.2 Communication between departments	2
3.3 Documentation database	11
3.4 Learning by doing or through trial-error	8
3.5 Show me how it's done	6
3.6 Training catalog	12

A small category with three codes is *(3.1) Based on instinct/intuition*, where the participants stated that they act according to their gut feeling on how to proceed with a task and what the proper way to achieve it successfully would be: *"when I had the opportunity to create requirements myself, it was more or less a kind of feeling as I set up the requirements and that was ok, but there were or still are difficulties, even now when it comes to creating requirements"* (translated from #11, §6).

The category *(3.2) Communication between departments* encloses two codes, which describe that the participants learn how a task must be done by contacting a department that is accountable for this task or topic. For example, if an employee from one department develops a code and another employee from a different department uses or verifies this code and faces a problem, this employee will contact the first one to solve any questions.

The category *(3.3) Documentation database* encloses 11 codes in which the participants describe acquiring information from a collection of company documents that are not publicly available.

The category *(3.4) Learning by doing or trial-error* refers to eight codes, where the participants stated that they learn something by trying to do it one way and failing. If they fail, they try another way, and by the outcome, they know which one is correct.

[16] The addition of the codes listed below does not add up to the total of the codes in this main category because four codes were not listed in any category.

Sometimes, the participants' actions revolve around the customers' regulations, which led to the sub-category *(3.4.1) From customers' regulations or material* with two codes.

Another common approach is the *(3.5) Show me how it's done*; the participants acquire information about how a task must be done when another person demonstrates how it is done or how it should be performed. This can be done by being shown something by *(3.5.1) An expert,* by *(3.5.3) Other colleagues,* or by *(3.5.2) Looking at others' jobs,* where one participant explained that: *"Well, at least for me it was like this: I started here and I was often told: yes, look at how the others do it and orient yourself based on that"* (translated from #110, §3).

The last category with 12 codes is *(3.6) Training catalog*, which refers to the participants acquiring any knowledge they need/want by participating in training that their employer offers. There is a list of training courses offered by the employer, and *(3.6.1) Employees communicate their needs* directly to their boss or training department, give *(3.6.2) Internal feedback after attending a training* in order to clarify if their learning goals have been met, and finally the employees just attend the training, which is *(3.6.3) Obligatory* for their job role: *"then we also had training courses, we have to attend a certain amount of further training, compulsory events, compulsory training every year."* (translated from #212, §49).

4.1.4. Step-by-step Description

Apart from the first three main categories, another relevant point to the employees' learning approach is the main category *(4.) Step-by-step description*, which refers to detailed descriptions of the steps they follow when they want to learn something. Only seven participants explained in detail what they do when they search for information. One participant described a memorizing technique, five participants analyzed the steps they take when they google something and how they move on afterward, and one mentioned beginning with a rough overview of a topic before delving into specialist literature. This person uses online courses to build a solid knowledge base before developing a project. For the rest of the respondents, using specific relevant keywords and criticizing the sources they look for information are important factors during their search (#210, §70; #211, §27-32).

4.1.5. Beliefs about Learning

The participants referred in 39 codes to general opinions about life or learning at several points during the interviews while describing their experiences or their learning process. These are collected in the main category *(5.) Beliefs about Learning* and give a little insight into their opinions or principles related to learning. Out of the 18 categories of this main category, seven seem to be common beliefs for more than one person. These are (beginning with the most common mentioned): *(5.5) Exercise solidifies new knowledge*, *(5.2) Always pros & cons*, *(5.17) Work is learned by working*, *(5.1) Age-based differences*, *(5.6) Gain through everything*, *(5.9) Knowledge offered vs. learner's capacity*, and *(5.12) Lifelong learning.* The rest were mentioned only by one person and refer to opinions that support that: *(5.3) Application of training content* after participating in training is necessary for knowledge acquisition; participants cooperate easier if they know each other: *(5.4) Easier collaboration with acquaintances, (5.7) Interactions help critical thinking;* during training there is a *(5.9) Knowledge transfer risk;* the daily use of a tool or knowledge is a requirement for learning it: *(5.10) Learn sth by using it everyday*; learning includes different kinds of teaching and learning methods: *(5.11) Learning definition, (5.13) Previous knowledge connections* are necessary; *(5.14) Search results require discernment; (5.15) Seeking help, saves time; (5.16) Self-educating* is always important, and finally; *(5.18) Value of Repetition for learning* is significant.

4.2. Self-Regulated Learning

The second research question aims to enlighten how self-regulated learning occurs within on-demand training for software engineers entering aerospace companies (RQ2). The two main categories that contain information about the existence of self-regulation while employees are participating in the training are *(16) Reactions to bad training courses* and *(17) Engagement with the training courses*. These two categories will be analyzed in the following subchapters.

4.2.1. Reactions to Inadequate Training Courses

The category *(16.) Reactions to inadequate training courses* consists of 38 codes (See Table 7). This category contains mostly codes from the second training, which is explained by the addition of question 30 in the Post-Training Questionnaire II: *"What do you do when you are participating in a training course, and it doesn't cover your learning needs 100%?"* (see Appendix I). The participants described what they did when they

are/were attending a training course that is/was not fulfilling their needs and goals. If they do not have such experience, they assume what they would do in such a situation. The term "inadequate training course" refers to a training course that either had negative characteristics or did not fulfill the participants' goals and/or expectations.

Table 7. Main category 16. Reactions to inadequate training courses

Name of the Category	Number of codes assigned
16. Reactions to inadequate training courses	38
16.1 Abandon the training course	5
16.2 Ask for a refund	2
16.3 Ask for clarifications	2
16.4 Discuss with colleagues	4
16.5 Do it anyway	1
16.6 Feedback questionnaire	13
16.7 Identify the problem	1
16.8 Inform colleagues about an inadequate training course	1
16.9 Keep looking for another training course	8
16.10 Select the useful parts	1

Sorted by frequency, most codes were assigned to the *(16.6) feedback questionnaire*, where the participants stated that by filling out the questionnaire after a training course, they expressed their opinion about it. This would be a questionnaire *(16.6.1) for the trainer,* and there is also *(16.6.2) for the manager/company* because the participants get back to their boss in person or via a questionnaire in order to express their evaluation of the training course they attended.

In case of an inadequate training course, eight codes refer to the option of (16.9) *keep looking for another training course* in order to acquire the knowledge the participants need. In five codes or four interviews, it was stated that the participants would *(16.1) abandon the training course* if they deemed it a waste of their time or they would *(16.4) discuss with colleagues* to check if they also had a similar experience and continue searching in order find another potential solution to learn what they need.

Apart from these, the participants mentioned that they would *(16.3) ask for clarifications* by directly contacting the trainer, *(16.2) ask for a refund*, and *(16.5) do it anyway* because the training course might be beneficial in the future, as one participants mentioned: *"if it's something that doesn't help right now, but might later, then I would make sure to finish*

it." (translated from #26, §70). Morevore, they try to *(16.7) identify the problem, (16.8) inform colleagues about the bad training course*, and finally try to *(16.10) select the useful parts* of it and focus on these.

4.2.2. Engagement with the Training Courses

This category refers to the *(17.) Engagement with the training courses* and its 23 codes are divided into two categories to distinguish the kind of engagement according to the two trainings: *(17.1) First training course* and *(17.2) Second training course* (See Table 8). The participants described if and how they used the training material. This differs between the two training courses because the training methods and materials differ. The *(17.1) First training course* related to accessing or using the material after the face-to-face training; three participants stated that they looked once into the materials they got after the face-to-face training, while four participants stated they never looked into it, and two mentioned that they might access it if they deal with something relevant in the future. The engagement of the participants in the *(17.2) Second training course* concerned whether and how much of the online material of the training course the participants accessed and studied before or after the face-to-face session. The majority stated that they accessed everything or almost everything before the face-to-face session, while three participants stated that they had looked at only a few videos but did not continue nor complete any quiz.

Table 8. Main category 17. Engagement with the training courses

Name of the Category	Number of codes assigned
17. Engagement with the training courses	23
17.1 First training course	9
17.1.1 Never	4
17.1.2 Once	3
17.1.3 Potential future use	2
17.2 Second training course	14
17.2.1 Almost nothing	4
17.2.2 Everything	4
17.2.3 Partially (majority)	6

4.3. Learning Needs of New Employees

The third research question sought to discover the learning needs (LN) of new employees entering aerospace companies and working specifically in the field of Requirements Engineering. The interview guidelines contained specific questions for the learning needs of the participants; these are the following: question 13 from Appendix G: *"Welche sind deine Lernbedürfnisse als Mitarbeiter/in?"* (translation: What are your learning needs as employee?). The same question was again as question 27 for the interview guidelines of the second training course, which are presented in Appendix K, and question 28 from Appendix J: *"Do you feel that you have certain learning need at this time of your career?"*. These led to the creation of the main category *(6.) LN of employees entering ASD*. Beyond this, the following categories can also be matched to this research question because they offer valuable information about what participants need. As presented in Chapter 3.3, the participants evaluated both trainings in written form by answering the Post Training Questionnaire and by analyzing their opinions during the interview. The material about evaluating the training courses shows critical skills and reflection regarding what is missing from the training they attended; it is divided into two categories: *(8) Evaluation of the 1st training course* and *(9) Evaluation of the 2nd training course.* Apart from the evaluation of the training courses, the participants expressed their ideas for improvement of the training courses, which refer to specific parts of the training that should or could be changed or planned differently based on their opinion. These ideas are included in *(10) Suggestions after the 1st training course and (11) Suggestions after the 2nd training course*. Finally, the category *(12) Gain* refers to the outcome of the participants' self-assessment of their experience during the training, which can be related to their former knowledge gaps.

4.3.1. Learning Needs of Employees entering ASD

The participants described in the codes of the category *(6) LN of employees entering ASD* what learning needs they have or had upon entering aerospace software development. This main category with 34 codes is divided into three categories, as shown in Table 9:

Table 9. Main category 6. Learning needs of employees entering Aerospace Software Development

Name of the Category	Number of codes assigned
6. LN of employees entering ASD	34
6.1 Application: more exercises	3
6.2 Content	30
6.3 Individualization	1

Under *(6.1) Application: more exercises*, the participants stated they need the training course to contain more opportunities to do activities on a specific topic so that they can practice and apply their knowledge directly in real project situations.

There are three codes in category *(6.2) Content*, which refer to needs related to subjects and specific topics. Alphabetically, the first code mentioned was *(6.2.1) Connections between SW roles*, which refers to the different roles, e.g., the tester, the verifier, and an engineer, that might perform in ASD and specifically the relations among the levels in the V-Modell. According to the participants, *(6.2.2) Companies' processes* are important to learn at the beginning of their employment with the company because they allude to specific procedures or how the implementation of systems/procedures in their company takes place. This also includes the correct steps of performing a task, which must be documented in written form and made available to employees. The participants also referred to specific subjects and tools they want to learn, and generally, they want to be informed about the latest news in their field, which are subdivided into *(6.2.3) Topics & tools* and particularly to *(6.2.3.1) Participants with different backgrounds need more information.* According to the participants, career changers need more introductory information and/or basic aviation standards.

Finally, one participant stated that they needed to differentiate and adjust the training or parts of it according to their individual needs and current knowledge in *(6.3) individualization*[17].

[17] This was extracted from the answers to the first Post-Training Questionnaire and presented in Pourtoulidou & Frey (2020) and in the end of the first project within the project partners.

4.3.2. Evaluation of the First Training Course

The main category *(8.) Evaluation of the First Training Course* contains 81 codes, which are the comments of the participants on the first training course. It is divided into *(8.1) Pros* and *(8.2) Cons*, which describe the advantages and the disadvantages of the course.

- *(8.1) Pros*

The *(8.1) Pros* include 44 codes regarding the advantages and positive characteristics of the first training and are divided into the *(8.1.1) content*, the *(8.1.2) methods*, and the *(8.1.3) trainer*, as shown in Table 10. The *(8.1.1) content* was mentioned in relation to the information that was transferred, which offered a valuable introduction to aerospace software development by presenting an overview of the fundamentals, even if parts of it were a repetition for a participant due to already known background information, connections, and processes within the V-Model *(8.1.1.1 – 8.1.1.6).* Regarding the *(8.1.2) methods*, the participants highlighted the importance of exercises, which offered opportunities to apply the theory and discuss the topics further with other participants *(8.1.2.1).* Within the exercises, the interaction among participants was also emphasized as they enjoyed discussing with employees from different companies and/or departments and/or with different roles from their own. The contribution of the expert discussion and the lecture quality were positively commented on with single codes *(8.1.2.2 – 8.1.2.3).* Similarly, the role of the trainer was praised *(8.1.3).*

Table 10. Category 8.1. Pros - Evaluation of the first Training Course

Name of the Category	Number of codes assigned
8. Evaluation of the 1st Training Course:	81
8.1 Pros	44
8.1.1 Content	19
8.1.1.1 Correlations	3
8.1.1.2 Information	9
8.1.1.3 Introduction	2
8.1.1.4 Overview	3
8.1.1.5 Processes	1
8.1.1.6 Repetition	1
8.1.2 Methods	23
8.1.2.1 Exercises	18
8.1.2.2 Expert discussion	1
8.1.2.3 Lecture	1
8.1.3 Trainer	2

- *(8.2) Cons*

The participants of the first training described the disadvantages of content- and methodology-related issues in *(8.2) Cons* and with 37 codes, as shown in Table 11. The comments regarding the *(8.2.1) Content* of the first training state that a few definitions of terms were not explained beforehand, and in particular in some chapters, e.g., in Re-Use, the theory was more than the participants could comprehend without a direct connection to practical application and specific in-depth details about the topic. In contrast to the short duration of the training course, the heavy content was also allocated to the codes regarding the *(8.2.2) Methods* of this training course *(8.2.2.4, 8.2.2.5).* This was visible in the slides of the presentations, which were overloaded according to the participants and did not contain examples. The examples were verbally described and explained by the trainer and did not break the "*monologue of a classic lecture*" (#16, §36), *(8.2.2.1, 8.2.2.3).* Another disadvantage was claimed to be that the exercises should have been more comprehensible for employees who have not seen and worked with requirements before *(8.2.2.2).* Finally, the participants felt that the expert appeared *"unmotivated"* (#17, §52) to take part and directly connect their experience with the goals of the training *(8.2.2.6).*

Table 11. Category 8.2. Cons - Evaluation of the first Training Course

Name of the Category	Number of codes assigned
8. Evaluation of the 1st Training Course:	81
8.2 Cons	37
8.2.1 Content	12
8.2.1.1 Definitions for terminology	2
8.2.1.2 Missing the big picture	3
8.2.1.3 Too general information	3
8.2.1.4 Too much theory	3
8.2.2 Methods	25
8.2.2.1 Examples	3
8.2.2.2 Exercises	5
8.2.2.3 Lecture	1
8.2.2.4 Short duration vs heavy content	7
8.2.2.5 Slides overloaded	7
8.2.2.6 Suitability of the expert	2

4.3.3. Evaluation of the Second Training Course

- *(9.1) Pros*

Regarding the second training, in *(9.1) Pros* with 83 codes, the advantages of the second training are divided into four subcategories, as shown in Table 12, with the most codes (68) referring to the *(9.1.1) blended concept*. The participants highlighted the benefits of being able to ask questions both online and face-to-face, work together in exercises, interact and network with the experts and the rest of the group, and get to know each other in the team event the day before *(9.1.1.1, 9.1.1.2, 9.1.1.3, 9.1.1.5, 9.1.1.7).* They also mentioned that the flexibility and the quizzes in the online phase were helpful because they could plan their engagement and test themselves independently *(9.1.1.4 - 9.1.1.6).* The role of the trainer, the content, and some other general points, such as the structure of the training course, were also positively commented on *(9.1.2, 9.1.3, 9.1.4).*

Table 12. Category 9.1 Pros - Evaluation of the second Training Course

Name of the Category	Number of codes assigned
9. Evaluation of the 2nd Training Course:	142
9.1 Pros	83
9.1.1 Blended concept	68[18]
9.1.1.1 Ask questions (f2f & online)	4
9.1.1.2 Exercises (f2f)	6
9.1.1.3 Expert discussion (f2f)	9
9.1.1.4 Flexibility (online)	12
9.1.1.5 Interaction & Networking	10
9.1.1.6 Quizzes (f2f)	3
9.1.1.7 Team event (f2f)	12
9.1.2 Content	4
9.1.3 General	6
9.1.4 Trainer	5

- *(9.2) Cons*

The disadvantages of the second training are distributed in 59 codes and three sub-categories, as shown in Table 13. They refer to issues during the *(9.2.1) F2f session,* the *(9.2.3) Online phase,* and in general to the fact that there was *(9.2.2) No evaluation*, which would issue the participants a certificate. In particular, the participants commented that the *(9.2.1) F2f session* required more time for the execution and improvement in the presentation of the second exercise. The printed code of this exercise was not feasible to read, process, and correct in such a short time (#21, §62; #22, §31-34). The disadvantages of the *(9.2.3) Online phase* concerned some technical problems of the platform, which hosted the training course and the video production *(9.2.3.4).* Almost all comments are stemming from one participant, who expressed their opinion extensively and found that the trainer moved redundantly in the video frame (#21, §86, 94, 96), *(9.2.3.5).* The participants mentioned that the examples were relatively simple and that a direct relation to practical application and a summary at the beginning or end of each video were missing *(9.2.3.1, 9.2.3.2, 9.2.3.3)*. The comment for a complete evaluation and the issue of an official certificate also came from one person *(9.2.2).*

[18] The addition of the codes listed below does not add up to the total of the codes in this main category because twelve codes were not listed in any category.

Table 13. Category 9.2 Cons - Evaluation of the second Training Course

Name of the Category	Number of codes assigned
9. Evaluation of the 2nd Training Course:	81
9.2 Cons	59[19]
9.2.1 F2F session	17[20]
9.2.1.1 Execution of exercises	12
9.2.1.2 Lack of time	2
9.2.1.3 More exercises	2
9.2.2 No final evaluation	3
9.2.3 Online phase	34[21]
9.2.3.1 Content of the videos	7
9.2.3.2. No summary in the videos	2
9.2.3.3 Poor quality of the examples in the videos	7
9.2.3.4 System problems	11
9.2.3.5 Trainer's appearance	6

4.3.4. Suggestions for the First Training Course

The main category *(10) Suggestions for the First Training Course* contains the participants' ideas on how specific parts of the training courses could be planned and executed differently to improve the quality of the training and align it with their needs and preferences. Therefore, it matches the third research question, and the 39 codes will be presented below, as shown in Table 14.

[19] The addition of the codes listed below does not add up to the total of the codes in this main category because five codes were not listed in any category.
[20] The addition of the codes listed below does not add up to the total of the codes in this main category because one code was not listed in any category.
[21] The addition of the codes listed below does not add up to the total of the codes in this main category because one code was not listed in any category.

Table 14. Main category 10. Suggestions for the first training course

Name of the Category	Number of codes assigned
10. Suggestions for the first training course	39
10.1 Content-related	5
10.2 Methods	34
10.2.1 Clarify definitions in advance	1
10.2.2 Exercises	16
10.2.3 Individualization	3
10.2.4 Interaction among different companies	2
10.2.5 Parallel to the job: implementation in a longer period	5
10.2.6 Short tests/questions	7

The majority of these codes referred to methodological suggestions. Only five codes express *(10.1) content-related* suggestions, which propose an increase in the topics of "Requirements Engineering" and generally of the "Architecture of requirements" and reduction of "Re-Use" topics, as well as a need for a small chapter, which would explain any company-specific differences, e.g., regarding definitions, after this training course, which would take place internally for each organization. The category *(10.2) methods* is divided into six sub-categories, with the category *(10.2.2) exercises* containing most codes. The comments of the participants regarding the exercises show a clear need for an "answer sheet", where the participants can study a correct example or try one example out with the trainer accompanying them *(10.2.2.1, 10.2.2.2).* Generally, the exercises should contain more details about, e.g., how to write requirements. They could belong to one topic that would be the leading example and subdivided into more exercises *(10.2.2.3, 10.2.2.4, 10.2.2.5).* The number of participants in each group should be smaller than 5 participants in group activities *(10.2.2.6).* The next category with the most codes referred to the option of adding short tests after, for example, two modules, in the form of a repetition of knowledge and in order to provide the opportunity to clarify any misunderstandings *(10.2.6).* The definitions of the topics should be clarified at the beginning of the training so that all participants are on the same level *(10.2.1).* Furthermore, the participants suggested keeping the target group of this training mixed from different companies to maintain the interaction among different roles and companies and offering the training spread over a more extended period to accompany the new employees at the beginning of their career *(10.2.4, 10.2.5).* The codes of the sub-category

(10.2.3) Individualization combined with the answers to Question 4 of the Post-Training Questionnaire I (See Table 15) express a neutral perspective with a tendency to like the possibility of being able to distinguish the training material and the time advocated at it according to the participants' needs. This outcome was derived from the averages of the 5-point Likert scale answers.

Table 15. Answers to Question 4 of Post-Training Questionnaire I

Question 4 of the Post-Training Questionnaire of the First Training Course:	Average of answers: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree
4.1. I would like to be able to skip a chapter with which I am already familiar.	3.36
4.2. I would like to be able to manage myself how much time I dedicate to each chapter.	3.72
4.3. I would like to be able to manage myself how much time I dedicate to each topic.	3.82
4.4. I would like access to such training courses online through a digital platform.	4.27

4.3.5. Suggestions for the Second Training Course

The 42 codes that are enlisted in this main category *(11) Suggestions for the Second Training Course* are also subdivided into two categories: *(11.1) content-related* and *(11.2) methods*, as shown in Table 16.

Table 16. Main category 11. Suggestions for the second training course

Name of the Category	Number of codes assigned
11. Suggestions for the second training course	42[22]
11.1 Content-related	3
11.2 Methods	36
11.2.1 All lectures online vs exercises f2f	2
11.2.2 Clarify all definitions in advance	2
11.2.3 Evaluation	4
11.2.4 Exercises	14
11.2.5 Longer duration	6
11.2.6 Online phase	8

[22] The addition of the codes listed below does not add up to the total of the codes in this main category because three code were not listed in any category.

It is interesting to mention that all sub-categories contain codes mentioned by up to three different participants. Only three codes refer to suggestions related to the content of the second training and these suggest adding specific details about the methods of the companies in Requirements Engineering and examples of requirements from the companies, which the participants could work on during the exercises *(11.1).* The majority of the codes belong to *(11.2) methods,* where the participants expressed their recommendations about methodological changes. Firstly, the participants stated that the theoretical parts should all be conveyed during the online phase in order to dedicate the f2f session completely to the exercises *(11.2.1).* Another suggestion was to clarify any specific definitions at the beginning of the training and maybe offer these in a hand-out *(11.2.2).* The missing evaluation could be established either as a final exam, which will prove the participants' knowledge and offer a certificate of attendance, or as short tests during the training or after the face-to-face session *(11.2.3).* The suggestions about exercises are spread to 14 codes and concern adding more exercises in general and then specifically practical applications with examples from a real project *(11.2.4).* The exercises and the examined codes[23] should be short, e.g., not ten pages code, and made available before the face-to-face session so that the participants can prepare potential tasks or roles they will have to fulfill during the exercise. Another suggestion about exercises is to either present one in a video in the online phase or record one real example from the face-to-face session and upload it to the online platform.

The participants think that a *(11.2.5) longer duration* of the face-to-face session would be better because there would be more time available for practical exercises and networking, e.g., two days.

The *(11.2.6) online phase* also gathered different suggestions. The participants proposed that over an online platform, there could be experts available to answer questions of the participants and maybe connect with them before the face-to-face session. This could take place as online meetings with the trainer, the expert(s), and the participants during the online phase before the face-to-face session in order to have a first contact and introductory round *(11.2.6.1, 11.2.6.2).* The choice of another platform to host the training course was also mentioned *(11.2.6.3).* Another suggestion refers to developing a short summary at the beginning of each video, where the content of the video would be

[23] The word "code" here refers to the text written in a programming language that was analyzed during one exercise.

presented shortly, and in that way, the viewers would know what is going to be discussed in each video in case they want to skip it *(11.2.6.4).* Finally, the participants commented that the gestures, movements, and the appearance of the trainer in full-body images are not necessary for the whole length of the videos. They suggested that either the trainer or the team that produced the videos should introduce themselves in the beginning, and then the person who is talking will cover only a small part of the screen, e.g., a small box in the corner or not appear at all, and have only the voice be heard *(11.2.6.5).*

4.3.6. Gain

The participants were asked if and what new information they learned in this training and what knowledge they acquired. 69 codes from their answers to this question are collected in the category *(12.) Gain* and divided into the following four categories, as shown in Table 17: *(12.1) Aviation aspects, (12.2) For future needs, (12.3) Overview of connections & fundamentals,* and *(12.4) Specific topics.* These questions were aimed at evaluating the training courses for the project. Simultaneously, the answers show the differences between the participants' former knowledge level and the current one after participating in the training according to their own self-assessment of their experience during the training. The outcome and this comparison may imply any former needs of the participants. Therefore, the codes are included in this chapter.

Table 17. Main category 12. Gain

Name of the Category	Number of codes assigned
12. Gain	69[24]
12.1 Aviation aspects	12
12.2 For future needs	2
12.3 Overview of connections & fundamentals	17
12.4 Specific topics	24

The participants appreciated the clarification and comparison of *(12.1) aviation aspects* with automotive standards regarding the topics discussed in the training. This is an issue for career changers with experience in other fields, such as automotive software engineering.

[24] The addition of the codes listed below does not add up to the total of the codes in this main category because 14 codes were not listed in any category.

Two participants mentioned that although they did not use the knowledge acquired immediately after the training, it would still be important in their career *(12.2) for future needs* when they work on projects directly related to software development in aerospace.

The participants referred to the *(12.3) overview of connections & background* as an important benefit of these training courses because maybe there was conveyed known information and terms for them, but the whole picture with the relations between, e.g., the levels of V-model and the different roles that a software engineer may undertake was beneficial to hear: *"for me, most of it (training content) was new. I had heard many of the terms before, but I didn't know the context of how they all fit together and what the whole process looked like. So, I hadn't even heard most of the words superficially, eh, but I didn't know what to do with them. I had no context for them"* (translated from #16, §6).

Finally, the participants mentioned *(12.4) specific topics* that they learned or were reminded of in this training, such as derived requirements, traceability, and requirements architecture. The participants also described a specific situation during their work where they used the acquired knowledge or gained after their participation in the training in code *(12.4.1) example from work.*

4.4. Differences among New Employees

The fourth research question is about the differences among the new employees who are hired in roles related to Aerospace Software and System Engineering. Specific personal information such as age, gender, ethnicity, and employer, which can lead to identifying a participant, were excluded from this study. The main category *(7.) Differences among employees entering ASD* contains information the participants shared about their professional and academic backgrounds. Apart from this main category, two additional categories were recognized to provide information about characteristics that differ among employees; these are *(14.4) Motivation* and *(15.) Experience with training*, which will be analyzed as follows.

4.4.1. Differences among Employees entering ASD

The category *(7.) Differences among employees entering ASD* is assembled from 51 codes, which contain the opinions of the participants about the characteristics of employees entering Aerospace Software Development (ASD) and how these differ. These

are divided into six sub-categories, as shown in Table 18, and also contain information gathered from the Prior-Training Questionnaires (see Appendix E and H).

Table 18. Main category 7. Differences among employees entering ASD

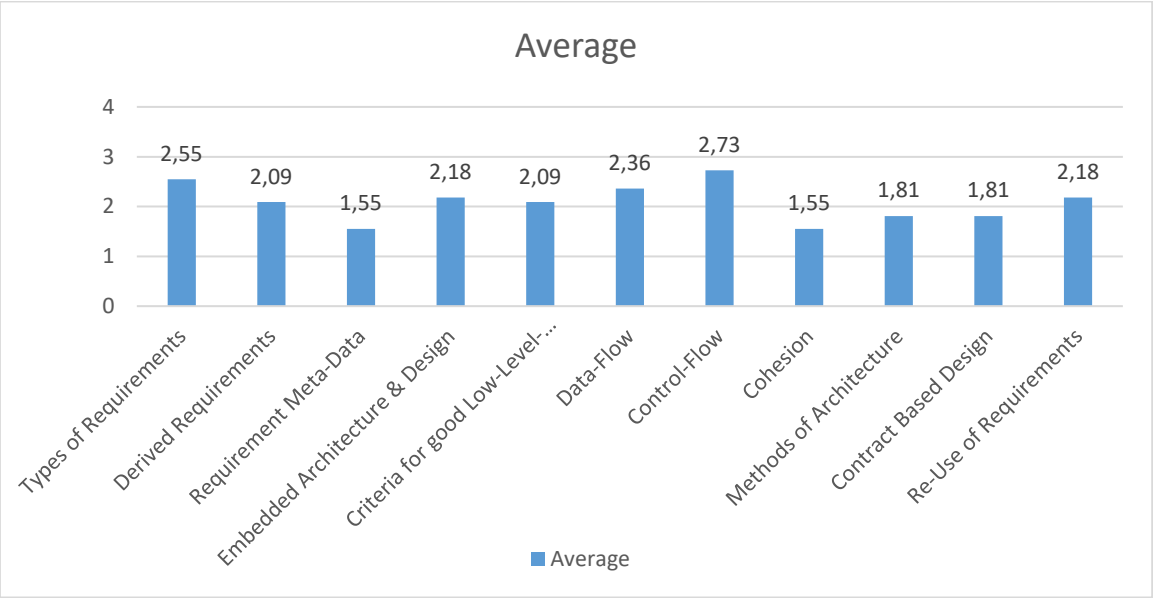
Name of the Category	Number of codes assigned
7. Differences among employees entering ASD	51
7.1 Industry standards	6
7.2 Job description	13
7.3 Knowledge	7
7.4 Prior Work Field	13
7.5 Study field	1
7.6 Years of experience	11

The participants identified differences in *(7.1) industry standards* between automotive and aviation engineering processes based on their experience from prior job roles.

They mentioned details about their current *(7.2) job description*, which refer to different tasks and roles that they are now responsible for. For example, some participants mentioned that they are currently writers, testers, or verifiers of requirements. From the participants' answers to question 4 of the Prior-Training Questionnaires, the following details about their current working field were revealed: they are now working on projects related to Software Development & Engineering, Aircraft Systems, Systems Aerospace, Software Development, Systems Engineering, System Design for Aircraft, Platform Software / Tool Development, Software & Model-based Software Integration test, Embedded Systems, Validation & Verification for the majority in Aerospace and Avionics and for the minority (9.5%) in Automotive, (9.5%) in Research & Development, (9.5%) in Computer Science.

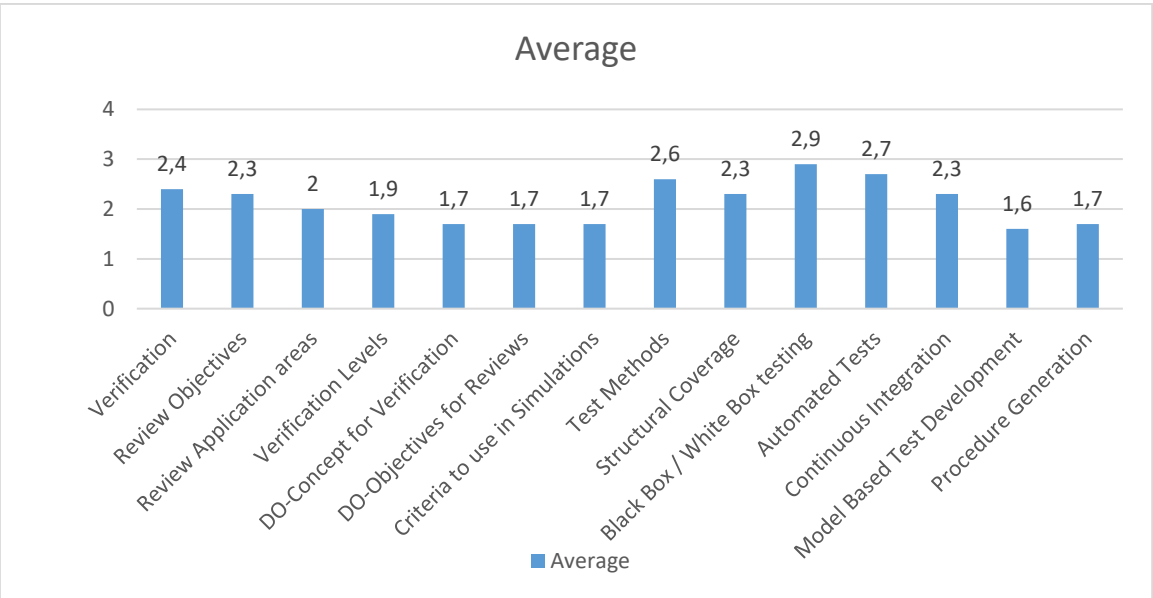
Category *(7.3) knowledge* contains information about the participants' former knowledge regarding the training's content, which was an attempt to discover the topics the participants were already familiar with. In addition to these results, the participants of the first training course answered a specific question on this matter and the answers are presented in Figure 7, where "1" stands for "I am not at all familiar with this topic.", "2" for "slightly familiar", "3" for "moderately familiar", and "4" for "very familiar".

Figure 7. How familiar are you with the following topics? First Training Course



The participants of the second training course also answered a specific question about their knowledge of the training content. The average of their answers for each topic is presented in Figure 8, where "1" stands for "I am not at all familiar with this topic," "2" for "slightly familiar," "3" for "moderately familiar," and "4" for "very familiar."

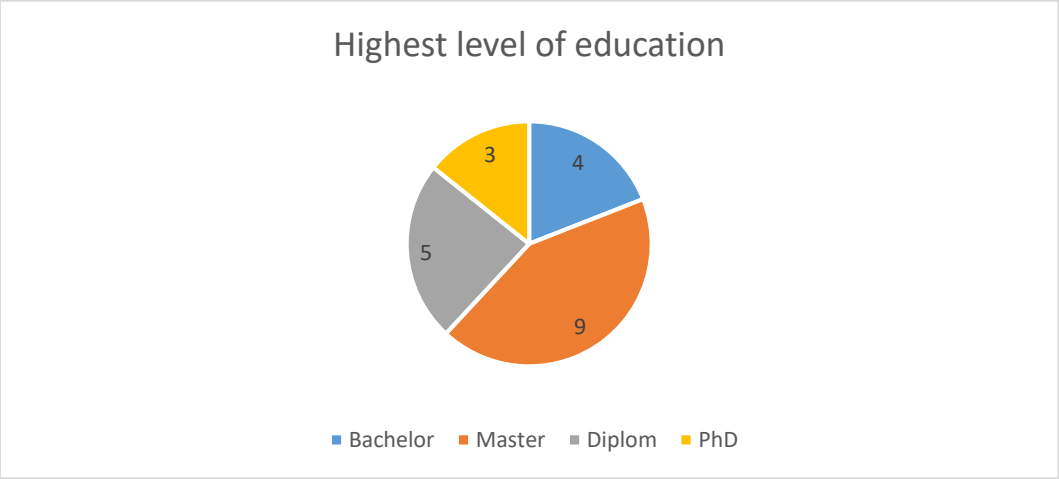
Figure 8. How familiar are you with the following topics? Second Training Course



The category *(7.4) prior work field* encloses codes where the participants referred to their working experience up to this point in their careers; specifically, codes where the participants identify themselves as *(7.4.1) career changers* and describe their *(7.4.2) experience in automotive*.

The sub-category *(7.5) study field* contains information about the participants' academic background, which they provided in the Prior-Training Questionnaires (see Appendix E and H). Based on the answers of the participants to the two Prior-Training Questionnaires, Figure 9 presents the academic background of all participants.

Figure 9. Participants' academic background



In the Prior-Training Questionnaires, they also detailed their study courses: Aerospace Engineering, Artificial Intelligence, Automation Engineering, Business Informatics, Computer Engineering, Computer Science, Electrical Engineering, Humanities, Mechanical Engineering, Mechatronics, Medical Technologies, Microelectronics, Microtechnology, Physics, and System Engineering[25].

Finally, the last category *(7.6)* contains codes, where the participants referred to a specific number of years of professional experience and information from the Prior Training Questionnaires (see Appendix E and H). The specific years of experience in each field will not be mentioned here to protect the anonymity of the participants. There were participants with more than ten years of experience in a field different from software development, and within this field, there were employees who had worked for many years in the automotive industry before switching to aerospace. The average of working in Aerospace Software Development is 1.44 years for the participants of the first training course and 1.23 years for the participants of the second training course. In both training courses, there were participants with more than two years of experience in Aerospace Software Development but less than two years in the company and therefore, they were sent to these introductory courses by their employees.

[25] To protect the anonymity of participants, the exact percentage of each study course is not disclosed.

4.4.2. Other / Motivation

One topic not directly associated with the main categories is *(14.4) Motivation*. This sub-category contains 38 codes, which are divided into eight sub-categories, as shown in Table 19. The participants referred to the reasons they or somebody else would participate in a training and the characteristics of a training that would drive them to participate actively in it.

Table 19. Category 14.4 Motivation

Name of the Category	Number of codes assigned
14. Other	72
14.4 Motivation	38[26]
14.4.1 Evaluation with point system	2
14.4.2 Sent from employer	4
14.4.3 Frequent tests	3
14.4.4 Get a certificate	8
14.4.5 Internal motivation	1
14.4.6 Need the knowledge	3
14.4.7 Pay for training themselves	12
14.4.8 Technological evolution	1

The evaluation that might take place within a training was mentioned as a reason to stay motivated through different perspectives in *(14.4.1) evaluation with point system*, *(14.4.3) frequent tests,* and *(14.4.4) get a certificate*. The participants referred not only to the result of acquiring a certificate, which will prove their knowledge officially (#210, §116-118), but also to short tests during training, which will force them to participate and engage with the training (#211, §82).

