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Acceptance-Driven Design Science Research

Designing an E-Service for Teachers' Professional Development on Technology-Enhanced Learning

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Abstract

The use of technology-enhanced learning (TEL) in higher education requires according to various sources appropriate competencies from teachers. Classical training programs can help to build them. However, such programs have problems: (1) due to limited resources, not all teachers can attend such a program at the same time, (2) teachers have too little time to attend a complete training program, and (3) in such programs, what is learned is often not used in their daily business afterwards. Online available e-services should help to solve these problems, but already existing e-services are hardly used. Therefore, the purpose of this thesis is to design an accepted e-service that enables teachers to build up the necessary competencies in self-study. The questions are how such an e-service can be designed, what needs to be described in terms of content, what requirements define such an e-service, and what constructs influence acceptance. The thesis applied a Design Science Research methodology, which is appropriate for designing artifacts in a scientific context. A literature review and a survey determined what must be described in terms of content. When it was realized that teachers often do not accept such e-services, the design-oriented problem also became a behavior-oriented one. However, since there was no approach on how to specifically incorporate theories of technology acceptance research (behavioral science) into the design of artifacts (design science), the thesis proposed and applied a specific research design pattern, the Acceptance-Driven Design Science Research (AD-DSR) approach. First, a literature review defined a specific Technology Acceptance Model. Second, expert interviews defined requirements for the design of the included constructs. Several design cycles designed the e-service, and at the end of each cycle, a qualitative evaluation on perceived usefulness and perceived ease of use provided suggestions for improvement. After completion of the e-service, a quantitative evaluation determined whether the design of the constructs was successful and which constructs influenced the acceptance. The research first shows which influencing factors in terms of content must be described in the e-service, e.g. cognitive aspects, which should be described, e.g. demographic differences, and which could be described, e.g. social aspects. The thesis also shows that system quality, conveying the novelty of e-service, technical support, content support, integration in own systems, job relevance, and social image positively influence the acceptance. Combined with the requirements of constructs that have been successfully designed, the thesis concludes by proposing a nascent design theory for the design of such e-services. The first application of the AD-DSR approach therefore shows successfully how the approach can be used to contribute to design and behavioral science and the thesis discusses insights for further improvement of the approach. In addition, the use of AD-DSR has helped the e-service gain acceptance among a segment of the target group, i.e. teachers with a higher interest in using TEL. Research found that while teachers generally use TEL, the majority use only standardized approaches. Therefore, such e-service is not of interest to most teachers, and instead of building competencies, accepted TEL approaches should be designed, e.g. using AD-DSR, which can be used across the board.

Contents

1. Introduction[1]

In the 1960s, with IBM computers, and in the early 1970s, with Intel processors, two decisive innovations slowly began to change our society and economy. In the following decades, information and communication technologies (ICTs) became increasingly important, eventually leading to a new infrastructure, the Internet. (Freeman and Louçã, 2002) With the rapid growth of this new infrastructure in the mid-1990s, ICTs became ubiquitous, and our economy and society began to rely heavily on these technologies (Barefoot et al., 2018). Even today, new ICTs are constantly emerging, such as new end-user devices and new digital platforms and services (Bukht and Heeks, 2017), leading to a constant transformation of work, communication, and everyday tasks (Barefoot et al., 2018). H.-D. Zimmermann (2000) considered this to be a digital economy, with challenges and opportunities in terms of the technologies themselves, but also in terms of organizational structures and processes. Mesenbourg (2001) defined three main components of this digital economy: the supporting infrastructure, the electronic business processes, and the electronic commerce transactions.

In this context, the media and politicians today often talk about digitization, digitalization, and digital transformation. According to Bloomberg (2018), these terms are often confused. Digitization refers exclusively to the process of converting analog information (e.g. text on a piece of paper) into digital information (e.g. a text-file stored on a computer) (Bloomberg, 2018; Mäkiö, Miroliubov, and Zhgun, 2018). Digitalization refers to using digital technologies to change and improve business models and business processes (Bloomberg, 2018; Mäkiö, Miroliubov, and Zhgun, 2018; Tømte et al., 2019; Reis et al., 2020). Digital transformation refers to a comprehensive customer-driven strategic business transformation through the implementation of

[1]Parts of this section are based on the following already published work: Schweighofer, Weitlaner, et al. (2019), Beer (2022a)

digital technologies and the change of organizational structures and processes. In contrast to digitalization, digital transformation takes the entire business and its strategy into account. (Bloomberg, 2018; S. Seufert and Meier, 2016) Thereby, technological aspects, economic aspects, and social aspects are essential (Mäkiö, Miroliubov, and Zhgun, 2018).

In recent years, digitization, digitalization, and digital transformation have become important topics in all industries (S. Seufert and Meier, 2016; Lukyanova, Shamaeva, et al., 2019; Hofhues and Schiefner-Rohs, 2020). The education sector is no exception, and various aspects of digital transformation have been discussed in this context, such as new digital approaches to learning, teaching, and administration (S. Seufert and Meier, 2016; van Ackeren, Kerres, and Heinrich, 2017; Lukyanova, Shamaeva, et al., 2019; Tømte et al., 2019). The importance of the topic was also emphasized by numerous funding initiatives (van Ackeren, Kerres, and Heinrich, 2017), and in Austria the Federal Ministry of Education, Science and Research has set as a specific digitalization goal the better use of digital technologies specifically in higher education (HE) (BMBWF, 2020).

However, the use of digital technologies in HE to improve teaching and learning was frequently discussed, albeit under different terms, even before the discussion of digitization emerged (Hofhues and Schiefner-Rohs, 2020). Among the terms used in these discussions, technology-enhanced learning (TEL) is highly attractive, because this term is broad and encompasses all technologies that make teaching and learning more effective, efficient and enjoyable (Goodyear and Retalis, 2010). Dror (2008) explained that the list of relevant technologies based on TEL's definition is constantly expanding and quite long, including mobile learning platforms, interactive videos, electronic blackboards, and software for presenting information like PowerPoint, as well as the WWW, email, and even mobile phones.

On the question of why TEL is discussed in relation to our digital economy, Schweighofer, Grünwald, and Ebner (2015) conducted a structured literature review in which they analyzed 1,089 publications on the digital economy for connections to TEL. They provided three answers. First, as explained earlier, in our digital economy new technologies are constantly being developed that change the way we work, communicate, and perform everyday tasks. According to them, this also leads to constant changes and new possibilities in the field of TEL. This is also supported by Dror (2008), who explained that that the list of relevant technologies for TEL is constantly expanding. Second, as new technologies continue to change the way we work and live, TEL should be used in the classroom to teach how to use these technologies. Third, since especially young people born between 1980 and 1994, the digital natives (Prensky, 2001), are accustomed to using various technologies in their daily life, they demand learning scenarios supported by those technologies. Many researchers have supported this claim (Pedró et al., 2006; Redecker et al., 2009; Noguera Fructuoso et al., 2015), while others have criticized that there is no convincing evidence for it (Bekebrede, Warmelink, and Mayer, 2011; Bullen and T. Morgan, 2011; Margaryan, Littlejohn, and Vojt, 2011).