The participants pointed out that a person learns when there is genuine and intense interest to learn something (#12, §76; #212, §83; #22, §101). This is clear in *(14.4.5.) internal motivation,* in which participants described that even when they could get away with googling the correct answer, they did learn because they wanted to: *"well, I learned there because I wanted to learn it, but theoretically you could have just googled it because there was no time limit"* (#22, §101). Similarly, they want to learn due to their perception of their needs as they *(14.4.6) need the knowledge* sometimes due to the *(14.4.8)*

[26] The addition of the codes listed below does not add up to the total of the codes in this main category because four codes were not listed in any category.

technological evolution, which might also lead employees to *(14.4.7) pay for training themselves.*

Nevertheless, the codes that referred to compulsory participation in training were the majority in this category and are included in *(14.4.2) sent from the employer*. It was mentioned here that the employer sends employees to training (#12, §14; #24, §203) and they are obligated to attend. This includes the costs of the training that the employer covered and the time of participation counted as work hours, which translates the participation to a work task of the employee *(14.4.2.1 paid from employer to go to training).*

4.4.3. Experience with Training

After the revision of the interview guideline for the second training course as described in 3.2, the addition of questions 22, 23, and 24 in the German Interview Guidelines II (See Appendix K) and of questions 12 and 13 in the English Interview Guidelines II (See Appendix J) contributed to getting more comments and information on the past experience of the participants with training courses. The codes of category *(15.) Experience with training* revealed whether the participants had already attended other training courses and described their experience during these. The 45 codes of this category are divided into the following five sub-categories: *(15.1) Bad examples, (15.2) Blended courses, (15.3) Good examples, (15.4) No participation in blended courses, (15.5) Online courses*, as shown in Table 20, and will be presented as follows.

Table 20. Main Category 15. Experience with training

Name of the Category	Number of codes assigned
15. Experience with training	45[27]
15.1 Bad examples	14
15.2 Blended courses	4
15.3 Good examples	13
15.4 No participation in blended courses	4
15.5 Online courses	6

The participants described their experience with prior training courses, wherein they mentioned some training courses they described as *(15.1) bad examples* or *(15.3) good*

[27] The addition of the codes listed below does not add up to the total of the codes in this main category because four codes were not listed in any category.

examples of training. In *(15.3) good examples*, they mentioned interesting and useful training courses with good characteristics, and in *(15.1) bad examples*, they described training courses with bad characteristics or where they had a negative experience. Some participants also reported specific reasons and details for judging a training course as an insufficient one; these are the graphics, the insufficient preparation of the trainer, the content that did not cover the topics that mattered or were not relevant for them at this time of their career, some technical problems of the online course, and questions that remained unanswered in case of low participation in the forum *(15.1.1 – 15.1.6).* Four participants mentioned that they have participated in a blended course in the past *(15.3)* and from the answers to questions 7 and 8 of the Prior-Training Questionnaire I (See Appendix E) and 6 and 7 of the Prior-Training Questionnaire II (See Appendix H):

- 3 out of 10 participants of the first and 2 out of 11 of the second training course stated that they have not participated in a training course thus far.
- 6 out of 10 participants of the first and 2 out of 11 of the second training course stated that they have not participated in an online training course thus far.

Regarding the question about participating in a blended training course of the Prior-Training Questionnaire II, only one person answered yes.

4.5. Companies' Demands and Employees' Needs

The fifth research question compares the demands of companies and the needs of employees entering the field of Aerospace Software Engineering. As described in 2.5, the talent demands of companies in this field were explored and analyzed during two research projects to develop two training courses. These outcomes, in contrast to those of the third research question presented in Chapter 4.3, answer the last research question as follows.

The talent demands of the companies in this network were communicated to the training developers during the development of the training courses. Talent demands refer to an underlying sense of obligatory demand regarding the knowledge, skills, and competencies the companies require their employees to possess or learn. In summary, a need analysis was conducted within the project network, which included relevant study courses in Germany. This involved multiple meetings with subject matter experts and managers, the distribution of a questionnaire about the training content, and the analysis of its answers (see Chapter 2.5). The talent demands of the companies in this research are detailed in the following topics presented in Table 21.

Table 21. Talent demands of companies

Demands	References
Introducing employees entering this field to the aerospace fundamentals (ISO6262, DO-178B, and DO-178C) that they will need in their immediate or future careers.	Project Workshop with BDLI, project meetings within the network, Pourtoulidou & Frey (2020), Zoller (2021), Sutter (2021), Alber & Freyer (2020), Schweiger (2021).
Respecting the time constraints of all participating companies and the availability of the employees.	Zoller (2021), Sutter (2021), Schweiger (2021).
Developing common broad content for training. This derived from a BDLI workshop in January 2017, as explained in Ch. 2.5.1, and was further discussed and finally agreed upon during the first project, which lasted between 2017 and 2020. The five topics derived from the workshop and their details were defined in meetings with the project partners. Due to the aforementioned time constraints, the decision between deepening or broadening was made for the broad content rather than focusing on more details and specialized information.	Zoller (2021), Sutter (2021), Schweiger (2021).

Regarding employees' learning needs, they differ from the objective demands mentioned above due to individual backgrounds, differences, and preferences of employees. To facilitate the comparison between demands and employees' needs, a summary of the categories that were answered to RQ 3 in Chapter 4.3 is necessary as follows. The participants stated to need the following topics as presented in Table 22.

Table 22. Learning needs of employees

Needs	Mentioned in the following Categories
Introduction to aerospace fundamentals and to differences between aerospace and automotive	6., 12.1, 12.3
Differentiation for each company's processes and tools	6.
Individualization according to personal levels of knowledge	6., 10.2
Flexibility in participation	9.1.2
Parallel to work implementation	10.2.4
Practical implementation of knowledge in exercises	6.
Guided implementation of knowledge in exercises (and/or an answer sheet)	8.2.2
Terminology explained in the beginning	8.2.1, 11.2.2
More real-world precise examples and exercises	8.2.2
Networking with experts and employees from different companies	9.
Evaluation of the participation in the end and/or short quizzes	10.2, 11.2
Training with a longer duration	11.2.4

The comparison of Table 21 and Table 22 shows that the similarities concern the necessity of introducing new employees to aerospace fundamentals along with differentiation from automotive standards. There is a shared acknowledgment of the need for adjustment to the employees' availability and time schedule, but employees need further flexibility in participating in training. The demands emphasize the development of common training content suggesting standardized knowledge, while employees stated the importance of differentiation for each company's processes and tools, even for a smaller section of the training. They also expressed a need for individualization of the content according to their current knowledge and competencies. What also stands out is the employees' need for practical implementation through exercises with work and real-world examples. Finally, the needs include networking with experts and employees from different departments and companies and evaluation mechanisms like quizzes within training or end-of-training assessments. Hence, the needs exceed the companies' demands that focus only on technical knowledge acquisition.

4.6. Summary

Chapter 4 presents the findings of the qualitative research according to the method of Thematic Qualitative Text Analysis by Kuckartz, which was used to address the five

research questions of this study. All categories are analyzed in the Code System (See Appendix L) with definitions and an example for every code. As shown in the screenshot of the Code System in Figure 10, it contains the main categories in column A, the categories in column B, and the sub-categories or codes in column C. Depending on how many sublevels each main category contains, the definition is always on the right column. The example of a code is always enclosed in Column F. Furthermore, the definitions are also provided in memos in the MAXQDA document, which is provided separately in digital form.

Figure 10. Code System - Partial screenshot

	A	B	C	D	E	F
1	**Main Cat.**	**Category**	**Sub-category**	**Definition: is always on the right of the category or marked with a '='**		**Code-Example from the interviews "#" = Number of the Interview, "§" = Number of the paragraph *If there is no example, it means there is no code in this category because all codes are subdivided into a subcategory.**
2		How the participants prefer to learn something, what actions do they follow, if they				
3		1.1 Ask sb near me	The respondents specifically mentioned that they would choose the nearest available person without specifying what experience this person has.			*wenn ich da nichts finde oder wenn ich weiß in meiner Nähe, der immer Zeit hat, jemand sitzt, der das eher weiß #19, §74*
4		1.2 Attend training	The participants stated that they choose to learn something by participating in a training.			*Inhaltlich, ja, prinzipiell werde ich immer Schulungen besuchen, wo mich die Themen entweder interessieren oder die ich beruflich grad brauch #26, §82*
5			1.2.1 F2F	The participants' opinions & statements about classroom-based training with face-to-face interactions.		*Ich mache auch Präsenz Veranstaltungen, die haben einen anderen, die haben die soziale Komponente mit dabei. Das darf man auch nicht vernachlässigen und bei bestimmten Trainings ist es auch ganz schön, wenn man dann jemanden hat, der einen erklärt und man direkt nachfragen kann. #23, §54*
6			1.2.2 Online	Participants' opinions & statements about trainings that take place online in a digital environment		*But if I want, if I have the goal of, let's say, learning deeply about a topic, then I would say an online course would be pretty much, would be yeah a good idea and what I would do, I mean, imagine that I want to learn for example, in this case, to develop my knowledge about image processing, then I would very likely do a course, it is what I have done for example, what I wanted to learn about parallel programming. So, programming for GPUs, eh, multi core CPUs, then I did a course about that I:Online? T29:Yes, in Coursera or Udemy or things like that, and then you get, let's say solid, solid grounds for your knowledge and then from that, of course, that, that will not be enough when you want to develop an application, but then it builds a solid ground from which you can start #29, §167-169*

Nevertheless, to offer a more comprehensive overview inspired by the Dobrovolny Model (2006, p. 163), which presented how adults learn in self-paced technology-based corporate training, three figures encapsulating key results mainly regarding RQ1 and RQ2 are hereinafter presented.

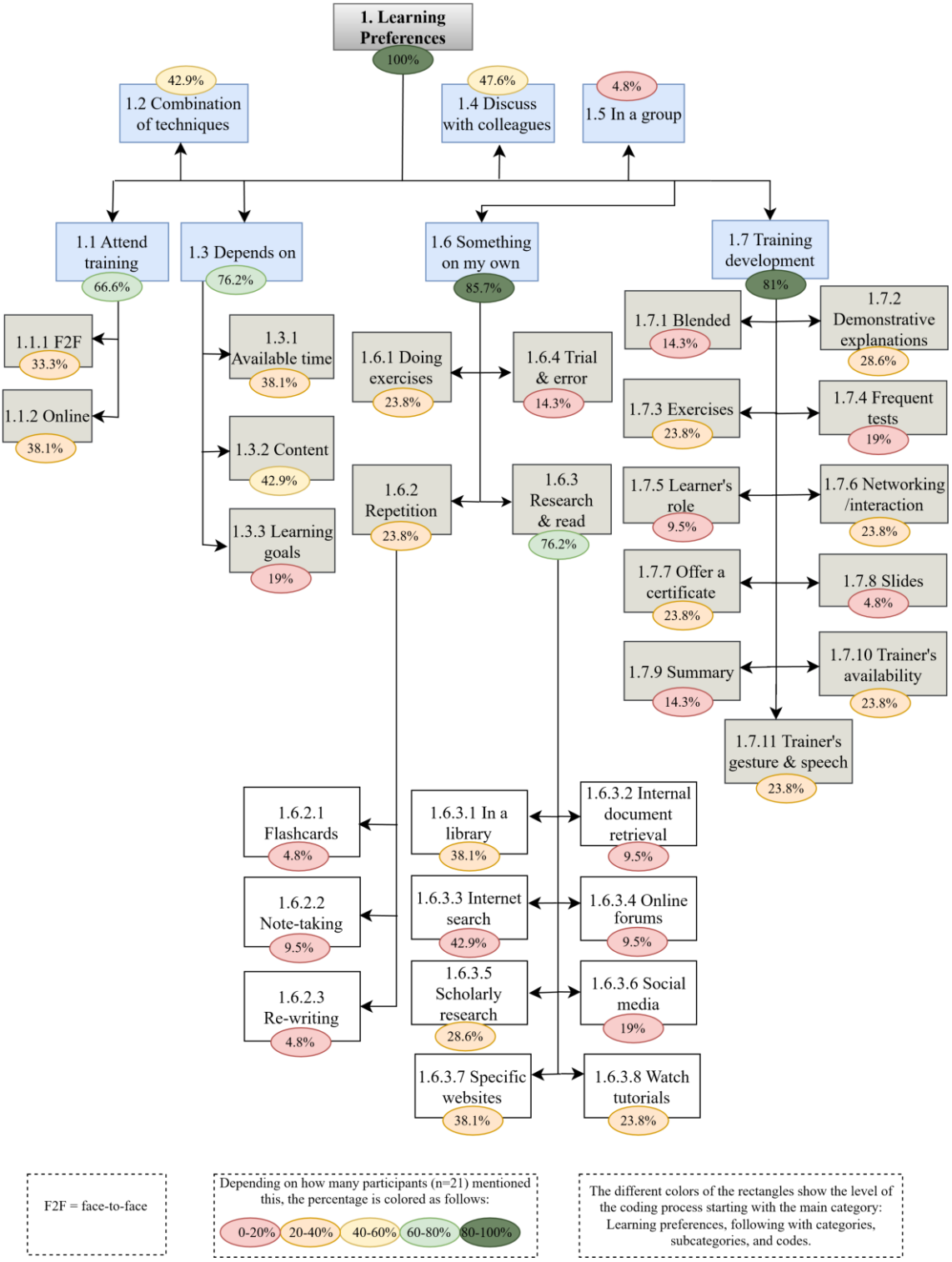
Figure 11 sums up the codes of the main category *(1.) Learning preferences* and shows how many participants have addressed each category and code. As mentioned in 4.1.1, the main category *(1.) Learning preferences* generally includes what the participants do when they want to learn a topic. These participants answered the relevant question by postulating hypothetical learning conditions where they control their learning and what learning resources they would choose. From top to bottom, Figure 11 presents the main category (dark grey rectangles), the categories (blue rectangles), the subcategories (light

beige rectangles), and the codes (white rectangles). Each rectangle is followed by a percentage (oval shape), which refers to the participants who mentioned each category and code. Depending on this number, the oval shapes are categorized into four colors: red color for 0-20%, orange for 20-40%, yellow for 40-60%, light green for 60-80%, and dark green for 80-100%. This categorization indicates that all participants expressed their preferred way to learn something, wherein 85.7%[28] mentioned that they would do something on their own *(1.7),* which would probably be doing their research and reading the material they find, as 76.2% referred to this *(1.7.3).* 81% analyzed the way they would like a training course to be developed and what they like in it *(1.8),* which aligns with the 66.6% of the participants who mentioned specifically that they would attend training to learn and what kind of training, face-to-face or online[29] *(1.2).* Also high is the percentage of 76.2% of the participants, who considered that their answer depends on factors that would maybe rush them, for example, the available time, the content, and the goals they have at the moment *(1.4).*

[28] The percentages are generated according to MAXQDA calculations and rounded to one digit after the decimal point (.).

[29] The percentages for the *(1.2.1) F2F* and *(1.2.2) Online* do not add up to the total percentage of *(1.2)* because some participants commented on both codes. In this case, the participants T17, T23, T25, T29, and T210 commented on both codes.

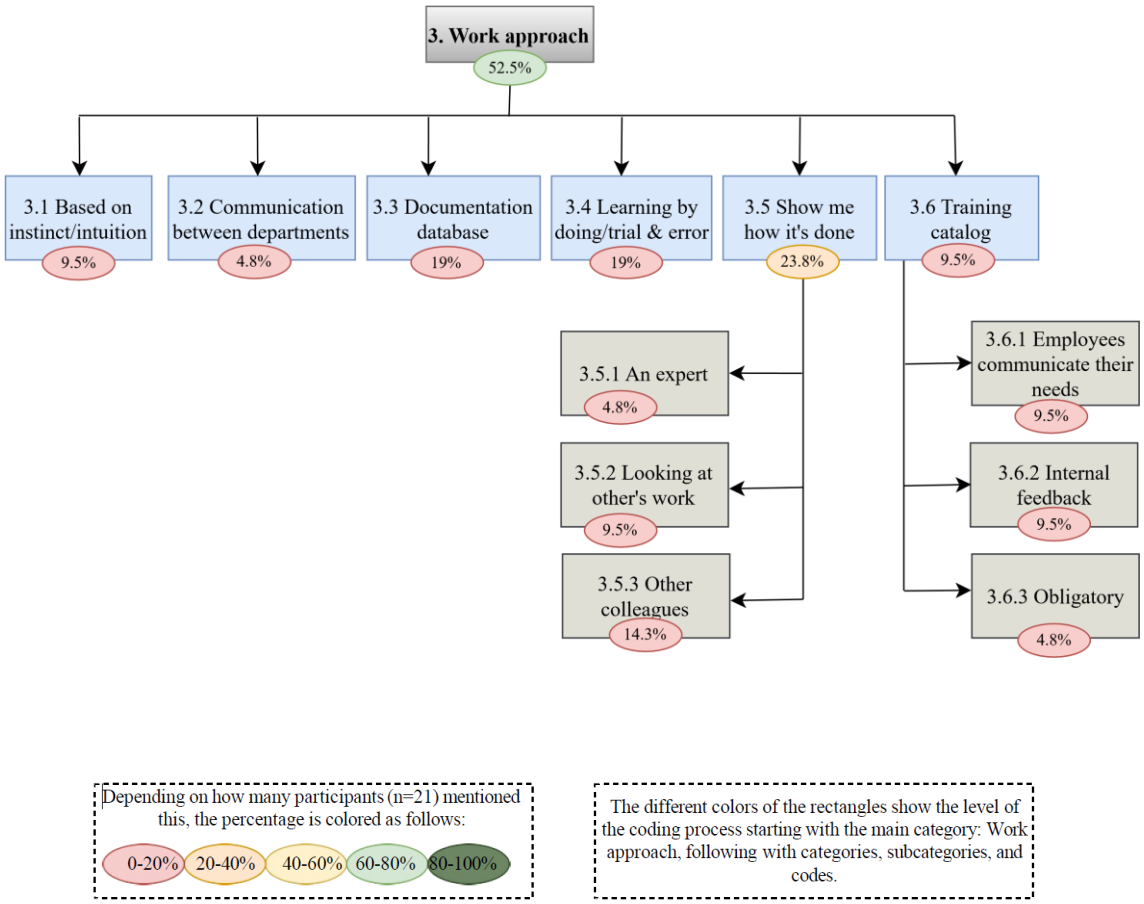
Figure 11. Summary of Main Category 1. Learning preferences



Note: Own figure, developed in draw.io. Depending on how many participants (n=21) mentioned this, the percentage in the elliptical shapes is colored as follows: red 0-20%, orange 20-40%, yellow 40-60%, light green 60-80%, and dark green 80-100%. The different colors of the rectangles show the level of the coding process, starting with the main category, (1.) Learning preferences, followed by categories, subcategories, and codes.

Figure 12 is created similarly for the main category *(3.) Work approach* and contains information about usual work processes that they observed in other employees and potentially adopted because *"this is how it's done here"* (#110, §3). 52.4% of participants commented about the work approach they recognize in their work environment. The percentages are relatively low here, with the category *(3.5) Show me how it's done* to be mentioned by the most participants, 23.8%. This refers to situations where employees learn knowledge or skills by observing and imitating the work and behavior of other employees, either directly watching somebody showing something in action, *(3.5.1) an expert* or *(3.5.3) other colleagues*, or studying already documented procedures on how it is done *(3.5.2)*. Equally often mentioned by 19% is accessing a documentation database of the company to acquire information *(3.3)* or trying out different procedures until succeeding *(3.4).* A similar approach during work is, according to 9,5%, following their instinct or intuition. Also, 9.5% explained that there is a *(3.6) training catalog* in their company that either contains training courses according to needs expressed by employees *(3.6.1)* or courses that are obligatory *(3.6.3),* wherein the participants give feedback after attending these *(3.6.2).* Lastly, it is interesting that 4.8% of the participants, which equals one participant, mentioned that they usually communicate with colleagues or experts from other departments in order to learn about a product or software they have developed and know more information about it *(3.2).*

Figure 12. Summary of Main Category 3. Work Approach



Note: Own figure, developed in draw.io. Depending on how many participants (n=21) mentioned this, the percentage in the elliptical shapes is colored as follows:0-20%, 20-40%, 40-60%, 60-80%, and 80-100%. The different colors of the rectangles show the level of the coding process, starting with the main category, (3.) Work approach, followed by categories, subcategories, and codes.

Apart from these two main categories, it is worthwhile to offer an overview of the main category *(2.) Problem-solving*, which refers to what 76.2% of the participants do when they try to solve a problem. Figure 13 presents this process. The steps that the employees take start with dealing with a problem they need to solve (dark grey rectangle). The codes belonging to this main category also contain questions the participants ask themselves during the problem-solving process. Therefore, the oval shapes in Figure 13 contain the questions that the employees mentioned in the interviews to consider before trying to solve the problem. These questions are:

- according to 38.1% of the participants, whether they can contact an expert regarding the issue they deal with.

- according to 9.5% of the participants, whether they can contact there is somebody near them who can help them with this,
- according to 28.6% of participants, whether they find a solution to it on their own,
- according to 42.9% of participants, what kind of problem is this that they are dealing with[30].

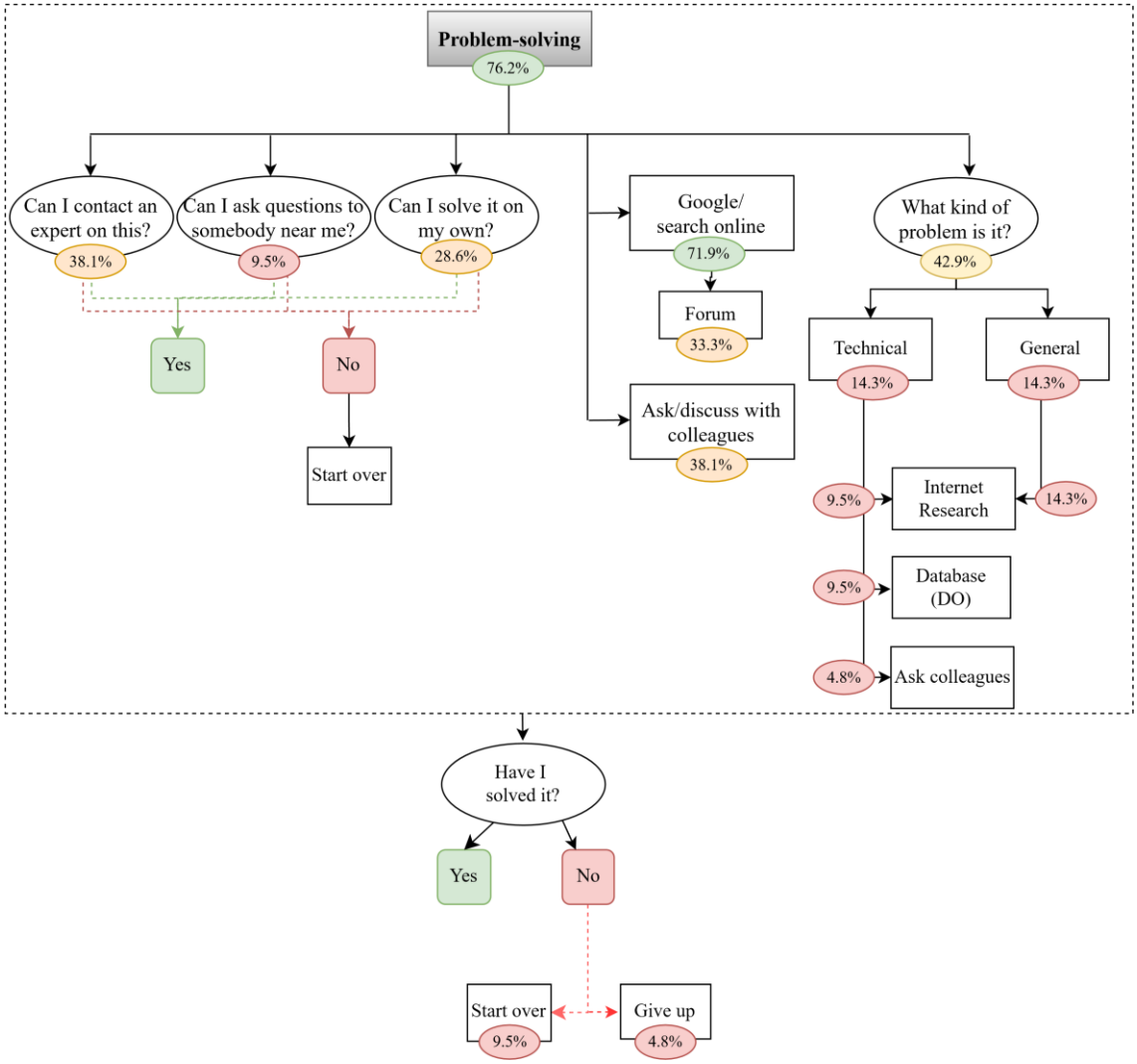
The rectangles contain the codes with specific actions; for example, 38.1% of the participants mentioned asking or discussing the problem with colleagues, while 71.9% of participants said that they searched online for a solution or information that would help them solve the problem. This was also mentioned as *"I just google it"* (#13, §75), wherein 33.3% of the participants further explained that they seek answers in forums, where other people ask a question about their problems, and somebody answers it, describing the solution.

When the participants considered first what kind of problem they were facing, a distinction between technical and general problems was possible. An equal 14.3% of the participants mentioned these two kinds of problems. For general problems, the next step seems to be online research. For technical problems, 9.5% of participants mentioned searching online, 9.5% mentioned checking the company's database for specific documents, and 4,8% mentioned asking colleagues for help.

After considering all these potential steps during problem-solving, 9.5% of the participants mentioned thinking about starting over and trying to solve a problem differently, for example, asking colleagues if their online research did not bring any successful results. Finally, one participant (4.8%) revealed that giving up is also an option if, in the end, nothing worked out.

[30] In Figure 13, the percentage of the participants that answered that the situation influences the problem was 42.9%, but from them, approximately 28.6% further specified what they do if they look for an answer to a technical or a general problem. This shows that the rest (approximately) 14.3% of the participants on this level did not classify specific kinds of problems, although they confirm that their problem-solving strategy depends on the circumstances of each situation.

Figure 13. Summary of Main Category 2. Problem-solving



Note: Own figure, developed in draw.io. Depending on how many participants (n=21) mentioned this, the percentage in the elliptical shapes is colored as follows:0-20%, 20-40%, 40-60%, 60-80%, and 80-100%.

5. Discussion

This research, with its focus on how employees learn during work, holds profound implications for the fields of workplace learning and training development. It answers key questions about employees' learning strategies and needs while also providing input for further exploration in this area. The conclusions drawn from the Thematic Qualitative Text Analysis and the identified categories illuminate the diverse learning strategies employed by employees, thereby enriching the understanding of workplace learning. These results carry specific limitations that derive from multiple factors. In qualitative research, covering large parts of the relevant population is impossible. For this study, the respondents came from a limited number of companies operating in aerospace engineering in Germany. The use of qualitative research methods introduces such a risk. However, in the context of informal learning strategies across different cultures, a previous study by Welk et al. (2023) demonstrated that employees' preferences for these strategies generally remain stable. Specifically, this study's results are based on self-assessment, descriptions, and recalling thoughts and actions. The respondents were encouraged to give a detailed description during the semi-structured interviews, which in some cases led to shorter interviews than desired. The addition of two questions after the first round of interviews in the interview guidelines aimed to prompt the respondents further to express themselves openly. As the second round of interviews took place with different participants and on a different training course, the influence of these additional questions on the duration of the interviews and the results remains uncertain. An increase in the codes of the second training course is visible, which may be justified by the additions of the extra questions in the guidelines of the interviews for the second training, by the different training material and methods, the experience of the interviewer with this population, and by the participants themselves, as they were not the same individuals with the first training course. While it is difficult for individuals to articulate their inner processes precisely, they can reliably respond to questions concerning their intentions, choices, preferences, moods, and beliefs (Ericsson & Simon, 1980; Haeffel & Howard, 2010; Fontana et al., 2015). Due to the companies’ confidential issues and anonymity purposes, other research methods, such as trace methods, were excluded. These issues also carried further restrictions for this study as any data related to the gender, age, and culture of the employees who took part in the training courses was out of limits. It is also essential to acknowledge that this research explored a specific kind of professionals who

are already equipped with primary academic education. The technological affinity in this group of professionals is admittedly high due to their academic background and everyday work tasks. Nevertheless, this chapter offers a comprehensive discussion of the research findings regarding self-regulated strategies of employees toward learning, their differences, and the contrast between demands and needs, accompanied by recommendations for practice and future research.

5.1 Self-Regulated Strategies of Employees toward Learning

The results of this study, described in Chapter 4, offer insights into employees' learning strategies and how self-regulation occurs in everyday work and during training. The five main categories associated with the first two research questions showed that the actions of the employees who participated in this study mainly evolved under the three main categories: *(1.) Learning preferences, (2.) Problem-solving, and (3.) Work approach*. This categorization is due to the differences in the learning conditions. The main category *(1.) Learning preferences*, wherein all participants mentioned something, referred to freely controlled conditions by the employees, and described their preferences if they could choose what they would do. This is not always possible at the workplace or during training. The main category (*2.) Problem-solving* included codes of 76.2% of the participants that described initiating a learning process due to a problem that had to be solved or fulfilling a real task during work. This changes the learning dimensions compared to the main category *(1.) Learning preferences*, where all participants described what they would choose for themselves without considering external conditions such as time restrictions, the art of the problem, or the availability of resources at the moment. Here, the role of the five dimensions by Kyndt & Beausaert (2017) and Segers et al. (2018) was made obvious in the learning process. This also bears a resemblance to the distinction of Decius & Decius (2022), wherein depending on the kind of stimulus, the learning process evolves toward informal or sovereign workplace. The internal stimulus is subdivided into the main category *(1.) Learning preferences*, while the external stimulus relates to the main categories *(2.) Problem-solving* and *(3.) Work approach*. The transition among the categories occurs explicitly when employees attempt to solve a problem. This outcome demonstrates interference with self-regulation, which appears to be present as learners decide their next steps in the learning process, and it confirms the findings of Kortsch et al. (2024). The learners' intention lies in the problem and progresses according to the specific problem and the dimensions this brings. For example,

if a problem occurs during work, the learner recognizes this, autonomously decides how to handle it, and is responsible for the timing of the next steps. The validation of these steps comes first from the problem/task itself (e.g., a code/software works or not) and/or afterward externally, from colleagues, managers, or clients. The participants of this study mostly engage with technical software systems and often receive validation directly from the system/software and subsequently from the clients that have ordered a software or product. The difference in the dimensions is also evident in the third main category *(3.) Work Approach*, wherein 52.4% of participants described strategies that take place in their company, and, therefore, they also follow them. Such strategies would be attending training or accessing the company's documentation database or library, where they would be able to find specific documents with the information they need or older procedures and projects. There were also strategies described that relate to other colleagues; when they contact, for example, the employees that created a product, this would occur through communication between departments. Lastly, innovative behavior also emerges when the employees have no other choice but to try something themselves by following their instincts.

In particular, regarding the first research question and what actions employees individually take to address their learning needs, the results of this study indicated that the participants mentioned 33 of the 39 strategies collected in Table 1. The most popular strategy is clearly looking up information by themselves, as shown in Chapter 4.1.1 with category *(1.6.3) Research & read*, about which 95.2% of participants mentioned something related to it, while the strategy to *(1.1) Attend training* is also popular with 66.7% of the participants supporting it, and in real-life settings where a problem occurs the strategy of help-seeking is much used by contacting colleagues or particularly experts (see categories *2.1*, *2.2*, *2.3*). Theoretically, employees prefer to look for information by themselves, but when time is valuable in professional matters, they prefer asking for help. As one participant mentioned, this is a new skill they acquired recently: *"Yeah, actually, that is the thing I learned over the time, that it is, it is that it is simpler when I call a couple of people and speak to them, then I am saving a lot of time instead of wasting it and trying to find and google by myself. I, I learned it over the period of time, like now occasional it is a simple call, yeah"* (#27, §36). A new outcome regarding the strategy 16. Internet research is that since the options nowadays have been multiplied, the learners have to evaluate the results of just googling something. As specifically mentioned by a

participant, *"I try to look for peer-reviewed information so that I know that what I'm reading isn't made-up stuff, and if it has to be more modern stuff, current trends, then I just try to go to sources which I just know that have a reputation"* (translated from #211, §32).

Adding the answers of the categories *(1.2) Combination of techniques*, *(1.3) Depends on*, and *(2.5) Depending on*, shows that 95.2% of the participants consider their steps toward acquiring the information or skill they need depending on each situation. They may use multiple learning techniques and adjust these to learning conditions depending on the topic they have to learn or the problem they have to solve. This indicates that a standard learning path is difficult to identify and that self-regulation continuously occurs in employees' work lives. Therefore, the timing of the utilization of self-regulated strategies is difficult to isolate. Contrary to Zimmerman's model, which delineates distinct phases for performance and self-reflection, this research reveals that social learning strategies, as also suggested by Margaryan et al. (2022), are employed throughout both these phases. This integration of social learning into the performance and self-reflection phases was evident in the data collected from new employees in aerospace companies. They described actively engaging in social learning not only during the execution of tasks but also while reflecting on their performance, suggesting a more fluid and continuous process of self-regulated learning. Figure 13 presents the process the employees follow when they deal with a problem or a challenge and shows multiple transitions between the performance and the self-reflection phases of Zimmerman's model. The monitoring that occurs during performance is closely followed by self-evaluation, and depending on the outcome of the self-evaluation, a new learning process may restart completely or change the learning strategy. This cyclical nature of self-regulation in workplace learning, which is indicated here, was highlighted by several researchers (Hadwin et al., 2011; Sitzmann & Ely, 2011; Tynjälä, 2013; Cuyvers et al., 2020). The results of this study mostly agree with what Kittel & Seufert (2023a) concluded, that employees reflect on their actions by using the strategies of monitoring and regulation but not with planning. The participants of this study described less their planning regarding learning compared to their reaction to external stimuli and specific actions they undertake in order to acquire specific knowledge or skills. The planning of learning relates mostly to formal learning settings wherein 66.7% of the participants stated that they attend training and 9.5% stated that

they would express their needs for training to their employers. This means that their employer takes care of the search for a suitable training course or the development of it.

The six strategies from Table 1 that were not mentioned were: 1. Anxiety reduction, 2. Control of learners' beliefs, 7. Emotion control, 28. Positive self-talk, 33. Self-efficacy, and 37. Teach to. The participants revealed nothing about their feelings and controlling these during work or their skills to be self-effacing. The opposite of strategy 37, to get something taught and shown how it is done in practice, was mentioned by various participants as a learning strategy within the main category *(3.) Work Approach*. The participants mentioned some beliefs related to learning and life-long learning in the main category *(5.) Beliefs about learning*, but there was no evidence of controlling these beliefs.

5.2 Differences among Employees

The similarities among employees regarding their learning strategies and preferences were commented on above; this section discusses the fourth research question, which aimed to explore the differences among new employees who are entering German aerospace companies. Since the learning needs of the third research question of this research refer to different characteristics of employees, they are subdivided under this chapter and will also be commented on later. The gap between the skills and competencies that new employees possess and the ones organizations require is always taken into consideration during onboarding (Bauer, 2010; Dessler, 2024). The hired employees undoubtedly differ, but the population of this study distinguishes extra due to hiring employees from pertinent fields, as expected and described in Chapter 2.5.

- Chapter 4.4 revealed the participants' differences in academic and professional backgrounds, job positions, and personal goals. The answers on the level of educational background in Figure 9 show that the participants had 19% bachelor's, 43% master's, 24% diploma, and 14% doctoral degrees. The variety of the pertinent fields to aerospace engineering was also confirmed; various domains encompass mainly engineering, technology, and informatics, as well as human and natural sciences. These new hires are not familiar with this industry's and each company's standards.

- The current job positions of the participants also vary. The participants, as new employees at the moment of the two training courses, stated that they were in different positions, from Software Engineering, Software and Systems Development in aerospace up to Automotive and general Research and Development within a company or Computer Sciences. The framework of the development of these training courses for several companies enhances this and includes the different company processes and internal organizational structures regarding upskilling/ learning, such as the existence of a training catalog, which is being updated according to employees' needs and the reflection of employees' feedback after attending training *(3.6).* The individual preferences regarding how employees learn diverge, as presented in Chapter 4.1.1 and in Table 4, with the most mentioned to be research and reading information mostly online *(1.7).*

- Differences regarding personal opinions related to learning were also found and presented in the main category *(5.) Beliefs about learning* were more generic truths they thought they applied during learning or universally for life. During the interviews, 42.9% of participants also referred to the reason they attended training or their motivation to learn new information or skills *(14.4)*. Such codes were presented in Chapter 4.4.2 and implicated as important reasons for the need to keep themselves updated due to technological evolution and their own desire to do it or that their employer considered it obligatory *(14.4).* 23.8% of the participants incorporated that evaluation during their participation in a training course or getting a certification at the end of it also enhances their motivation to attend training.

- Another topic where new employees seem to differ is their *(15.) Experience with Training*, which was analyzed in Chapter 4.4.3. New Employees who just entered their job after their academic studies had only a brief period of time in their company. Therefore, it is logical that 23.8% of the participants stated that they had not attended a training course up to this point. It is worth commenting here that 28.6% of the first training course's participants mentioned that they had not attended an online course thus far, while only 9.5% of the second training course answered the same. This may have been influenced by the COVID-19 pandemic and the technological changes that occurred between 2019 and 2021. As one participant commented, *"We've been doing things only online recently and then the motivation to go into such face-to-face*

training was worlds higher, like I say 2-3 years ago when you had 1-2 such face-to-face meetings every weekend, er, every week and you were bored somewhere. Now it was probably the other way around. Now you were happy to work with people again or to see something, I say carefully or try out something together, or take a look at something together, mhm, I have to say, I actually don't know whether it was because of this Corona situation or because of the content. I find that very difficult" (translated from #21, §142). 19% of the participants mentioned that something has changed compared to before the COVID-19 pandemic.

What also differs among employees are their learning needs, which are presented in Table 22. Hence, the results related to the third research question about the learning needs of new employees are commented on here.

- The need for practical, real-world examples and exercises was clearly expressed by 52,5% of the participants. This information has been previously established; returning to the fundamental adult learning theories, the relevance of the knowledge served to adult learners is very important, according to Knowles. Since Knowles (1975), the authenticity of learning experiences has been highlighted by Young (1993), Billett (1996), and Smith et al. (2002), to name but a few. The most critical detail are experts' contributions to offering authentic learning experiences to novices in their engagement with learning within the organization's network. This, in conjunction with self-regulation, was obvious in the conclusions of Margaryan et al. (2022), who discovered that "deliberate practice" is the most frequent learning behavior among crowdworkers. This term represents strategies such as *learning by trial & error* and *seeking knowledge and help (e.g., in online communities)* (Margaryan et al., 2022, p. 504), which were also included in the results of this study (See categories *1.6.3.4, 1.6.4, 2.7.1).* This, in connection with the codes of 19% of the participants *(1.6.3.6),* confirms the increase in the use of social media and forums, as Münk & Walter (2017) mentioned.

- 80% of the participants of the first training course agreed with the statement of the Post-Training Questionnaire that they would like to have access to a training course, like the one they attended, online through a digital platform. In the second training

course, which was a blended course, the participants were neutral, with a 3.3[31] average to the statement *"I prefer face-to-face over online training courses".* A preference for online courses was also not verified as their answers created an average of 2.8[32], with the majority remaining again neutral. The combination of online and face-to-face sessions was positively noted by 9 out of 11 participants, while only two participants disagreed with this. Out of the answers to the Post-Training Questionnaires, no definite conclusion can be drawn, but the comments of the participants during the evaluation of the training courses showed that the participants valued the direct contact and interaction with the trainer, the other participants, and the experts *(9.1.1.1, 9.1.1.5*). This aligns with recent surveys among employees and HR and learning directors, where face-to-face interaction was evaluated as very useful (Cegos, 2018). Employees appreciate foremost face-to-face training on specific topics and, afterward, equally, any on-demand support from trainers and online resources (Cegos, 2018). Hewett et al. (2017) also concluded that human interaction plays a crucial role in blended workplace learning. They emphasized that interpersonal communication and collaboration significantly enhance the learning experience, making it more effective. Their findings suggest that while digital tools and online resources are valuable, the integration of face-to-face interactions fosters deeper engagement, better understanding, and a more supportive learning environment. Sarma et al. (2020) also highlighted that *"optimal education remains blended education, combining face-to-face and online, where each can do what each does best."* (p.7).

- The 100 codes describing that employees would do something on their own *(1.6)* by researching on the internet for information *(1.7.3)* and the specification that this would be their first move to solve a problem *(2.9)* confirm the earlier findings of Berg & Chyung (2008), that supported that *"respondents perceived that having access to computer technology would be a more important factor than having physical proximity to their colleagues"* (Berg & Chyung, 2008, p. 239). This was even more obvious in the answer of one participant of this study, who mentioned: *"T22: My first step when I am anyway sitting at the computer is to google. I: and when you are not*

[31] Of the 5-Likert-Scale with answers: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

[32] Of the 5-Likert-Scale with answers: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

sitting at the computer? T22: Then find a computer and then google." (translated from #22, §165-167). The use of computers is almost mandatory for everyday work among aerospace software engineers. The proximity to colleagues was mentioned to be the second least important factor in the study of Berg & Chyung (2008), which explored the factors that influence informal learning in the workplace. Although asking for help was mentioned fewer times than doing something on my own, it still seemed to be very important for the respondents of this study because they found it can be time-saving and easier than looking by themselves for answers *(1.6, 2.1, 2.2, 2.3, 2.9).* This could relate to the conclusion of Lin et al. (2018), who discovered that "*experienced employees preferred to build new knowledge and identities than receive knowledge from instructors passively*." (Lin et al., 2018, p.111).

5.3 Demands vs. Needs

To comment on the dipole between demands and needs, it was necessary, to sum up the learning needs of new employees entering German aerospace companies, which were presented in great detail in Chapter 4.3 and commented on above. As explained in 2.2.1, there is an identified gap between the skills and competencies that the workforce possesses and the ones organizations need (Chegg & Harris, 2013; Kövesi & Csizmadia, 2016; European Commission, 2020; Guo et al., 2022). Demands refer to objective needs highly influenced by society, technology, and law changes (Gieseke, 2008). These are translated from organizations and are also mentioned as organizational development or business needs (Smith, 2003; Sava, 2012). These, as presented in Chapter 4.5, are mostly content-related demands for the introduction of new employees to the aerospace standards that differ from, for example, automotive software engineering. Among the broad content that could be transmitted within this training course, the partners of the first project decided to limit the analysis of the content in order to cover more topics in the available time. The organizational conditions for the implementation of the training course that would be developed in order to fulfill the introduction purposes were that it should last approximately as long as a one-semester course at a university and that the execution has to follow the employees' schedule and availability. The outcome of this research complies with the demand for introductory training but indicates further needs. These needs were already commented on in the previous subchapter, but it is worth highlighting here the contradiction that arises because the employees mentioned that despite needing an introductory course, this should also contain specialized processes of each company.

They embrace the implementation of a common training course for different companies that enables interaction and networking but state further that an introduction to each company's processes and real-world examples and exercises are necessary. The need for evident practical use of the training content appeared in category (*8.2.1.2*). It is also interesting to comment that the participants of the first training course consider important on average of 3.3 the training content to be relevant to their current work. This implies a moderate level of perceived relevance. While the participants of the second training course rated on average of 3.6 the relevance of the training content to be important. This shows that they consider attending training useful also for their future career *(12.2).* After all, in the workplace, learning takes place through real-world experiences, by addressing professional challenges, and by resolving job-related issues without predefined learning objectives (Eraut, 2000; Nitsche et al., 2011; van de Weil et al., 2004; Cuyvers, 2020). Additionally, as mentioned above in the employees' needs, participation in training should nowadays surpass the traditional time and space constraints and offer flexibility and individualization of the training content to the learners *(9.1.1.4, 10.2.3),* as one participant commented: *"I would say that the format of the slides with the video is good enough, […], from the sense that you will have that material forever with you and you will be able to, um, I don't know, check it again, in case that you have any doubt and then if you have that for the 80% of the content, but not for the 20% that is going to be explaining live then maybe you have the feeling that you would like to have it that in video as well because maybe you forgot about something, and then you think: Ah, I have all of these lectures in video, and I can check it again"* (#29, §149).

5.4 Recommendations for Practice

According to the beliefs of the respondents about learning *(5.)* and their actions toward learning (Figure 11 and Figure 13), it was acknowledged that learning is a continuous process, which is consistent with the theory of lifelong learning. Employees combine their learning strategies, constantly reflect on their learning, and alter their actions to achieve the desired outcome. This section translates into practical recommendations of what the results of this study have to offer to all actors involved in organizational learning. The insights presented can be valuable for employers, companies, managers, training developers, and employees in general and also outside of the aerospace industry due to the broad academic and professional background of the employees who participated and the fact that employees in other fields nowadays decide to entirely change careers for

financial reasons or engage in pertinent fields. In either case, the beginning of a new employee in a company requires training, no matter what it is called.

- **Employers**

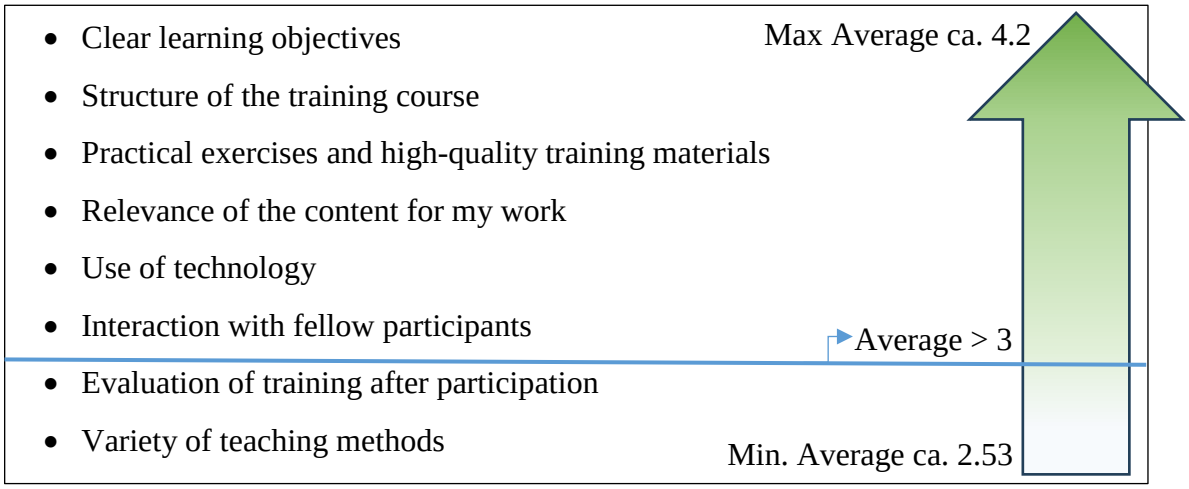
At the organizational level, starting with the employers, they have to ensure that the onboarding of new hires seamlessly occurs and is flexible to their needs. As previous research has also outlined (van Breda-Verduijn & Heijboer, 2016; Jeske & Olson, 2021; Decious et al., 2022), human resource development must offer structured learning opportunities and simultaneously allow individual development. This should be communicated through managers, human resources departments, and the entire company culture. A learning culture adopted and promoted by all actors within a company is critical to this (Cseh & Crocco, 2020; Welk et al., 2023). In practice, promoting learning and individual development of employees can be expressed through a learning culture that praises continuous learning and provides formal and informal workplace learning opportunities. For instance, new employees frequently mentioned the ability to contact subject matter experts during training and everyday work life as crucial for their learning process. Additionally, having dedicated learning places within the company, referred to as learning islands or open-space-conference (Mandl et al., 2004), was identified as a key factor in providing a conducive learning environment. Furthermore, offering simulations of real-world examples, along with coaching, and mentoring, emerged as essential strategies that support learning at the workplace. Each company should investigate internally which informal learning strategies are preferred by its employees and bring these in line with the organizational goals (Welk et al., 2023), as mentioned in Chapter 2.2. For example, Pennings et al. (2020) concluded that the two most preferable were informal mentorship and a safe learning environment, while Coetzer et al. (2017) stated two beneficial factors within informal learning in small businesses: short decision paths and social proximity. The company's size could potentially influence the strategies that are used the most.

- **Training developers**

Apart from the general organizational environment, which should enable continuous learning, there are some results that would be helpful for training developers to consider during the development of training courses. First, accommodating the employees' needs

described in Chapter 5.2 or analyzing these before development ought to be a priority for training developers as it benefits the training outcome. Offering different options of learning methods and tools to evaluate themselves proved to be desired *(11.2.3)*, but this might be challenging for some learners (#24, §227). Specifically, regarding the development of a training course, several elements as the following should be ensured (presented in Figure 14 by stating from the most important to the least important as evaluated by the participants of the two training courses in the prior training questionnaires):

Figure 14. Important for Training course development



Note. Own figure.

Additionally, elements like demonstrative exercises, frequent tests, gaining a certification, trainer availability, and summaries at the beginning or end of videos or chapters should also be considered *(1.8)*.

Second, as the results of this study indicated, it is easier for learners to describe their preferred strategies as in the main category *(1.) Learning preferences* than the actual ones as in the main categories (*2.) Problem-solving* and *(3.) Work approach* because the latter depends on the situation, and they decide on the spot what they would do. This shows the need for skills and competencies to be able to evaluate the situation and choose strategies that derive from self-regulation and metacognition. As such, it is necessary to be cultivated because employees enter with various differences, and the skill of self-regulation or a high level of it cannot be taken for granted. After all, the learning strategies that adults currently use can be modified, and new ones can be learned (Weinstein et al., 2000). As Sitzmann & Ely (2011, p.436) suggested, implementing training interventions

to promote self-regulation among employees will also be useful. Delen et al. (2014) emphasized that training and self-regulatory activities could enhance the use of self-regulation strategies. Before or in parallel with teaching self-regulating learning strategies to employees, it would be necessary to assist them in recognizing the ones they already acquire and use. Furthermore, learning and changing competencies must be supported in the workplace (Zimmermann, 2009; Bell et al., 2017).

- **Employees**

The role of individuals in workplace learning cannot be neglected. While the organizational environment, processes, and culture have a significant impact on employees' learning, the individuals themselves are part of it, as analyzed in Chapter 2.3. What employees can do to enhance their self-regulation and informal learning aligns with the arguments in favor of lifelong learning discussed in Chapter 2.1. Embracing the principles of continuing education, actively setting personal learning goals, and monitoring their current learning strategies and progress is one step in enhancing their self-regulation. Their self-reflection is another important step in being capable of evaluating their learning, recognizing their gaps, and expressing accordingly their needs to somebody who is in a position to support them. This includes being able to look for a colleague or expert within their company or even outside. Communicating their needs to their managers is also valuable during this process. The figures presented in Chapter 4.6 (Figures 11, 12, and 13) can help employees understand how their learning occurs under different conditions, whether they are solving an urgent problem or following the learning steps of other employees within their company. Table 1 also offers an overview of popular self-regulated, informal, and learning strategies. Employees might recognize some of the strategies they already comprehend and use, or they might learn new ones that could be profitable to use. They are the ones who have to try these and judge if they obtain value from them. This also applies to tools and resources they have available or not. Each employee should assess and utilize what is at their disposal. If certain tools are lacking, it is essential to identify these gaps and seek appropriate solutions. Regardless of the motivation for learning and further qualifying themselves, workplace learning contains a shared responsibility of individuals and companies (Cuyvers et al., 2020).

5.5 Recommendations for Future Research

This research focused on new employees and their self-regulated learning strategies. Due to confidentiality restrictions, it was not possible to explore the relation of demographic variables to informal learning and self-regulation strategies. Existing studies have shown that demographic factors can influence informal workplace learning (Harteis et al., 2015; Decius et al., 2019). Published data about millennials show differences in preferences regarding learning at the workplace (Thompson, 2016; Thejovathi & Krishnan, 2020). An interesting area for future research could involve comparing the learning strategies could of younger and older generations, especially in the context of the increasing use of artificial intelligence in learning. Additionally, research on artificial intelligence foresees and promises that adaptive learning using artificial intelligence can construct more specialized learning paths, which enables detailed tracking of the learning process and offers continuous feedback based on learners' needs.

Although the literature has shown that employees' use of informal learning strategies doesn't change as time goes by (Weinstein et al., 2000), environmental factors may influence these, and new strategies can be learned (Tews et al., 2017; Welk et al., 2023). This is where self-regulation interferes, as a participant mentioned that after reflecting on their own actions, they prefer seeking help than wasting time to solve a problem on their own (#27, §36). Despite the difficulties of longitudinal studies, it would be interesting to conduct such studies with the same employees after working in this field for two years to explore how and if their self-regulated learning strategies evolve after the beginning stage of entering a new job position. This was also suggested by Littlejohn et al. (2016) in their study in order to study the impact of learning events in more depth in the long term when several *"cycles of self-regulation"* will have taken place (p. 224). This could explain what learners do when they succeed; for example, when solving a problem, the strategy they followed is somehow being validated as successful. To explore this among employees who worked longer than two years in the same company and job role and have learned strategies from colleagues or adopted strategies deriving from the company, the level of self-regulation and informal learning could be investigated using the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich & De Groot (1990), and the informal workplace learning scale (Decius et al., 2019).

Apart from longitudinal studies with employees with different amounts of experience in the specific field, further research could also look for similarities and differences in self-regulated and informal learning strategies in other professions. There are conclusions for employees in the finance, health, and education sectors (Bjork et al., 2013; Cerasoli et al., 2018; Smet et al., 2022). The literature in this context presents conflicting viewpoints. Older theories, such as the LNT, expect the organization of learning to be related to the organization of work (Poell et al., 2000; Eraut, 2004), which implies that learning paths were found to differ across occupations (Poell et al., 2018). Contrary to this, outcomes of a study with engineering students indicate that self-regulated learning is not subject-dependent for learners (Rotgans & Schmidt, 2009), and Smet et al. (2022) also supported that informal work-related learning outcomes are not exclusively linked to particular positions. However, task complexity has been correlated positively with informal learning (Jeon & Kim, 2012; Schürmann & Beausaert, 2016; Decius et al., 2021). Apart from differences between sectors, potential differences between work environments and specific work procedures, for example, between positions that involve service, administrative, corporate, and managerial tasks, may be worth further exploring them.

Another beneficial research direction would be exploring the influence of environmental factors because, as it was mentioned earlier, they may influence learning strategies. Organizational culture is one of these factors, as it plays a significant role in onboarding (Bauer, 2010), learning opportunities (Govaerts & Baert, 2011), and learning strategies (Kittel & Seufert, 2023a). For such research, specific information about the work and learning processes within companies would be required in parallel with using questionnaires that would measure the self-regulation and/or informal learning strategies of employees. Apart from the organizational aspects, the motivation of individuals could also be a part of it. It is an element that is also influenced by employers as well as individuals' interests, as the results of this study indicated. If employers pay for training, employees will, of course, attend it because they are obligated to do it *(14.4.2.1).* Paying by themselves is always an option, but their motivation to learn and be kept updated on technological evolution is what drives them.

6. Conclusion

Employees, upon entering job positions, attend training to acquaint themselves with the new company's processes and special information about their new position. Beyond the initial training, their onboarding continues with engaging in various courses to enhance their technical and general knowledge, skills, and qualifications (Snell, 2006; Dessler, 2024). This continuous learning process persists throughout their professional career (Smith, 1984; Bauer, 2010;). Such training may not necessarily align with the precise needs of an employee's distinct professional development stage (Kövesi & Csizmedia, 2016; Guo et al., 2022). In parallel, the learning conditions, preferences, and strategies of employees are remarkably diverse and are constantly evolving to meet their ongoing needs and the demands of the companies.

Efforts have been exerted by the research community to discern the nature of workplace learning that enhances employee performance, but the strategies applied by employees in realistic day-to-day working conditions remain uncharted. The occupations and industries that have been explored remain limited in quantity (Fontana et al., 2015; van Houten-Schat et al., 2018; Margaryan et al., 2022). The research covers either only formal learning or informal learning (Kittel & Seufert, 2023a; Smet et al., 2024) but never simultaneously. This study investigated employees' strategies toward learning and their needs when entering a new job position. Employees who recently entered aerospace companies attended two training courses, and on these occasions, they described their learning strategies during formal and informal learning situations. During the two training courses attended by the employees, they were able to articulate their activities within the formal learning environment and discuss the various informal learning opportunities available to them, both during these courses and in their workplace in general.

The self-regulation of employees, including the process of choosing learning strategies and controlling their learning process, was also explored. This research focused on new employees and their self-regulated learning strategies, specifically during the transition period into aerospace software engineering and the early stages of their careers. The new employees in this field seem to prefer looking for knowledge by themselves independently. Their choice of actions depends strongly on the problem they are dealing with or the learning situation they are experiencing. This is evident in situations where they can decide freely what they will do to learn, as opposed to situations where resolving a problem immediately is the priority. In the latter situations, employees ask for help sooner, either directly from their colleagues or experts

in their company or online in forums. Enabling employees' learning strategies can result in boosting the companies' profits by enhancing their workforce performance and, subsequently, their productivity.

Attempting to tailor employees' individual needs is not always realistic. Therefore, it becomes imperative to provide employees with tools that can support their own learning and self-regulatory skills and enable them to enhance their introduction to their new field. This can be achieved by training employees in learning and self-regulation strategies, particularly those strategies that are recognized for their effectiveness in the industry they are specifically active in.

Another point to consider is enhancing the learning culture and structures within a company, such as implementing and updating the company's training catalog, establishing contact between departments, and receiving and interpreting participants' feedback after training. All these concern the organizational structure and the company's learning culture, which shows the company's values and their alignment with continuing learning and how this can occur practically during everyday work life.

Neither employees nor employers can create their ideal learning conditions in the workplace without being influenced by each other (Billet, 2006; Smith & Kelly, 2016). Training developers and managers standing in the middle of this process ought to consider the specific needs and demands from both perspectives in order to deliver valuable training material and experience that will benefit both sides (all actors). Learning should be placed at the center of employees' development so that it is enabled and promoted in formal, informal, and non-formal circumstances of professional life (Kortsch et al., 2024). This underscores the importance of considering both formal and informal learning in the workplace, as they both play a crucial role in employees' development. According to the insights of the respondents of this study, learning is a continuous process, and they often combine their learning strategies, constantly reflect on their learning, and alter their actions to achieve the desired outcome.

References

Alaoui, A., Liebert, T., & Raab, C. (2020). *LuFo-V-2 Verbundprojekt ASSET-2 (Avionic System Software Embedded Technology 2): Berichtzeitraum: 01.01.2017-31.03.20.20 Abschlussbericht.* [Nord-Micro GmbH & Co. OHG.] https://doi.org/10.2314/KXP:1756910103

Alber, O., & Freyer, H. (2020). ASSET2 - Avionic System Software Embedded Technology 2: ASSETT2 Schlussbericht zu Nr. 8.2: Berichtszeitraum: 01.01.2017 bis 31.03.2020 (Version: 1). [Silver Atena GmbH]. https://doi.org/10.2314/KXP:1753936047

Allen, M. C. (2006). Overview and Evolution of the ADDIE Training System. *Advances in Developing Human Resources,* 8(4), 430-41.

Allen, M. W., & Sites, R. (2012). *Leaving ADDIE for SAM: An agile model for developing the best learning experiences.* Alexandria, VA: American Society for Training and Development.

Altschuld, J. W., & B. R. Witkin. (2000). *From Needs Assessment to Action: Transforming Needs into Solution Strategies*. Sage Publications, Thousand Oaks.

Anderson, L., Krathwohl, D., & Bloom, B. (2001). *A Taxonomy for Learning, Teaching, and Assessing: a revision of Bloom's Taxonomy of Educational Objectives.* Longman.

Argote, L. (2013). *Organizational Learning: Creating, Retaining and Transferring Knowledge.* Springer.

Argyris, C., & Schön, D. A. (1996). *Organizational learning II: Theory, method, and practice* (2nd ed.). Addison-Wesley.

Arnold, T. (2021). *Weiterentwicklung von Modellen Betrieblichen Lernens. Durch Einbezug des Lernens mit digitalen Medien.* Bielefeld: wbv. https://doi.org./10.3278/6004724w

Baitsch, C. (1998). Lernen im Prozess der Arbeit. In M. Baethge, M. (Ed.), *Forschungsstand und Forschungsperspektiven* (pp. 269-337). Waxmann.

Bandura, A. (1971). *Social Learning Theory.* General Learning Press.

Bandura, A. (1991). Human agency: The rhetoric and the reality. *American Psychologist*, 46, 157-162.

Barbe, W. B., Swassing, R. H., & Milone, M. N. (1979). *Teaching through modality strengths: concepts practices.* Zaner-Bloser.

Barnett, R. (1999). Learning to work and working to learn. In D. Boud & J. Garrick (Eds.), Understanding learning at work (pp. 29-44). London: Routledge.

Basten, D., & Haamann, T. (2018). Approaches for Organizational Learning: A Literature Review. *SAGE Open*, 8(3). https://doi.org/10.1177/2158244018794224

Bauer, T. N. (2010). *Onboarding new employees: Maximizing success.* SHRM Foundation. https://www.shrm.org/foundation/ourwork/initiatives/resources-from-past-initiatives/Documents/Onboarding%20New%20Employees.pdf

Bear, D. J., Tompson, H. B., Morrison, C. L., Vickers, M., Paradise, A., Czarnowsky, M., Soyars, M., & King, K. (2008). Tapping the potential of informal learning. An ASTD research study. American Society for Training and Development.

Becker, K., & Bish, A. (2021). A framework for understanding the role of unlearning in onboarding. *Human Resource Management Review*, 31(1). https://doi.org/10.1016/j.hrmr.2019.100730

Bell, B. S., & Kozlowski, S. W. J. (2008). Active learning: effects of core training design elements on self-regulatory processes, learning, and adaptability. *Journal Applied Psychology*, 93, 296-316. https://doi.org/10.1037/0021-9010.93.2.296

Bell, B. S. & Kozlowski, S. (2012). Toward a Theory of Learner-Centered Training Design: An Integrative Framework of Active learning. In Kozlowski, S.W.J. & Salas, E. (Eds.), *Learning, Training, and Development in Organizations (pp.263-300).* Routledge/Taylor and Francis Group.

Bell, B. S., Tannenbaum, S. I., Ford, J. K., Noe, R. A., & Kraiger, K. (2017). 100 years of training and development research: what we know and where we should go. *Journal of Applied Psychology*, 102(3), 305-323. https://doi.org/10.1037/apl0000142

Bednall, T. C., & Sanders, K. (2017). Do Opportunities for Formal Learning Stimulate Follow-Up Participation in Informal Learning? A Three-Wave Study. Human Resource Management, 56, 803–20. https://doi.org/10.1002/hrm.21800

Bennett, D., & Ananthram, S. (2021). Development, Validation and Deployment of the EmployABILITY Scale. *Studies in Higher Education*, 1-15. https://doi.org/10.1080/03075079.2021.1888079

Berg, S.A., & Chyung, S.Y.Y. (2008). Factors that influence informal learning in the workplace. *Journal of Workplace Learning*, 20(4), 229-244. https://doi.org/10.1108/13665620810871097

Bergsteiner, H. Avery, G. C., & Neumann, R. (2010). Kolb's experiential learning model: critique from a modelling perspective. *Studies in Continuing Education*, 32(1), 29-46. https://doi.org/10.1080/01580370903534355

Berwick, R. (1989). Needs assessment in language programming: From theory to practice. In R.K. Johnson (Ed.), *The second language curriculum* (pp. 48-62). Cambridge University Press.

Bierema, L. L. (2016). Navigating Professional White Water: Rethinking Continuing Professional Education at Work. *New Directions for Adult and Continuing Education*, 151, 53-67. https://doi.org/10.1002/ace.20195

Bilger, F., Gnahs, D., Hartmann, J., & Kuper, H. (2013). *Weiterbildungsverhalten in Deutschland. Resultate des Adult Education Survey 2012.* W. Bertelsmann.

Billett, S. (1993). Authenticity and a culture of practice. *Australian and New Zealand Journal of Vocational Education Research*, 2(1), 1-29.

Billett, S. (1996). Situated learning: Bridging sociocultural and cognitive theorizing. Learning and Instruction, 6(3), 263-280. https://doi.org/10.1016/0959-4752(96)00006-0

Billett, S. (2000). Guided learning at work. *Journal of Workplace Learning*, 12(7), 272-285. https://doi.org/10.1108/13665620010353351

Billett, S. (2004). Workplace participatory practices: conceptualizing workplaces as learning environments. *Journal of Workplace Learning*, 16(6), 312-324. https://doi.org/10.1108/13665620410550295

Bissell, J., White, S., & Zivin, G. (1971). Sensory modalities in children's learning. In Lesser G. S. (Ed.), *Psychology and educational practice* (pp.130-155). Scott, Foresman and Company.

Bjork, I.T., Toien, M., & Sorensen, A.L. (2013). Exploring informal learning among hospital nurses. *Journal of Workplace Learning*, 25(7), 426-440. https://doi.org/10.1108/JWL-01-2013-0003

Blanchard, B. N., & Thacker, J. W. (2010). *Effective Training: Systems, Strategies, and Practices.* 4. Pearson Education.

Bloom, B., Englehart, M., Furst, E., Hill W., & Krathwohl, D. (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain*. David McKay Company.

BMAS - Bundesministerium für Arbeit und Soziales (2022). *Fachkräftestrategie der Bundesregierung.* https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/fachkraeftestrategie-der-bundesregierung.pdf?__blob=publicationFile&v=8

BMBF - Bundesministerium für Bildung und Forschung (2022). *Weiterbildungsverhalten in Deutschland 2020*. Ergebnisse des Adult Education Survey-AES Trendbericht, 2. überarbeitete Auflage.

BMWK - Bundesministerium für Wirtschaft und Klimaschutz (n.d.). *Fachkräfte für Deutschland*. Retrieved November 20, 2023, from https://www.bmwk.de/Redaktion/DE/Dossier/fachkraeftesicherung.html

Boahin, P., & Hofman, W. H. A. (2014). Perceived effects of competency-based training on the acquisition of professional skills. International Journal of Educational Development, 36, 81-89. https://doi.org/10.1016/j.ijedudev.2013.11.003

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research, 31*(6), 445-457. https://doi.org/10.1016/s0883-0355(99)00014-2

Bonk, C.J., Kim, K.J., & Zeng, T. (2005). Future Directions of Blended Learning in Higher Education and Workplace Learning Settings. In Kommers, P. & Richards, G. (Eds.), *Proceedings of ED-MEDIA 2005-World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 3644-3649). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/20646/

Borkowski, J.G., Chan, L.K.S., & Muthukrishna, N. (2000). A process-oriented model of metacognition: links between motivation and executive functioning. In Schraw, G. & Impara, J. (Eds.), *Issues in the Measurement of Metacognition* (pp.1-41). Buros Institute of Mental Measurements, University of Nebraska.

Boydell, T. (1976). *The Identification of Training Needs.* British Association for Commercial and Industrial Education. Grosvenor Press.

Bradshaw, J. (1972). A taxonomy of social need. In: McLachlan, G. (Ed.), *Problems and progress in medical care: essays on current research* (pp.71-82). Oxford University Press.

Bradshaw, J. (1994). The conceptualization and measurement of need: a social policy perspective. In: Popay, J. & Williams, G. (Eds.), *Researching the People's Health (pp.45-57).* Routledge.

Branch, R. M. (2009). Instructional Design: The ADDIE Approach. Springer. https://doi.org/10.1007/978-0-387-09506-6

Brusilovsky, P., & Peylo, C. (2003). Adaptive and Intelligent Web-based Educational Systems. *International Journal of Artificial Intelligence in Education,* 13, 156 – 169.

Busse von Colbe, W., Coenenberg, A.G., Kajüter, P., Linnhoff, U., & Pellens, B. (2021). Betriebswirtschaft für Führungskräfte (5th ed.). Stuttgart: Schäffer-Poeschel. https://doi.org/10.34156/9783791037615

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research,* 65(3), 245-281. https://doi.org/10.2307/1170684

Cannon-Bowers, J. & Bowers, C. (2012). Synthetic Learning Environments: On Developing a Science of Simulation, Games, and Virtual Worlds for Training. In Kozlowski, S.W.J. & Salas, E. (Eds.), *Learning, Training, and Development in Organizations* (pp.229-261). Routledge/Taylor and Francis Group.

Cedefop (2020). *Adult learning and continuing vocational education and training valued by Europeans – Insights from a pan-European opinion survey conducted by Cedefop,* Publications Office. http://data.europa.eu/doi/10.2801/72311

CEGOS' European Research (2018, June). *Transformation, Skills & Learning: how to address the future. Key findings.* https://static.global-learning-development.com/wp-content/uploads/2018/07/24143247/brochure_cegos_transformation_skills_learning_2018.pdf

Cerasoli, C. P., Alliger, G. M., Donsbach, J. S., Mathieu, J. E., Tannenbaum, S. I., & Orvis, K. A. (2018). Antecedents and outcomes of informal learning behaviors: A meta-analysis. *Journal of Business and Psychology,* 33(2), 203-230. https://doi.org/10.1007/s10869-017-9492-y

Chao, G. T., O'Leary-Kelly, A. M., Wolf, S., Klein, H. J., & Gardner, O. D. (1994). Organizational Socialization: Its Content and COnsequences. Journal of Applied Psychology, 79(5), 730-743. https://doi.org/10.1037/0021-9010.79.5.730

Chang, K., Ehrlich, K., & Millen, D. (2004, November). *Getting on board: A social network analysis of the transformation of new hires into full-time employees*. Position paper presented at Computer-Supported Cooperative Work, Workshop on Social Networks, Chicago.

Chegg & Harris Interactive (2013, October 29). *Bridge That Gap: Analyzing the Student Skill Index.* Chegg, The Student Hub.

Chiu, W., Thompson, D., Mak, W.-M., & Lo, K. L. (1997). Re-thinking training needs analysis: A proposed framework for literature review. *Personnel Review,* 28(1/2), 77-90.

Clarke, N. (2005). Workplace learning environment and its relationship with learning outcomes in healthcare organizations. *Human Resource Development International,* 8, 185-205.

Coady, M. (2021). Continuing Professional Education. In Rocco, T.S., Smith, M. C., Mizzi, R. C., Merriweather, L. R., & Hawley, J. D. (Eds.), *The Handbook of Adult and Continuing Education* (pp.257-265). Stylus Publishing.

Coetzer, M. F., Bussin, M., & Geldenhuys, M. (2017). The Functions of a Servant Leader. *Administrative Sciences*, 7(5). https://doi.org/10.3390/admsci7010005

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). *Learning styles and pedagogy in post-16 learning: A systematic and critical review.* Learning and Skills Researcg Centre.

Cohen, A. (2021, May 10). *How to Quit Your Job in the Great Post-Pandemic Resignation Boom.* Bloomberg.com. https://www.bloomberg.com/news/articles/2021-05-10/quit-your-job-how-to-resign-after-covid-pandemic

Cohen, N., & Galbraith, M. (1995). Mentoring in the learning society. *New Directions for Adult and Continuing Education,* 66, 5-14. https://doi.org/10.1002/ace.36719956603

Collard, S., & Law, M. (1989). The Limits of Perspective Transformation: A Critique of Mezirow's Theory. *Adult Education Quarterly,* 39(2), 99-107.

Colley, H., Hodkinson, P., & Malcolm, J. (2002). *Non-formal learning: Mapping the conceptual terrain. A consultation report.* University of Leeds Lifelong Learning Institute. http://www.infed.org/archives/e-texts/colley_informal_learning.htm

Commission of the European Communities (2001). *Communication from the Commission. Making a European Area of Lifelong Learning a Reality*. COM (2001) 678 final. Brussels. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52001DC0678&rid=2

Commission of the European Communities (2006). *Adult learning: It is never too late to learn.* COM (2006) 614 final. Brussels. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0614:FIN:EN:PDF

Coombs, P.H. (1985). *The world crisis in education: A view from the eighties*. Oxford University Press.

Cross, J. (2007). *Informal learning: Rediscovering the natural pathways that inspire innovation and performance.* Pfeiffer.

Cseh, M., & Crocco, O.S. (2020). Globalizing HRD Academic Practice: Developing a Global Mindset for Teaching and Research. *Advances in Developing Human Resources,* 22, 57-71. https://doi.org/10.1177/15234223198862

Cunningham, J. (1998). *The workplace: A learning environment.* Paper delivered at the First Annual Conference of the Australian Vocational Education and Training Research Association, Sydney.

Cunningham, J., & Hillier, E. (2013). Informal learning in the workplace: key activities and processes. *Education + Training*, 55(1), 37-51. https://doi.org/10.1108/00400911311294960

Cuyvers, K., Donche, V., & Van den Bossche, P. (2016). Learning beyond graduation: exploring newly qualified specialists' entrance into daily practice from a learning perspective. *Advances in Health Sciences Education,* 21, 439-453. https://doi.org/10.1007/s10459-015-9640-y

Cuyvers, K., Van den Bossche, P., & Donche, V. (2020). Self-Regulation of Professional Learning in the Workplace: a State of the Art and Future Perspectives. *Vocations and Learning,* 13, 281-312. https://doi.org/10.1007/s12186-019-09236-x

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology,* 53(6), 1024-1037. https://doi.org/10.1037/0022-3514.53.6.1024

Decius, J., & Decius, L. (2022). Sovereign Workplace Learning: A Process Model to Integrate Self-regulated and Informal Learning. *Academy of Management Proceedings*, 2022(1). https://doi.org/10.5465/AMBPP.2022.14907abstract

Decius J., Schaper N., & Seifert, A. (2019). Informal workplace learning: Development and validation of a measure. *Human Resource Development Quarterly*, 30, (4), 495-535. https://doi.org/10.1002/hrdq.21368

Decius, J., Schaper, N., & Seifert, A. (2021). Work characteristics or workers' characteristics? An input-process-output perspective on informal workplace learning of blue-collar workers. *Vocations and Learning,* 14(2), 285-326. https://doi.org/10.1007/s12186-021-09265-5

Delen, E., Liew, J., & Willson, V. (2014). Effects of interactivity and instructional scaffolding on learning: Self-regulation in online video-based environments. *Computers & Education,* 78, 312–320. https://doi.org/10.1016/j.compedu.2014.06.018

Delors, J. (1996). *Learning: the treasure from within,* UNESCO, Paris, 1996.

Derven, *M. (*2008*).* Management onboarding. *Journal of Training and Development*, 3(2) 49-52.

Dessler, G. (2024). *Human Resource Management*. 17th Ed. Pearson.