Regardless, it is undisputed that TEL is a key issue for higher educational institutions (HEIs) in Austria. Between 2000 and 2005, the Austrian Federal Ministry of Education, Economics and Culture had already launched three tender programs to promote the use of technology in HE teaching (Pfichter, 2009). In 2000, this led to the establishment of the "Forum Neue Medien" network, from which the "Forum Neue Medien in der Lehre Austria/fnma" association emerged in 2003. This association supports and networks Austrian HEIs in matters of TEL. In 2007, 37 HEIs were members of the association. (Zwiauer et al., 2007) Today, the association has 47 members[2] from a total of 73 HEIs in Austria (Pausits et al., 2021).

In 2015 the association conducted a large-scale study on the status of TEL at Austrian HEIs, in which 49 of the 72 HEIs surveyed participated. 36 of these used TEL HEI-wide, 10 in some departments, and in 3, TEL was used by individual faculty members. This means that TEL was an issue at all 49 responding HEIs. (Bratengeyer et al., 2016) Pausits et al. (2021) also confirmed that most HEIs in Austria have already implemented technical and organizational structures and services related to TEL. This is further illustrated by how the topic has been embedded in the strategy of individual HEIs (e.g., Kopp and Polaschek, 2015; PHST, 2018).

Furthermore, according to the study by fnma, most HEIs saw the added value of TEL in the didactic variety and in the support of face-to-face teaching (Bratengeyer et al., 2016). Hero (2020) also noted that experts recommended using technology in the classroom because it can add value

[2] https://www.fnma.at/verein/ordentliche-mitglieder (last access: 2021-08-05)

and benefit to the learning process. Panda and S. Mishra (2007) described some of these advantages. For instance they claimed that students would have access to educational resources from outside the HEI and teachers could create, update, and revise course materials easily and quickly (Panda and S. Mishra, 2007). Schulmeister (2006) summarized the benefits of TEL, describing that TEL can be used to overcome four barriers: (1) time, (2) space, (3) analog-digital, and (4) norm barrier.

1.1. Problem Statement[3]

In order to take advantage of all the benefits TEL can provide, teachers must have the appropriate skills. Researchers have emphasized this point repeatedly over the past two decades (see Hodgson, 2004; Casanova, Moreira, and Costa, 2009; Jans and Awouters, 2009; Hossain, 2010; Rienties, Brouwer, and Lygo-Baker, 2013; Baumgartner et al., 2015; Gulbahar and Kalelioglu, 2015; Bezuidenhout, 2018; Hero, 2020; Pausits et al., 2021). Experts at Austrian HEIs interviewed as part of the fnma study also emphasized the fact that continuing education for teachers is essential to ensure the success of TEL (Bratengeyer et al., 2016).

Two crucial factors must be considered. First, as new technologies are constantly being developed in our digital economy, teachers must also constantly renew their skills in this area (Bezuidenhout, 2018; Matveeva et al., 2020). Second, technical competency in the use of technologies alone is not sufficient for the successful use of technologies in the classroom (Hodgson, 2004; Jans and Awouters, 2009; Rienties, Brouwer, and Lygo-Baker, 2013; Gulbahar and Kalelioglu, 2015). A widely used (Chai, Koh, and C.-C. Tsai, 2013; Rosenberg and Koehler, 2015) framework that describes the required competencies in general terms is the Technological Pedagogical Content Knowledge (TPACK[4]) framework (P. Mishra and Koehler, 2006).

[3]Parts of this section have already been published in: Beer (2022a), Beer and Hatzl (2022)

[4]The original used acronym TPCK was later changed to TPACK (Thompson and P. Mishra, 2007)

Building such competencies in the context of professional development is a virtue of HEI teachers, according to Shagrir (2012). HEIs support this by integrating relevant topics into didactic training programs or by offering special training programs (Bremer, 2010). According to the fnma study, 35 Austrian HEIs have already offered such training programs on TEL for their teaching staff in 2015 (Bratengeyer et al., 2016). In addition, a cross-HEI training program called eDidactics was launched in Styria in October 2015, which was developed in cooperation with all nine Styrian HEIs. This program originally consisted of eight modules on various topics of TEL (Kopp, Ebner, et al., 2016). The program is still running and currently consists of nine modules[5].

Although eDidactics can be described as successful, and regular evaluations show that participants are satisfied with the program, it can never reach all teachers at Styrian HEIs due to the limited participant capacity in the face-to-face courses, which, in turn, is due to limited resources. Furthermore, the effectiveness of such professional development training programs is sometimes questioned in the literature. So, Lossman, et al. (2009) described that many such programs have the problem that what is learned is not put into practice afterwards. They blamed the time gap between the training and the application, which results in many teachers no longer being able to implement what they have learned or to solve emerging problems. In a study by Malik, Nasim, and Tabassum (2015), HEI teachers confirmed this problem by questioning the effectiveness of professional development training programs in terms of follow-up in practice. Another problem is the available time itself. Due to their heavy workload, it is difficult for teachers to find time to attend such training programs (Hossain, 2010).

E-Services providing e-training, web-based training, or distance learning can help solve these problems and offer teachers more flexibility in terms of time, place and choice of content (Hossain, 2010). They provide information whenever teachers need it; therefore, the effectiveness in terms of follow-up in practice should also be higher. Examples, with a focus on German-speaking countries, are "erwachsenenbildung.at"[6], "Digitaler Freischwimmer"[7], "Dig-

[5]https://edidactics.at (last access: 2021-08-06)
[6]https://www.erwachsenenbildung.at (last access: 2023-05-10)
[7]https://www2.tuhh.de/zll/freischwimmer (last access: 2023-05-10)

ital Learning Map"[8], and "eLearning Blog TU Darmstadt"[9].

However, although such e-services are mostly freely available, teachers hardly use them and are often not aware of their existence (Bratengeyer et al., 2016). A survey conducted at one of the Styrian HEI indirectly confirmed this. The study showed that, among other reasons, teachers did not use TEL approaches mainly due to uncertainty, technical problems or lack of support and, crucially, information. The latter indicates that these teachers were not aware of such e-services or hardly used them. (Schweighofer and Zullus, 2019)

It seems like HE teachers do not accept such e-services. The acceptance of a technology in general can be defined as the behavioral intention (BI) to use a technology and the actual use (AU) of it (Venkatesh and Davis, 1996). The acceptance of TEL approaches by learners, who are in this case teachers at HEIs, is a common topic in research and there is a plethora of studies providing different results what influencing factors determine this acceptance. For instance, Jaw, O. Yu, and Gehrt (2012) showed positive significant effects on adoption of new e-learning services due to compatibility, observability, and trialability, and negative effects due to complexity. Farahat (2012) pointed out that social influence of students' referent group can have significant positive effect on the intention to use online learning, and Salloum and Shaalan (2019) indicated that facilitating conditions, performance expectancy, and social influence have positive effects on the intention to use e-learning systems. Summarized, these existing studies have showed how different constructs under various circumstances can influence acceptance and should therefore be considered in the design of new TEL approaches.

Furthermore, looking at Germany, the government has already funded many projects with the intention to provide e-services on TEL. Most of these projects failed and the provided e-services are not available anymore. The reasons can be summarized with missing visibility, missing business models and a missing plan how to support and maintain the e-service after the end of the project. Regarding user acceptance most of these projects also failed because value and relevance was not addressed clearly enough for teachers'

[8]https://www.e-teaching.org/community/digital-learning-map (last access: 2023-05-10)

[9]https://blog.e-learning.tu-darmstadt.de (last access: 2023-05-10)

daily business. (Haug and Wedekind, 2009) Additionally, several studies have already provided insights on how critical user involvement can be in the development and use phase of TEL projects (e.g., So, Lossman, et al., 2009; Nawaz, 2011).

In summary, teachers at HEIs need to have the necessary skills to use TEL effectively and efficiently. Therefore, there are many professional development training programs in Austria. These programs have some problems that can be solved by e-services that enable teachers to build the skills necessary to successfully implement TEL approaches in self-study. Several projects attempted to provide such e-services in the past. Many of these projects failed. Some e-services are no longer accessible and others are hardly used by teachers. Consideration of acceptance constructs and user involvement seem to be critical success factors in designing such an e-service. Post-project support and maintenance are also key factors.

1.2. Methodological Challenge

The problem statement shows that there is a lack of accepted e-services that enable teachers to build the necessary competencies to successfully implement TEL approaches. To design such an accepted e-service, using an agile development method with high user involvement seems to be an obvious choice. The higher user involvement should eventually lead to an e-service that fully reflects the users' requirements and should therefore be accepted by them.

However, not all situations and projects are suited for agile methods. Sometimes plan-driven methods are better choices. Boehm and Turner (2003) compared agile and plan-driven methods and defined their respective home grounds. According to their comparison, plan-driven methods seem to be the better choice for funded research projects at HEIs. According to them, plan-driven methods have merit when, among other things, high assurance is important, teams and projects are larger, the customer is not on-site, documentation is important, the project is generally more formalized, increments are longer, test plans and procedures are thoroughly documented, and compliance with policies and procedures is important. These are all characteristics of funded research projects conducted at HEIs. Because the bulk of this thesis was conducted as part of such a research project, a different methodology was required.

The Design Science Research (DSR) framework by Hevner, March, et al. (2004) is a well-established research paradigm in information systems research (Gregor and Hevner, 2013). It is a problem-solving paradigm with the goal of creating new artifacts (Hevner, March, et al., 2004), such as an e-service for teachers on TEL. The research conducted in this thesis essentially followed the guidelines and steps of DSR as an appropriate methodology for both a doctoral thesis and funded research projects. However, the author of this thesis missed a clear approach that shows how user acceptance issues can be addressed in the context of DSR. There are researchers who have used theories or models of technology adoption to assess the acceptability of a designed artifact within a DSR project (e.g., see Golding and Donaldson, 2009; Haugstvedt and Krogstie, 2012), but they have not clearly demonstrated how and if at all they have used existing theories of technology adoption to design the artifact. Platzer (2011) argued that it is difficult to derive requirements or design implications for new artifacts from existing theories or models, and that designers and developers therefore cannot do so. If so, this would mean that results of technology acceptance research, which provide important influencing factors and design principles for accepted artifacts, would be irrelevant for the practical implementation of new artifacts.

In summary, designing accepted new artifacts, such as a new e-service, as part of a funded research project at a HEI is methodologically challenging. Agile methods can be difficult to use in the context and it seems that there are no approaches to DSR where existing theories of technology acceptance guide the design of artifacts.

1.3. Research Objectives and Research Questions

To address the problem and the methodological challenge, a research project was launched in 2019. The goal was to design an accepted online e-service called eCampus (purpose). This e-service should provide teachers in the Styrian HE sector with the necessary competencies to successfully implement TEL approaches (outcome). In the long run, this should translate into more and better TEL implementations in Styrian HE courses (impact).

Since 2013, the author of this thesis has been working on the design of an e-service to support teachers in the use of TEL. From the start, DSR was used to answer the following guiding research question:

> *RQ (initial).* How can we design an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

After realizing that the teacher acceptance of such e-services is a challenge in this field, the guiding research question was refined to:

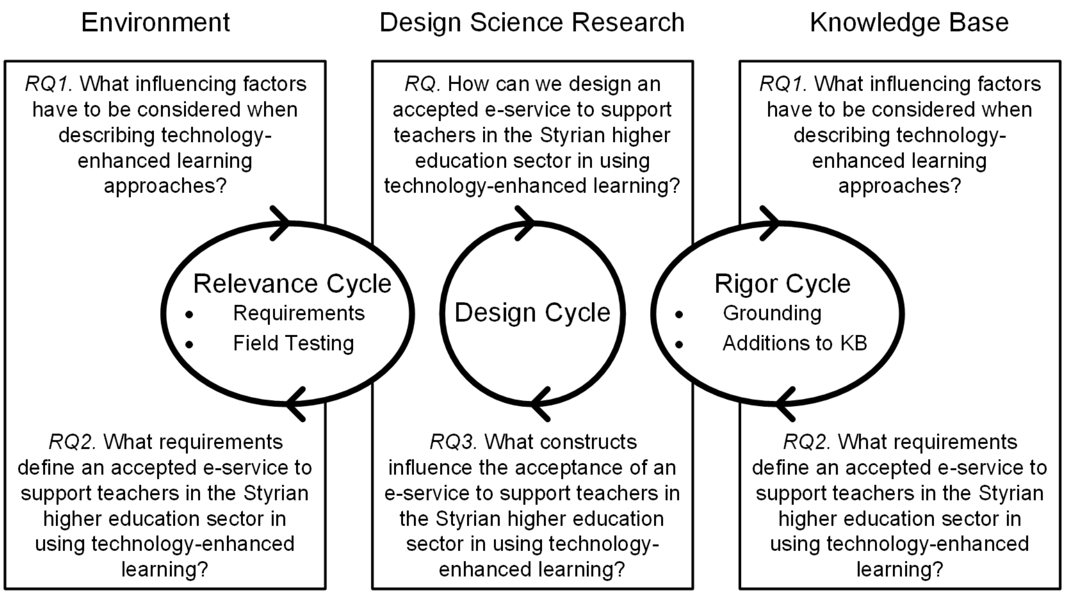
> *RQ.* How can we design an **accepted** e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

Figure 1.1 shows the guiding RQ and the additional subordinate RQs of this thesis in relation to the DSR framework by Hevner, March, et al. (2004). Thuan, Drechsler, and Antunes (2019) proposed to establish similar RQs along the three cycles of the DSR framework. As can be seen, *RQ1* and *RQ2* are both located in the environment and knowledge base, as both areas of the framework are affected. *RQ1* was necessary to get a clearer understanding of what content is relevant to teachers on the proposed eCampus. This can be seen as an extension of the TPACK framework, which is too general for this task. *RQ2* was intended to show what requirements arise when considering user acceptance during DSR, and *RQ3* was intended to shed light on what constructs, some of which are used to determine requirements, actually influence the acceptance of such e-services.

With respect to the research objectives, this thesis seeked to contribute in several ways. Gregor and Hevner (2013) divided contributions in DSR projects into three levels: situated implementation of the artifact (Level 1), nascent design theory (Level 2), and well-developed design theory about embedded phenomena (Level 3). In addition, Hevner, March, et al. (2004) emphasized that evaluation within a DSR project requires the definition of appropriate evaluation criteria to determine whether or not a contribution has been successfully achieved. In this regard, this thesis attempted to provide three contributions; two Level 1 contributions and one Level 2 contribution.