Destatis (2022). Berufliche Weiterbildung in Unternehmen. „Sechsten Europäischen Erhebung über die berufliche Weiterbildung in Unternehmen (CVTS6 – Sixth Continuing Vocational Training Survey)". https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Weiterbildung/Publikationen/Downloads-Weiterbildung/weiterbildung-unternehmen-5215201209004.html

Department of Education and Science (2000). *Learning for Life: White Paper on Adult Education.* Stationery Office.

Dewey, J. (1938). *Experience and Education.* Collier Books.

Dewhurst, F. W., & Cegarra-Navarro, J. G. (2004). External communities of practice and relational capital. *The Learning Organization*, 11(4/5), 322-331. https://doi.org/10.1108/09696470410538224

Dobrovolny, J. (2006). How Adults Learn from Self-Paced, Technology-Based Corporate Training: New focus for learners, new focus for designers. *Distance Education*, 27(2), 155-170. https://doi.org/10.1080/01587910600789506

Dosi, G., Pereira, P.C., Roventini, A., & Virgillito, M.E. (2022). Technological paradigms, labour creation and destruction in a multi-sector agent-based mode. *Research Policy*, 51(10). https://doi.org/10.1016/j.respol.2022.104565

Dunlap, J. C., & Grabinger, S. (2003). Preparing Students for Lifelong Learning: A Review of Instructional Features and Teaching Methodologies, *Performance Improvement Quarterly*, 16(2), 6-25 https://doi.org/10.1111/j.1937-8327.2003.tb00276.x

Dunn, R., & Dunn, K. (1979). *Learning syles/teaching styles: Should they be matched.* Educational leadership.

Dunphy, D., Turner, D., & Crawford, M. (1997). Organizational learning as the creation of corporate competencies. *Journal of Management Development,* 16(4), 232-244.

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: the MASRL model. *Educational Psychologist*, 46(1), 6-25. https://doi.org/10.1080/00461520.2011.538645

Elkjaer, B., & Wahlgren, B. (2006). Organisational Learning and Workplace Learning - similarities and differences. In Antonacopoulou, E., Jarvis, P., Elkjaer, E., Høyrup, S., & Andersen, V. (Eds.), *Learning, Working, and Living. Mapping the Terrain of Working Life Learning* (1, pp.15-32). Palgrave Macmillan.

Ellis, A.M., Nifadkar, S.S., Bauer, T.N., & Erdogan, B. (2017). Newcomer adjustment: Examining the role of managers' perception of newcomer proactive behavior during organizational socialization. *Journal of Applied Psychology*, 102 (2017), 993-1001. https://doi.org/10.1037/apl0000201

English, H. D., & English, H. C. (1958). *A Comprehensive Dictionary of Psychological and Psychoanalytic Terms.* Longman.

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26(2), 247-273. https://doi.org/10.1080/158037042000225245

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology,* 70(1), 113-136. https://doi.org/10.1348/000709900158001

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review,* 87, 215-251. https://doi.org/10.1037/0033-295X.87.3.215

Erpenbeck, J. & Sauter, W. (2013). So werden wir lernen! Kompetenzentwicklung in einer Welt fühlender Computer, kluger Wolken und sinnsuchender Netze. Springer Gabler. https://doi.org/10.1007/978-3-642-37181-3

Eurofound. (n.d.). *Skills and training | European Foundation for the Improvement of Living and Working Conditions*. Retrieved August 17, 2023, from https://www.eurofound.europa.eu/en/topic/skills-and-training

European Commission (2015). *Employment and social developments in Europe 2015*, European Commission, Directorate-General for Employment, Social Affairs and Inclusion, Publications Office. https://data.europa.eu/doi/10.2767/42590

European Commission (2020). An Agenda for New Skills and Jobs: A European Contribution towards Full Employment. An Initiative of the European Union.

Eurydice (n.d.). *Adult education and training funding.* European Commission. Retrieved November 27, 2023, from https://eurydice.eacea.ec.europa.eu/national-education-systems/germany/adult-education-and-training-funding

Faure, E. (1972). *Learning to be: The world of education today and tomorrow*. UNESCO, Paris.

Fake, H., & Dabbagh, N. (2020). Personalized learning within online workforce learning environments: exploring implementations, obstacles, opportunities, and perspectives of workforce leaders. *Technology, Knowledge and Learning,* 25(4), 789-809.

Fenton M., Field, E., & Mugayar-Baldocchi, M. (2021, August 23). *Piecing together the talent puzzle: When to redeploy, upskill, or reskill*. McKinsey & Company. https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/the-organization-blog/piecing-together-the-talent-puzzle-when-to-redeploy-upskill-or-reskill

Ferreira, R. & Abbad, G. (2013). Training needs assessment: where we are and where we should go. *Brazilian Administration Review,* 10(1). https://doi.org/10.1590/S1807-76922013000100006

Fischer, G. (2000). Lifelong learning – more than training. *Journal of Interactive learning Research*, 11(3), 265-294.

Fontana, R. P., Milligan, C., Littlejohn, A., & Margaryan, A. (2015). Measuring self-regulated learning in the workplace. *International Journal of Training and Development*, *19*(1), 32-52. https://doi.org/10.1111/ijtd.12046

Ford, L. (2009). Improving training transfer. *Industrial and Commercial Training,* 41(2), 92-96. http://dx.doi.org/10.1108/00197850910939135

Frey, A., Pourtoulidou, D., & Skotnik, N. (2023). *Modellbasierte Softwareentwicklung auf Basis von Anforderungen, Integration von Software Baukasten-Elementen und Wissenstransfer: Abschlussbericht zum Projekt IDEA - Integrierte Design- und Entwicklungsumgebung für Aerospace: Projektlaufzeit: 01.04.2019-31.12.2022.* [Technische Hochschule Ingolstadt, Zentrum für Angewandte Forschung]. (TIB, forthcoming)

Furey, W. (2020). The Stubborn Myth of "Learning Styles" – State teacher-license prep materials peddle a debunked theory. *Education Next, 20(3), 8-12.*

https://www.educationnext.org/stubborn-myth-learning-styles-state-teacher-license-prep-materials-debunked-theory/

Gagne, R. (1985). *The Conditions of Learning* (4th Ed.). Holt, Rinehart & Winston.

Gagne, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design* (4th ed.). Harcourt Brace Jovanovich College Publishers.

Gajadhar, S. (2007). *Leerwegen von ervaren docenten*. [Learning paths of experienced teachers]. Master's thesis Education Studies, Tilburg University, The Netherlands.

Galy, E., & LeMaster, J. (2006). Organizational Learning Stages of Assimilation, Integration and Optimization and their Relationship with User Satisfaction of Enterprise Resource Planning Systems. *Journal of International Technology and Information Management*, 15(4), 61-76. https://doi.org/10.58729/1941-6679.1182

Gangopadhyay, A., & Huang, Z. (2004). Studying the Value of Information Sharing in E-Business Supply Chain Management. *Journal of International Technology and Information Management,* 13(1), 49-60.

Garavan, T., McCarthy, A., Lai, Y., Murphy, K., Sheehan, M., & Carbery, R. (2020). Training and organisational performance: A meta-analysis of temporal, institutional, and organisational context moderators. *Human Resource Management Journal,* 1-26.

Garvin, D. A. (1993). *Building a Learning Organization.* Harvard Business Review.

Geller, L. (1982). The failure of self-actualization theory: A critique of Carl Rogers and Abraham Maslow. *Journal of Humanistic Psychology, 22,* 56-73.

Gieseke, W. (2008). *Bedarfsorientierte Angebotsplanung in der Erwachsenenbildung.* Bertelsmann.

Gil, A. J., Garcia-Alcaraz, J. L., & Mataveli, M. (2015). The training in organizational changes processes in the Spanish wine sector. *European Journal of Training and Development,* 39(4), 315-331. https://doi.org/10.1108/EJTD-09-2014-0067

Goldstein, I., & Gessner, M. (1988). Training and development in work organisations. *International Review of Industrial and Organisational Psychology*, 43-72.

Gomes, R., & Sousa, D. (2023). The Relevance of structured onboarding in the assimilation of organizational culture. *World Journal of Advanced Research and Reviews,* 18(1), 690-697. https://doi.org/10.30574/wjarr.2023.18.1.0659

Götz, T. (Hrsg.). (2011). Emotion, Motivation und selbstreguliertes Lernen. Schöningh.

Götz, T., Nett, U. E., & Hall, N. (2013). Self-Regulated Learning. In Hall, N. & Götz, T. (Eds.), *Emotion, Motivation, and Self-Regulation: A Handbook for Teachers (*pp.123-166). Emerald Group.

Gould, D., Kelly, D., White, I., & Chidgey, J. (2004). Training needs analysis. A literature review and reappraisal. *International journal of nursing studies*, *41*(5), 471-486. https://doi.org/10.1016/j.ijnurstu.2003.12.003

Govaerts, N., & Baert, H. (2011). Learning patterns in organizations: towards a typology of workplace-learning configurations. *Human Resource Development International*. 14(5), 545-559. https://doi.org/10.1108/13665621111097245

Grace, A. P. (1996). Striking a critical pose: andragogy - missing links, missing values. *International Journal of Lifelong Education,* 15(5), 382-392. http://doi.org/10.1080/0260137960150506

Grosemans, I., Smet, K., Houben, E., De Cuyper, N., & Kyndt, E. (2020). Development and Validation of an Instrument to Measure Work-Related Learning. *Scandinavian Journal of Work and Organizational Psychology,* 5(1), 3, 1-16. https://doi.org/10.16993/sjwop.99

Gully, S., & Chen, G. (2012). Individual differences, attribute-treatment interactions, and training outcomes. In Kozlowski, S.W.J. & Salas, E. (Eds.), *Learning, Training, and Development in Organizations* (pp.3-64). Routledge/Taylor and Francis Group.

Guest, G. (2006). Lifelong learning for engineers: A global perspective. *European Journal of Engineering Education,* 31(3), 273-281. http://doi.org/10.1080/03043790600644396

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design. *Trendsand issues in instructional design and technology*, 16-25.

Guo, Y., Langer, C., Mercorio, F., & Trentini, F. (2022). Skills Mismatch, Automation, and training: Evidence from 17 European Countries Using Survey Data and Online Job Ads. *CESifo,* Munich, 2022. *EconPol Forum,* 23 (5), 11-15.

Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially shared regulation of learning. In Zimmerman, B. J. & Schunk, D. H. (Eds.), *Handbook of self-regulation of learning and performance* (pp. 65-84). Routledge/Taylor & Francis Group.

Hadwin, A. F., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In Schunk, D., & Greene, J. (Eds.), *Handbook of Self-Regulation of Learning and Performance* (2nd ed.) (pp. 83-106). Routledge.

Haeffel, G.J, & Howard G.S. (2010) Self-Report: Psychology's Four-Letter Word. *The American Journal of Psychology*, 123(2), 181-188.

Harish, S. (2022, July 25). *Reskilling and Upskilling for a Future-Ready Workforce*. HRWorld From The Economic Times. https://hr.economictimes.indiatimes.com/news/workplace-4-0/learning-and-development/reskilling-and-upskilling-for-a-future-ready-workforce/93087787

Harteis, C., Billett, S., Goller, M., Rausch, A., & Seifried, J. (2015). Effects of age, gender and occupation on perceived workplace learning support. *International Journal of Training Research,* 13(1), 64–81. https://doi.org/10.1080/14480220.2015.1051349

Hartree, A. (1984). Malcolm Knowles' Theory of Andragogy: A Critique. *International Journal of Lifelong Education,* 3(3), 203-210. https://doi.org/10.1080/0260137840030304

Harwardt, E. (2021). *AuTomatisierte, Hoch EffizieNte Software Entwicklung (ATHENE) of Avionic System Software Embedded Technology - (ASSET-2): ATHENE Schlussbericht (ATHENE) for the ASSET-2 ATHENE (ASSET-2).* [DIEHL Aerospace GmbH.] https://doi.org/10.2314/KXP:1789563798

Heckel, M. (2022, July 1). *Industry 5.0 Human-centric machines.* VDE dialog. https://dialog.vde.com/en/vde-dialog-editions/2022-03-artificial-intelligence/human-centric-machines

Herpel, H. J. (2020). *Verbundvorhaben ASSET-2; Teilvorhaben: Datenbankgestützte Erfassung und Verarbeitung der Signale in On-Board Rechnersystemen (DAIDALOS): Schlussbericht.* [Airbus Defence and Space GmbH]. https://doi.org/10.2314/KXP:1757268979

Hewett, S., Becker, K., & Bish, A. (2017). Blended workplace learning: the value of human interaction. *Education & Training,* 61 (1), 2-16. https://doi.org/10.1108/ET-01-2017-0004

Hodkinson, P., & Hodkinson, H. (2004). The Complexities of Workplace Learning: Problems and Dangers in Trying to Measure Attainment. In Rainbird, H., Fuller, A., & Munro, A. (Eds.), *Workplace Learning in Context* (pp. 259-275). Routledge.

Hoggan, C., & Hoggan-Kloubert, T. (2023). The Ethics of Radical and Transformative Education. *Adult Education Quarterly*, *73*(4), 363-381. https://doi.org/10.1177/07417136231187840

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research review,* 17, 63-84. https://doi.org/10.1016/j.edurev.2015.11.002

Horvat, M., & N. Kailer (1989). Needs Analysis in Continuing Engineering Education - Matching Individual and Organisational Needs. *European Journal of Engineering Education*, 14(1), 97-104. https://doi.org/10.1080/03043798908903341

Hussy, W., Schreier, M., & Echterhoff, G. (2013). *Forschungsmethoden in Psychologie und Sozialwissenschaften für Bachelor.* Springer. https://doi.org/10.1007/978-3-642-34362-9

International Institute of Business Analysis (IIBA) (2009). A guide to the Business Analysis Body of Knowledge 2.0 (BABOK Guide 2.0). Ontario.

International Institute of Business Analysis (IIBA) (2015). A guide to the Business Analysis Body of Knowledge 3.0 (BABOK Guide 3.0). Ontario.

Illeris, K. (2002). The Tree Dimensions of Learning. Copenhagen/NIACE, Roskilde University Press.

Illeris, K. (2003). Workplace learning and learning theory. *Journal of Workplace Learning,* 15(4),167-178, https://doi.org/10.1108/13665620310474615

Jacobs, R.L. (2003). *Structured on-the-job training: Unleashing employee expertise in the workplace.* Berrett-Koehler.

Jacobs, R. L., & Park, Y. (2009). A proposed conceptual framework of workplace learning: Implications for theory development and research in human resource development. *Human Resource Development Review*, 8(2), 133-150. https://doi.org/10.1177%2F1534484309334269

Jain, S., Bajaj, B., & Singh, A. (2023). Linking Metacognition, Workplace Cognitive Competencies and Performance: A Integrative Review-Based Conceptual Framework. Primenjena psihologjia, 16(1), 107-147.

Janson, M. (2022, August 12). *Wo die meisten Fachkräfte fehlen.* Statista. https://de.statista.com/infografik/27975/berufe-mit-dem-groessten-arbeitskraeftemangel-in-deutschland/

Jarvis, P. (2006). *Towards a Comprehensive Theory of Human Learning*. Routledge/Falmer Press.

Jeon, K. S., & Kim, K. N. (2012). How do organizational and task factors influence informal learning in the workplace? *Human Resource Development International,* 15(2), 209-226. https://doi.org/10.1080/13678 868.2011.647463

Jeske, D., & Olson, D. (2022). Onboarding new hires: recognising mutual learning opportunities. *Journal of Work-Applied Management*, 14(1), 63-76. https://doi.org/10.1108/JWAM-04-2021-0036

Johnson, D.W., & Johnson, R. T. (1999). Making cooperative learning work. *Theory Into Practice,* 38(2), 67-73. https://doi.org/10.1080/00405849909543834.

Jones, N. B., Herschel, R. T., & Moesel, D. D. (2003). Using "knowledge champions" to facilitate knowledge management. *Journal of Knowledge Management*, 7(1), 49-63. https://doi.org/10.1108/13673270310463617

Kaewpet, C. (2009). Communication Needs of Thai Civil Engineering Students. *English for Specific Purposes,* 28, 266-278. https://doi.org/10.1016/j.esp.2009.05.002

Kaplan, A. (2021). *Higher Education at the Crossroads of Disruption: The University of the 21st Century.* Emerald Publishing.

Kaplan, J. (2021, October 2). *The psychologist who coined the phrase 'Great Resignation' reveals how he saw it coming and where he sees it going. 'Who we are as an employee and as a worker is very central to who we are'*. Business Insider. https://www.businessinsider.com/why-everyone-is-quitting-great-resignation-psychologist-pandemic-rethink-life-2021-10

Kawalilak, C., & Groen, J. (2021). Adult Learning. In Rocco, T.S., Smith, M. C., Mizzi, R. C., Merriweather, L. R., & Hawley, J. D. (Eds.), *The Handbook of Adult and Continuing Education (pp.73-80).* Stylus Publishing.

Kellenberg, F., Schmidt, J., & Werner, C. (2017). The Adult Learner: Self-Directed, Self-Regulated, and Reflective. Signum Temporis, 9(1), 23-29. https://doi.org/10.1515/sigtem-2017-0001

Kettner, P. M., Moroney, R., & Martin, L. (1999). *Designing and managing programs: An effectiveness-based approach* (2nd ed.). Sage.

Khaled, A. (2008). *Leerwegen creëren (z)onder invloed van het werk. Een onderzoek naar leerwegen onder reclasseringswerkers*. [Creating learning paths (un)influenced by work: A study into learning paths among probation officers]. Master's thesis Education Studies, Nijmegen: Radboud Universiteit, The Netherlands.

Kim, L. (1998). Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor. *Organizational Science,* 9(4), 506-521.

Kirby, D., Curran, V., & Hollett, A. (2009). Non-formal adult learning programs at Canadian post-secondary institutions: Trends, issues, and practices. *Canadian Journal of University Continuing Education*, 35 (2), 63-86.

Kittel, A. F. D., Kunz, R. A. C., & Seufert, T. (2021). Self-Regulation in Informal Workplace Learning: Influence of Organizational Learning Culture and Job Characteristics. *Frontiers in Psychology,* 12, 1-19. https://doi.org/10.3389/fpsyg.2021.643748

Kittel, A. F. D., & Seufert, T. (2023a). It's all metacognitive: The relationship between informal learning and self-regulated learning in the workplace. *PLoS ONE,* 18(5): e0286065. https://doi.org/10.1371/journal.pone.0286065

Kittel, A. F. D., & Seufert, T. (2023b). Fostering informal learning strategies. *Journal of Computer Assisted Learning,* 39, 1953-1971. https://doi.org/10.1111/jcal.12854

Klein, H.J., & Heuser, A.E. (2008). The learning of socialization content: A framework for researching orientating practices. In Martocchio, J.J. (Ed.), *Research in Personnel and Human Resources Management, (pp.279-336),* 27, Emerald Group Publishing Limited. https://doi.org/10.1016/S0742-7301(08)27007-6

Klein, H., & Weaver, N. (2000). The Effectiveness of an Organizational Level Orientation Program in the Socialization of New Hires. *Personnel Psychology*. 53, 47-66.

Knowles, M. (1973). The adult learner: A neglected species. Gulf Publishing Company.

Knowles, M. (1975). Self-directed learning: A guide for learners and teachers. Association Press.

Knowles, M., Holton III, E., Swanson, R., & Robinson, P. (2020). The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development (9th ed.) Routlege. https://doi.org/10.4324/9780429299612

Koal, T. (2020). *Auftragsbezeichnung: Effiziente Entwicklung eingebetteter sicherer Luftfahrtsysteme: Schlussbericht ASSET-2: Laufzeit des Projektes: 01.01.2017-30.03.2020.* [Philotech Systementwicklung und Software GmbH]. https://doi.org/10.2314/KXP:1753281776

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development* (1). Prentice-Hall.

Kortsch, T., Decius, J., & Paulsen, H. (2024). Lernen im Unternehmen. Formal, informell, selbstreguliert. Hogrefe.

Kövesi, K., & Csizmadia, P. (2016). Industry perception of new engineering graduates: The gap between requirements and reality. In *Proceedings of 44th SEFI Conference. Engineering Education on Top of the World: Industry-University Cooperation, SEFI 2016,* held in Tampere. http://sefibenvwh.cluster023.hosting.ovh.net/wp-content/uploads/2017/09/kovesi-industry-perception-of-engineering-graduates-152_a.pdf

Kuckartz, U. (2014). *Qualitative Text Analysis: A Guide to Methods, Practice & Using Software.* Sage Publications.

Kühnlein, G. (1999). *Neue Typen betrieblicher Weiterbildung. Arbeitshilfe für Betriebs- und Personalräte.* Hans Böckler Stiftung.

Kultusministerkonferenz (KMK) – Sekretariat der ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland (2001): Sachstands- und Problembericht zur „Wahrnehmung wissenschaftlicher Weiterbildung an den Hochschulen". Beschluss der

Kultusministerkonferenz vom 21.09.2001. http://www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2001/2001_09_21-Problemberichtwiss-Weiterbildung-HS.pdf

Kurnat-Thoma, E., Ganger, M., Peterson, K., & Channell, L. (2017). Reducing annual hospital and registered nurse staff turnover- A 10-element onboarding program intervention. *SAGE Open Nursing*, 3, 1-13. https://doi.org/10.1177/2377960817697712

Kyndt, E., & Baert, H. (2013). Antecedents of Employees' Involvement in Work-Related Learning: A Systematic Review. *Review of Educational Research,* 83(2), 273-313. https://doi.org/10.3102/0034654313478021

Kyndt, E., & Beausaert, S. (2017). How do conditions known to foster learning in the workplace differ across occupations? In Ellingson, J. E., & Noe, R. A. (Eds.), *Autonomous learning in the workplace* (pp. 201-218). Routledge. https://doi.org/10.4324/9781315674131-11

Leat, M.J., & Lovell, M. J. (1997). Training needs analysis: weaknesses in the conventional approach. *Journal of European Industrial Training,* 21(4), 143-153. https://doi.org/10.1108/03090599710171396

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior,* 45, 79-122.

Levy, M. (1987). *The Core Skills Project and work-based learning: An overview of the development of a new model for the design, delivery and accreditation of vocational education and training.* Manpower Services Commission.

Li, L. C., Grimshaw, J. M., Nielsen, C., Judd, M., Coyte, P. C., & Graham, I. D. (2009). Use of communities of practice in business and health care sectors: a systematic review. *Implementation Science,* 4(27). https://doi.org/10.1186/1748-5908-4-27

Lin, X.-F., Liang, J.-C., Tsai, C.-C., & Hu, Q. (2018). The moderating role of self-regulated learning in job characteristics and attitudes towards web based continuing learning in the airlines workplace. *Australasian Journal of Educational Technology,* 34(1), 102-115. https://doi.org/10.14742/ajet.3198

Lisman, A., Natte, M., & Poell, R. F. (2007). Op zoek naar leerwegtypen van verpleegkundigen [Looking for learning path types for nurses]. *Develop,* 3(2), 22-31.

Littlejohn, A., Milligan, C., Fontana, R. P., & Margaryan, A. (2016). Professional learning through everyday work: how finance professionals self-regulate their learning. *Vocations and Learning,* 9, 207-226. https://doi.org/10.1007/s12186-015-9144-1

Lynch, K., & Buckner-Hayden, G. (2010). Reducing the new employee learning curve to improve productivity. *Journal of healthcare risk management: the journal of the American Society for Healthcare Risk Management*, 29(3), 22-28. https://doi.org/10.1002/jhrm.20020

Malcolm, J., Hodkinson, P., & Colley, H. (2003). The interrelationships between informal and formal learning, *Journal of Workplace Learning*, 15(7/8), 313-318. https://doi.org/10.1108/13665620310504783

Mandl, H., Kopp, B., & Dvorak, S. (2004). Aktuelle theoretische Ansätze und empirische Befunde im Bereich der Lehr-Lern-Forschung – Schwerpunkt Erwachsenenbildung – Deutsches Institut für Erwachsenenbildung. http://www.die-bonn.de/esprid/dokumente/doc-2004/mandl04_01.pdf

Mansfield, B. (1991). Deriving standards of competence. In Fennel, E. (Ed.), *Development of assessable standards for national certification*. Department for Education and Employment.

Mansfield, B. (2004). Competence in transition. *Journal of European Industrial Training*, 28(2/3/4), 296-309. https://doi.org/10.1108/03090590410527672

Mansfield, B., & Mitchell, L. (1996). *Towards a Competent Workforce*. Gower, Aldershot.

Manuti, A., Pastore, S., Scardigno, A. F., Giancaspro, M. L., & Morciano, D. (2015). Formal and informal learning in the workplace: a research review. *International Journal of Training and Development*, 19, 1-17. https://doi.org/10.1111/ijtd.12044

Margaryan, A. (2019). Comparing crowdworkers' and conventional knowledge workers' self-regulating learning strategies in the workplace. *Human Computation*, 6(1), 83-97. https://doi.org/15346/hc.v6i1.5

Margaryan, A., Albert, J., & Charlton-Czaplicki, T. (2022). Workplace Learning in Crowdwork Questionnaire (WLCQ): Measuring Self-regulated Learning and Skill Development in Online Platform Work. *International Journal of Training and Development*, 26(3), 495-515. https://doi.org/10.1111/ijtd.12268

Margaryan, A., Littlejohn, A., & Milligan, C. (2013). Self-regulated learning in the workplace: strategies and factors in the attainment of learning goals. *International Journal of Training and Development*, 17 (4), 245-259. https://doi.org/10.1111/ijtd.12013

Margaryan, A., Milligan, C., & Littlejohn, A. (2012). What is learned through work? A typology of professional learning in the workplace. In Gijbels, D., Donche, V., Van Den Bossche, P., Stets, A., Van Waes, S., and Aerts, A. (Eds.), *Book of Abstracts of the 6th EARLI SIG 14 Learning and Professional Development Conference 'Learning in Transition'* (p. 130). University of Antwerp, Antwerp, Belgium.

Marsick, V. J., & Neaman, A. (2018). Adult informal learning. In N. Kahnwald & V. Täubig (Eds.), *Informelles Lernen* (pp. 53-72). Wiesbaden: Springer Fachmedien. https://doi.org/10.1007/978-3-658-15793-7_4

Marsick, V. J., & Volpe, M. (1999).The Nature and Need for Informal Learning. *Advances in Developing Human Resources*, 1(3), 1-9. https://doi.org/10.1177/152342239900100302

Marsick, V. J., & Watkins, K. E. (1990). *Informal and incidental learning in the workplace*. Routledge.

Marsick V. J., & Watkins, K. E. (2001). Informal and Incidental Learning. *New Directions for Adult and Continuing Education*, 89, 25-34. https://doi.org/10.1002/ace.5

Maslow, A. H. (1987). *Motivation and Personality*. (3rd ed.). Harper and Row.

Maurer, R. (2022, August 20). *The Brave New World of Onboarding*. Society for Human Resource Management. https://www.shrm.org/topics-tools/news/all-things-work/brave-new-world-onboarding

Mazmanian, P. E. (1977). *A Model (Based Upon Open Systems Organizational Theory) For Continuous Educational Needs Assessment In Continuing Professional Education Programs.* Paper presented at the Adult Education Research Conference, Minneapolis, Minnesota.

McClusky, H. Y. (1971). The Adult As Learner. In McNeil, R. J. & Seashore, S. E. (Eds.). *Management of Urban Crisis*. (pp.27–39). The Free Press.

McGhee, W., & Thayer, P. W. (1961). *Training in business and industry.* Wiley.

McGuire, D., Germain, M.L., & Reynolds, K. (2021). Reshaping HRD in light of the COVID-19 pandemic: an ethics of care approach. *Advances in Developing Human Resources*, 23(1), 26-40. https://doi.org/10.1177/1523422320973426

McManus, D.J., & Snyder, C.A. (2003). Knowledge Management: The Role of Epss. *Journal of International Technology and Information Management,* 12(2), 17-28.

Merriam, S. B., Caffarella, R. S., & Baumgartner, L.M. (2007). *Learning in Adulthood: A Comprehensive Guide* (3rd Ed.). John Wiley & Sons.

Merrill, M. D. (2002). First principles of instructional design. *Educational Technology Research and Development,* 50(3), 43–59. https://doi.org/10.1007/BF02505024

Merrill, M. D., Tennyson, R. D., & Posey, L. O. (1992). *Teaching concepts: An instructional design guide* (2nd Ed.). Educational Technology Publications.

Mezirow, J. (1994). Understanding transformation theory. *Adult Education Quarterly*, 44(4), 222-232.

Mezirow, J. (1997). Transformative Learning: Theory to Practice. *New Directions for Adult and Continuing Education,* 74.

Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International Journal of Lifelong Education*, 19(1), 54-72. https://doi.org/10.1080/026013700293458

Milligan, C., Fontana, R. P., Littlejohn, A., & Margaryan, A. (2015). Self-regulated learning behaviour in the finance industry. *Journal of Workplace Learning*, 27(5), 387-402. https://doi.org/10.1108/JWL-02-2014-0011

Mikolajczyk, K. (2021). Changes in the approach to employee development in organisations as a result of the COVID-19 pandemic. *European Journal of Training and Development*, 46(5/6). https://doi.org/10.1108/EJTD-12-2020-0171

Molloy, J.C., & Noe, R.A. (2010). "Learning" a living: continuous learning for survival in today's talent market. In Kozlowski, S.W.J. & Salas, E. (Eds.), *Learning, Training, and Development in Organizations* (pp.333-361). Routledge/Taylor and Francis Group.

Molinsky, A., & Pisman, S. (2019, April 11). *The Biggest Hurdles Recent Graduates Face Entering the Workforce.* Harvard Business Review. https://hbr.org/2019/04/the-biggest-hurdles-recent-graduates-face-entering-the-workforce

Morano, R. (1973). Determining organizational training needs. *Personnel Psychology*, 26, 479-487.

Morgan, K. A. (2015). Solon in Plato. *Trends in Classics*, 7(1), 129-150. https://doi.org/10.1515/tc-2015-0008

Morgan, K. (2023, April 11). *Has quitting become too cool?* BBC Work Life. https://www.bbc.com/worklife/article/20230411-the-great-resignation-has-quitting-become-too-cool

Morris, T. H. (2019). Experiential learning – a systematic review and revision of Kolb's model. Interactive *Learning Environments*, 28(8), 1064-1077. https://doi.org/10.1080/10494820.2019.1570279

Münk, D., & Walter, M. (Eds.). (2017). *Lebenslanges Lernen im sozialstrukturellen Wandel*. Wiesbaden: Springer VS. https://doi.org/10.1007/978-3-658-14355-8_8

Munro, K.M. (2008) Continuing Professional Development and the Charity Paradigm: Interrelated Individual, Collective and Organisational Issues about Continuing Professional Development. *Nursing Education Today*, 28(8), 953-961. http://dx.doi.org/10.1016/j.nedt.2008.05.015

Müskens, W., & Lübben, S. (2015). Die Erfassung formell und informell erworbener Lehrkompetenzen in der wissenschaftlichen Weiterbildung. In Hartung, O., Rumpf, M. (Eds.) *Lehrkompetenzen in der wissenschaftlichen Weiterbildung. Theorie und Empirie Lebenslangen Lernens* (pp.109-131). Springer VS, Wiesbaden. https://doi.org/10.1007/978-3-658-08869-9_7

Nitsche, S., Dickhäuser, O., Fasching, M. S., & Dresel, M. (2011). Rethinking Teachers' Goal Orientations: Conceptual and Methodological Enhancements. *Learning and Instruction*, 21, 574–586. https://doi.org/10.1016/j.learninstruc.2010.12.001

Noe, R., Clarke, A., & Klein, H. (2014). Learning in the Twenty-First-Century Workplace. *Annual Reviews of Organizational Psychology and Organizational Behavior*, 1, 245-275. http://dx.doi.org/10.1146/annurev-orgpsych-031413-091321

Noe, R. A., & Ellingson, J. E. (2017). Autonomous Learning in the Workplace: An Introduction. In Ellingson, J. E. and Noe, R. A. (Eds.), *Autonomous Learning in the Workplace* (pp. 1-12). Routledge. https://doi.org/10.4324/9781315674131-6

Nolan, M., Owens, R., Curran, M. & Venables, A. (2000). Reconceptualising the outcomes of Continuing Professional Development. *International Journal of Nursing Studies*, 37 (5), pp.457-67.

Nonaka, I. (1991). The Knowledge Creating Company. *Harvard Business Review*, 69, 96-104.

Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-creating Company.* Oxford University Press.

O'Connell, P. (1999). *Adults in Training: An International Comparison of Continuing Education and Training.* Organisation for Economic Co-operation and Development.

OECD. (2007, July). Lifelong Learning and Human Capital, Policy Brief. July 2007. http://www.oecd.org/dataoecd/43/50/38982210.pdf

O'Reilly, A. P. (1973). Skill requirements: Supervisor-subordinate conflict. *PERSONNEL PSYCHOLOGY*, 26 (1), 75-80. https://doi.org/10.1111/j.1744-6570.1973.tb01118.x

Otto, B., Perels, F., & Schmitz, B. (2011). Selbstreguliertes Lernen. In: Reinders, H., Ditton, H., Gräsel, C., & Gniewosz, B. (Eds.) Empirische Bildungsforschung. VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-93021-3_3

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning Styles: Concepts and Evidence. *Psychological Science in the Public Interest*, *9*(3), 105-119. https://doi.org/10.1111/j.1539-6053.2009.01038.x

Palalas, A., & Wark, N. (2020). The relationship between mobile learning and self-regulated learning: a systematic review. *Australasian Journal of Educational Technololgy*, 36(4), 151-172. https://doi.org/10.14742/ajet.5650

Panadero, E. (2017). A Review of Self-regulated Learning: Six Models and Four Directions for Research. *Frontiers in psychology*, 8, 422. https://doi.org/10.3389/fpsyg.2017.00422

Paruzel, A., Danel, M., & Maier, G. W. (2020). Scrutinizing Social Identity Theory in Corporate Social Responsibility: An Experimental Investigation. *Frontiers in Psychology*, 11, 580620. https://doi.org/10.3389/fpsyg.2020.580620

Pennings, H.J.M., Bottenheft, C., Van de Boer-Visschedijk, G.C., & Stubbé, H.E. (2020). Judging informal learning interventions: a vignette study. *Journal of Workplace Learning*, 32(1), 1-15. https://doi.org/10.1108/JWL-02-2019-0027

Perkins, D. (1992). *Smart Schools: From Training Memories to Training Minds.* The Free Press.

Permats, E., & Östman Ellison, O. (2021). *The Effects of National and Organizational Culture on the Onboarding Process for Engineers in Multinational Midsize Companies: A Qualitative Analysis of the Onboarding Process at Zound Industries.* KTH School of Industrial Engineering and Management.

Pfeiffer, I., Dauser, D., Gagern, S., Hauenstein, T., Kreider, I., & Wolf, M. (2019). *Weiterbildungsförderung in Deutschland. Bestandsaufnahme und Analyse aktuell genutzter Instrumente.* f-bb-Dossier, 01/19.

Piaget, J. (1970). Piaget's theory. In Mussen, P. (Ed*.), Carmiachael's manual of child psychology* (1, pp. 703-732). John Wiley.

Pilling-Cormick, J., & Garrison, D.R. (2007). Self-directed learning and self-regulated learning: conceptual links. *Canadian Journal of University Continuing Education,* 33 (2) 13-32.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Education Research*, 31(6), 459-470. https://doi.org/10.1016/S0883-0355(99)00015-4

Pintrich, P. R. (2000). The Role of Goal Orientation in Self-Regulated Learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press. https://doi.org/10.1016/B978-012109890-2/50043-3

Pintrich, P. R., Wolters, C. A., & Baxter, G. P. (2000). 2. Assessing Metacognition and Self-Regulated Learning. In Schraw, G., & Impara, J. C. (Eds.), Issues in the Measurement of Metacognition (pp. 43–97). Buros Institute of Mental Measurements. http://digitalcommons.unl.edu/burosmetacognition/3

Pintrich, P.R., & De Groot, E.V. (1990). Motivational and Self-regulated learning components of classroom academic performance. *Journal of Educational Psychology,* 82, 33-40.

Poell, R. F. (2005). HRD beyond what HRD practitioners do: A framework for furthering multiple learning processes in work organizations. In C. Elliott, & S. Turnbull (Eds.), *Critical thinking in human resource development* (pp. 85-95). Routledge.

Poell, R. F. (2017). Time to 'flip' the training transfer tradition: Employees create learning paths strategically. *Human Resource Development Quarterly*, *28*(1), 9–15. https://doi.org/10.1002/hrdq.21279

Poell, R.F., Chivers, G.E., van der Krogt, F.J., & Wildemeersch, D.A. (2000). Learning-network theory: organizing the dynamic relationships between learning and work. *Management Learning*, 31(1), 25-49.

Poell, R. F., & Van Der Krogt, F. J. (2016). Employee strategies in organising professional development. In Billett, S., Dymock, D. & Choy, S. (Eds.), *Supporting learning across working life: Models, processes and practices* (p. 29-46). Springer. https://doi.org/10.1007/978-3-319-29019-5_2

Poell, R. F., Lundgren, H., Bang, A., Justice, S. B., Marsick, V. J., Sung, S. & Yorks, L. (2018). How do employees' individual learning paths differ across occupations? A review of 10 years of empirical research. *The Journal of Workplace Learning,* 30(5), 315-334.

Porath, C. L., & Bateman, T. S. (2006). Self-Regulation: From Goal Orientation to Job Performance. *Journal of Applied Psychology*, 91(1), 185–192. https://doi.org/10.1037/0021-9010.91.1.185

Pourtoulidou, D., & Frey, A. (2020). Developing a joint training course for German Aerospace Companies. In *Proceedings of the 2nd International Academic Conference on Teaching, Learning and Education* (pp.44-52). Diamond Scientific Publishing. https://www.doi.org/10.33422/2nd.tleconf.2020.11.63

Pourtoulidou, D., & Frey, A. (2021), Blended Learning in Aerospace Companies' Training Course: Conversion of a Classroom-Based Training to Blended Format. In Heiß H.-U., Järvinen, H.-M., Mayer A., & Schulz A. (Eds.), *Proceedings of the SEFI 49th Annual Conference: Blended Learning in Engineering Education: Challenging, Enlightening and Lasting?* (pp.1154-1162). https://doi.org/10.5821/conference-9788412322262.1257

Puustinen, M. & Pulkkinen, L. (2001). Models of Self-regulated Learning: A review. *Scandinavian Journal of Educational Research*, 45(3), 269-286. http://dx.doi.org/10.1080/00313830120074206

Queeney, D. S. (2000). Continuing professional education. In Wilson, A. & Hayes E. (Eds.), *Handbook of adult and continuing education,* (pp. 375-392). Jossey-Bass.

Reglin, T. (2009). *Ziele des Einsatzes von eLearning in der beruflichen Bildungsarbeit.* [PhD Thesis, Friedrich-Alexander-Universität Erlangen-Nürnberg. https://open.fau.de/handle/openfau/984

Reich, A., Rooney, D., Gardner, A., Willey, K., Boud, D., & Fitzgerald, T. (2015). Engineers' professional learning: a practice-theory perspective. *European Journal of Engineering Education,* 40(4), 366-379. http://dx.doi.org/10.1080/03043797.2014.967181

Riding, R. & Cheema, I. (1991). Cognitive Styles: An Overview and Integration. *Educational Psychology,* 11, 193-215. https://doi.org/10.1080/0144341910110301

Robbins, S. R., & Judge, T.A. (2023). *Organizational Behavior*. 19th edition. Pearson Education.

Rogowski, B. A., Calhoun, B. M., & Tallal, P. (2014). Matching Learning Style to Instructional Method: Effects on Comprehension. *Journal of Educational Psychology,* 197(1), 64-78. https://doi.org/10.1037/a0037478

Röhr-Sendlmeier, U. M., & Käser, U. (2012). Das Lernen komplexer sprachlicher Strukturen - Wissenserwerb nach unterschiedlichen Lernmodi. In Röhr-Sendlmeier, U. M. (Hrsg.), Inzidentelles Lernen. *Wie wir beiläufig Wissen erwerben* (pp. 43-85). Logos-Verlag.

Rollag, K., Parise, S., & Cross, R. (2005). Getting new hires up to speed quickly. *MIT Sloan Manager Review,* 26(2), 35-41.

Rotgans, J., & Schmidt, H. (2009). Examination of the context specific nature of self-regulated learning. *Educational Studies,* 35(3), 239-253. https://doi.org/10.1080/03055690802648051

Roth, B. B., Asbjornsen, A., & Manger, T. (2016). The relationship between prisoners' academic self-efficacy and participation in education, previous convictions, sentence length, and portion of sentence served. *Journal of Prison Education and Reentry,* 3(2), 106-121. http://dx.doi.org/10.15845/jper.v3i2.1040

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54-67. https://doi.org/10.1006/ceps.1999.1020

Salas, A. (2013). *To SAM or not to SAM?* Stylelearn.

Salas, E. & Kozlowski, S. (2012). Learning, Training, and Development in Organizations: Much Progress and a Peek Over the Horizon. In Kozlowski, S.W.J. & Salas, E. (Eds.), *Learning, Training, and Development in Organizations* (pp.461-476). Routledge/Taylor and Francis Group.

Salas, E., Tannenbaum, S. I., Kraiger, K., & Smith-Jentsch, K. A. (2012). The Science of Training and Development in Organizations: What Matters in Practice. *Psychological Science in the Public Interest, 13*(2), 74-101. https://doi.org/10.1177/1529100612436661

Sambrook, S. (2005). Factors Influencing the Context and Process of Work-Related Learning: Synthesizing Findings from Two Research Projects. *Human Resource Development International,* 8(1), 101–119. https://doi.org/10.1080/1367886052000342591

Sammet, J., & Wolf, J. (2019). *Vom Trainer zum agilen Lernbegleiter.* Springer.

Sarma, S., Flowers Ford, F., Floewers Ford, D., & Bonvillian, W. B. (2020, October). *Applying New Education Technologies to Meet Workforce Education Needs*. Research Brief for the MIT Work of the Future project: MIT Work of the Future research brief.

Sava, S. (2012). *Needs Analysis and Programme Planning in Adult Education.* Barbara Budrich Publishers.

Savicevic, D. (1999). *Adult education: From practice to theory building.* Peter Lang.

Schiefele, U., & Pekrun, R. (1996). Psychologische Modelle des fremdgesteuerten und selbstgesteuerten Lernens. In Weinert, F. E. (Hrsg.), *Enzyklopädie der Psychologie. Band 2: Psychologie des Lernens und der Instruktion* (pp. 250–278). Hogrefe.

Schiersmann, C. (2007). *Berufliche Weiterbildung*. Vs Verlag für Sozialwissenschaften.

Schmitz, B. (2001). Self-Monitoring zur Unterstützung des Transfers einer Schulung in Selbstregulation für Studierende. Eine prozessanalytische Untersuchung. *Zeitschrift für Pädagogische Psychologie.* 15, 181–197.

Schmitz, B., & Wiese, B. S. (2006). New perspectives for the evaluation of training sessions in self-regulated learning: Time-series analyses of diary data. *Contemporary Educational Psychology*, *31*(1), 64–96. https://doi.org/10.1016/j.cedpsych.2005.02.002

Schürmann, E., & Beausaert, S. (2016). What are drivers for informal learning? *European Journal of Training and Development,* 40(3), 130–154. https://doi.org/10.1108/EJTD-06-2015-0044

Schweiger, A. (2021). *ProMethEuS - Software-Produktlinien und Methoden zur Entwicklung sicherer Systeme in der Luft- und Ramfahrt: Schlussbericht.* [Airbus Defence & Space GmbH.] https://doi.org/10.2314/KXP:181519426X

Segers, M., Messmann, G., & Dochy, F. (2018). Emergence, theoretical foundation, and conceptualisation of informal learning at work. In Messman, G., Segers, M. & Dochy, F. (Eds.), *New Perspectives on Learning and Instruction*. *Informal Learning at Work: Triggers, Antecedents, and Consequences* (pp. 1-11). CRC Press.

Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where to go. *Psychological Bulletin,* 137(3), 421-442. https://psycnet.apa.org/doi/10.1037/a0022777

Sloots, M. (2008). *Leerwegcreatie: (on)afhankelijk van werken in teamverband.* [Learning path creation: (in)dependent on teamwork]. Master's thesis Education Studies, Nijmegen: Radboud Universiteit, The Netherlands.

Smet, K., Grosemans, I., De Cuyper, N., & Kyndt, E. (2022). Outcomes of Informal Work-Related Learning behaviours: A Systematic Literature Review. *Scandinavian Journal of Work and Organizational Psychology,* 7(1), 2, 1-18. https://doi.org/10.16993/sjwop.151

Smith, R. E (1984). Employee orientation: 10 steps to success. *The Personnel Journal*, 63 (12), 46-48.

Smith, P. (2003). Workplace Learning and Flexible Delivery. *Review of Educational Research*, 73(1), 53–88. https://doi.org/10.3102/00346543073001053

Smith, R.J., & Kelly, A. (2016). Workers' Perspectives and Preferences for Learning Across Working Life. https://doi.org/10.1007/978-3-319-29019-5_12

Smith, P., Wakefield, L., & Robertson, I. (2002*). Preparing for flexible delivery. Learners and their workplaces.* Adelaide National Centre for Vocational Education Research

Snell, A. (2006). Researching onboarding best practice: Using research to connect onboarding processes with employee satisfaction, *Strategic HR Review*, 5(6), 32-35.

Stetar, B. (2005). Training: It's Not Always the Answer, *Quality Progress,* 38(3), 44-49.

Sutter, A. (2021). *ASSET2 - Avionic System Software Embedded Technology 2: Entwicklung innovativer Konzepte für automatisierte Testverifikation und parallele Architekturen sowie Beitrag zur embedded Softwareentwicklung: Schlussbericht zum Vorhaben ASSET-2: Berichtszeitraum: 01.01.2017 bis 30.09.2020.* [Bericht, Liebherr-Aerospace Lindenberg GmbH]. https://doi.org/10.2314/KXP:1787291537

Sweller, J. (1988). Cognitive Load During Problem Solving: Effects on Learning. *Cognitive Science*, 12(2), 257-285. https://doi.org/10.1207/s15516709cog1202_4

Sze-yeng, F., & Hussain, R. M. R. (2010). Self-directed learning in a socioconstructivist learning environment. *Procedia - Social and Behavioral Sciences*, 9, 1913–1917. https://doi.org/10.1016/j.sbspro.2010.12.423

Tannenbaum, S. I., Beard, R. L., McNall, L. A., & Salas, E. (2010). Informal Learning and Development in Organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp. 303-332). Routledge.

Taylor, E. (2000). Fostering Mezirow's Transformative Learning Theory in the Adult Education Classroom: A Critical Review. *Canadian Journal for the Study of Adult Education*,14(2), 1-28.

Tennant, M. C. (1986). An evaluation of Knowles' theory of adult learning. *International Journal of Lifelong Education*, 5(2), 113-122, https://doi.org/10.1080/0260137860050203

Tennant, M. C. (1993). Perspective Transformation and Adult Development. Adult Education Quarterly, 44(1), 34-42. https://doi.org/10.1177/0741713693044001003

Tews, M. J., Michel, J. W., & Noe, R. A. (2017). Does fun promote learning? The relationship between fun in the workplace and informal learning. Journal of Vocational Behavior, 98, 46-55. http://dx.doi.org/10.1016/j.jvb.2016.09.006

Thejovathi, K.S., & Krishnan, L. R. K. (2020). Learning preferences of millennials in R&D work environment in the IT industry. *International Journal in Commerce, IT & Management*, 10(6), 1-6.

Thompson, K. S. (2016). Organizational Learning Support Preferences of Millennials. *New Horizons in Adult Education and Human Resource Development*, *28*(4), 15-27. https://doi.org/10.1002/nha3.20158

Tjepkema, S., Stewart, J., Sambrook, S., Mulder, M., ter Horst, H., & Scheerens, J. (2002). *HRD and learning organisations in Europe*. Routledge.

Tynjälä, P. (2013). Toward a 3-P Model of Workplace Learning: a Literature Review. *Vocations and Learning*, 6, 11–36. https://doi.org/10.1007/s12186-012-9091-z

UNESCO (2020, April). *National Education Responses to COVID-19. Summary report of UNESCO's online survey.* https://unesdoc.unesco.org/ark:/48223/pf0000373322?posInSet=36&queryId=N-eda9541d-2fee-47ff-9a4d-fd4edaf5a392

Vahs, D. (2023). *Organisation: Ein Lehr- und Managementbuch* (11th ed.). Schäffer-Poeschel.

van Breda-Verduijn, H., & Heijboer, M. (2016). Learning culture, continuous learning, organizational learning anthropologist. *Industrial and Commercial Training*, 48(3) 2016, 123-128. https://doi.org/10.1108/ICT-11-2015-0074

Vancouver, J. B., Halper, L. R., & Bayes, K. A. (2017). Regulating our own learning: Stuff you did not realize you needed to know. In Ellingson, J. E. and Noe, R. A. (Eds.), *Autonomous Learning in the Workplace* (pp. 95-116). Routledge. https://doi.org/10.4324/9781315674131-6

van den Heuvel, M. (2019, May 07). Digitaler Wandel: Arbeitsmarkt 2030: Was kommt auf Ingenieure zu? VDI. https://www.vdi.de/themen/nachwuchs-ausbildung-arbeitsmarkt/digitale-zukunft

van de Wiel, M.W.J., Szegedi, K.H.P., & Weggeman, M.C.D.P. (2004). Professional learning: Deliberate attempts at developing expertise. In: Boshuizen, H.P. A., Bromme, R., & Gruber, H. (Eds.), *Professional Learning: Gaps and transitions on the way from novice to expert* (pp. 181-206). Kluwer.

an der Krogt, F. J. (1998). Learning network theory: The tension between learning systems and work systems in organizations. *Human Resource Development Quarterly*, 9, 157–177

Van Laer, S., & Elen, J. (2020). Adults' Self-Regulatory Behaviour Profiles in Blended Learning Environments and Their Implications for Design. *Tech Know Learn*, 25, 509-539. https://doi.org/10.1007/s10758-017-9351-y

van Houten-Schat, M. A., Berkhout, J. J., van Dijk, N., Endedijk, M. D., Jaarsma, A. D. C., & Diemers, A. D. (2018). Self-regulated learning in the clinical context: a systematic review. *Medical education*, *52*(10), 1008–1015. https://doi.org/10.1111/medu.13615

Van Maanen, J., & Schein, E.H. (1979). Toward of Theory of Organizational Socialization. *Research in Organizational Behavior,* 1, 209-264.

Verein Deutscher Ingenieure e.V. (VDI) (April, 2019a). *Ingenieurausbildung für die digitale Transformation: Zukunft durch Veränderung.* VDI-Studie. https://www.vdi.de/ueber-uns/presse/publikationen/details/vdi-studie-ingenieurausbildung-fuer-die-digitale-transformation

Verein Deutscher Ingenieure e.V. (VDI) (May, 2023a). *VDI-/IW-Ingenieurmonitor 4. Quartal 2022.* https://www.vdi.de/ueber-uns/presse/publikationen/details/vdi-iw-ingenieurmonitor-4-quartal-2022

Verein Deutscher Ingenieure e.V. (VDI) (July, 2023b). *VDI-/IW-Ingenieurmonitor 1. Quartal 2023.* https://www.vdi.de/ueber-uns/presse/publikationen/details/vdi-iw-ingenieurmonitor-1-quartal-2023

Vu, T., Bennett, D., & Ananthram, S. (2023) Learning in the workplace: newcomers' information seeking behaviour and implications for education. *Studies in Continuing Education,* 45(2), 208-227. https://doi.org/10.1080/0158037X.2022.2041593

Wahba, M. A., & Bridwell, L. G. (1976). Maslow reconsidered: A review of research on the need hierarchy theory. *Organizational Behavior and Human Performance, 15* (2), 212-240.

Watkins, K., & Marsick, V. (1992). Towards a theory of informal and incidental learning in organizations. *International Journal of Lifelong Education*, 11(4), 287-300. https://doi.org/10.1080/0260137920110403

Weinstein, C. E., Husman, J., & Dierking, D. (2000). Self-Regulation interventions with a focus on learning strategies. In Boekaerts, M., Pintrich, P., & Zeidner, M., *Handbook of Self-Regulation* (pp. 727-747). Academic Press.

Weinstein, C. E., & Meyer, D. K. (1991). Cognitive learning strategies and college teaching. *New Directions for Teaching & Learning,* 45, 15-26. https://doi.org/10.1002/tl.37219914505

Weinstein, C. E., Palmer, D., & Schulte, A. C. (1987). *Learning and Study Strategies Inventory (LASSI).* H & H Publishing.

Welk, S., Kortsch, T., & Kauffeld, S. (2023). How to Foster Informal Learning. *Zeitschrift für Arbeits- und Organisationspsychologie,* 67(2), 92-106. https://doi.org/10.1026/0932-4089/a000394

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity.* Cambridge University Press.

Wenger-Trayner, E., Fenton-O'Creevy, M., Hutchinson, S., Krubiak, C., & Wenger-Trayner, B. (Eds.). (2015). *Learning in landscapes of practice: Boundaries of identity, and knowledgeability in practice-based learning.* Routledge.

Willemse, B. M., de Jonge, J., Smit, D., Depla, M. F., & Pot, A. M. (2012). The moderating role of decision authority and coworker-and supervisor support on the impact of job demands in nursing homes: A cross-sectional study. *International Journal of Nursing Studies,* 49(7), 822-833 https://doi.org/10.1016/j.ijnurstu.2012.02.003

Williamson, K. (1998). Discovered by chance: The role of incidental information acquisition on an ecological model of information use. *Library and Information Science Research*, 20, 23-40. https://doi.org/10.1016/S0740-8188(98)90004-4

Winne, P. H. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences*, 8, 327-353.

Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In Zimmerman, B. J., and Schunk, D. H. (Eds.), *Handbook of Self-Regulation of Learning and Performance* (pp.15-32). Routledge.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In Hacker, D.J., Dunlosky, J., & Graesser. A. C. (Eds.), *Metacognition in educational theory and practice* (pp.277-304). Erlbaum.

Witkin, H. A. (1962). *Psychological differentiation: studies of development.* Wiley.

Witkin, H. A., & Goodenough., D.R. (1981). *Cognitive styles: essence and origins*. International Universities Press.

Witkin, H. A., Moore, C. A., & Goodenough, D. R. (1977). Field dependence and field independence, cognitive styles and their educational implications. *Review of Educational Research*, 47(1), 1-64.

World Economic Forum. (2023). *Future of Jobs Report 2023, Insight Report* https://www.weforum.org/reports/the-future-ofjobs-report-2023/

Yolles, M. (2009). Competitive advantage and its conceptual development: An exploration. *Business Information Review*, *26*(2), 93-111. https://doi.org/10.1177/0266382109104411

Young, M. F. (1993). Instructional design for situated learning. *Educational Technology Research and Development*, 41(1), 43–58.

Zahidi, S. (2020, January 22). *We need a global reskilling revolution – here's why"*. World Economic Forum. https://www.weforum.org/agenda/2020/01/reskilling-revolution-jobs-future-skills/

Zemke, R. (1985). The Honeywell studies: How managers learn to manage, *Training*, 22(8), 46-51.

Zerzan, J. T., Hess, R., Schur, E., Phillips, R. S., & Rigotti, N. (2009). Making the most out of mentors: A guide for mentees. *Academic Medicine,* 84(1), 140-144. https://doi.org/10.1097/ACM.0b013e3181906e8f

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81, 329-339. https://doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J. (1998). Academic Stydying and the Development of Personal Skill: A Self-Regulatory Perspective. *Educational Psychologist*, 33(2/3), 73-86.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: an overview. *Theory Into Practice*, 41(2), 64-70.

Zimmermann, H. (2009). *Weiterbildung im späteren Erwerbsleben.* wbv.

Zoller, T. (2021). *Abschlussberict zum Vorhaben: Avionic System Software Embedded Technologie-2 (ASSET-2): Teilvorhaben der AES Aerospace Embedded Solutions GmbH: "Entwicklung neuer Technologien für die bessere Beherrschung der Projektkomplexität und zur Wiederverwendung von Software" (ASSET-2_AES): Luftfahrtforschung und -technologie: Laufzeit des Vorhabens: 01.01.2017 bis 30.09.2020*. [AES Aerospace Embedded Solutions GmbH]. https://doi.org/10.2314/KXP:1789738814

Appendices

A. Transcription Guidelines

Guidelines	Example in the Text
Each spoken contribution is transcribed as a separate paragraph, including short interjections from other people.	"Yes," "No," "Exactly," “Aha”, “Hm”
Paragraphs of the person conducting the interview are introduced by “I:” and those of the person being interviewed are introduced by unique abbreviations “T…”.	“T11:”, “T21:”
It is transcribed word for word, not phonetically or summarily. Existing dialects are not transcribed but translated as accurately as possible into standard English or German so that the texts can be searched easily.	I’m not = I am not
Pauses longer than 3 seconds are marked with:	(…)
Particularly emphasized terms are highlighted in bold.	**Text**
External disturbances are noted in double brackets, stating the cause.	(telephone ringing)
If a person laughs during the interview, it is marked with:	(laughing) or (lacht)
Incomprehensible words and passages are marked with:	(unv.)
Names of cities, companies, colleagues, trainers, participants etc., are anonymized and noted in brackets, stating the topic:	(Company’s Name)

B. Data Consent Form I

Einverständniserklärung

Ich _____

(Name, Vorname)

erkläre, dass ich die Teilnehmendeninformation zum Forschungsprojekt:

Forschungsprojekt:	*Avionik System Software Embedded Technologie 2*
	WP5.1 Aus- und Weiterbildung
Durchführende Institution:	*Technische Hochschule Ingolstadt*
Projektleitung:	*Prof. Dr. Andreas Frey*
Interviewerin:	*Despoina Pourtoulidou*
Interviewdatum:	_____

und diese Einverständniserklärung zur Interviewteilnahme erhalten habe.

- ✓ Ich wurde für mich ausreichend mündlich und/oder schriftlich über die wissenschaftliche Forschung informiert.
- ✓ Ich erkläre mich bereit, dass die Informationen im Rahmen des Telefoninterviews s anonymisiert aufgezeichnet und verarbeitet werden. Nach erfolgter Auswertung wird die Aufzeichnung ausnahmslos vernichtet. Die Technische Hochschule Ingolstadt gewährleistet, dass alle Informationen sowie meine personbezogenen Daten nicht an Dritte weitergegeben werden. Bei wissenschaftlichen Veröffentlichungen wird aus den Daten nicht hervorgehen, wer an dieser Untersuchung teilgenommen hat. Meine persönlichen Daten sowie die Interviewaufzeichnung unterliegen dem Datenschutzgesetz und werden nach Beendigung des Forschungsprojekts ausnahmslos gelöscht.
- ✓ Ich weiß, dass ich jederzeit meine Einverständniserklärung, ohne Angabe von Gründen, widerrufen kann, ohne dass dies für mich nachteilige Folgen hat.
- ✓ Mit der vorstehend geschilderten Vorgehensweise bin ich einverstanden und bestätige dies mit meiner Unterschrift.

_____ _____

(Ort, Datum) (Unterschrift)

C. Data Consent Form II - German

Einverständniserklärung

Ich _____

(Name, Vorname)

erkläre, dass ich die Teilnehmendeninformation zum Forschungsprojekt:

Forschungsprojekt:	*Integrierte Design und Entwicklungsumgebung für Aerospace WP4.3 Wissenstransfer*
Durchführende Institution:	*Technische Hochschule Ingolstadt*
Projektleitung:	*Prof. Dr. Andreas Frey*
Interviewerin:	*Despoina Pourtoulidou*
Interviewdatum:	_____

und diese Einverständniserklärung zur Interviewteilnahme erhalten habe.

- ✓ Ich wurde für mich ausreichend mündlich und/oder schriftlich über die wissenschaftliche Forschung informiert.
- ✓ Ich erkläre mich bereit, dass im Rahmen des Forschungsprojekts Daten über mich gesammelt, aufgezeichnet und anonymisiert transkribiert werden. Es wird gewährleistet, dass meine personenbezogenen Daten nicht an Dritte weitergegeben werden. Bei wissenschaftlichen Veröffentlichungen wird aus den Daten nicht hervorgehen, wer an dieser Untersuchung teilgenommen hat. Meine persönlichen Daten sowie die Interviewaufzeichnung unterliegen dem Datenschutzgesetz.
- ✓ Ich weiß, dass ich jederzeit meine Einverständniserklärung, ohne Angabe von Gründen, widerrufen kann, ohne dass dies für mich nachteilige Folgen hat.
- ✓ Mit der vorstehend geschilderten Vorgehensweise bin ich einverstanden und bestätige dies mit meiner Unterschrift.

_____ _____

(Ort, Datum) (Unterschrift)

D. Data Consent Form II - English

Participation Consent Form

I

_____

(Surname, Name)

confirm that I am informed orally or in writing about the Research project:

Research project:	*Integrierte Design und Entwicklungsumgebung für Aerospace WP4.3 Wissenstransfer*
University:	*Technische Hochschule Ingolstadt*
Project manager:	*Prof. Dr. Andreas Frey*
Researcher:	*Despoina Pourtoulidou*
Date of the Interview:	_____

and that:

- ✓ I agree to my interview being audio-recorded. The audio recording made during this interview will be available only for the interviewer. No other use will be made of them and no one apart from the interviewer will be allowed access to the original recordings.
- ✓ My anonymity will be preserved at all stages of this research, and no information that identifies me will be made publicly available in case of scientific publications, e.g., dissertations, scientific papers, and project reports.
- ✓ I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without any consequences for me of any kind.
- ✓ I agree to take part in the above study.

_____ _____

(Place, Date) (Signature)

E. Prior-Training Questionnaire - I

Prior-training Questionnaire

Thank you for taking the time to complete this survey, you will need approximately 10 minutes. We truly value the information you will provide us. Your responses will contribute to the development of our training course "Requirement Engineering and Embedded Architecture and Design". This training is part of the WP5.1 in the Research Project ASSET-2 that aims at the development of a training course for software engineers with or without former experience in aerospace software engineering & relevant parts of the system engineering. The research is conducted by Ingolstadt University of Applied Sciences - Technische Hochschule Ingolstadt, seeks to improve this training course and does not evaluate the employee's knowledge or performance. This questionnaire explores the educational background and experience of the participants and their expectations regarding training courses generally and specifically about these topics.

The anonymity of the participants is guaranteed and no personal data will be required to complete this survey. Any acquired information will be only in-house available and not for the project partners or your employers. The project report will be at your disposal after completion of the research project. If you have any questions or comments on the survey or the project, feel free to contact us at despoina.pourtoulidou@thi.de.

1. What is your highest level of education?
    a. Bachelor's degree
    b. Master's degree
    c. Diplom[33]
    d. Doctorate degree
    e. Other:
    ……
    ……

2. What was your field of study? By different fields, please mention also each type of studies.
    ……
    ……
    ……
    ……

3. How many years of professional experience do you have and in which field?
    ……
    ……
    ……
    ……

4. Which is the field you are now working on?
    ……
    ……

[33] Certificate / academic degree for the completion of study in higher education with obligatory study period more than 3 years.

……
……

5. How familiar are you with the following topics?

	Not at all	Slightly	Moderately	Very
Types of Requirements				
Derived Requirements				
Requirement Meta-Data				
Embedded Architecture & Design				
Criteria for good Low-Level-Requirements				
Data-Flow				
Control-Flow				
Cohesion				
Methods of Architecture				
Contract Based Design				
Re-Use of Requirements				

6. How much experience do you have with writing requirements?
    a. I have never been involved in writing requirements.
    b. I have worked with requirements but not written requirements myself.
    c. I have written requirements.
    d. I have written and reviewed requirements.

7. Have you ever participated in a training course during your professional career?
    a. No
    b. Yes

If yes, how often do you participate in a training course considering the last 3 years?
Please give approximately a number of times: _____

8. Have you ever participated in an online training course during your professional career?
    a. No
    b. Yes

If yes, how often do you participate in an online training course considering the last 3 years?
Please give approximately a number of times: _____

9. Which kind of the following types of training courses do you prefer?
    a. Traditional classroom courses (offline)
    b. Online courses (computer based courses)

Can you give us a reason as an example for your preference?
……
……
……

10. Which kind of training courses do you prefer?
    a. Mostly the ones with practical exercises
    b. Mostly the ones with theoretical parts
    c. Both with theory and practice

11. Which of the following aspects do you find important for a training course?

	Not at all important	Less important	Important	Very important	Extremely important
Clear learning objectives					
Relevant content to my work					
High quality of course material					
Structure of the program					
Variety of teaching methods					
Practice					
Group activities					
Interaction with fellow participants					
Use of technology					
Methods of assessment					
Evaluation of the course after participation					

F. Post-Training Questionnaire - I

Post-training Questionnaire

Thank you for taking the time to complete this survey, you will need approximately 10 minutes. We truly value the information you will provide us. Your responses will contribute to the development of our training course "Requirement Engineering and Embedded Architecture and Design". This training is part of the WP5.1 in the Research Project ASSET-2 that aims at the development of a training course for software engineers with or without former experience in aerospace software engineering & relevant parts of the system engineering. The research is conducted by Ingolstadt University of Applied Sciences - Technische Hochschule Ingolstadt, seeks to improve this training course and does not evaluate the employee's knowledge or performance. This questionnaire explores the experiences of the participants made during the training and their personal evaluation of the course as a feedback for further improvement.

The anonymity of the participants is guaranteed and no personal data will be required to complete this survey. Any acquired information will be only in-house available and not for the project partners or your employers. The project report will be at your disposal after ASSET-2 completion. If you have any questions or comments on the research project, feel free to contact us at despoina.pourtoulidou@thi.de.

Despoina Pourtoulidou
Prof. Dr. Andreas Frey
Technische Hochschule Ingolstadt
Esplanade 10, D-85049 Ingolstadt
www.thi.de

1. Please indicate your level of agreement with the statements listed below.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The objectives of the training were clearly defined.					
The training objectives were met.					
The training was well structured.					
The quality of course materials was high.					
The topics covered were relevant to me.					
The teaching methods were appropriate.					
The variety of teaching methods enhanced the understanding of the topics.					
The discussion with experts from the industry allowed me to gain a better and deeper understanding of the subject matter.					
The practical exercises allowed me to gain a better and deeper understanding of the subject matter.					
Participation and interaction were encouraged.					
The time allotted for the training was sufficient.					
The meeting room and facilities were adequate and comfortable.					
The potential value as future reference material is high.					
This training experience will be useful in my work.					

2. In your opinion, to what extent did this training cover following aspects?

	Not at all	A little	Adequate	A lot	Completely
Clear learning objectives					
Relevant to my work					
High quality of course material					
Structure of the program					
Variety of teaching methods					
Practice					
Group activities					
Interaction with fellow participants					
Use of technology					
Methods of assessment					
Evaluation of the course after participation					

3. Please indicate in which topics would you want more, less or same amount of information:

	Not at all	Less	Neutral	More	Much more
Types of Requirements					
Derived Requirements					
Requirement Meta-Data					
Embedded Architecture & Design					
Criteria for good Low-Level-Requirements					
Data-Flow					
Control-Flow					
Cohesion					
Methods of Architecture					
Contract Based Design					
Re-Use of Requirements					

Other:

……

……

4. Please indicate your level of agreement with following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like to be able to skip a chapter with which I am already familiar.					
I would like to be able to manage myself how much time I dedicate to each chapter.					
I would like to be able to manage myself how much time I dedicate to each topic.					
I would like to have access to such trainings online through a digital platform.					

5. Which further aspects of the training are eligible for improvement?

……

……

……

……

G. Interview Guidelines - I

Semi-Structured Interview / Leitfadengestützte Interviews

Introduction

Zuerst bedanke ich mich für Ihre/deine Zeit und Ihre/deine Bereitschaft, mir im Rahmen dieses Projekts und meiner Dissertation ein Interview zu geben. Ihre/deine Antworten werden zur Entwicklung der Weiterbildungsschulung des Arbeitspakets 5.1 im Forschungsprojekt ASSET-2 für Softwareingenieure mit oder ohne vorherige Erfahrung in der Luft- und Raumfahrtsoftwareentwicklung und relevanten Teilen der Systemtechnik beitragen.

Die Forschung wird von der Technische Hochschule Ingolstadt durchgeführt, strebt, wie bereits erwähnt, die Weiterentwicklung der Schulung an und bewertet weder das Wissen noch die Leistung des Mitarbeiters. Ihre Anonymität ist garantiert und es werden keine personenbezogenen Daten benötigt. Die erfassten Informationen sind nicht für die Projektpartner oder Ihre Arbeitgeber erhältlich und werden streng vertraulich und anonymisiert nur für wissenschaftlichen Zwecke verwendet.

Ich habe dazu eine Vereinbarung zum Datenschutz vorbereitet. Sie können sich /Du kannst dich die Erklärung durchlesen und unterschreiben, wenn diese für Sie/dich passend ist. Ihre /Deine Angaben werden vertraulich behandelt und anonymisiert.

A. Einverständniserklärung

Da ich unser Gespräch nicht vollständig erinnern werde, bitte ich dich um Erlaubnis das Gespräch aufzunehmen. Nach Art. 5 der Datenschutzgrundverordnung (DSGVO) Grundsätze für die Verarbeitung personenbezogener Daten wird unser Gespräch vertraulich nur für wissenschaftliche Zwecke verwendet.

Gibt es von Ihrer/deine Seite noch Fragen?

Wenn Sie keine weiteren Fragen haben, würde ich nun mit dem Interview beginnen.

Identifizieren: Einsteiger oder Quereinsteiger

B. Erinnerung an das Training „Requirement Engineering und Embedded Architecture and Design“: Kurze Zusammenfassung der Inhalte

C. Rückblick auf den Training-Kurs
   1. Was war für dich neu / bekannt? Was hast du gelernt?

   2. Wie würdest du deine Kenntnisse oder Fähigkeiten nach dem Besuch des Kurses einschätzen?

   3. Hast du etwas aus dem Training bereits in deiner Arbeit genutzt? Wenn ja, → Könntest du mir eine Situation aus deiner Arbeit beschreiben wo du dich gemerkt hast, dass der Kurs dir geholfen hat?

4. Könntest du mir ein paar Beispiele geben, wo du gemerkt hast, dass dieses Training für dich nützlich wird.

5. Welche von deinen Lernbedürfnisse hat dieses Training abgedeckt?

6. Was hat dir gut bei diesem Training gefallen?

7. Was hat dir nicht gut gefallen?

D. Verbesserungsvorschläge bezüglich ihren Lernbedürfnissen & der Adaptivität des Trainingskurses

8. Was würdest du ändern?

9. Wie würdest du den Kurs anders gestalten?

10. Was würdest du für dich bei den Inhalten ändern?

11. Was würdest du für dich bei den Lernmaterialien ändern? Z.B. Anderer Form: digitaler Zugang?

12. Was würdest du für dich bei dem Zeitrahmen ändern?

E. Persönliche Lernbedürfnisse

13. Welche sind deine Lernbedürfnisse als Mitarbeiter/in?

14. Welche sind deine persönlichen Lernpräferenzen? Wie lernst du am liebsten wenn du die freie Wahl hast? Z.B. Bücher, Internetrecherche, Kontakt & Austausch mit Kollegen und/oder Experten/innen

15. Wie würdest du lieber deine Lernbedürfnisse abdecken? Z.B. durch schriftliche und/oder digitale Literatur, Workshops/ Trainingskursen, Expertengespräche, andere?

F. Nutzen & Notwendigkeit des Kurses: Einen Überblick über die erwähnten Themengebiete zu bekommen: (regarding fields of aerospace software engineering & relevant parts of the system engineering)

16. Wie würdest du die Notwendigkeit / das Nutzen des Kurses bewerten? eher allgemeines (oder/ und wichtiges) Wissen für dich?

17. Wo siehst du das Nutzen des Kurses für dich?

18. Würdest du dieses Training an anderen Kollegen weiterempfehlen?

    a. Berufseinsteiger/innen
    b. Quereinsteiger/innen

19. Siehst du das Nutzen dieses Trainings für Einsteiger/innen höher oder niedriger als für Quereinsteiger/innen? Und warum?

20. Welche Unterschiede entstehen deiner Meinung nach zwischen Einsteiger/innen und Quereinsteiger/innen, die man unbedingt bei der Entwicklung des Kurses beachten soll?

21. Fällt Ihnen/ dir sonst noch etwas ein in diesem Kontext?”

H. Prior-Training Questionnaire - II

Prior Training Questionnaire

Thank you for taking the time to complete this survey, you will need approximately 10 minutes. We truly value the information you will provide us. Your responses will contribute to the development of our training course “Fundamentals in Avionics Software Development”. This training is part of the WP4.3 in the Research Project IDEA that aims at the development of a training course for software engineers with or without former experience entering aerospace software engineering.

The research is conducted by Ingolstadt University of Applied Sciences - Technische Hochschule Ingolstadt, seeks to improve this training course and does not evaluate the employee’s knowledge or performance. This questionnaire explores the experiences of the participants made during the training and their personal evaluation of the course as feedback for further improvement.

The anonymity of the participants is guaranteed and no personal data will be required to complete this survey. Any acquired information will be only in-house available and not for the project partners or your employers. The project report will be at your disposal after IDEA completion. If you have any questions or comments on the research project, feel free to contact us at despoina.pourtoulidou@thi.de.

Despoina Pourtoulidou
Prof. Dr Andreas Frey
Technische Hochschule Ingolstadt
Esplanade 10, D-85049 Ingolstadt
www.thi.de

1. What is your highest level of education?
    a. Bachelor's degree
    b. Master's degree
    c. Diplom[34]
    d. Doctorate degree
    e. Other:……

2. What was your field of study? By different fields, please also mention each type of study.
    ……
    ……
    ……

3. How many years of professional experience do you have, and in which field?
    ……
    ……
    ……

4. Which is the field you are now working on?
    ……
    ……
    ……

5. Please mark how familiar you are with the following topics:

	Not at all	Slightly	Moderately	Very
Verification				
Review Objectives				
Verification Levels				
DO-Concept for Verification				
DO-Objectives for Reviews				
Criteria to use in Simulations				
Test Methods				
Structural Coverage				
Black Box / White Box Testing				
Automated Tests				
Continuous Integration				
Model-based Test Development				
Procedure Generation				

[34] Certificate / academic degree for the completion of study in higher education with obligatory study period more than 3 years.

6. Have you ever participated in a training course during your professional career?
    a. No
    b. Yes

If yes, how often do you participate in a training course considering the last 3 years?
Please give approximately a number of times: _____

7. Have you ever participated in an online training course during your professional career?
    a. No
    b. Yes

If yes, how often do you participate in an online training course considering the last 3 years?
Please give approximately a number of times: _____

8. Have you ever participated in a blended training course[35] during your professional career?
    a. No
    b. Yes

If yes, how often do you participate in an online training course considering the last 3 years?
Please give approximately a number of times: _____

9. Which kind of the following types of training courses do you prefer?
    a. Traditional classroom courses (offline)
    b. Online courses (via a digital platform)
    c. Blended courses

Can you give us a reason as an example for your preference?
……
……

10. Which kind of training courses do you prefer?
    a. Mostly the ones with practical exercises
    b. Mostly the ones with theoretical parts
    c. Both with theory and practice

[35] Blended course is a course that includes an online part (via a digital platform) and a face-to-face session.