Figure 1.1.

Research Questions in Relation to the Design Science Research Framework by Hevner (2007)



The first planned contribution was the designed e-service eCampus, i.e. an artifact and thus a Level 1 contribution. The contribution was considered successful if the users were satisfied with the design of the e-service and accepted it, and more than 10 percent of the teachers at Styrian HEIs, i.e. about 630 teachers[10], had used the e-service at least once. Satisfaction and acceptance were measured with a corresponding survey at the end of this thesis.

The second planned contribution was a nascent design theory in the form of design principles and technological rules for similar e-services, i.e. a Level 2 contribution. Even if the e-service was not accepted as a whole at the

[10]https://unidata.gv.at/ (last access: 2022-09-15 for the year 2021)

end, the work should contribute design principles and technological rules that positively influence the acceptance of similar e-services. If significant statements could be made in this context at the end of the work, this was considered a success.

Finally, the third planned contribution was the overall approach to the design of an accepted artifact, in this work an e-service. This is also an artifact and thus a Level 1 contribution. However, user acceptance may strongly depend on circumstances that cannot be influenced when designing an artifact. Therefore, the approach designed in this thesis should include components that examine user acceptance of the designed artifact from a scientific perspective, thus contributing to the knowledge base. If the approach was carried out according to plan, the designed artifact was accepted, and/or significant conclusions could be drawn about acceptance constructs for the e-service, this contribution could be considered successful.

1.4. Hypotheses

With respect to hypotheses in DSR projects, there are two main ways. On the one hand, S. Zimmermann (2018) suggested that no hypotheses are formulated. On the other hand, Offermann et al. (2009) suggested to start with a general research hypothesis as a guiding hypothesis. As the DSR process continues, this general research hypothesis should be refined by smaller hypotheses, as the general research hypothesis is typically difficult to evaluate.

In this thesis, the second method was applied. Therefore, the general research hypothesis that guided the research process was:

> *H.* When a strong focus is placed on user acceptance in the design process, an accepted e-service can be designed to support teachers in the Styrian higher education sector in using technology-enhanced learning.

During the research, additional hypotheses were formulated and evaluated to refine this general research hypothesis. These hypotheses can be found in the respective chapters of this thesis.

1.5. Main Publications and Thesis Outline

During the thesis, the author has published seven publications that contribute to this work. The following list presents them in chronological order. For each publication, there is a brief summary and an explanation of how the publication contributes to this work. The author of this thesis was main contributor for all listed publications.[11].

P1 **Patrick Schweighofer, Stefan Grünwald, and Martin Ebner (2015). "Technology Enhanced Learning and the Digital Economy: A Literature Review." In: *International Journal of Innovation in the Digital Economy (IJIDE)* 6.1, pp. 50–62**
Summary: A literature review of known relationships between technology-enhanced learning and the digital economy.
Contribution to thesis: This initial work has demonstrated the importance of TEL in today's world and thus has formed the most fundamental motivation for this thesis.

P2 **Patrick Schweighofer and Martin Ebner (2015). "Aspects to Be Considered when Implementing Technology-Enhanced Learning Approaches: A Literature Review." In: *Future Internet* 7.1, pp. 26–49**
Summary: A literature review that categorizes a plethora of influencing factors that can be considered when implementing TEL approaches.
Contribution to thesis: This paper has provided a detailed overview of what content may be relevant when describing TEL approaches.

P3 **Patrick Schweighofer, Doris Weitlaner, et al. (2019). "Influential Factors for Technology-Enhanced Learning: Professionals' Views." In: *Journal of Research in Innovative Teaching & Learning* 12.3, pp. 268–294**
Summary: A quantitative research approach based on survey data to assess the importance of influencing factors that can be considered when implementing TEL approaches.
Contribution to thesis: The results of this work have provided a clearer understanding of what content is relevant to teachers in the

[11]Please note that the author has changed his name during the thesis project and was formerly known as Patrick Schweighofer

Styrian HE sector and should therefore be included in the designed e-service eCampus.

P4 **Patrick Schweighofer and Günter Zullus (2019).** ***Technologiegestützes Lehren und Lernen an der Fachhochschule CAMPUS 02: Eine Studie zur Erhebung der IST-Situation*****. BoD–Books on Demand**
Summary: A quantitative research approach based on survey data that investigates the current situation regarding the use of TEL at a Styrian HEI.
Contribution to thesis: This publication has provided the first evidence that existing training programs and online content on TEL are hardly used by teachers at Styrian HEIs. Additionally, the results of the studies are summarized in Section 2.1, as they represent the actual situation of the use of TEL at one of the HEIs for which the e-service eCampus is designed.

P5 **Patrick Beer (2022a). "A Research Design Pattern for Design Science Research Focusing on User Acceptance: Designing the E-Service eCampus." In:** ***Service Engineering–Wissenschaft und Praxis: zwei Seiten derselben Medaille*****, pp. 105–129**
Summary: A publication introducing Acceptance-Driven Design Science Research (AD-DSR). AD-DSR is a research design pattern that helps to address user acceptance in DSR projects.
Contribution to thesis: The paper has presented the methodology and research design used in this thesis to address the methodological challenge explained earlier in this chapter.

P6 **Patrick Beer and Stefanie Hatzl (2022). "Differences through Focus on User Acceptance? The Design of an E-Service for Teachers on Technology-Enhanced Learning." In:** ***Service Engineering–Wissenschaft und Praxis: zwei Seiten derselben Medaille*****, pp. 131–143**
Summary: A case study showing how AD-DSR can be used to derive requirements that should lead to an accepted artifact.
Contribution to thesis: The results have represented the acceptance constructs and the requirements derived from them, which were used for the design (requirements) and later evaluation (acceptance constructs) of the designed e-service eCampus.

P7 **Patrick Beer (2022b).** ***Bericht eCampus Akzeptanzumfrage*****. Tech. rep. published under CC BY 4.0 within the Styrian Higher Educational Institutions**

Summary: An internal report with the results of a quantitative research approach based on survey data discussing the acceptance of the e-service eCampus.
Contribution to thesis: This internal report has provided the final evaluation of the designed e-service eCampus, indicating whether the e-service was accepted, how the design process helped increase acceptance, and what constructs influenced acceptance of the e-service.

Finally, Figure 1.2 shows the outline of the thesis. The figure contains all chapters and sections of the thesis and shows in which chapters the results of the previously listed publications are mainly included. The general structure of the thesis is based on the publication scheme for DSR studies proposed by Gregor and Hevner (2013).