11. Please mark which of the following aspects you find important for a training course.

	Not at all important	Less important	Important	Very important	Extremely important
Clear learning objectives					
Relevant content to my work					
High quality of course material					
Structure of the training course					
Variety of teaching methods					
Practical exercises					
Group activities					
Interaction with fellow participants					
Use of technology					
Evaluation of the course after participation					

I. Post-Training Questionnaire - II

Post Training Questionnaire

Thank you for taking the time to complete this survey, you will need approximately 10 minutes. We truly value the information you will provide us. Your responses will contribute to the development of our training course “Fundamentals in Avionics Software Development”. This training is part of the WP4.3 in the Research Project IDEA that aims at the development of a training course for software engineers with or without former experience entering aerospace software engineering.

The research is conducted by Ingolstadt University of Applied Sciences - Technische Hochschule Ingolstadt, seeks to improve this training course and does not evaluate the employee’s knowledge or performance. This questionnaire explores the experiences of the participants made during the training and their personal evaluation of the course as a feedback for further improvement.

The anonymity of the participants is guaranteed and no personal data will be required to complete this survey. Any acquired information will be only in-house available and not for the project partners or your employers. The project report will be at your disposal after IDEA completion. If you have any questions or comments on the research project, feel free to contact us at despoina.pourtoulidou@thi.de.

Despoina Pourtoulidou
Prof. Dr Andreas Frey
Technische Hochschule Ingolstadt
Esplanade 10, D-85049 Ingolstadt
www.thi.de

1. Please indicate your level of agreement with the statements listed below regarding this training.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The objectives of the training were clearly defined.					
2. The training objectives were met.					
3. The training was well structured.					
4. The quality of course materials was high.					
5. The topics covered were relevant to me.					
6. The teaching methods were appropriate.					
7. The variety of teaching methods enhanced the understanding of the topics.					
8. The discussion with experts from the industry allowed me to gain a better and deeper understanding of the subject matter.					
9. The practical exercises allowed me to gain a better understanding of the subject matter.					
10. The interaction with fellow participants was valuable.					
11. The time allotted for the training was sufficient.					
12. The meeting room and facilities were adequate and comfortable.					
13. The potential value as future reference material is high.					
14. This training experience will be useful for my career.					

2. Did you engage with the online material in the Moodle platform during the online phase of the training?

a. No
b. Yes
- If no, do you plan to until February 2022 that you will have access to the training?

……
……

3. Please indicate your level of agreement with following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I participated at the online phase with no problems.					
2. I like to be able to skip a chapter that I am already familiar with.					
3. I like to be able to manage myself how much time I dedicate to each chapter (e.g. V1 is a chapter).					
4. I like to be able to manage myself how much time I dedicate to each topic (e.g. V1-1 is a topic).					
5. I like to be able to self-regulate my participation at the quizzes.					
6. I prefer face-to-face over online training courses.					
7. I prefer online over face-to-face training courses.					
8. I like the combination of online and face-to-face sessions as part of a training.					
9. I find the blended concept (=online and face-to-face sessions) of this training satisfying.					

4. What did you like most about the training?

……
……
……

5. What did you not like about the training?

……
……
……

6. Do you have any suggestions that can help us improve the training program?

……
……
……

Thank you!

J. Interview Guidelines German - II

Semi-Structured Interview / Leitfadengestützte Interviews

(1) Introduction

Zuerst bedanke ich mich für deine Zeit und deine Bereitschaft, mir im Rahmen dieses Projekts und meiner Dissertation ein Interview zu geben. Deine Antworten werden zur Entwicklung der Weiterbildungsschulung „Fundamentals in Avionics Software Development“ beitragen. Die Forschung wird von der Technische Hochschule Ingolstadt durchgeführt und strebt die Weiterentwicklung der Schulung an und bewertet weder das Wissen noch die Leistung der Teilnehmenden. Deine Anonymität ist garantiert und es werden keine personenbezogenen Daten benötigt. Die erfassten Informationen sind nicht für unsere Projektpartner oder deine Arbeitgeber erhältlich und werden streng vertraulich und anonymisiert nur für wissenschaftlichen Zwecke verwendet.

(2) Einverständniserklärung

Ich habe dazu eine Vereinbarung zum Datenschutz vorbereitet. Du kannst dir die Erklärung durchlesen und unterschreiben, wenn diese für dich passend ist. Deine Angaben werden vertraulich behandelt und anonymisiert. Da ich mich an unser Gespräch nicht vollständig erinnern werde, bitte ich dich um Erlaubnis das Gespräch aufzunehmen. Nach Art. 5 der Datenschutzgrundverordnung (DSGVO) Grundsätze für die Verarbeitung personenbezogener Daten wird unser Gespräch vertraulich nur für wissenschaftliche Zwecke verwendet.

(3) Erinnerung an das Training „Requirement Engineering und Embedded Architecture and Design“:

Gibt es von deiner Seite noch Fragen? Wenn du keine weiteren Fragen haben, würde ich kurz dich an die Inhalte des Trainings erinnern. Die Online Phase via Moodle ist am Anfang August gestartet und die Präsenzveranstaltung am 12. Oktober in Ingolstadt stattgefunden. Die Inhalte beziehen sich auf Verification. Die Kapitel auf die Moodle Platform beinhalten ein oder mehrere Videos für jedes Thema bzw. Topic, die Präsentationsfolien und ein Quiz.

(4) Rückblick auf den Training-Kurs

1. Wie war deine Erfahrung an dem Verification-Training?
    a. Online Phase (02.08-11.10.2021 oder danach falls du dich wieder eingeloggt hast)
    b. F2f am 12.10.2021
    c. Team Event am 11.10.2021
2. Wie hast du dich mit dem Training auseinandergesetzt? Hast du dir die Trainingsmaterialien angeschaut z.B. im Moodle die Videos angeschaut? Die Quizzes gemacht? Ein Quiz wiederholt? Ein Video wieder angeschaut?

3. Was hat dir gut bei diesem Training gefallen?
4. Was hat dir nicht gut gefallen?

5. Was würdest du ändern? Wie würdest du den Kurs anders gestalten?
6. Was würdest du für dich bei den Lernmaterialien ändern? Z.B. Anderer Form: digitaler Zugang?

7. Was würdest du für dich bezüglich Inhalte oder Themen wünschen?
8. Was würdest du bezüglich Lernmethoden, Übungen etc. wünschen?
9. Was würdest du für dich bei dem Zeitrahmen ändern?

10. Wie würdest du deine Kenntnisse oder Fähigkeiten nach dem Besuch des Kurses einschätzen?
11. Was war für dich neu / bekannt? Was hast du gelernt?

12. Wo siehst du den Nutzen des Kurses für dich?
13. Welche von deinen Lernbedürfnisse hat dieses Training abgedeckt?
14. Hast du etwas aus dem Training bereits in deiner Arbeit genutzt?
15. Wenn ja, → Könntest du mir eine Situation aus deiner Arbeit beschreiben wo du dich gemerkt hast, dass der Kurs dir geholfen hat?
16. Könntest du mir ein paar Beispiele geben, wo du gemerkt hast, dass dieses Training für dich nützlich wird. Sowohl während des Trainings als auch danach (ab 02.08, vor dem Präsenztag 12.10?)

17. Wie würdest du die Notwendigkeit / den Nutzen des Kurses bewerten? eher allgemeines (oder/ und wichtiges) Wissen für dich?
18. Wie siehst du den Nutzen der Online Phase für dich und für deine Zukunft?
19. Wie siehst du den Nutzen der Präsenzveranstaltung für dich und für deine Zukunft?
20. Würdest du ein konkretes Teil des Trainings als wichtiger/ wertvoller für dich? Z.B. Übungen, Videos/Theorie, Expertendiskussionen, Team Event?
21. Würdest du dieses Training an anderen Kollegen weiterempfehlen?

Wir haben bisher über den Kurs geredet und jetzt reden wir über dich:

22. Hast du bis heute an einem anderen Blended Training Kurs teilgenommen privat oder in deiner jetzigen Firma/Arbeitgeber? Oder Präsenztraining? Was hat es dir da gefallen?
23. Hast du bis heute an einem anderen Präsenztraining Kurs teilgenommen privat oder in deiner jetzigen Firma/Arbeitgeber? Was hat es dir da gefallen?
24. Was war etwas, dass dir an einem anderen Kurs guten Eindruck gemacht hat?
25. Welche sind deine persönlichen Lernpräferenzen?
26. Wie bildest du dich weiter? Wie hältst du dich auf dem Laufenden des Stands der Technik?
27. Wie lernst du am liebsten wenn du die freie Wahl hast? Z.B. Bücher, Internetrecherche, Kontakt & Austausch mit Kollegen und/oder Experten/innen?

28. Welche sind deine Lernbedürfnisse als Mitarbeiter/in?
29. Wie würdest du lieber deine Lernbedürfnisse abdecken? Z.B. durch schriftliche und/oder digitale Literatur, Workshops/ Trainingskursen, Expertengespräche, andere?
30. Was machst du, wenn ein Kurs, an dem du teilnimmst, nicht so 100% zu dir passt?

31. Fällt dir sonst noch etwas ein, was du mir erzählten möchtest?

K. Interview Guidelines English - II

Semi-Structured Interview

(1) Introduction

Thank you for giving me the opportunity to discuss and ask you several questions about our training course that you attended on October 12th of 2021. You contribute to the development of the training course "Fundamentals in Avionics Software Development" and my PhD research.

This training is part of the WP4.3 in the Research Project IDEA and aims at the development of a training course for software engineers with or without former experience in aerospace software engineering & relevant parts of system engineering. The research is conducted by Ingolstadt University of Applied Sciences, seeks to improve this training course, and does not evaluate your knowledge or performance. Your anonymity is guaranteed and no personal data will be required. Any acquired information will be only available in-house and not for the project partners or your employers.

(2) Declaration of consent to the collection and processing of data by Ingolstadt University of Applied Sciences

I ask you to sign the declaration of consent for the collection and processing of data by us. It is impossible to fully remember our conversation; therefore, I ask for your permission to record it. The recorded file will only be used for research purposes and all personal data will be excluded from the transcription.

(3) Reminding the training: Summary of the Topics

Do you have any other questions? If not, I want to briefly remind you of our agenda and the topics of the training since the training started on Aug 2nd, 2021, and the f2f session took place 2-3 months ago. So, the online phase, where you could access the training through the Moodle platform, contains material about verification. In the Moodle Platform, each chapter contains a video or videos about each topic, the presentation slides of the video(s), and, at the end, a Quiz.

(4) Training Course

1. How did you experience the Verification training (general question)?
    a. the Online phase since August 2nd via Moodle?
    b. the F2f session on October 12th in Ingolstadt
    c. the team event on October 11th
2. How did you engage with the training's material (e.g. did you check all the Videos and documents in the Moodle platform, did you re-watch a video, did you re-take a quiz)?

3. What did you like about this course (online+f2f)?
4. What did you not like about this course (online+f2f)?

5. What would you like to be different during the online phase?
6. What would you like to be different during the face-to-face session?

7. What would you like to be different regarding the topics: e.g. more in -depth content in particular topics?
8. What would you like to be different regarding teaching methods? exercises?
9. What would you like to be different regarding the time frame?

10. How would you assess your knowledge after the training? How do you feel about your knowledge or skills after taking the course?
11. What was new for you from the training materials? What was already known for you?

12. Have you ever participated in a blended training course? If not, in a face-to-face training? What was something that you like about it?
13. What did make a good impression on you in the training course that you have participated till today?

14. How do you assess the gain of this training course for you?
15. Were there any learning needs of yours covered? Could you mention one example? To what extent were the identified learning needs of yours achieved?
16. Is there something specific that you learned and you know it will be useful for you professionally in the future? How?
17. Where? To what extent?
18. Could give an example where you realized that something from the training will be useful for you later? During the training or afterward.

19. How do you assess the gain of this training course for you and your future career overall?
20. How do you assess the gain of the online phase for you?
21. How do you assess the gain of the face-to-face session for you?
22. Would you assess one of these parts as more important/valuable?
23. Would you suggest this blended training to other employees/ colleagues?

24. What are your personal learning preferences?
25. How do you stay informed/updated about the new technology? How do you educate yourself?
26. How do you prefer to learn something if you have the freedom to choose, e.g., from books, from online material, from discussion with colleges or experts, from training courses?

27. What are your personal learning needs as an employee?
28. Do you feel that you have certain learning needs at this time of your career?
29. What do you personally do to cover your learning needs?
30. What do you do when you are participating in a training course and it doesn't cover your learning needs 100%?

31. Is there anything else that you want to add here? Generally, comment on something about the course.

L. Code System

Main Cat.	Category	Sub-category	Definition: is always on the right of the category or marked with a '='	Code-Example from the interviews "#" = Number of the Interview, "§" = Number of the paragraph *If there is no example, it means there is no code in this category because all codes are subdivided into subcategories.
1. Learning preferences	How the participants prefer to learn something, what actions do they follow, if they could freely choose a tool or a process.			
	1.1 Attend training	The participants stated that they choose to learn something by participating in a training.		*Inhaltlich, ja, prinzipiell werde ich immer Schulungen besuchen, wo mich die Themen entweder interessieren oder die ich beruflich grad brauch* *#26, §82*
		1.1.1 F2F	The participants' opinions & statements about classroom-based training with face-to-face interactions.	*Ich mache auch Präsenz Veranstaltungen, die haben einen anderen, die haben die soziale Komponente mit dabei. Das darf man auch nicht vernachlässigen und bei bestimmten Trainings ist es auch ganz schön, wenn man dann jemanden hat, der einen erklärt und man direkt nachfragen kann.* *#23, §54*
		1.1.2 Online	Participants' opinions & statements about trainings that take place online in a digital environment	*But if I want, if I have the goal of, let's say, learning deeply about a topic, then I would say an online course would be pretty much, would be yeah a good idea and what I would do, I mean, imagine that I want to learn for example, in this case, to develop my knowledge about image processing, then I would very likely do a course, it is what I have done for example, what I wanted to learn about parallel programming. So, programming for GPUs, eh, multi core CPUs, then I did a course about that* *I: Online?* *T29: Yes, in Coursera or Udemy or things like that, and then you get, let's say solid, solid grounds for your knowledge and then from that, of course, that, that will not be enough when you want to develop an application, but then it builds a solid ground from which you can start* *#29, §167-169*
	1.2 Combination of techniques	The participants stated to use simultaneously different techniques in order to learn something.		*eine gute Kombi, also, erstmal selbst anlernen, Quiz machen, gucken ob man noch igrnedwo noch offene Frage hat und dann kann man die diskutioeren, ist gut* *#23, §42*

	1.3 Depends on	The participants stated that the selection of actions in order to learn, differs and depends on the available time, goals and information, which they want to learn/acquire.		*Es kommt darauf an, es kommt auf den Fall darauf an, aber bevorzugt schriftlich oder mit einem Experten dann* *#13, §38*
		1.3.1 Available time	how much time the participants have, when they want to learn sth. The participants choose an action to learn which can be quickly implemented no matter the source and way of acquiring it.	*also, wenn ich etwas schnell brauche, würde ich Internetrecherche machen und mir die Informationen selber zusammensuchen,* *#19, §94*
		1.3.2 Content	whether the subject of what they want to learn has to do with theory or on-hand practical knowledge e.g. software: for theory they prefer f2f and for practical topics they prefer online learning methods.	*Mhm, na ja kommt darauf an, wenn es etwas Generelles ist, ja dann frage ich natürlich Google erst und schaue ich da ob ich einen groben Überblick bekomme, ähm, um mich ein bisschen einzuarbeiten. Der nächste Schritt wäre wahrscheinlich, dass ich im Unternehmen einfach einen Spezialisten suche, der Mitarbeiter helfen kann und ich darüber fragen kann. Wenn es da auch keine Antworten gibt, ja, dann würde ich mich wahrscheinlich im letzten Schritt äh darüber erkundigen, ob mich jemand darüber außerhalb des Unternehmens helfen kann.* *#110, §43*
		1.3.3 Learning goals	what do the participants want to learn and why	*Ähm das ist jetzt die Frage, wenn es bloß ein Detail ist über das ich nicht Bescheid weiß, dann hilft es natürlich schon einfach mal nachzufragen, wenn es jetzt ein Thema ist von dem ich grundsätzlich keine Ahnung habe, hilft mir entweder wieder ein Kollege weiter oder ein geführter Kurs ist natürlich auch sehr praktisch dann.* *#26, §46*
	1.4 Discuss with colleagues	The participants state that they ask/ discuss with colleagues if they want to learn something.		*oder mit Kollegen über einen Kaffee mal darüber diskutieren, wie er das sieht, was er für Erfahrungen hat, wenn es eben schon jemandem gibt. Im Kollegenkreis finde ich es eigentlich das einfachste, weil man da zumindest schon zwar mit einer Meinung behaftet, aber zu mindestens schon auf Erfahrung zurückgreifen kann,* *#21, §178*
	1.5 In a group/ collectively	The person describes a situation when learning together with other people.		*Ähm, ja, also, ich denke schon in einer Gruppe zu lernen, also, ich rede von Uni-Zeiten, noch daran denkt, schon öfter in der Gruppe, also, ein Teil selber im Selbststudium in Ruhe lernt, aber ein Teil in der Gruppe in der Diskussion untereinander, dadurch, dass man auch gegenseitig Sachen erklärt, die man selber verstanden hat z.B., bringt äh, einen guten Effekt* *#14, §45*
	1.6 Something on my own	The participants refer to an action of learning, which they can implement on their own without any other person involved.		*am Anfang würde ich mir oder bringe ich mir selber was bei oder gucke mir an, ähm, hol mir Informationen oder informiere ich mir selber über das Thema, ähm, und wenn ich dann, soweit, verstanden habe* *#25, §44*

		1.6.1 Doing exercises	apply the information, e.g., solving equations, running a code		*Übungen sind sehr wichtig, weil nur durch Übungen kann man dann das was man, kann man rausfinden, ob das man, was gelernt hat, richtig verstanden hat* *#22, §77*
		1.6.2 Repetition	either a task is repeatedly practiced or information is re-read as memorization technique		*ich bin immer der Freund von Wiederholung, ähm, weil, ja, du kriegst es einmal erzählt, du findest alles toll, vielleicht hast du dann nochmal irgendwie Zeit auf dem Weg nach Hause dann irgendwie im Zug das Ganze anzugucken* *#12, §38*
			1.6.2.1 Flashcards	use cards as an aid to learning (memorizing information and testing themselves-active recall)	*Oder bei einer Sprache, wie man, da muss ich auch erstmal lesen, wie konjugiert man Wörter und dann kann man lustige Verben nehmen und kann die (lachen) den schreiben oder Hieroglyphen z.B. habe ich mir gerne Flaschkards gemacht, die eine Seite Hieroglyphe, auf der anderen Seite wie spricht man das aus und so dann mit Karteikarten einfach. Ich bin ein visueller Lerntyp* *#22, §119*
			1.6.2.2 Re-writing	write text sequences again and again in order to memorize it	*ganz allgemein persönlich für dich, wie lernst du?* *T13: Mit abschreiben* *I: Aha* *T13: Abschreiben und lernen* *#13, §66-69*
			1.6.2.3 Note-taking/summarizing	write down important information about something they are reading/watching/attending & sum up content	*Ja, wenn ich jetzt wirklich auf so Test oder so was lerne, wie einmal für mein DGQ-Qualitätsmanagementbeauftragten, dann mache ich mir am Endeffekt so eine Art Spickzettel, und schreibe da die Kernelemente von dem, was wir da gelernt haben, runter und äh, äh, die müssen dann mehr oder weniger schon öfters wiederholt werden und alle auswendig gelernt. Das ist so mein Ding* *#12, §68*
		1.6.3 Research & read	The participants mentioned that they search for information and then study it.		*Ah, eh, yes, yes, I think that my studies play a role, because in my study, I used to eh, how can, how can I explain it? In my study, I learned how to go, to go, ehm, eh, I mean, to search for new topics in internet, new topics, I haven't hear about it before and all, I mean, during my study, I was just doing that, most of the time we have project and you have not heard about that topic before and you have to, eh, to learn many things by yourself and actually, I think it's, it helps me to, ehm, it helped me to learn things, new things, because most of the time I have not asked us,* *#210. §136*

			1.6.3.1 In a library	They look for a book in the (university) library and then reading it in order to learn what they are searching for.	*Ja, ich hab mir einfach Bücher aus der Bibliothek geholt* *I: Aha ok* *T22: und hab die auf meinem Schreibtisch gelegt und dann hab die vergessen (lachen)* *I: Und dann* *T22: Nein, ich hab da nachgeguckt (lachen) das Wissen ist (unv.) gegangen (lachen) Nein, ich habe natürlich nachgeguckt, weil ich irgendwas, ähm, ich habe die Codes gehabt, die vorher schon jemand geschrieben hatte und wenn ich da irgendwas nicht gekannt hab oder so habe ich dann nachgeschaut in dem Buch und auch wenn ich selber nicht mehr wusste, wie man irgendwas programmiert, dann habe ich einfach das Buch genommen, hab durchgesucht, had geguckt und hab ich meistens was gefunden* *#22, §155-159*
			1.6.3.2 Internal document retrieval	They look for the desired information/answer within company's library/database, in documents which are stored somewhere in the company in physical or digital state.	*Ja, also, wir haben eine kleine Bibliothek oder ähm, ja, Bibliothek, also, wir haben halt Bücher innerhalb unserer Firma und die sind sogar online eingetragen, also, man sieht online welche Bücher es gibt und also, da habe ich mich auch schon bedient und geguckt "ah ja ok, das ist ein interessantes Buch, das leihe ich mir mal aus und schaue da mal rein" ja, das habe ich auch schon gemacht* *#25, §54*
			1.6.3.3 Internet search (Google)	They look for information in the world wide web and maybe search for information directly in google.	*Wenn ich mich weiterbilden muss, dann muss sowieso ins große, weite Internet (lacht) außer ich gucke, dass es irgendeine Schulung dafür gibt, ja* *I: Hm, also erst mal Internet? also wenn ich dich fragen würde wie* *T23: Ja, ja, klar* *I: Und* *T23: Also ich habe noch ein Fachbuch dort darüber rumliegen, ja. Da kann man auch mal reingucken, aber Internet ist halt einfach schnell* *#23, §66-70* *I just go to google, try to look, type the question I look for and try to choose something* *#27, §49*
			1.6.3.4 Online forums	They search for information in forums' posts.	*dann habe ich meine Fachforen oder subreddit die quasi die News ganz automatisch sprudeln.* *#211, §74*

			1.6.3.5 Scholarly research	They search in published articles for information.	*oder wenn man wirklich an der Spitze der Forschung unterwegs ist, dann wirklich die Papers lesen, mehrfach lesen, genervt sein und dann nochmal lesen* *#21, §178*
			1.6.3.6 Social media	They follow specific training organizers, companies or experts on LinkedIn/Twitter/YouTube.	*auf Twitter oder so was* *I: Ok* *T22: Da gibt's auch manchmal interessante Ideen von Leuten oder ja* *#22, §123-125*
			1.6.3.7 Specific websites	They know and visit purposely these website when they look for sth e.g. Wikipedia, Software's / product's website.	*Like nature? Or the other Discovery Channel, too, eh, there are some some others that are in Spanish, so maybe (laugh) not so well known for the English speaking but Sataka? I don't know if you heard it, probably not because they write in Spanish* *#29, §165*
			1.6.3.8 Watch tutorials	They look online for a video with the explanation of a subject or procedure.	*Ähm, dann suche ich mir gerne irgendwelche Tutorials* *#15, §42*
		1.6.4 Trial & error	running a code / software, failing, trying again by changing something, failing, trying again, …, maybe succeeding		*also, äh, so oft zumindest mathematische Sachen oder auch so neue Programmiersprache aneignen, äh, oder eben Algorithmen zu durchsteigen ist einfachste bei mir zumindest sehr viel „ich muss es ausprobieren". Ich muss auf die Nase fallen, muss es nochmal machen, muss nochmal auf die Nase fallen* *#21, §162*
	1.7 Training development	Participants' opinions about the characteristics of a training/and what it entails.			
		1.7.1 Blended	with both offline and online content		*Mixed is better, because it is also good to have the opportunity to talk in person not only with the professor and with you but also with the other participants. Then, in many cases people is asking questions that maybe you didn't think of or yeah, this kind of things that only come after put in perspective eh, of different people into the same place. I think it is very beneficial. You can also do that with some kind of forum-style included in the campus but it is not the same* *#29, §61*

		1.7.2 Demonstrative explanations	sb shows how sth is performed / solved / functioning in order to make it clear	*Ähm bei den Beispielen wäre schon wichtig gewesen das Format, dass man von der Formatierung ein Requirement anschaut* *I: Aha* *T13: und dass man vielleicht das erste Beispiel zusammen macht mit jemandem, also, mit dem Dozenten und dass der anhand der Beispiele genauer erklärt wie man das mach* *#14, §23-25*
		1.7.3 Exercises	doing activities upon a specific topic	*finde Übungen gut, um das Verständnis zu vertiefen. Das hilft mir wahnsinnig viel, wenn ich was quasi genauer verstehen will und wenn ich mich dann selber noch reinkopf, dann kommen ganz anderen Fragen in mir selbst auf als wenn ich nur zuhöre. Da bekomme ich langfristig ein besseres Verständnis und dann würde ich schon dafür, dass man versucht quasi so viel Theorie wie nötig, aber nicht mehr wie nötig* *#16, §22*
		1.7.4 Frequent tests	answering quizzes in a regular base in order to show how much they know about a topic	*ich meine, wenn man halt, wenn man halt ein Material also was zum Lernen verteilt, in dem derjenige auch selber daran interessiert ist, das zu lernen und ich könnt überlegt habe, ob das auch vielleicht einen Mehrwert darstellt, wenn man auch in dieser Online Phase auch gewisse Meilensteine hineinlegt, damit man die Leute auch animiert dazu auch in Zwischenschritten sich dieses Wissen anzueignen und nicht dann am Tag vor der Präsenz Veranstaltung alles noch mal anschaut oder alles anschaut und erst dann feststellt: Ah, ich habe die Hälfte nicht verstanden (lachen) und äh, meistens ist es dann auch nur schnell, schnell und dann ist es nicht vielleicht, nicht so vernünftig angeschaut worden, wenn man vielleicht, du hast ja gesagt, ihr habt so ein Quiz drin gehabt* *#212, §75*
		1.7.5 Learner's role	what the participant of a training is expected to do	*ich weiß nicht ob man das den Teilnehmern entscheiden sollte, weil der, der weiß ja noch nichts, wenn er damit anfängt. Ich glaube das sollte sich lieber der überlegen, der den Kurs macht und nicht der Teilnehmer* *#24, §227*
		1.7.6 Networking/interaction	meeting new people who might be useful in the participants' career and having the opportunity to converse	*auch in der Gruppe, wo man da sich noch austauschen kann. Ich finde das hat schon große Vorteile* *#14, §19*

		1.7.7 Offer a certificate	after completing the training, the participants can acquire an official document, which verifies their successful participation	*Do you want to test your knowledge that you took from the training?* *T210: Exactly, exactly, because when I invest time in learning something from new, new topics or something else, I would like at the end to, a little evaluate my knowledge.* *I: Okay, you want, okay and is it important for you also to get a paper, a certificate of participation?* *T210: Exactly, something like that, yeah* *#210, §9-12*
		1.7.8 Slides	when do the participants access the slides of the presentation / training material	*Also, wenn ich während des Trainings die exakten Folien, die präsentiert werden, schon vor mir habe, habe ich natürlich den Vorteil, ich kann mir direkt Notizen machen, aber vielleicht den Nachteil, dass ich eher die Folien vor mir ja durchlese, bevor sie präsentiert werden. Also, dass ich nicht ganz aktiv zuhöre. Das ist jedenfalls meine Erfahrung.* *#18, §36*
		1.7.9 Summary	the main points of the training or separate parts of it are presented shortly	*Ich bin immer ein Freund, wie gesagt, davon noch mal das Prägnante irgendwie hervorzuheben* *#23, §106*
		1.7.10 Trainer's availability	the participants should be able to contact the trainer or get feedback during the online phase	*Yeah, yeah, but if there is the option to do it f2f then maybe I would go for that, instead of writing it in the forum I would wait, that is actually what I did. I would not write in the forum and then I would say it in the moment, in the f2f session* *#29, §65*
		1.7.11 Trainer's gestures & speech	how sb sounds when giving a lecture and how sb moves and appear while giving an online lecture	*Wenn es hier zu sehr, zu sehr wie abgelesen klingt, dann langweilt mich das eher,* *#212, §6* *Ähm, das hängt davon ab, wenn es nur so eine Vorlesung ist, wo man die Folien sieht und einer im Hintergrund spricht, dann, ich mag lieber so wo man auch das Gesicht und die Gestik dazu sieht, wenn es eine Vorlesung im Internet ist* *#19, §84*

2. Problem-solving	2.1 Ask a more experienced colleague - expert	the participants turn for help to a colleague that they know is more skillful and possesses the necessary information or has developed the software they are working with.		*Aber wenn ich weiß, dass Kollegen davon Ahnung haben, dann frage ich Kollegen* *#18, §44*
	2.2 Ask/discuss with colleagues	the participants ask colleagues, if they know something about a topic and discuss it.		*ich meistens an Arbeitskollegen fragt man nach: hast du das schon Erfahrung gemacht? Und wenn natürlich die Antwort kommt, dass da wenig Erfahrung ist, dann dann muss ich ja dann, muss ich doch mal noch mal im Internet nach recherchieren. Genau, aber ich meine eigentlich aktuell sind es eher Kollegen und dann dann Internet.* *#212, §17*
	2.3 Ask somebody near me	The participants ask a colleague that sits near them or is within reach.		*wenn ich einen Kollegen in Reichweite habe, dann frage ich ihn zuerst, sonst geht es mit der Google Suche weiter.* *#26, §42*
	2.4 Database (DO)	The participants mentioned that they look for documents with restricted access, like the DO, which contains software considerations in airborne systems and equipment certification.		*Also, wenn wirklich ganz explizit irgendwie ein Problem, dann diese blöde DO ausschlagen und hoffen, dass irgendwas drin steht* *#21, §176*
	2.5 Depending on	the participants stated that the situation and the topic of the problem determines their actions. They distinguish their actions according to the nature of the problem:		*Ähm, das kommt ein bisschen auf das Problem an, erst würde ich schauen ob es ein Problem ist, das es häufiger vorkommt oder irgendwas dazu quasi in der Literatur gibt, so irgendwas, irgendwas, wo ich unmittelbar darauf zugreifen kann, wenn nicht, dann gehe ich quasi zum Kollegen, dem ich denke, der damit besser auskennt und frage ihn wie das Ganze is* *#16, §26*
		2.5.1 General problem	if it is a general problem related to knowledge or something theoretical, then they do a general research for relevant literature	*wenn ich natürlich weiß, dass ein total allgemeines Problem, dann fange ich natürlich an zu recherchieren, also Literatur online und so weiter.* *#18, §48*
		2.5.2 Technical problem	if it is something specifically technical, they look for a solution in the official standards (DO-178C)	*Kommt auf das Problem an, wenn es ein reines Programmierproblem ist, dann google ich und suche meine Tutorials zusammen, wenn es ein Problem ist, was jetzt spezifischer auf die Aufgabe bezogen ist, dann suche ich mal Hilfe bei den Kollegen, also, wenn das projektbezogenes Problem ist ja, das sind so die wesentliche Ansätze* *#15, §66*
	2.6 Give up	the participants stated that after not finding the answer or solution to their problem, they stop looking.		*Wenn ich dann keinen im Umfeld finde, der dann sagt „der weißt" dann hm, kann man auch mal aufgeben* *#21, §180*

	2.7 Google/search online for literature/solution	the participants stated that they search online for a solution		*Ach so, wenn, mhm, wenn das kein, ähm, ich schaue meistens im Internet nach #19, 74*
		2.7.1 Forum: find answers from others' questions	the participants look specifically for answers to their problem in forums where other people have asked similar questions	*Digitale Literatur, die immer klassische Internetseite wie „Stack Overflow", wo quasi viele Fragen gestellt wurden und da auch alles beantwortet wurde, was man so im alltäglichen oft braucht. Da findet man oft verschiedene Antworten untereinander, das hilft dann auch dem Verständnis, wenn man verschiedene Lösungsansätze gezielt auf sein Problem bekommt. #16, §28*
	2.8 Library: search for a book	the participants stated that they search in the library for a relevant book in order to learn more about the topic and find a solution		*also, ähm, z.B. wenn ich an der Hochschule bin, dann ähm, und ist es was komplexeres, also, nicht nur irgendwie eine Frage oder so was, dann würde ich schon in dem Bibliothekskatalog erstmal reingehen und gucken ob es ein Buch gibt und dann das besorgen aber sonst es gibt auch schon online ganz viele Bücher, ähm, auch über den Bibliothekskatalog, also, viel finde #22, §167*
	2.9 On my own first	The participants commented that their first action of trying to solve a problem would be by themselves before contacting somebody to ask for information or generally for help.		*schaue ich halt einfach erst mal in Google halt nach ob ich irgendwas schriftliches finde, äh, wenn es relativ leicht durch durchdenken oder verstehen ist, dann bin ich dann schon fertig #212, §10*

3. Work approach	The actions, which the participants follow to undertake a work task. The participants describe common work practices, adopted from their work environment or organization culture and/or procedures which are referred as established in their company.		*wir hätten immer, der Task-leader hat ständig geredet, die anderen haben im Hintergrund nach Informationen gesucht und haben irgendwas gefunden in der Regel, meistens hat jeder irgendeiner Hälfte gefunden und alles zusammen reichte dann (lachen)* *#24, §295*
	3.1 Based on instinct/ intuition	the participants acted upon their personal feelings on what is the proper way to do a task	*Von dann, von meinem bisherigen Werdergang war z.B. es so gewesen, dass ich Requirements sozusagen hatte und musste dann damit arbeiten und wenn ich mal in die Gelegenheit gekommen bin, Requirements selbst zu erstellen, dann war das mehr oder weniger so eine Art Gefühl gewesen, wie ich die Requirements aufgestellt habe und das war dann ok so, aber es gab oder es ist nach wie vor auch schwierig, auch jetzt, wenn es gerade um das Erstellen von Requirements geht,* *#11, §6*
	3.2 Communication between departments	the participants learn how a task must be done by contacting a department that is responsible for this task	*Da haben wir irgendwann mal gesagt, nach der so und so vielten Baseline "ok, du pass auf, wir haben hier das und das Problem, das geht schlecht zu testen mit den" oder wir haben so eine, also, die Prüfstände werden hier selber gebaut in der Firma, die werden auch in der Produktion für Abnahmetests benutzt, ja, was gibt eine Prüfstandsabteilung und ähm, die bauen uns die Dinge, die wissen auch schon so aus Erfahrung relativ gut, was wir ungefähr brauchen, deswegen äh, ist das, kriegen wir auch wenn die Spezifikation, die von uns kam, für den Prüfstand, also, der muss auch spezifiziert werden und danach sollte der auch dann gebaut werden, aber da die in der Regel immer erst zu spät fertig wird und die schon mal anfangen müssen, bauen die dann halt nach besten Wissen und Erfahrung, was sie kennen, bauen die dann schon mal was los und in der Regel passt es dann auch* *#24, §183*
	3.3 Documentation database	the participants acquire information from a collection of company's data	*Yeah, or in the, I mean, here, not so much Googling, because many of the documentation that I have to read is internal, is confidential of the company and basically, we have it in our own servers, I mean, typical case, I have to have to do whatever, and then they tell me "okay, this folder, this folder, this folder and this folder, you will find this document, this document, this document and this document, and here you have all the information" and then you are right, so the place you open the document, and then all of a sudden you find a document, or 1700 pages (laugh) and then in that document, you have to find the information that you need and, okay, in some cases, it is easy, because there you find the information, maybe you need one hour or a couple of hours to collect information from different documents, and then you are done* *#29, §109*

	3.4 Learning by doing or through trial-error	the participants learn sth when trying doing in with one way and failing. When failing they try another way and by the outcome they know which one is the correct one.		*ich habe das eher so, ähm, learning-by-doing würde ich sagen* *#14, §1*
		3.4.1 from customers regulations or material	the participants learn how a task should be performed by following the guidelines and requirements of the clients for whom they have to perform this task e.g. develop a product	*abe ich es anhand mhm, vom Projekt gelernt oder gemerkt, worauf es ankommt oder es gab vom Kunden aus How-Tools, wie ähm, ja wie Requirements auszusehen haben und so was, die habe ich mir halt durchgelesen also, einfach Dokumente gelesen von den und gefragt, ja* *#25, §38*
	3.5 Show me how it's done	the participants learn sth when another person represents how it is done / working		
		3.5.1 An expert	a person within the company, which is known to be very skillful in a field, showcases how an employee must delegate a task.	*da hat uns einer irgendwie ein alter Knochen hier aus der Firma, hat uns da was erzählt aus dem Thema und da wurde man schon auf die richtige Spur gebracht* *#24, §77*
		3.5.2 Looking at others' work	in order to learn how something should be done, the person was told to observe and mimic how other employees have already completed similar tasks.	*Ne, (lachen) also, ich hätte schon deutlich lieber gewünscht, dass ich das vorher gescheit beigebracht hätte. Das sag ich mal so, es war nicht effektiv wie ich zu Beginn gearbeitet habe, ohne Vorkenntnisse einfach nur schauen, wie machen das die andere ungefähr und dann selber, das war nicht meine präferierte Vorgehensweise, sondern am Anfang da ich die Schulung noch nicht hatte und notgedrungen mit den Themen angefangen habe und dann mir das irgendwie selber beibringen musste* *#14, §13*
		3.5.3 Other colleagues	colleagues not specifically experts show how something should be delegated.	*ich habe hier in der Arbeit Requirements gezeigt wurde, wie die Arbeit funktioniert, wie ich es tun soll, wie es von mir gewünscht ist,* *#110, §7*
	3.6 Training catalog	the participants acquire the knowledge they need/want, by participating in a training which is offered by their employer. There is a list of trainings offered by the employer.		*Ähm, da gibt's so ein Trainingsportal bei uns hier an der Firma, da werden auch so Kurse, die sind vom Prinzip her fast so ähnlich wie euers, also, dass da einer was erzählt und dann gibt's im Hintergrund eventuell noch irgendwelche Grafiken oder Texte, die man dazu lesen kann und dann gibt's ein Abschlussquiz, also, vom Prinzip her genauso wie euers. Das kann man dann selbstständig bearbeiten, wenn man gerade Zeit hat.* *#24, §209*