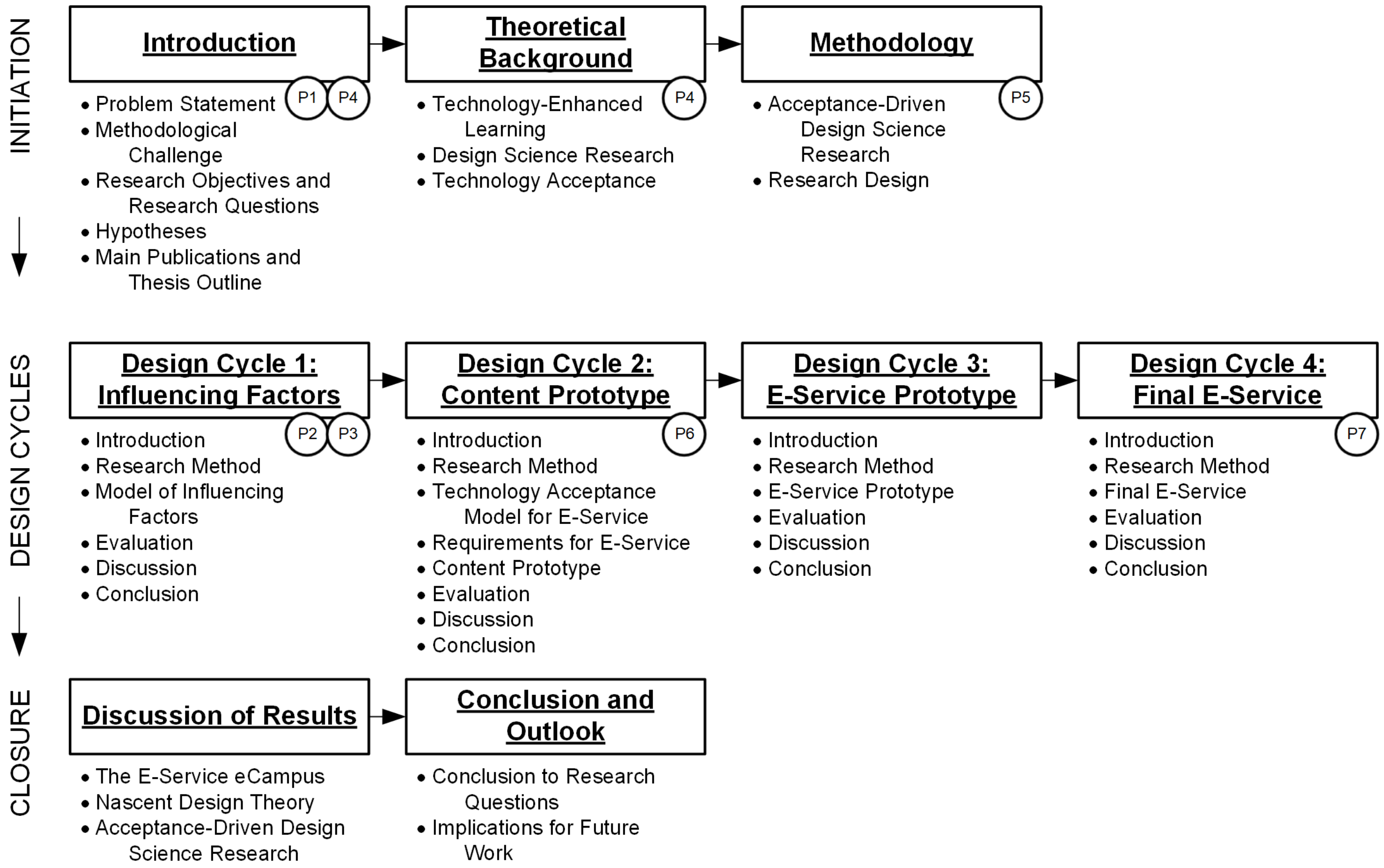
Chapter 1 (Introduction) is the introductory part of the thesis and formulates the motivation and main research agenda. Chapter 2 (Theoretical Background) gives the theoratical background of related work about TEL, DSR and technology acceptance. The following Chapter 3 (Methodology) describes the methodology of the thesis, namely the Acceptance-Driven Design Science Research approach, including the research design.

The main part of the thesis describes the four design cycles of the DSR project. Thereby, the structure of each chapter is also based on the suggestion by Gregor and Hevner (2013). Chapter 4 (Design Cycle 1: Influencing Factors) discusses the first design cycle about influencing factors. Chapter 5 (Design Cycle 2: Content Prototype) is the second design cycle and shows the first prototype for the content and builds the fundamentals for the later evaluation. Chapter 6 (Design Cycle 3: E-Service Prototype) presents the results of the third design cycle in which the first full prototype was designed. Finally, Chapter 7 (Design Cycle 4: Final E-Service) evaluates the final e-service in the fourth and last design cycle.

To the end, Chapter 8 (Discussion of Contributions) discusses the contributions of this thesis and Chapter 9 (Conclusion and Outlook) gives the answer to the research questions and an outlook for future work.

Figure 1.2.

Thesis Outline



2. Theoretical Background

This second chapter provides the relevant theoretical background necessary to achieve the planned research objectives of this thesis. The first section therefore provides an overview of technology-enhanced learning (TEL) to understand the context of the content of the designed artifact. It includes benefits and approaches, as well as instructional designs and necessary competencies related to TEL. In addition, the section provides a brief overview of e-services that are similar to the e-service eCampus that was designed as part of this thesis.

The second section discusses the Design Science Research (DSR) approach in detail. This is necessary to lay the foundation for the DSR-based research approach introduced in Chapter 3. For this purpose, the section describes the general idea of DSR, its guidelines, contribution types, and selected process models for applying DSR.

Finally, the third section describes theories and models of technology acceptance research and how they relate to DSR. This is necessary so that the DSR-based research approach (see Chapter 3) can appropriately address aspects of technology acceptance research.

2.1. Technology-Enhanced Learning[1]

According to Sun, Finger, and Z. L. Liu (2014), researchers began to recognize the flexibility and repeatability of computer programs for instruction in the 1970s. Sun, Finger, and Z. L. Liu (2014) claimed that this was the starting

[1]Parts of this section are based on the following already published work: Schweighofer, Weitlaner, et al. (2019), Beer (2022a)

point for research in educational computing. Since then, the use of digital technologies in teaching and learning processes has been continuously discussed, using different terms such as as e-learning, computer-assisted instruction, educational technology, educational computing, distributed learning, technology-enhanced learning and more (T.-W. Chan et al., 2006). During these 50 years, technologies have evolved in many areas, and so has their use in education. Pahl (2003) argued that some technological developments, such as the Internet, have even radically changed the field of education.

Sun, Finger, and Z. L. Liu (2014) showed this development in a large-scale literature review in which 2,694 journal articles between 1977 and 2005 from four major international journals in the field of educational computing were analyzed. Their findings showed that between 1977 and 1981, most of the research was on computer-assisted instruction (CAI), specifically with the use of personal computers. Over the next decade, research in CAI was at a peak, focusing specifically on design issues and the use of existing programme packages in education. From 1992 to 1995, the focus on CAI slowly began to shift toward web-based learning as well as intelligent tutoring systems. The rapid growth of the Internet led to an increase in research on web-based learning from 1996 to 2000, and research related to the term e-learning was conducted more frequently. From 2001 to 2005, research in web-based learning continued to increase. The focus was specifically on personalization and adaptability. Towards the end of this phase, the focus gradually shifted to mobile learning and ubiquitous learning as the relevant technologies became more widespread. (Sun, Finger, and Z. L. Liu, 2014)

Nowadays, a highly attractive term used in the context of educational computing is technology-enhanced learning (TEL), which is also mainly used in this thesis. The term is broadly defined and encompasses all technologies that make teaching and learning more effective, efficient and enjoyable (Goodyear and Retalis, 2010). In this sense, according to Goodyear and Retalis (2010), technologies can be used:

- for accessing and studying learning material;
- for learning through inquiry;
- for learning through communication and collaboration;

- for learning through construction;
- for learners' assessments;
- for digital and multimedia literacy.