		3.6.1 Employees communicate their needs	the participants themselves express to their employer what they need to learn in order to find a suitable course to attend	*exactly, we have we have, eh, we have at the end of the year, at the end of the year, eh, we have a discussion of, the discussion with the lead and eh, during that discussion, you have the possibility to ehm, to tell him what do you want to learn in the next year, what's your goal for the next year, what do you want to do and so on and so based on those information, they can organize training for* *#210, §98*
		3.6.2 Internal feedback	After the participation at a training the employees report to their employers how the training was and what was achieved.	*wir haben hier so eine Regelung in der Firma, wenn einer auf Dienstreise war, dann geht er hinterher, wenn er wieder da ist, ein Viertel Stunde zu seiner Abteilungs- und Bereichsleitung und erzählt er kurz, was er gemacht hat, damit man festgestellt kann, ob das was gebracht hat oder ob das, dass es keine Vergnügensreise war* *#24, §55*
		3.6.3 Obligatory	The participants must attend specific trainings.	*Genau, ähm, dann hatten wir noch so Schulungen, wir müssen halt jährlich auch eine gewisse Fortbildung, Pflichtveranstaltungen, Pflichtschulungen machen. Da geht es um allgemeine Themen wie Cybersecurity vielleicht oder Exportkontrolle oder kann man sich so ein bisschen ein paar Sachen aus unser Schulungs Katalog von T212-Firma und die meisten Sachen sind aber halt, ja, ich sag, eher es gibt eine ganz gezwungene Maßnahme* *#212, §49*

4. Step by step description: criteria of selection	The person described in detail the process of learning and how the selection of further steps is made (according to what criteria can a source/article or the next step be chosen).	*Ok ganz praktisch jetzt was wäre dein erster Schritt?* *T211: Ich würde es googeln, also wenn ich ein Problem habe, würde ich es googeln oder auf Youtube suchen.* *I: ok und dann kommen irgendwelche Ergebnisse. Hast du irgendwelche Kriterien, um auszuwählen?* *T211: In dem Bereich, wo ich mich auskenne, habe ich dann schon ein Gefühl dafür ob das in die richtige Richtung geht oder ob das mein Problem löst oder das Problem nur schlechter macht. In Dingen in denen ich keine Ahnung habe, schaue ich mich eigentlich möglichst breit zu informieren oder seriöse Quellen zu benutzen, Google-Scholar, und dann von dem Punkt aus... aber ich bringe es mir selbst bei.* *I: Was heißt seriöse Quellen für dich? Hast du bestimmte Webseiten, die du kennst und wirklich vertraust oder?* *T211: Wenn es jetzt ein Thema ist, wo ich quasi Dinge verifizieren muss und Background Infos brauche dann versuche ich auf Peer-Reviewed Informationen zu gehen damit ich weiß, dass das was ich lies kein erlogenes Zeug ist und wenn es moderneres Zeug sein muss, aktuelle Trends, dann versuche ich einfach auf Quellen zu gehen wo ich einfach weiß, die haben eine Reputation.* *#211, §27-32*

5. Beliefs about Learning	Participants' statements about learning. Here they describe something as "logical truth" while it may be a subjective attitude or opinion.		
	5.1 Age-based differences	The participants stated that after a specific age the learners do not change their learning strategies/behaviors/practices and learning strategies/preferences of younger generation differ.	*Hm, ich glaube nicht, aber das kann auch daran liegen, dass man ab einem bestimmten Alter wahrscheinlich nicht mehr so viel ändert an sich selber* *#24; §189*
	5.2 Always pros & cons	The participants stated that every situation has positive and negative features. Here they referred specifically to every training method.	*Das hat alles seine Vor und Nachteile* *#23, §104*
	5.3 Application of training content	The participants stated that they need to use the acquired knowledge soon after a training.	*Das ist jetzt mit dem Training in die Richtung, war das erste Mal, das bringt scheinbar auch was, ist tatsächlich so da ist was bisschen hängen geblieben. Aber ich glaube, ich musste es jetzt das tatsächlich oder ich hätte es zeitnah irgendwo anwenden müssen, weil es geht schnell wieder raus* *#21, §168*
	5.4 Easier collaboration with acquaintances	The participants stated that employees can work together better when they know each other before or have already worked together in the past.	*die Leute kannten sich schon von früher und wenn die Leute voneinander wissen, wie sie ticken, dann geht das Ganze auch viel geräuschloser und mit viel weniger Diskussion,* *#24, §161*
	5.5 Exercise solidifies new knowledge	The participants stated that practical exercise where the taught knowledge is use, is necessary for comprehension.	*Ich glaube wirklich praktisch nachher arbeiten zu können, muss man sich wirklich an einem Beispiel auseinandersetzen und dann man da eher rein* *#15, §18*
	5.6 Gain through everything	The participants stated that there is always a benefit out of a situation, even if it not the exactly the knowledge they needed to acquire at the moment.	*als diesen Erfahrungsschatz ist es definitiv was wert, ob dann zum Schluss was Produktives wirklich daraus kommt außer Verzweiflung* *#23, §26*
	5.7 Interactions help critical thinking	The participants stated that hearing others' questions and opinions, can help to reflect their own knowledge.	*ist aber auch nicht schlecht, denn man reflektiert selber darüber. Also, ich würde nicht sagen, dass man daraufhin jetzt das Training in eine Variante für Quereinsteiger und in eine Variante für Einsteiger aufsplittern sollte, würde ich nicht machen. Im Gegenteil, ich finde solche Fragen grundsätzlich immer nochmal ganz gut sich zu hinterfragen, ob die eigene Meinung oder das eigene Wissen an der Stelle so passend ist, ne, weil man ja irgendwo auch eingefahren ist in einigen Stellen* *#17, §56*
	5.8 Knowledge offered vs. learner's capacity	The participants stated that the information somebody can absorb is limited and sometimes there too much information offered.	*ich sage mal so ähm, es wird immer ein Spagat geben müssen zwischen wie viel packe ich da rein und wie viel können die Leute verdauen,* *#23, §82*

	5.9 Knowledge transfer risk	The participants stated that there is a possibility that the learner will not understand what the teacher/trainer tries to explain and convey.	*Leute können einem immer versuchen irgendwas zu erklären und äh, in 90% der Fällen funktioniert das auch,* *#23, §52*
	5.10 Learn something by using it everyday	The participants stated that learning occurs successfully when the knowledge/competence is practiced/used everyday.	*Ich sag mal, normalerweise richtig lernen macht man wenn man […] sich extrem dafür interessiert, bzw. am besten, wenn man es halt täglich benutzt* *#12, §76*
	5.11 Learning definition	The participants stated that learning is a process, which includes all different kind of teaching/learning methods.	*ähm, ich denke mal, dass Lernen ist eine Mischung aus allem,* *#12, §28*
	5.12 Lifelong learning	The participants stated that learning never stops and they continuously need to keep learning.	*when changing from one area to another, most of the time, also, when you change from one project to another, you have to learn new things. I mean, it's a normal situation, you always have to learn new things, even, even in the same project, when you, when you change from from one wall to another. Most of the time, you have to learn new things. So, from one area from one technology area to another (laugh) you have to learn, you cannot live another way, you have to learn, Most of the time, you have a little experience, so you just have to complete it with something else, but ehm, let's say in all cases, you have to learn* *#210, §134*
	5.13 Previous knowledge connections	The participants stated that sometimes they find conenctions (Gedankenanstöße) to remember a topic the already know.	*Das wäre natürlich, ja, das ist schon nicht schlecht, weil da kann man sich zumindest, vielleicht doch mit schnellerer Geschwindigkeit so ein Video anschauen* *I: Aha (lacht)* *T21: Ja, oft braucht man nur so ein paar Gedankenanstöße, dass man weiß „Ah, ja, das habe ich mal gehört, wie war das genau“ dann* *I: Gedankenanstöße, aha* *#21, §172-175*
	5.14 Search results require discernment	The participants stated that the online research needs careful selection and checking of the information presented.	*also, ähm, bei Suchmaschinen muss man sich ja ein bisschen durcharbeiten, da kommt auch sehr viel Schrott, was entweder gar nichts mit dem Thema zu tun hat* *#24, §283*
	5.15 Seeking help, saves time	The participants stated their lesson learned in their career up to this point about how reaching out to colleagues for solving a problem, takes les time than keep researching by themselves.	*Yeah, actually, that is the thing I learned over the time, that it is, it is that it is simpler, when I call a couple of people and speak to them, then I am saving a lot of time instead of wasting it and trying to find and google by myself. I, I learned it over the period of time, like now occasional it is a simple call, yeah* *#27, §36*

	5.16 Self-educating	The participants stated that learning needs also individual actions to deepen into the knowledge and understand it.	*ja, ein Training ist immer gut, gibt einen guten Einstieg, aber die Vertiefung, die muss man schon selber machen und notfalls irgendwo anders Informationen einholen. Selbstbildung ist auch immer ganz wichtig!* *#12, §28*
	5.17 Value of Repetition for learning	The participants stated that people learn only through repeatedly doing something e.g. use, exercise, studying, learning.	*ich denke, wenn man das oft und wiederholt wird, man lernt ja aber nur durch Wiederholung, dann denke ich, verfestigt das so ein bisschen und das kriegt man dann hinterher schnell wieder raus bei neuen Leuten.* *#24, §63*
	5.18 Work is learned by working	The participants stated that employees become acquainted with every day work tasks only through actual every day work.	*Ich weiß nicht ob solche Trainings überhaupt vorhanden sind, ja, weil das meiste lernt man doch im Job, in dem man sich mit einem Problem auseinandersetzt, und, bevorzugen, schwierig zu sagen, ja, ein Training ist immer gut, gibt einen guten Einstieg, aber die Vertiefung, die muss man schon selber machen und notfalls irgendwo anders Informationen einholen* *#12, §28*

6. LN of employees entering ASD	The participants described what learning needs they have or had upon entering aerospace software development; what employees think they need to learn when entering this field.			
	6.1 Application: more exercises	The participants stated they need a training to contain more opportunities to do activities upon a specific topic in order to use their knowledge directly in practical situations.		*Der Nutzen könnte vielleicht größer gewesen sein, wenn wie ich schon erwähnt habe, mehr Anwendungsbezug direkt gehabt hätt* *#16, §36*
	6.2 Content	The participants stated their personal needs related to subjects and topics and knowledge.		
		6.2.1 Connections between SW roles	There are different functions within the V-Modell e.g., the tester, the verifier.	*vielleicht auch von unterschiedlichen Perspektiven, die einen schreiben haben vielleicht mal mit Requirements engineering zu tun gehabt, die anderen vielleicht nur mit der Implementierung von Software und ähm, dass man halt dann dort irgendwie hat, diese Kette irgendwie kennt, hat vielleicht so Art ein System, ein Flugsystem und dann hat man innerhalb das Kontrollsystem und da hat man einen kleinen Computer und dann sieht man halt vielleicht, aber ganz nur skizziert wie diese Anforderung von ganz weit oben, ganz nach unten kommt, bis die dann kurz vor dem Equipment steht und dann sich Leute Gedanken machen müssen, wie das dann in einer konkreten Funktionalität umgesetzt werden soll in Software und selbst dann wird der Schritt, von dem Requirement tatsächlich in Quellcode dann letztendlich einfließt. Das sind dann schon immer ganz wichtige Verständnisthemen, wenn man das dann an einem Beispiel erklärt* *#212, §71*
		6.2.2 Companies' processes	The participants stated that the specific procedures or how the implementation of systems/procedures in their company takes place is important.	*Und ich denke mal so methodische Details, mhm, weiß ich nicht, ob man da eingehen muss im Rahmen der Schulung, weil das macht jede Firma halt so wie es da der Firmen deren Prozess vorsieht. Da muss man eh eine Schulung drüber kriegen, damit man das richtig macht* *#24, §79*
		6.2.3 Topics & tools	The participants refer to specific subjects and tools which they want to learn, and generally that they want to be informed about the latest news in their field.	*Schwierig, also, wir haben momentan bei manchen speziellen Tools äh, ein paar Fragen offen, wie man mit bestimmten Dingen umgehen, bzw. ob das das Tool überhaupt hergibt, also es ist ein so spezielles Sachen, deswegen kann ich das schlecht beantworten, ja, also, es ist jetzt nicht so, dass ich sage: Oh, da! Äh, wobei, warte mal, doch! Also, wo ich noch, wo ich noch für mich persönlich schonungslos sehe, geenau das ist Tool Qualifikation, doch, ja, stimmt, jetzt, wo du so fragst* *#23, §74*

			6.2.3.1 participants with different backgrounds need more information	The participants stated that more introductory information and/or basic aviation standards are needed for career changers.	*Ja, aber das geht nicht, das kann das Training nicht, das würde die Schulung nicht bewältigen können. Also, das muss man halt dann, wenn Leute aus wie z.B. bei mir aus Physik kommen, muss man vorher mitgeben: hier, schau dir das vorher an und dann kannst ins Training gehen #19, §56*
	6.3 Individualization	The participants stated their need to differentiate and adjust the training according to their individual needs and current knowledge.			*ja, weiß nicht wie das wäre, aber so irgendwie individueller auf unsere Bedürfnisse einzugehen wäre hilfreich #14, §35*

7. Differences among employees entering ASD	The participants described differences which apply to employees entering ASD.			
	7.1 Industry standards	The participants referred to what is valid in different companies. Processes upon various topics differ from sector to sector e.g. automobile vs. avionic, aerospace.		*Vor allen, insbesondere bei Leuten, die in anderen Branchen vorher gearbeitet haben, weil die testen tatsächlich wohl so, also, ich kenne es selber nicht, mir hat es ein Kollege erzählt, der das vorher in der Autoindustrie gemacht hat, ähm, der sagte, die testen wirklich strukturbasiert solange bis sie überall drin waren in der Software und dann sind die zufrieden und das ist ja genau das, was wir in der Luftfahrt nicht machen* *#24, §63*
	7.2 Job description	The participants referred to different tasks and job roles e.g. requirements tester, writer, verifier		*Ähm, ja sozusagen, mir war z.B. nicht bewusst, dass ein Code auch die derived Requirements ehtalten muss, also, vielleicht würde ich es später rausfinden, wenn ich ein Problem hätte (lachen) aber ja, ich beschäftige mich jetzt nicht direkt mit Requirements schreiben* *#19, §16*
	7.3 Knowledge	The participants referred to differences related to former knowledge and to topics that they are already familiar with.		*Ich hatte bisher keine Software nach Requirements entwickelt, sondern einfach nur Software geschrieben, mit der nur ich gearbeitet hab und dementsprechend entsprechend die anpassen konnte. Das heißt ich musste da nicht großartig mit anderen Entscheidungen treffen, über was ich nachher machen soll, aber nicht wie sie geschrieben soll* *#15, §60*
	7.4 Prior work field	The participants referred to differences related to their prior working experience.		*I think, before I came here I was in a hardware-based company so when I came I wished I had more programming* *#27, §59*
		7.4.1 Career changers	The participants mentioned that they see themselves as career changers (Quereinsteiger/innen) or referred to characteristics of employees that formerly were working in other fields.	*Ja, klar, also, man ist ja als Quereinsteiger auch äh, Anfänger, man weiß vielleicht wie, man hat sich auf anderen Themen spezialisiert, man hat sich fachlich komplett wo anders spezialisiert und wenn man hier wieder bei null anfängt, dann ist man nicht mehr wie ein Einsteiger, sag ich es mal so* *#110, §49*
		7.4.2 Experience in automotive	The participants mentioned their experience in the automotive field.	*in automotive, that is the sector, in which I was before,* *#29, §77*
	7.5 Study field	what they studied e.g., software engineering, physics, mathematic, informatics		*wie Software, also, ich hatte im Studium große Software Anteile, aber der Schwerpunkt war doch auf Elektrotechnik, also, ja, ich hatte quasi den richtigen Schwerpunkt.* *#16, §44*
	7.6 Years of experience	the participants have different experiences because of the overall different years they have worked in this field.		*wie lange du tätig in diesem Bereich bist? [00:01:43]* *T14: Ähm, RE Engineering eigentlich ziemlich genau 2 Jahren* *#14, §6-7*

8. Evaluation of the first training course	The participants evaluated the 1st training.				
	8.1 Pros	The participants described the advantages of the 1st training and what they liked about it.			
		8.1.1 Content	The participants referred to advantages related to the training topics.		
			8.1.1.1 Correlations	The participants stated that they could link information to the background goals of the content they were working with.	*es hilft den großen, den ganzen Zusammenhang zu erkennen, ich fühle mich jetzt eher auf der rechten Seite von dem V-Modell* *#12, §22*
			8.1.1.2 Information	The participants referred to gain of information.	*aber inhaltlich denke ich, war auf jeden Fall sinnvoll, sinnvoll ausgewählt die Themen* *#14, §11*
			8.1.1.3 Introduction	The participants stated that they gained a good presentation of what knowledge starting to work in this field is necessary.	*aber ich denke mal, das ist ein relativ guter Einstieg, ja, weil wer nimmt sich in der Arbeit denn die Zeit und erklärt dir alles so detailliert, wie das in dem Training stattgefunden hat* *#12, §18*
			8.1.1.4 Overview	The participants stated that they gained a general outlook of what knowledge starting to work in this field is necessary.	*Also, es hat schon ganz guten Überblick gegeben.* *#12, §8*
			8.1.1.5 Processes	The participants stated that they learned about procedures in the field.	*und wenn man eine Möglichkeit hat, sag ich mal, diese Vorgehensweisen zu generalisieren und das auch noch zu optimieren ist es natürlich für alle Beteiligten ganz gut.* *#11, §12*
			8.1.1.6 Repetition	The participants stated that hearing again about these topics was nice and beneficial.	*war schon schön, dass man es wiederholt hat* *#12, §4*

		8.1.2 Methods	The participants referred to advantages related to the teaching methods.		*aber sonst finde ich es gut, dass erst Theorie besprochen wird und dann eine Übung stattfindet* *#13, §35*
			8.1.2.1 Exercises	The participants referred to what they valued about the exercises of the training.	*Und was ich auch gut fand, ist, dass zwischen den reinen Vortrag auch noch eben andere Methoden noch angewandt wurden wie z.B. die Übungen oder die Diskussionen an den Stellen, wo man untereinander in Diskussionen gekommen ist* *#17, §14*
				8.1.2.1.1 interaction among employees The participants stated that they enjoyed being able to discuss with employees from different companies and/or department and/or with other roles as their own.	*Was mir auch sehr gut gefallen hat, ist, dass aus anderen Firmen Teilnehmer dabei waren und dementsprechend dann Austausch hatte* *#17, §14*
			8.1.2.2 Expert discussion	The participants referred to what they liked regarding the discussion with the expert from a company.	*ich finde die gut, ich fand das Gespräch im Anschluss dran beim Mittagessen, wo man mit dem Experten austauschen konnte, also, den zwangslosen Teil sehr gut,* *#17, §52*
			8.1.2.3 Lecture	The participants commented positively on the lectures of the training.	*Also, gut war auf jeden Fall der Vortrag an sich.* *#13, §23*
		8.1.3 Trainer	The participants commented positively on the trainer.		*Der Vortragende (lachen) Er hat's gut gemacht, fand ich gut, ja wirklich,* *#19, §18*
	8.2 Cons	The participants described what they did not like about the 1st training.			
		8.2.1 Content	The participants referred to disadvantages and drawbacks regarding the content of the 1st training.		*Es war mal mit der Kohäsion, ach ne, ein Thema hab ich noch im Kopf wo, meiner Meinung nach, ein bisschen sehr viel Zeit drauf gegangen ist. Das hätte ich vielleicht in dem Rahmen nicht so gemacht.* *#12, §86*

			8.2.1.1 Definitions for terminology	The participants stated that there were some terms which were not explained beforehand.	*und dann ist noch, ich weiß nicht mehr welche Begriffe da stehen, hier steht Verwendung von Begriffen, ohne die vorher zu definieren. Das ist halt schon 3 Monate her, dass ich das geschrieben habe und weiß leider auch nicht, welche genauen Begriffe ich damit meine, ich weiß nur, dass es auf den Folien war, man hat mal was verwendet, was erst später genauer erklärt wurde* *#16, §52*
			8.2.1.2 Missing the big picture	The participants stated that the connection to the overall V-Modell was not clear on specific parts.	*aber dann hatte ich schon wieder teilweise das Gefühlt, dass man so ein bisschen den Fokus verloren hat, auf welche Ebene sind wir eigentlich gerade, ne, weil einfach diese Trennung zwischen den drei Themen dann vorhanden ist. Das ist auch, wie gesagt nur ein Input meiner persönlichen Meinung* *#12, §48*
			8.2.1.3 Too general information	The participants stated that the content was very broad.	*aber wo ich mir die Sachen im Nachgang nochmal angeguckt habe, sind die Informationen, die man da hat vielleicht noch ein bisschen allgemein* *#11, §20*
			8.2.1.4 Too much theory	The participants stated that the duration and the amount of the theoretical parts was disproportionate.	*dass die langen Theorieblöcke und dass alles sehr trocken war* *#16, §14*
		8.2.2 Methods	The participants referred to methodological problems of the 1st training.		
			8.2.2.1 Examples	The participants stated that examples were missing from the slides.	*aber es ist ein ziemlich schwieriges Thema, das halt doch sehr trocken ist. Es ist nicht wie andere Vorträge oder andere Schulungen, dass man konkrete Beispiele zeigen kann wie in ein konkretes Projekt gekoppelt ist, aber ich glaube Beispiele helfen immer eine ganze Menge, so was zu verstehen* *#15, §20*
			8.2.2.2 Exercises	The participants stated that the exercises of the 1st training should be improved and developed clearly.	*bei der Übung am zweiten Tag da ging es ja um die Low Level Requirements, da war die die Aufgabe ein bisschen unklar oder nicht ganz, ganz klar definiert* *#18, §32*
				8.2.2.2.1 large groups = The participants stated that the groups which worked together on the exercises were too large.	*ich sag mal, für mich waren die Gruppen zu groß. Ich hätte lieber 3 Gruppen gemacht und die Leute von der Gruppengroße bestimmen. Das war dann sowieso so gewesen, 2-3 Leute haben dann gar nichts gemacht, haben mehr oder weniger zurückgezogen aus der Diskussion und dann gab's 1-2 mit den hat man über Kleinigkeiten verloren,* *#12, §32*

			8.2.2.3 Lecture	The participants stated that it was difficult to stay concentrated for so long during the lecture.	*quasi nicht diese stundenlangen Monologe, wo es irgendwann schwierig ist zuzuhören #16, §36*
			8.2.2.4 Short duration vs heavy content	The participants stated that the training was too compact and the amount of information was disproportionate to the available time for the training.	*war natürlich sehr lang, es war sehr viel Wissen, dass man natürlich äh, ja, ich glaube es ist auch nicht gedacht gewesen, dass alles in einem Tag durchgeführt wird, aber das fand ich schon anstrengend, also, an dem 1. Tag wann ich nach Hause kam, ist mein Kopf doch geknackt, weil es sehr viel war #110, §15*
			8.2.2.5 Slides overloaded	The participants commented that the slides contained too much plain text.	*ich würde die Folien, ähm, ein bisschen, äh, optischer aufbereiten, also, weil das ist dann momentan sehr sehr viel Text und, ich sag mal, wenn man in der Schulung drinsitzt, dann hat man Schwierigkeiten gleichzeitig dem Vortragenden zu folgen und den Blick auf die Folien zu behalten und wenn viel Text auf der Folie ist, dann ist man mehr oder weniger relativ fix abgelenkt #11, §16*
			8.2.2.6 Suitability of the expert	The participants commented on the motivation and the agreement of the expert to the training goals.	*während ich dem Beitrag direkt während des Trainings teilweise etwas unmotiviert erlebt habe. Also, das heißt nicht, dass er demotiviert war, sondern dass das rausgegriffen hat, fand ich nicht direkt eingebunden mit dem Rest des Trainings. Ich weiß nicht wie er das Training kannte vorher, so dass er darauf Bezug nehmen konnte. Das war nicht schlecht, aber war nicht so, dass ich sofort sagen konnte: ok, das ist jetzt der Punkt aus dem Training, der jetzt mal dadurch vielleicht mehr erklärt oder als Beispiel aus der Praxis etwas gebracht wurde, ja #17, §52*

9. Evaluation of the second training course	The participants evaluated the 2nd training.				
	9.1 Pros	The participants described the advantages of the 2nd training and what they liked about it.			
		9.1.1 Blended concept	The participants commented positively on the blended concept.		*Nö, pff, also, wie gesagt, ich finde das ist eine gute Kombi, also, erstmal selbst anlernen, Quiz machen, gucken ob man noch irgendwo noch offene Frage hat und dann kann man die diskutieren, ist gut* *#23, §42*
			9.1.1.1 Ask questions (f2f & online)	The participants stated how important it is to be able to ask questions in direct contact to with the trainer.	*wie gesagt, gerade dieses äh, diese Möglichkeit für Rückfrage ist natürlich absolut wichtig und ähm, das hat man halt bei reinen Online Kursen nicht,* *#23, §52*
			9.1.1.2 Exercises (f2f)	The participants referred to what they valued about the exercises of the training.	*in der Präsenzveranstaltung fand ich auch gut, fand ich die Übung auch sehr gut, ähm, zumindest die erste, glaube ich, wo man die Requirements auch ein bisschen, ähm, guckt und da hat man auch nähmlich mit den anderen Teilnehmenden besprochen oder diskutiert so ein bisschen, ähm, was gut ist, was schlecht ist, ähm, und das fand ich wieder sehr gut,* *#25, §22*
			9.1.1.3 Expert discussion (f2f)	The participants referred to what they liked regarding the discussion with the experts from the partner companies.	*das Netzwerken mit den Experten war top, der Austausch mit den Experten hat glaube ich das meiste gebracht, dass man die Gesichter gesehen hat.* *#211, §16*
			9.1.1.4 Flexibility (online)	The participants commented positively on the possibility/opportunity to plan on their own the time, place, content and participation in the online phase.	*es war auf jeden Fall sehr flexibel und jeder kann so viel lerne, wie er möchte und es ist ja niemand gezwungen irgendwas zu machen, auch vielleicht vom Arbeitgeber* *#22, §191*

			9.1.1.5 Interaction & Networking	The participants stated that they enjoyed being able to discuss with employees from different companies and/or departments and/or with participants which act in roles different as their own.	*the second point was that it was really good for networking, ah, as I said before it was my very first job at a company within the aerospace and I was not completely aware of what are the other people, how many other companies are doing what they are doing and it is not exactly similar but there are many similarities and it was kind of opening to see what other possibilities (are), in case I want to change ah, the tasks of jobs I am taking #27, §2*
			9.1.1.6 Quizzes (f2f)	The participants stated that they liked the quizzes in the online phase where they could test themselves on their own and summarize the most important topics.	*Es war weitgehend auch gut erklärt, ja und ähm, durch das Quiz ist mir dann auf jeden Fall auch nochmal die, ich sag mal, die wichtigen Punkten von dem ganzen halt irgendwo aufmerksam gemacht worden und konnte dadurch auch dann nochmal, vielleicht ist das auch der Hintergedanke von dem Ganzen, man konnte sich nochmal angucken, ja, finde ich da vielleicht noch was zu und konnte dann im Ende nochmal eine Frage #23, §10*
			9.1.1.7 Team event (f2f)	The participants commented that they valued the team event and believed these activities influenced positively the introduction and the friendly atmosphere of the training.	*Very nice, very nice, I liked it a lot I mean I think it is a good idea, also, because you get to know eh, the organizers of the event as well as the other participants, a little bit in an informal context* *I: Yeah* *T29: And then I think that makes a little bit things easier later for people to be me more open to, because you know sometimes people is more eh, avoiding to speak in public in front of people, you know. Yeah, I think that was a good idea* *#29, §67-69*
		9.1.2 Content	The participants stated that they liked the training topics.		*f you don't have background in the DO-178C the whole virtual material is amazing. It's very good material for learning about that. I mean, you can get more out of that. #29, §157*
		9.1.3 General	The participants commented on a generic level that they liked the training.		*about anything specific, I can tell you that overall my experience was positive. I mean in general I liked how was the structure and how the information was presented, let's say as an overview, as a general opinion I think it was pretty fine #29, §1*
		9.1.4 Trainer	The participants commented positively on the trainer's role.		*eh, also, the professor, who works there are, I really forgot his name, the professor, I do not remember his name, was very into the field, very enthusiastic to, ehm, to help us, I think, he is happy to teach, like, a person who is happy to teach, so, I was very pleased with how the training was, and, and with how it was done. #27, §18*

	9.2 Cons	The participants describe what they did not like about the 2nd training.			
		9.2.1 F2F session	The participants described negative elements of the f2f session of the 2nd training.		
			9.2.1.1 Execution of exercises	The participants stated that problems occurred during the execution of the exercises.	*vielleicht das Beispiel nächstes Mal, also das vor Ort Beispiel, was wir hatten, da war der Ausdruck ein bisschen schlecht, dass man den wirklich vorher ähm, ich sag es jetzt mal, mit einem Informatiker oder jemandem, der gut programmieren oder die Programmierkonzepte kennt, aufbereiten und nicht nur ausdrucken* *#21, §54*
			9.2.1.2 Lack of time	The participants stated that there was more time needed for the execution of the exercises.	*auch die Zeit war dann ein bisschen knapp, vielleicht da noch mal mehr Zeit, ja, ich weiß, mehr Zeit investieren oder das erste Beispiel einfach, was war das erste Beispiel?* *#21, §62*
			9.2.1.3 More exercises	The participants mentioned that they would like to do more exercises during the course.	*I wanted to have more practice exercises* *#210, §8*
		9.2.2 No evaluation	The participants commented negatively that there was no final exam in order to evaluate their knowledge.		*but I was a little disappointed about the fact that eh, I miss an evaluation at the end, eh, that was, only on that point I am a little bit dissapointed as* *#210, §146*
		9.2.3 Online phase	The participants described negative elements of the online phase of the 2nd training.		
			9.2.3.1 Content of the videos	The participants referred to disadvantages regarding the content of the 2nd training.	*Ähm, manchmal hab ich mir ein bisschen schwer getan zum Praxisbezug zu kriegen* *#21, §24*
			9.2.3.2. No summary in the videos	The participants stated that there was no short summary in the beginning or end of each video.	*Ja, aber da ich habe ich mir ein bisschen schwer getan, etwas zu überspringen, weil im Endeffekt war es mir nicht ganz klar, wenn ich, im Endeffekt war es mir nach dem Video oder im Video, das habe ich dir letztes Mal gesagt, irgendwann klar „ah ja, das hast du eigentlich schon gekannt" weil ja kein, so kein kurz Zusammenfassung oder keine, äh, keine, ja* *#21, §226*

			9.2.3.3 Poor quality of the examples in the videos	The participants stated that the examples were too theoretical and not practically applicable.	*genau was ich aufgeschrieben hab, ähm, da waren, es gaben, glaube ich 4 Videos mit expliziten Beispielen* *I: Ja* *T21: Ähm, […] ähm, ich hab mich eigentlich da gefreut, dass ich jetzt Praxiserfahrung sehe, aber das waren so einfache Lehrbuchbeispiele, dass es dann wieder langweilig war.* *#21, §28-30*
			9.2.3.4 System problems	The participants stated that the Moodle platform had problems e.g. quizzes had mistakes or malfunctions.	*da war so eine Frage dabei, wo man äh, zeigen sollte, dass man für diese Logikgleichung keine modified decision/ condition coverage hinkriegt, es ging aber sogar mit endlos eins Testfällen und dann kam der Buchstabe in den Antworten vor oder in den Fragen vor den Antworten nicht vorkam und so was, also, da ist sicherlich etwas mal kaputt geändert worden* *#24, §143*
			9.2.3.5 Trainer's appearance	The participants commented on the movements and generally how the trainer was shown in the videos.	*Ne, vielleicht, es ist nicht so ein großes Problem, aber in den Videos, war den Herr Name-des-Trainers relativ groß dargestellt, also, viel von seinem Körper dargestellt und er hat sehr extrem mit den Händen gefuchtelt und mir ist es manchmal passiert zumindest wenn ich mit Kopfhörer auf klein Monitor dann war, dass ich mich auf ihn mehr konzentriert war, warum er jetzt rumfuchtelt, weil ich habe immer gewartet, dass er irgendwo hinzeigt und war ein bisschen ablenkend. Also, vielleicht nur den Schulterbereich nur zeigen, weiß nicht ob das besser ist* *#21, §86*

10. Suggestions for the first training course	The participants expressed their ideas and recommendations for improvement of the 1st training. - The participants expressed their ideas on how something from the training could be planned and performed differently in order to improve the quality of the training and to better align it with their needs and preferences.			
	10.1 Content related	The participants commented on potential changes regarding specific topics.		*bei dem Thema EAD, das war eigentlich so das light Thema von den zwei Tagen, ob ich am Anfang so viel auf RE eingegangen wäre […] Ich hätte es wahrscheinlich auch mal erwähnt, aber es wurde schon relativ detailliert in RE Management quasi […]* *I: Aha [00:30:21]* *T12: äh, Zeit investiert, sag ich es mal so, wie schreibe ich die und das Ganze. Ist vielleicht auch ganz gut, um danach die Übungen zu machen, aber ich glaube man hätte es, gerade was das angeht, ein bisschen reduzieren können,* *#12, §78-80*
	10.2 Methods	The participants expressed their recommendations about methodological changes.		
		10.2.1 Clarify definitions in advance	The participants stated that specific (all) definitions should be introduced and explained in the beginning of the training.	*Da gab es ja auch schon ein paar Diskussionen, weil ab einem gewissen Punkt geht das ja dann irgendwie auseinander. Dann gibt es gewisse Begrifflichkeiten, die nur in bei uns hier zum Beispiel verwendet werden, die für andere Unternehmen nichts sagen.* *#18, §86*
		10.2.2 Exercises	The participants made recommendations regarding the exercises:	

			10.2.2.1 Answer sheet: correct example	There should be a sheet with complete exercises that show how the correct process of solving a problem is. In this case of writing requirements.	*Und ich hätte gern Musterlösungen von den Übungen gehabt, also, oder, dass man ungefähr weiß, das geht in die richtige Richtung oder hier läuft man total gegen die Wand, so ein Beispiel zumindest, wie es jemand hätte lösen können* *I: Vor, also, gleichzeitig mit der Übung oder eher danach?* *T19: Danach, also, schon erstmal ein bisschen Gedanken machen in der Übung und dann vielleicht mitten drin ein Hint so in die Richtung geht und dann am Ende könnten wir die Musterlösung* *#19, §28-30*
			10.2.2.2 Example exercise with the trainer	The trainer should show at first an example exercise before asking the participants to work independently or in groups.	*und dass man vielleicht das erste Beispiel zusammen macht mit jemandem, also, mit dem Dozenten und dass der anhand der Beispiele genauer erklärt wie man das macht* *#13, §25*
			10.2.2.3 Exercises with more details/depth	The exercises should be formulated further in detail with more specific information.	*Aber irgendwie noch ein bisschen detaillierter oder ausführlicher, also, ich hatte, ich hatte schon das Gefühl, ich habe was dazugelernt nach den Übungen, aber es könnte mehr sein, also, ich könnte, glaube ich, mehr aus einer Übung mitnehmen, wenn die ein bisschen detaillierter noch wären* *#18, §32*
			10.2.2.4 More exercises	There should/could be more exercises in order to practice more or present more specific procedures.	*würde ich es persönlich begrüßen, wenn man in, also, wenn man mehr Praxiseinheiten in so einer Schulung noch hätte.* *#11, §16*

			10.2.2.5 One example with different exercises	The exercises should belong in one common example/study case and could refer to the different levels of e.g. the V-Modell.	*wird eventuell bisschen transparenter, wenn man da ein einziges Beispiel nimmt, #12, §46*
			10.2.2.6 Smaller groups	The participants should work together in smaller groups with less than 5 people.	*Ich hätte lieber 3 Gruppen gemacht und die Leute von der Gruppengroße bestimmen. Das war dann sowieso so gewesen, 2-3 Leute haben dann gar nichts gemacht, haben mehr oder weniger zurückgezogen aus der Diskussion und dann gab's 1-2 mit den hat man über Kleinigkeiten verloren, klar das hat auch irgendwo die Schwierigkeiten im realen Leben aufgezeigt, aber ich würde die Gruppengroße auf 2-3 beschränken #12, §32*
		10.2.3 Individualization	The participants stated that the training should take into consideration the individual differences and needs of the participants.		*Also, dass man da vielleicht die Möglichkeit hat: ok, diese Pakete, diese Inhalte interessieren mich besonders und dann gezielt halt darauf die Schulung auszurichten, dass man nicht über alles belastet wird [00:09:27]* *I: Ok, also, die Gelegenheit Kapitel auszuwählen oder eins zu überspringen? [00:09:36]* *T110: Genau, so Schwerpunkte einfach auszuwählen, das würde ich noch ganz gut finden #110, §27-29*
		10.2.4 Interaction among different companies	The participants stated that they value the contact with employees from different companies, which is possible in such a training.		*ich würde die Gruppen nicht trennen, weil tatsächlich auch während der Gespräche, die wir hatten, jeder hat sein Input reingebracht bei gewissen Themen und da kann man genauso voneinander lernen sowohl die Einsteiger als auch die Quereinsteiger von anderen Bereichen, also, nein ich würde es nicht trennen #110, §53*

		10.2.5 Parallel to the job: implementation in a longer period	The participants stated that the training could be implemented with more dates in a longer period of time so that they can parallel use the acquired knowledge on their job.	*Ja, also, vielleicht das Training über mehreren Tagen verteilt, z.B. an einem Tag in der Woche und dann halt fünf Wochen hintereinander, aber nicht alles hintereinander.* *#19, §22*
		10.2.6 Short tests/questions	The participants stated that the training should include questions in order to summarize the training content and test the acquired knowledge.	*ich würde immer nach 1-2 Modulen, von mir aus nach 1-2 Stunden oder nach einem halben Tag oder so was, würde ich für diese Module so ein kleines multiple choice raushauen, je nachdem wie lange gedauert hat, es ist immer n bisschen, das muss ja schon Sinn machen, ne, also, die Module müssen ja schon fertig sein und am Ende würde ich, am Ende von dem Ganzen würde ich es vielleicht nochmal machen,* *#12, §38*

11. Suggestions for the second training course	The participants expressed their ideas and recommendations for improvement of the 2nd training. - The participants expressed their ideas on how something from the training could be planned and performed differently in order to improve the quality of the training and to better align it with their needs and preferences.			
	11.1 Content-related	The participants commented on potential changes regarding specific topics.		*ein bisschen in die Tiefe zu gehen und auch dann ähm, vielleicht mit den Unternehmen zusammenarbeiten, um rauszufinden welche Methode sie benutzen und dann das eben so spezifizieren, dass man das so anwenden kann. Weil, wenn man nicht das man lernt, was man in der Firma gar nicht haben will* *#22, §61*
	11.2 Methods	The participants expressed their recommendations about methodological changes.		
		11.2.1 All lectures online vs exercises f2f	The participants stated that the theoretical parts can be conveyed during the online phase and dedicate the f2f session for the exercises.	*Yeah, yeah, I would say that if I had to change something about the structure, I would say that the lectures that Trainer's Name did f2f, that this is not so necessary to do it f2f, that that could be also included in the lecture from the beginning also, because when you have several lectures and let's say there are one or two in the middle, that are missing that, you know that, because it is said in the platform that they are going to be face to face, you might have the feeling that you are continuing with the lecture, but you don't have the previous information that you need in order to continue* *I: Aha* *T29: Even when that is not true. Even when you arrive two weeks later, I mean, the new content is not related with the other, it can happen and you can have that feeling that you're continuing but you have that question in your head. Is the missing content necessary? For what I learned enough? Maybe I am not understanding something now, because I am missing previous information* *#29, §143-145*
		11.2.2 Clarify all definitions in advance	The participants stated that specific (all) definitions should be introduced and explained in the beginning of the training.	*du hattest damals auch gewünscht, dass es vielleicht ein Hand-out gibt?* *T1: Ah, ja, genau* *I: Mit den Definitionen so als Begriffserklärung, so vielleicht als eine DIN A4 Seite, wo alle Begriffe* *T21: Genau, die verwendet werden* *#21, §233-236*
		11.2.3 Evaluation	The participants stated that they would like to be able to test their knowledge.	