Dror (2008) claimed that the list of relevant technologies based on TEL's definition is quite long. First, there are technologies that are developed or intentionally used for formal learning, such as mobile learning platforms, interactive videos, electronic blackboards, and software for presenting information like PowerPoint. Second, the list needs to be expanded to include technologies such as the WWW, email, and even mobile phones, as learning also occurs informally. Clearly, the list of technologies relevant in this sense is constantly expanding. (Dror, 2008)

Hoffmann (2016) further stated that in Austria the term e-learning has also frequently been used and has long been a lived practice at Austrian higher educational institutions (HEIs). He used the term e-learning to describe innovations in education that are based on multimedia learning objects and telecommunications networks. Based on a survey of experts, he also showed which specific e-learning topics had already been implemented in Austria between 2000 and 2015. According to his results, topics such as learning platforms, blended learning, e-learning materials and the use of feedback tools were implemented during this period, while topics such as m-learning, e-learning strategies at HEIs and course recording were not. (Hoffmann, 2016)

In 2015, another large-scale study surveyed 72 HEIs in Austria about their e-learning status. Of the 49 responding institutions, all reported using e-learning at least occasionally. Most even stated that they had been using e-learning for more than ten years. The study also confirmed the findings of Hoffmann (2016) and showed that blended learning and the distribution of e-learning materials were used in many HEIs, while m-learning and course recordings were used much less frequently. The results were also consistent with regard to learning platforms, as the study showed that all HEIs used a learning platform. However, regarding e-learning strategy the results differed as this study showed that most HEIs had an e-learning strategy or it was in planning. (Bratengeyer et al., 2016)

In order to concretize the results of this comprehensive view, Schweighofer and Zullus (2019) conducted a study in 2018 to survey the current situation regarding TEL at the CAMPUS 02 University of Applied Sciences (UAS). The study included feedback from a total of 143 lecturers and 275 students. The results of this study showed that especially tools that were made available across the board at the UAS (e.g., Moodle, document cameras and Office 365) were used more frequently. However, other tools that were advertised at the UAS and were available on the Internet completely or partially free of charge (e.g., Quizlet, Quizwork, Edpuzzle, Anki) were rarely or never used, with the exception of Kahoot. The results also showed that for both teachers and students the provision of digital content from third parties (e.g., YouTube, links, papers) was the most useful and user-friendly, and in addition also had the greatest loosening effect. In general, the study showed a large degree of agreement between the opinions of teachers and students. This study also confirmed that the use of instructional videos or course recordings seems to fall short. Last but not least, the study also showed that instructors often did not integrate TEL into their teaching concepts due to time constraints, lack of compensation, uncertainty, technical problems, and/or lack of support. (Schweighofer and Zullus, 2019)

A study from Germany showed similar results in this regard. The tools provided by the institution across the board, such as the learning platform with its common functions, were used most frequently. However, the study also clearly showed that more specialized tools that were even integrated into the learning platform (e.g., an audience response system, a micro-blogging tool, and a video conferencing tool) were hardly used. Compared to the other studies, course recording was used more frequently here. (Bond et al., 2018)

From the point of view of the author of this thesis, it can be summarized that in German-speaking countries, and specifically in Austria, TEL is definitely a widespread topic at HEIs and is basically also frequently used to improve teaching. The COVID-19 pandemic also showed that the infrastructure for this has also been in place for some time, and that many HEIs were able to switch to online teaching more quickly because the necessary technical and organizational structures and services were already in place (Pausits et al., 2021). However, it is also clear that the full potential and possibilities of TEL are far from being exploited.

2.1.1. Advantages of Technology-Enhanced Learning[2]

The benefits of using TEL in higher education (HE) teaching are various. In Austria most HEIs see the added value of TEL in the didactic variety and in the support of face-to-face teaching (Bratengeyer et al., 2016). At the CAMPUS 02 UAS, teachers and students stated that the greatest advantages of the use of TEL are the variety and loosening up of teaching, the promotion of the possibility of independent repetition and consolidation of content, and more local and temporal flexibility (Schweighofer and Zullus, 2019). In regard to online learning, results provided by Alexander, Truell, and Zhao (2012) showed that students see especially the following two advantages: more convenience and more flexibility. Adedara and Onwuegbuzie (2014) claimed that e-learning is more cost effective than traditional learning, provides more flexibility, enables more personalized learning, and encourages students to take more personal responsibility when it comes to learning. Hero (2020) also noted that experts recommend using technology in the classroom because it can add value and benefit to the learning process. Panda and S. Mishra (2007) listed some of the advantages (excerpt):

- Students have access to educational resources from outside the HEI.
- Teachers can create, update, and revise course materials easily and quickly.
- Interaction between teachers and students increases and is more flexible.
- The delivery of the course materials is independent of location and time.
- Ability to create high quality learning materials by combining text, graphics, and multimedia elements.
- Ability to access experts in real-time with minimal loss of their productivity.
- Ability to create interactive and dynamic learning experiences.
- Ability to serve large groups of students, at potentially lower cost.

Schulmeister (2006) summarized the benefits of TEL, describing that it can be used to overcome four barriers:

[2] Parts of this section are based on the following already published work: Beer (2022a)

Time barrier TEL can save students a lot of time, for example, by allowing them to access learning materials more quickly and easily. In addition, TEL allows students to travel back in time, for example, by watching course recordings over and over again at their own pace.

Space barrier TEL enables teachers to create virtual learning objects and virtual learning spaces. In this way, students can, for example, take virtual field trips to otherwise inaccessible places.

Analog-digital barrier TEL allows teachers to combine text, graphics, audio, video and animation to create interactive and dynamic learning objects.

Norm barrier TEL makes learning possible for everyone. Regardless of a person's special needs, TEL can be used to create individualized and personalized learning objects that are specifically designed to meet those needs.

2.1.2. Technology-Enhanced Learning Approaches

Looking at the definition of TEL according to Dror (2008) and Goodyear and Retalis (2010), there are of course many possible approaches to using technology in teaching. It is difficult to categorize the possible approaches due to this diversity and the technological progress, through which new approaches are constantly being developed. Nevertheless, to give an overview of possible approaches, this section presents exemplary categorizations with examples from the literature. This shows the variety of possibilities.

Atherton (2018) described 50 ideas (approaches and tools) how TEL can be used. He classified these ideas into eight categories. In the following, the categories are briefly presented with examples.