			11.2.3.1 Certificate/final exam	= in order to get a certificate after a final exam	*but it was okay and as I say it an evaluation could be more, eh, more appreciated* *#210, §8*
			11.2.3.2 Short tests	= in form of short tests during the training	*oder quasi den Wissenstand monatlich regelmässig abfragen* *#211, §10*
		11.2.4 Exercises	The participants made recommendations regarding the exercises:		*Ja, weil so Code-editoren z.B. die färben bestimmte Segmente vom Code, dann ist es übersichtlicher zu lesen und es kommt gerade darauf an, wenn man komplett neu Einsteiger hat, dann wissen die vielleicht nicht wirklich, wie man jetzt den Test schreibt, was natürlich, ich glaube, das man sogar im Studium (lachen) mit Sicherheit, dann könnten sie z.B. ein zwei Tests schreiben, um den Code zu testen. Man muss mal den vorher sagen „auf was sie testen sollen z.B.* *I: Ok* *T22: Also, ein bisschen interaktiv* *I: Ok (...)* *T22: Das sollte eigentlich schon möglich sein, denke ich* *I: Ja* *T22: Weil man braucht nur einen so ein Code Editor* *#22, 39-45*
			11.2.4.1 Examples	= there should be additionally an example exercise either presented in a video in the online phase or in the f2f session	*Ähm, wenn man da ein Beispiel oder ein, ein angedachtes Beispiel mit Code und ein bisschen außen rum gezeigt hätte, hätte ich es interessanter gefunden* *#21, §30*
			11.2.4.2 Exercises with companies' examples	= the exercises should contain situations of the companies' procedures.	*aber vielleicht hätte man mehr oder vielleicht, ja, die Expertenrunde war z.B. sehr gut und vielleicht hätte man, die war, denke ich, so gut, weil die Requirements* *I: einfach spezifisch* *T25: Genau, die waren, ja, ist auch generell so spezifisch diese Requirements, aber vielleicht hätte man da mit den Unternehmen oder mit anderen Unternehemen die Requirements als Beispiel nehmen können, ich glaube das, das wäre ja...* *#25, §58-60*

			11.2.4.3 More exercises	There should/could be more exercises in order to practice more or present more specific procedures	*Yeah that I think maybe in the course of Trainer's Name (IDEA training), he focused more in the theory. But yeah, maybe that could be a critic to it. Like, yes, put in the theory not, that is absolutely fine, but then for the, for the person that has to learn all of those concepts, to do it through the through doing exercises, maybe not mandatory, because I think in these courses, the exercises were not mandatory, but let's say an amount enough, so that the person that is involved, wants to say, wants to buy the course with the proper knowledge about it, can have enough material to practice* *#29, §137*
			11.2.4.4 Pre-training preparation for the exercises	The participants could receive prior to the f2f session information about the exercises so that they can prepare potential tasks/roles they have to fulfill.	*wie gesagt, wirklich richtig machen wollen würden, musstest zwischen Tag dahin hocken und die Leute müssten sich vorbereiten, aber ob jetzt das ist jetzt das Sinnvolle der ganzen Sache sein kann, weiß ich nicht, ja, ähm, da vielleicht einfach,* *#23, §24*
			11.2.4.5 Short examples/exercises	The participants suggested the exercises would be shorter e.g. the code does not need to be 10 pages.	*ich würde nochmal vier Requirements wegnehmen und sagen "das und das ist es jetzt" und dann würde ich da halt vielleicht versuchen drüben zu diskutieren, viellleicht ist es dann etwas zu einfach, so dass dann man gar nicht mehr diskutieren braucht (lachen) schwer zu sagen, also, das mit den Requirements, mit der Requirementsdiskussion ist sehr* *#23, §26*
		11.2.5 Longer duration	The participants suggested the f2f session would last longer as 1 day e.g. 2 days f2f.		*one, one of the issues I had was that I wish it was for two days minimum, i think one day was too short* *#27, §2*
		11.2.6 Online phase	The participants made recommendations regarding the online phase:		
			11.2.6.1 Online meeting before the f2f = there could be meetings with the trainer and the participants taking place online during the online phase before the f2f session in order to have a first contact and introductory round.		*ich würde aber, ich weiß es gab im Mittelpunkt einen Zoom Meeting gab, um Dinge zu klären, vielleicht würde ich einen Stand-der-Dinge Meeting ein unkompliziertes zusammenkommen, vielleicht nur eine halbe Stunde alle 2,3,4 Wochen, wünschen,* *#211, §82*
			11.2.6.2 Online networking = there would be opportunities in the online platform to connect with other participants and/experts		*dann vor allem dieses Netzwerken würde ich mir online wünschen und erlaubt auch neben der Arbeit das flexibler zu machen* *#211, §82*
			11.2.6.3 Platform = to offer the training via another platform which would be more user-friendly or via multiple different platforms		*Ja vielleicht nächstes Mal ein bisschen flexibler bei der Plattform-Wahl sein,* *#211, §10*

			11.2.6.4 Short summary presenting the video's content = the content of the video could/should be summarized in the beginning of the video/chapter	*be ich dir letztes Mal gesagt, irgendwann klar „ah ja, das hast du eigentlich schon gekannt" weil ja kein, so kein kurz Zusammenfassung oder keine, äh, keine, ja* *I: Ja, Genau* *T21: Was kommt auf dich zu Video war* *I: Ja, ja, dass hast du mir auch kurz an dem Präsenztag erzählt, ich habe jetzt meine Notizen aus dem Tag und ich, ähm, du hast mir damals erzählt, dass du z.B. gerne ein so im Anfang jedes Videos ein Art Outline hättest* *T21: Genau, ja, stimmt* *I: So kurz Sekunden, hast du damals gesagt, so eine kurze Zusammenfassung als Einstieg, worum es in diesem Video geht* *#21, §226-231*
			11.2.6.5 Trainer's appearance in video/online = the appearance of the trainer in full-body image is not necessary in the whole length of the videos.	*Also, vielleicht nur den Schulterbereich nur zeigen, weiß nicht ob das besser ist* *I: Nur Kopf?* *T21: Oder nur Kopf… Kann aber auch sein, dass es nur die Gewohnheit von mir mittlerweile ist, dass man nur den Kopf sieht, weil mir in 100.000 Videokonferenzen drin hängen ist.* *#21, §86*

12. Gain	The participants described if and what new information did they learn in this training and what knowledge they acquired.		*Also, ich hab auf jeden Fall einen besseren Überblick bekommen gerade jetzt in Bezug auf Software-Entwicklung und die ganzen Zusammenhänge,*
	12.1 Aviation aspects	The participants mentioned that many aviation related aspects were clarified.	*generell neu war für mich die, äh, Thematik bei dem Luftfahrtsektor, da ich da vorher nicht unterwegs war, da aber, ich bin da quasi Anfänger in dem Bereich Avionik und ähm, was das Requirement Engineering angeht* *#17, §6*
	12.2 For future needs	The participants mentioned that this training will be beneficial for their future career.	*siehst du einen Nutzen dieses Trainings für dich?* *T22: (...) (...) Also, wenn hypothetisch, wenn ich es brauchen würde, ja (lachen)* *I: Es könnte für deine Zukunft?* *T22: Jetzt, weil ich jetzt nicht brauche, ist eher so „hm"* *I: Eher allgemeines Wissen?* *T22: Genau, so allgemeines Wissen, dass wenn ich es irgendwann raus grabbeln kann, dann ist es da, aber, wenn ich es brauchen würde für jeden Tag, dann hätte es auf jeden Fall sehr viel gebracht, aber da ich es auch nicht angewendet habe z.B. es ist nicht so präsent mehr* *#22, §75*
	12.3 Overview of connections & fundamentals	The participants mentioned that they got a recap of the relations and the basics in this field.	*Also, ich hab auf jeden Fall einen besseren Überblick bekommen gerade jetzt in Bezug auf Software-Entwicklung und die ganzen Zusammenhänge, ähm, gut V-Modell kannte ich vorher auch schon klar, aber ähm, die ganze Zusammenhänge* *#12, §6*
	12.4 Specific topics	The participants mentioned specific topics that were new for them in these trainings.	*Definitiv, ähm, selbst bei dem RE sind zu mindestens einige Aspekte aufgetaucht, die wir dann hier und da noch einfließen lassen können und dementsprechend für uns, also, für mich persönlich neu waren und für unsere Firma denke ich an der Stelle zu mindestens das noch mal anders bewertet habe als die einzelnen Teile* *#17, §8*

		12.4.1 Example from work	The participants described a specific situation during their work, where they realized the acquired knowledge or gain after their participation in the training.	*können Sie mir vielleicht ein Beispiel, vielleicht eine Situation aus Ihrer Arbeit beschreiben, wo Sie gemerkt haben: ach ja, das habe ich schon beim Training gehört oder gesehen [00:04:15]* *T17: Ja, ganz konkret, es ging um die Unterscheidung zwischen Low- und High-Level-Requirements. Das heißt was ist ein Low Level Requirement, was ist ein High Level Requirement im Gegensatz dazu und ähm und äh, hier ist es zu mindestens die Sicht differenzierter als es vorher war und genau, das ist dann auch konkret dann ins Spec1 eingeflossen* *#17, §9*

13. Recommendation to colleagues	The participants shared whether they would suggest this training to colleagues.		*Yes, I will, definitely. Actually, once I came back, I was telling my fellow colleagues that it is a nice opportunity to see it and that the training was really nice. Even, some, the team leader,* *#2.7, §20*
	13.1 Time period of participation	The participants stated that there is a suitable time period of attending this training when entering this field.	*ich würde es prinzipiell nur für Einsteiger empfehlen, also, quasi Leute wie ich, die gerade angefangen haben, 2-3-4 Wochen in der Firma und dann so eine Schulung. Dem Kontext halte ich dann auch sinnvoll und konnte man sinnvoll gestalten, ja* *#1.6, §42*

14. Other	Codes that cannot be related to the above existing categories.			
	14.1 Conditions of the two trainings	The participants asked or commented something about the trainings.		
		14.1.1 Date of interview	The participants commented on the time that has passed since the training took place. The interview took place approx. 3 months after the training. The participants were informed from the beginning that the interview will take place in 3 months time.	*Hu, das liegt lange her,* *#15, §6*
		14.1.2 Expectations for the training	The participants mentioned the information they had from their company about the training and what they were promised/hoping to learn.	*was ich ein bisschen schade fand, ähm, das Ziel vom Training ist, dass wir Teilnehmer einen unterschiedlichem Wissenstand haben, und dass dann individuell zugeschnitten werden soll, aber davon habe ich jetzt nicht viel mitbekommen, also, ehrlich gesagt, es wurde selten darauf eingegangen, was die individuellen Teilnehmer für Erfahrungen haben, sondern das war doch eher eine ganz normale Vorlesung quasi, der Professor redet und die anderen können Fragen stellen, aber es war nicht wirklich so, bis auf den Übungsteil vielleicht, es war nicht interaktiv so dass auf die einzelnen Kursteilnehmer speziell eingegangen wurde [00:09:32]* *I: Also, würdest du für mehr … Freiheit bei den Inhalten wünschen z.B. ein Kapitel zu überspringen? [00:09:45]* *T14: Ich weiß nicht wie es genau ausschauen soll. so hab ich zumindest am Anfang den Kurs verstanden, dass das die Idee ist, wie man individuell auf die einzelnen Stärken eingeht, ähm, wie man die unterschiedlichen Wissensstände untereinander besser involvieren kann, ähm, aber ich könnte jetzt nicht sagen, wie man das besser machen könnte, ich hab nicht irgendwie gemerkt, dass ein neuer Ansatz ist oder so dabei war* *#14, §29-31*
		14.1.3 Information about the training	The participants asked information about the training.	*Aha, also, erstmal hätte ich vielleicht noch eine Frage zur Gesamteinordnung, weil da gab's, gibt's noch zum Planungsprozess und zum Entwicklungsprozess gibt's auch solche Kurse oder* *#24, §29*
		14.1.4 Preparation for the interview	The participants had notes, which they read before and during the interview. According to their notes they remembered details and gave feedback about the trainings.	*Genau, ich habe mich da nochmal gestern ein bisschen reingelesen, ich glaube ich kann jetzt so wieder was dazu sagen* *#24, §7*

	14.2 Influence of the COVID pandemic	The participants referred to potential differences which occurred due to the COVID-pandemic conditions.		*wie ich sag mal vor 2-3 Jahren wo du jedes Wochenende, äh, jede Woche 1-2 solche Präsenzmeetings hattest und du dich irgendwo gelangweilt hast. Jetzt war es wahrscheinlich genau umgekehrt. Jetzt hast du dich gefreut mal wieder mit Leuten zusammenzuarbeiten oder mit Leuten zusammen was, ich sage jetzt vorsichtig, durchspielen oder durch, ja, sich anzuschauen. Ähm, ich muss sagen, ich weiß es tatsächlich nicht, ob es daran lag, ob es an dieser Corona Situation lag oder am Inhalt lag. Das tue ich mir ganz schwer* *#21, §142*
	14.3 Keeping up to date	The participants described what do they do in order to stay updated to the latest news about their field.		*Und ich habe auch ganz viele Youtube Kanäle, die immer das neuste Zeug haben... die abonniere ich, und so bleibe ich im Stand der Technik.* *#211, §74*
	14.4 Motivation	The participants referred to the reasons they or somebody else would like to or have to participate in a training.		
		14.4.1 Evaluation with point system	The participants stated to feel the motivation of earning more point in a grading system.	*egal was jetzt irgendwie die Leute sagen dies bezüglich wird nicht ausgewertet du kriegt dein Vorgesetzter oder sonst irgendwas, ähm, irgendwie muss man für sich selbst ein paar Punkte rausholen, sag ich mal so ne, und ich hab natürlich auch an der Stelle jetzt auch irgendwann aufgehört und habe dann nicht dreißig Runden gedreht oder so* *#23, §8*
		14.4.2 Sent from employer	The participants stated that they attended a training because their employer told them to.	*ähm, es war auf jeden Fall sehr flexibel und jeder kann so viel lerne, wie er möchte und es ist ja niemand gezwungen irgendwas zu machen, auch vielleicht vom Arbeitgeber (lachen)* *I: Ja* *T22: Das weiß man ja nicht, wenn man da hingeschickt wird, ähm, ne, finde ich sehr gut und auch der Präsenztag an sich ähm, war sehr, sehr schön, nochmal gesagt, nochmal dankeschön* *#22, §192-193*
			14.4.2.1 Paid from employer to go to training = The participants stated specifically that the employer covered the costs of attending a training and counted as work hours, which means they were paid to attend a training.	*Ja genau entweder muss ich dableiben, weil es Präsenz ist oder der Arbeitgeber zahlt dafür und man muss auch da bleiben* *#211, §56*
		14.4.3 Frequent tests	The participants stated that small frequent quizzes like tests or meetings with the consortium during the online phase would make them stay motivated and engage with the training.	*vielleicht nur eine halbe Stunde alle 2,3,4 Wochen, wünschen, einfach, dass man schon mal die Leute sieht, dass man Leute auch ein bisschen zwingt, da was zu machen* *#211, §82*

		14.4.4 Get a certificate	The participants attend a training in order to earn a certificate.	*about the thing with the certification. If you want to we can, I can send you a part participation's called certification, but it will be it will not be so formal, because, but I can still give you a certification of attendance of this training* *T210: Ok you can do that, yeah* *I: Yeah, I mean, I will write all the details of who we are and what we did in terms of this project. And that you participated in with so many hours, for example, because as you said: you spent time learning during so if you want, like to have a paper written, we can also do that. But yeah, the exam that was missing in the end is very interesting that you said that the* *T210: Exactly I would like to have, I would like to have an evaluation at the end, just for my, for my, for my, let's say, for my own feelings and when I invest my time in doing something I really, like at the end to have an evaluation but to know if our, if our good or if I need more effort, or I mean, just for my for my own thing* *I: Is it like? It's like you want the, if I may say it like that, like an confirmation of someone of like external?* *T210: Someone else, exactly* *#210, §113-118*
		14.4.5 Internal motivation	The participants stated that they wanted to learn something because they wanted to be informed about something.	*Ich sag mal, normalerweise richtig lernen macht man wenn man […] sich extrem dafür interessiert, bzw. am besten, wenn man es halt täglich benutzt* *#12, §76*
		14.4.6 Need the knowledge	The participants stated that they needed to learn something as a reason to attend a training.	*Wenn man das Wissen danach nicht sofort weiter vertiefen kann, dann würde ich eher die Schulung gar nicht machen, sondern erst versuchen, die an dem Zeitpunkt zu machen, wenn man tatsächlich sicherer, ähm, wenn man sich darauf vorbereiten möchte, dass man tatsächlich, dann, dann auch wirklich beginnt, mit dem Werkzeug zu arbeiten* *#212, §49*
		14.4.7 Pay for training themselves	The participants referred to situations where they covered the costs of attending a training themselves.	*aber ähm, danach nicht mehr, also, jetzt bei irgendwelchen Schulungen, wo man Kohle für hinlegt, diese dann meist auch schon ausgereift genug, dass man irgendwas mitnehmen kann.* *#23, §80*

		14.4.8 Technological evolution	The participants stated that the evolution of technology forces them to stay informed and keep learning.	*for me, for me, is a part of my job. Yeah, it's a part of my job. I cannot stay without updating so for me it's when I tried to imagine my life without learning it's not possible, learning is a part of my job, I have to learn, things are going so faster, that if you, if you just stay, ehm, if you just in the past, you will not be able to understand new things. I mean, and many companies are always moving from, from old technologies to the new ones, so you have to learn, so learning is a part of my job really* *#210, §104*
	14.5 Selection of trainings	The participants explained how do they choose a training to attend.		*Basically, a first step let's say brainstorming or getting I mean if I want to learn about the topic, probably I will entering all of the platforms that exist who said Coursera, Udemy, Udacity, edX in all of them, I will see that whole offer of all of these platforms. I will see the review of the people that did before and I will see how much the content of these courses adapt to what I need and then I will select from, from a pre-selection of 20 or 25 one and then I will go with that and I will be, I will have more or less the certainty that that is the best one of all of the ones of all the information that I have available basically, yes, that would be more or less like it and then if I start with it and I see that it is not as I expected then, yeah, I will quit (laugh) very likely but that is unlikely that is unlikely, in most of the cases I fill in because before starting I know more or less what should I expect* *#29, §177*
	14.6 Use of former trainings	The participants stated what do they do with trainings in which they participated in the past.		*Ja, ja, das war mein Plan, also, wenn ich jetzt, äh, äh, wenn ich mit dem Werkzeug natürlich jetzt in Kontakt kommen wieder und ähm, dann würde ich mir natürlich auch was zeigen lassen von Kollegen, aber würde mir auf jeden Fall noch mal äh, die Schulungsmateriellen zu ansehen. Auf jeden Fall, das war auch der Plan, wenn ich, ich hoffe, ich weiß noch, wo es liegt (lachen)* *#212, §89*
	14.7 What brings sb with prior experience	The participants stated what in their opinion is the different background knowledge of employees with prior experience.		*Mhm, meine Erfahrung vorher? Na ja, schwierig, strukturiertes Denken hilft in der Zusammenhang immer, aber ansonsten würde ich sagen, früher hatte ich kein Berührungspunkte gehabt* *#15, §58*

15. Experience with training	The participants revealed, if they have already participated in any other training courses and described their experience during these.			*das andere Training war mehr so n bisschen so, ich sag mal so, allgemein gefasst, ne, aber ging's generell um Teststrategien und alles. Das ist so ein Grundbasistraining, wenn man so will, wenn man dann allerdings hier auf der Arbeit sitzt, ist es schon wieder so, dass man in bestimmten Bereichen viel weiter ist als man in dem Training eigentlich gemacht hat und dafür hat man mal in dem Training mehr so einen generellen Überblick gekriegt, was einmal allerdings auch weiterhilft so ein bisschen* *#1.2, §28*
	15.1 Bad examples	The participants described prior training courses that they attended and in their opinion had negative characteristics.		*man kann aber auch einen Algorithmus zu Roboter-Pfadfindung und dann ist noch die Präsentationsart schlecht, das macht ja, kein Spass und das war kein guter Kurs. Also da wäre es vielleicht toll gewesen, dass man Hausaufgaben abgibt und jeder muss sich selbst Gedanken drüber machen oder man überarbeitet die Folien so, dass es bildlicher dargestellt wird was ist das Problem und wie man es lösen kann aber wenn die Medien nicht passend sind dann macht es auch kein Spass.* *#211, §54*
		15.1.1 Poor slides/presentation	The participants mentioned that the slides were overloaded and the presentation was poorly developed and transmitted.	*es gab so eine Schulung, wo die im Hintergrund so ein bisschen viel Grafik design gemacht haben. Da gab's irgendwie so, so, so Comic Puppen, die da irgendwie miteinander gesprochen haben oder teilweise waren da auch Sprechblasen zu sehen. Das fand ich da schon ein bisschen infantil. Das habe ich den dann im Feedback auch mitgeteilt, glaube das wurde auch danach nicht mehr gemacht, aber ähm, ja, das ist halt immer, der, der so was machen muss, der denkt halt anders als der, der es mitmachen muss und der, der daran teilnehmen muss und je nachdem in welcher Richtung er denkt, kann das dann durchaus mal ein bisschen weg eskalieren in eine Richtung oder ein bisschen Grafik überladen oder so was,* *#24, §223*
		15.1.2 Technical problems	The participants mentioned that there was a system malfunction.	*Ja, ok, das war von der Organisation sehr schlecht, weil das war eine Präsenz Schulung und das ist Corona wieder irgendwo dazwischengekommen und das wurde kurzfristig dann geplant und es ist so abgelaufen, dass ich kein Zugriff auf Kursmateriale hatte und es wurde dann durchgezogen und am Ende vom dritten Tag war die Prüfung.* *#26, §56*

		15.1.3 Unanswered questions	The participants mentioned that if a course doesn't have many participants the questions written in the forum may not be answered.	*processing in those kinds of platforms. In the one where it was more populated with students, this works perfectly but in the ones where there are not so many students it is very likely that there will be a lot of unanswered questions* *I: Yeah. Yeah,* *T29: yeah and then it loses a little bit, eh, eh, like the aim you know is not reached. I do* *#29, §115-117*
		15.1.4 Unprepared trainer	The participants mentioned that the problems occured during the training were maybe due to the lack of trainer's preparation.	*aber der der den Kurs geleitet hat, hat die Technik nicht beherrscht und mich verliert man da, wenn man nicht irgendwie also wenn es unpraktisch ist das Wissen aufzunehmen, weil die Technik nicht richtig funktioniert oder weil es nicht gut vorbereitet oder strukturiert ist,* *#211, §50*
		15.1.5 Unsuitable content	The participants mentioned that the training content did not bring any benefit/new knowledge to them.	*Besonders schlecht war aber ein ähnliches Beispiel, das war ein Kurs in Qualitätsmanagement für Produktentwicklung und er hat ja auch sehr viel von seinem Leben erzählt, aber es waren keine Erfahrungen, sondern nur wie gut er war, es so ein Loben von seinen Taten vor 20 Jahren. Es hat keinen Kursteilnehmer etwas gebracht, es hat nur echt viel Zeit gefressen und es bringt mir ja nichts, dass mir jemand vor mir den ich nicht kenne total lobt, dass es besonders gute Triebwerke bei Rolls Royce gebaut hat, das hat mir nichts gebracht war auch kein guter Kurs* *#211, §50*
		15.1.6 Unsuitable period of participation	The participants mentioned that the training content did not bring any benefit/new knowledge to them.	*Ähm, das war eigentlich ganz gut, äh, was natürlich schlecht war, das kann auch die Schulung nichts dafür: Es war eher der Zeitpunkt, weil wenn man natürlich, äh, ja, äh, okay, "T212-Name macht die Schule, du wirst ja immer mit dem Werkzeug beschäftigen" Ich habe mich heute noch nicht mit dem Werkzeug beschäftigt, ähm, aber das wird jetzt vielleicht sogar nächsten Wochen ja erst jetzt beginnen. Die Schulung ist aber über fast schon drei Jahre her oder drei Jahre? Ja, fast drei Jahre war eher so am Anfang und das ist natürlich immer schlecht, wenn man eine Schulung hat, wenn man sich vorher mit dem Thema, also vorher mit dem Thema gar nicht beschäftigen konnte oder hat, das heißt, man kann an alten Wissen nicht andocken, weil sie nicht nicht anschließend wissen, was man neu lernt, das heißt, ich finde, da lernt man grundsätzlich schlechter* *#212, §49*

	15.2 Blended courses	The participants described their experience at a blended training (with f2f and online parts).	*Aber so, so von blended konzept in der Hochschule, wir hatten ein Seminar, das war ähm, online und dann haben wir uns getroffen im Labor und haben Übungen dazu gemacht. Das war wärend Corona jetzt auch, also, das lezte, äh, 2020 war das noch glaube ich, genau da haben wir online Vorlesung gehabt und, mit Hausaufgaben (lachen) also, praktische Übungen und äh, dann haben wir uns einmal alle getroffen und haben ähm, bisschen was gebastelt an den Sensoren* *#22, §87*
	15.3 Good examples	The participants described prior trainings that they attended and in their opinion had positive characteristics.	*ich war ja, in diesen üblichen Vorträgen auf Konferenzen oder so, diese virtuelle Konferenzen, die jetzt die letzten Jahren waren oder ja, eineinhalb Jahren waren. Das war es schon üblich, dass man sich, da gab es das Skype-Bildchen irgendwo daneben gehalten, aber eben nur den Kopf und das ist doch angenehmer, wie die ganzen Menschen rumzuhampeln, ein bisschen übertrieben gesagt* *#21, §104*
	15.4 No participation in blended courses	The participants mentioned that they have not participated in a blended training.	*Well, I meant before the pandemic, before the corona pandemic startet most of the time there was face-to-face, but eh, since corona pandemic to, to, I take it online* *I: And have you also participated in blended courses, that have both face-to-face and…* *T210: No, not in blended, everything only online, so end to end online* *#210, §30-32*
	15.5 Online courses	The participants described their experience at an online training.	*ich kenne es jetzt auch viel von so ähm so online Seminaren, da wird natürlich am Anfang: äh, ich bin Name, ich bin irgendwas, weiß was ich, stelle mich vor, äh, da macht es man natürlich mit Bild, aber um eigentlichen Inhalt, wird oft die Kamera dann ausgeblendet* *#21, §94*

16. Reactions to inadequate training courses	The participants described, what did they do when they are/were attending a training that does/did not fulfill their needs and goals. If they do not have such experience, they assume what they would do in such situation.		
	16.1 Abandon the training course	The participants completely stop attending a training.	*Also, wenn es jetzt ein Kurs ist, von dem ich jetzt z.B. schon alles weiß der mich nicht weiterbringt würde ich den wahrscheinlich sogar abbrechen.* *#26, §70*
	16.2 Ask for a refund	The participants contact the person/company that organized the training and ask for their money to be paid back.	*Ich würde auf jeden Fall mich beschweren und sagen, dass das Geld zurück will. Ja, kommt darauf an, wie heftig es ist. Natürlich auch* *#212, §55*
	16.3 Ask for clarifications	The participants contact the trainer in order to ask questions about unclear information or the goals of the training.	*Falls ich mir nicht so ganz sicher bin, was im weiteren Verlauf in einem Kurs, den ich abbrechen möchte, noch kommt dann würde ich vielleicht mit dem Kursleiter reden damit er vielleicht in irgendwelchen Detailthemen, die meine Fragen beantworten genauer eingeht.* *#26, §74*
	16.4 Discuss with colleagues	The participants talk with their colleagues about the training they attended and did not fulfill their goals.	*Oder wieder auf die Kollegen zurückgreifen, so ungefähr „ihr habt auch den Kurs gemacht, wie habt ihr das und das dann gelernt oder wie habt ihr das euch angeeignet? Oder habe ich den Kurs falsch verstanden?“ kann auch mal sein, habe ich da irgendwo etwas ganz nicht mitgekriegt, vielleicht musste ich einfach Video 3 nochmal anschauen* *I: Aha (lacht)* *T21: Ne, (lacht), kann schon, es kann schon passieren, also, wenn man so Videos anschaut und dann nicht ganz aufmerksam ist, kann etwas schnell durchrutschen, wenn eine Katze drüben sitzt* *#21, §206-208*
	16.5 Do it anyway	The participants continued and completed the training despite any problems they encountered.	*Wenn es etwas ist, das im Moment nicht hilft, aber vielleicht später mal, dann würde ich schon schauen, dass ich den zu Ende bringe.* *#26, §70*
	16.6 Feedback questionnaire	The participants give their feedback in form of answering a questionnaire where they can evaluate the training they attended.	*schwierige Frage, also, ich erzähle es dir jetzt (lachen) also, ich schreibe es im Fragebogen vielleicht am Ende des Trainings, wenn so was gibt,* *#19, §68*

		16.6.1 For the trainer	The participants give their evaluation of the training they attended to the trainer.	*Yeah, I mean, most of the time at the end of the training, we have the Fragebogen, so we still have those, we have the opportunity to assess the training, to assess the training, the training, because eh, that is always the occasion for me to write, ehm, what didn't to fit my needs or something, if I find something bad or if I have a eh, bad feeling or something like that I use that Fragebogen to to express myself,* *#210, §122*
		16.6.2 For the manager/ company	The participants give their evaluation of the training they attended to their employer.	*I mean most of the time the company pays for that and even if you have to do that the company is the person, who can come money back and what everything I can do is just to explain myself in the end, in that Fragenbogen, so, most of the time we receive two of them, one for for our company and one for the for the company who offers the training* *#210, §124*
	16.7 Identify the problem	The participants try to understand what causes this reaction.		*So, most of the time I have to, I have to ask to, ehm, to make sure what was the problem. I mean, the problem can even be the trainer, could be the trainer, the trainer is not enough or the trainer don't find the right words to explain what you want to explain or maybe the training materials is awful or not well organized or something like that, so, it always depends, always depends what other say, I don't have any possibility to affect the training itself.* *#210, §128*
	16.8 Inform colleagues about an inadequate training course	The participants contact their colleagues in order to let them know of their opinion about the training they attended.		*if in the future somebody comes to me and ask me and tell me I want to attend to it training offered by such a company, I don't know and ask my opinion, I can just tell you: okay, I have a bad experience with the company and I will not, I will not suggest that training to to the colleague,* *#210. §128*
	16.9 Keep looking for another training course	The participants continue their search for a suitable training in order to cover their learning needs.		*that was let's say a bad course maybe or maybe a not fulfilling course, how to say in not to offend anyone, would you keep looking for something after?* *T27: Yes, I would keep looking for something else, some other way, some other course, probably different, yes, I will try* *#27, §44-45*

	16.10 Select the useful parts	The participants choose which parts/chapters of the training are beneficial for them and study/engages with these.	*Yes, actually, I would definitely try to watch it for, for a couple of lessons or try to see if there is something helpful and check the curriculum to understand like what is the point of my interest and if there are ten topics and ther is a topic of my interest I will try to learn those topics, which are useful for me, the content which the useful for me but not all the way, it depends, maybe ehm, as the course goes on, maybe I will decide, if there is a partial interest for me, I will definitely try.* *#27, §43*

17. Engagement with the training courses	The participants describe if and how did they use the training material.			
	17.1 First training course	The participants described if and how they used the training material after the implementation of the 1st training.		
		17.1.1 Never	The participants never looked into the material.	*aber hast du vielleicht etwas aus dem Training genutzt? Oder nicht unbedingt genutzt sondern begegnet? [00:05:44]* *T15: Äh, in dem Fall leider nein, weil ich eigentlich derzeit nur an Softwareentwicklung arbeite und mir mit dem Requirements erst so demnächst anfängt* *#15, §13-14*
		17.1.2 Once	The participants looked into the material one time.	*Ne, ne, ich hab's in der Tat, habe ich mir die Unterlagen angeguckt, weil ich in der Tat vor dem Problem war, dass ich Requirements erstellen muss oder musste, je nachdem und da, wie gesagt, wollte ich eigentlich, ich sag mal, das Gelernte wollte ich anwenden* *#1.1, §24*
		17.1.3 Potential future use	The participants stated that they might access the training material if they need it in the future.	*I: Aha, ok, hast du ein Gefühl, dass du irgendwann wieder die Materialien brauchen wirst und würdest du auf sie zurückgreifen?* *T12: Ähm* *I: Vielleicht ist es schwierig zu bewerten?* *T12: Ja, es ist schwierig zu bewerten, weil, wie gesagt, ich momentan nicht in dem Bereich arbeite, aber ich finde, die Materialien waren an sich ganz gut, ne, und wenn ich mich jetzt mit diesem Prozess an sich beschäftigen müsste, wäre, glaube ich, aktuelle das Beste, was ich zur Verfügung hätte* *#12, §57-60*

	17.2 Second training course	The participants described if and how they engaged with the material of the 2nd training (during or after).		
		17.2.1 Almost nothing	The participants accessed and studied maybe two or three videos and did no quiz.	*ich hab selber die Videos z.B. gar nicht gesehen, außer kurze Teile, ähm* *#22, §191*
		17.2.2 Everything	The participants accessed and studied all online topics.	*did you, the moodle course had also slides, videos and also quizzes, did you see these? did you take a quiz?* *T29: Yeah, I think I did some of them but eh, I don't very much how where they, I think I had, I did all of them, if I remember correctly, when I did it, I mean I did the whole course before we had this f2f session* *I: Aha* *T29: And if I remember properly I did everything* *#29, §44-47*
		17.2.3 Partially (majority)	The participants accessed and studied almost all topics except for two or three videos or quizzes.	*Ja, weil irgendwie, ich hatte, glaube ich, mir haben 2 Videos gefehlt, die habe ich davor zeitlich nicht geschafft und die waren, glaube ich welche, die zeitlich so vom Plan danach angeordnet waren, die habe ich dann einfach angeschaut* *#2.1, §22*