- Edtech will always change – quickly (e.g., gamification, flipped classroom, bring your own device)
- Emerging tech (e.g., artifical intelligence, virtual reality)
- Assessment/assignment tools (e.g., WISEflow, Turnitin, Spiral)
- Social media (e.g., Facebook, Twitter, Pinterest)
- Video and audio tools (e.g., Edpuzzle, Panopto, YouTube)
- Collaborative working (e.g., Padlet, G Suite for Education[3], Notability)

[3]current name: Google Workspace for Education Fundamentals

- Games, polls and student response systems (e.g., Slido, Kahoot!, Quizlet)
- Presentation platforms (e.g., PowerPoint, Explain Everything, Canva)

Bratengeyer et al. (2016) used three categories in their survey: (1) e-learning offerings, (2) teaching materials provided, (3) systems and methods used in teaching. Following, these three categories are listed with the approaches assigned by Bratengeyer et al. (2016).

- E-Learning offerings
  - Learning with social media
  - Online-only courses
  - Massive open online courses
  - Mobile learning
  - Course recordings
  - Game-based learning
  - Blended learning courses
- Teaching materials provided
  - Multimedia/interactive materials
  - Instructional videos
  - Open educational resources
  - E-Journals, e-books
  - Databases
- Systems and methods used in teaching
  - Virtual classrooms
  - Online repositories for teaching materials
  - E-Assessments
  - E-Portfolios
  - Cloud or file management systems
  - Learning materials via external web services

Köhler, Igel, and Wollersheim (2018) described four future scenarios for the year 2028 that also categorize the use of technology in teaching. They described the first scenario as "classically analog". Here, according to Köhler, Igel, and Wollersheim (2018), the proportion of technologies in teaching is the lowest and can take place in three variants: (1) no explicit use of digital infrastructure, (2) flipped classroom concepts in which larger parts of knowledge transfer are carried out online, and (3) an increase in informal education that reduces the separation between HEI and postgraduate teaching and is characterized by situated learning and virtual assistance systems. The second scenario is "fully digital/virtual learning". Köhler, Igel, and Wollersheim (2018) described that here learners use digital and digitally connected learning objects for every learning action. In this scenario, adaptive and machine learning, research-oriented and -based learning as well as augmented and virtual reality are used more often. The third scenario is what they called "e-examinations on demand and individualized learning entry points". Here, self-directed e-assessments and principles of artificial intelligence are used to enable individualized study programs. Finally, scenario four is "Open Educational Resources + Open Science". In this scenario, a wide variety of technologies are used so that students have access to study programs and learning objects from different HEIs, thus creating a virtual information market. (Köhler, Igel, and Wollersheim, 2018)

The examples show the variety of ways in which technologies can be used in teaching and that they can also be categorized differently. There does not seem to be a uniform categorization and approaches/tools are also assigned differently by different sources. However, due to the multitude and the rapid further development, this is not surprising from the point of view of the author of this thesis.

2.1.3. Instructional Design and Competencies for Technology-Enhanced Learning[4]

Instructional Design (ID) or Instructional System Design (ISD) is a process for developing learning experiences and environments that applies learning strategies to make the acquisition of knowledge and skills more efficient, effective, and engaging (Merrill et al., 1996). The origins of ID are in behaviorism and systems thinking (Rogers, 2002; Branch and Merrill, 2012). It is related to TEL in that professionals combine ID and instructional media,

[4]Parts of this section have already been published in: Schweighofer and Ebner (2015), Schweighofer, Weitlaner, et al. (2019)

which include various technologies (e.g., computers, the Internet, mobile devices, and social media), to achieve their goals (Reiser, 2001). There are now a variety of instructional design models (Branch and Merrill, 2012) that can assist in this design process.

For example, Ćukušić et al. (2010) looked in particular at the development process itself and considered the four phases of planning, implementing, controlling, and improving, using learning outcomes as control variables. Alonso, Manrique, and Viñes (2009) showed a more detailed model for developing effective e-learning for teaching a programming language. They divided the process into five phases: analysis, design, implementation, execution, and evaluation. Fink et al. (2013) treated the topic as learn service engineering. They suggested that TEL approaches should be treated as services. In this way, Fink et al. (2013) claimed that structured development comparable to the engineering discipline of service engineering (Bullinger, Fähnrich, and Meiren, 2003) is possible.

According to Branch and Merrill (2012), practically all of these models are related to the ADDIE model, although the origin of this model is unknown (Molenda, 2003). ADDIE stands for analyze, design, develop, implement and evaluate, i.e. the process steps of a systematic product development approach. ADDIE itself is therefore not a specific, fully elaborated model, but rather a structure used by different approaches (Branch and Merrill, 2012). These approaches define which influencing factors must be considered in the process steps (Lohr, 1998). Both the process steps and the influencing factors belong together. An ID model defines which steps are to be performed and the influencing factors determine what needs to be considered in detail. This provides the general framework for the competencies required to use TEL. The definition of TEL also implies that the possibilities for TEL approaches are very diverse and various aspects need to be considered in the successful implementation of these approaches.

Q. Wang (2009) considered pedagogical, social, and technological perspectives in a proposed ID model. Alonso, Manrique, and Viñes (2009) considered the following aspects in each step of their model: perception, attention, cognitive load, coding, retrieval/transfer, and metacognition. The learn service engineering approach proposed by Fink et al. (2013) considers four main aspects: economic aspects, technical aspects, didactic aspects, and general organizational conditions. Rovai and Downey (2010), with regard to the development of online learning programs and the determination of their success, proposed to consider seven important factors: planning, marketing and recruitment, financial management, quality assurance, student retention, faculty development, and online course design and pedagogy. Finally, the issue of structured e- and m-learning development has also been explored as part of the pan-European UNITE project. The project evaluated a pedagogical framework that takes into account five components: pedagogical framework context, pedagogical approaches, assessment techniques, current pedagogical practices implemented in national curricula and national specifics, and teacher training. (Granić, Mifsud, and Ćukušić, 2009)

A widely used (Chai, Koh, and C.-C. Tsai, 2013; Rosenberg and Koehler, 2015) framework that describes influencing factors as required competencies is the Technological Pedagogical Content Knowledge (TPACK[5]) framework (P. Mishra and Koehler, 2006). In this framework, knowledge about content (C), pedagogy (P), and technology (T) provides the foundation. However, P. Mishra and Koehler (2006) emphasized that the interaction of these three knowledge areas is also essential and thus four additional areas emerge: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK).

Looking at the various influencing factors or necessary competencies of each source, one can see that they are not uniform and none of them seem to take into account all possible factors, especially not to an applicable level of detail.

2.1.4. E-Services on Technology-Enhanced Learning

One of the goals of this thesis was the design of an e-service that provides teachers in the Styrian HE area with the necessary competencies for the use of technologies in teaching. As already mentioned in the introduction, such or similar e-services already exist. The following list contains some

[5]The original used acronym TPCK was later changed to TPACK (Thompson and P. Mishra, 2007)

examples and a short description of them. They represent meta artifacts of the knowledge base in the sense of DSR (see Section 2.2). In the selection process, emphasis was placed on the e-service being available online and in German, offering content on TEL, and showing different types of such e-services with the selection. The selection was additionally extended by an international example. The geographical focus of the selection results from the fact that the scope of this thesis was the region of Styria in Austria, a German-speaking region.

erwachsenenbildung.at[6] A comprehensive e-service providing not only content for TEL but adult education in general. In the TEL section, tools and methods as well as general and current topics are covered in the form of articles. In some cases, links to other pages that provide additional information are also embedded.

Digitaler Freischwimmer[7] A modern e-service providing ideas how digital tools can be used in teaching and learning scenarios divided into six categories: (1) designing group work, (2) activating students, (3) examining and giving feedback, (4) accompanying writing processes, (5) overall didactic scenarios, and (6) legal and didactical frameworks. The ideas are presented in the form of articles.

Digital Learning Map[8] A collection of TEL best practices at German HEIs. The best practice examples are submitted by the HEIs and presented on the platform in a standardized form as individual articles. There are currently 167 practical examples on the platform.

eLearning Blog TU Darmstadt[9] A blog with different posts covering various aspects of TEL. The blog uses 23 categories and has over 1,000 blog posts.

TELU[10] A collection of short courses (micro-lessons) and examples from real-life educators. The micro-lessons consist of several units, some of which also include videos. The examples are presented in a standardized form.

[6] https://www.erwachsenenbildung.at (last access: 2023-05-10)

[7] https://www2.tuhh.de/zll/freischwimmer (last access: 2023-05-10)

[8] https://www.e-teaching.org/community/digital-learning-map (last access: 2023-05-10)

[9] https://blog.e-learning.tu-darmstadt.de (last access: 2023-05-10)

[10] http://telu.me (last access: 2023-05-10)

2.2. Design Science Research[11]

In the field of information systems (IS) research, a paper by Nunamaker Jr, M. Chen, and Purdin (1990) presumably can be seen as an influential starting point for DSR (Kuechler, Vaishnavi, and Kuechler Sr, 2007). At this time, research on design of IS was viewed with suspicion by the majority of IS researchers who strictly followed the behavioral science paradigm in their research (Kuechler, Vaishnavi, and Kuechler Sr, 2007). However, Nunamaker Jr, M. Chen, and Purdin (1990) included design and design research in their proposed System Development Research Methodology and noted that both play an important role in IS research. After that, gradually more and more IS researcher used the design science paradigm in their research (Kuechler, Vaishnavi, and Kuechler Sr, 2007).

The behavioral science paradigm in IS research uses methods of natural science research to develop and justify theories. These theories should explain or predict phenomena regarding the analysis, design, implementation, management and use of IS. In doing so, they help researchers to understand the interactions between people, technology and organizations. These interactions must be managed to provide IS that help an organization to be more effective and efficient (Hevner, March, et al., 2004)

The design science paradigm in IS originates from engineering and the science of the artificial (Simon, 1996). Hevner, March, et al. (2004) named it a problem-solving paradigm that is used to create new artifacts that help to make the analysis, design, implementation, management and use of IS more efficient and effective. These artifacts can be constructs, models, methods, or instantiations (Hevner, March, et al., 2004).

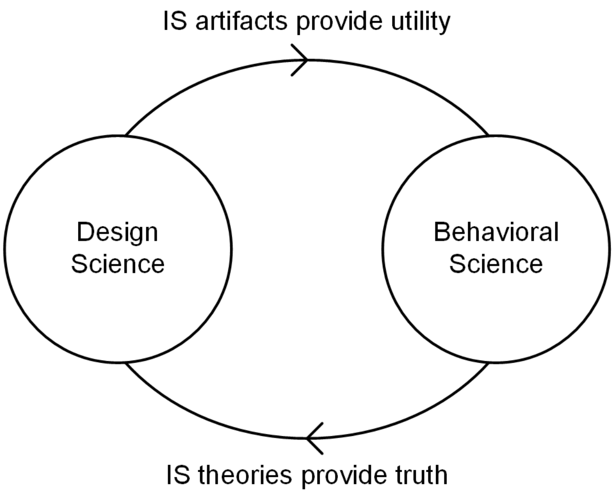
Comparing behavioral science and design science, Simon (1996) pointed out that the first is concerned with how things are, while the latter is concerned with how things ought to be. Regarding IS research, Hevner and Chatterjee (2010) claimed that these two paradigms are inseparable. As Figure 2.1 shows the results of behavioral science are IS theories that provide truth and, therefore, show how things are. These theories are used in design science to create IS artifacts that provide utility. Therefore, design science

[11] This section has already been published in: Beer (2022a)

shows how things ought to be. The cycle continues anew because behavioral science uses the IS artifacts from design science to test and justify new theories. (Hevner and Chatterjee, 2010)

Figure 2.1.

Complementary Nature of Design Science and Behavioral Science (Hevner and Chatterjee, 2010)

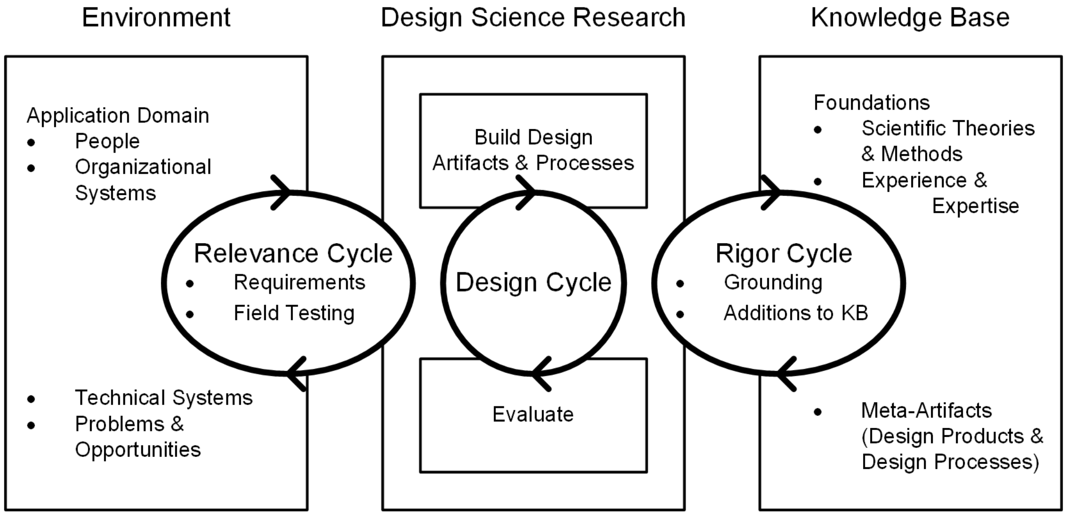


In order to combine the complementary nature of behavioral and design sciences, Hevner, March, et al. (2004) proposed a conceptual framework for IS research. Hevner (2007) extended the framework with three inherent research cycles (see Figure 2.2), and this DSR framework has become a well-established research paradigm in IS research (Gregor and Hevner, 2013).

In the middle of the framework are the two major design science activities of building the design artifact and evaluating it. The iteration between these two activities, the design cycle, can be seen as the heart of DSR. The environment defines the problem space. The goal is to first analyze the application domain that consists of its people, organizational systems, technical systems and various problems and opportunities to define business needs. The fulfillment of these business needs is later assessed and evaluated in the same context. Both defining requirements and field testing represent the relevance

Figure 2.2.

Design Science Research Framework (Hevner, 2007)



cycle. In the knowledge base lies the foundation for the conducted DSR. The knowledge base provides scientific theories and methods, experience and expertise, as well as meta-artifacts, all of which are used during DSR. Likewise, DSR must contribute to the knowledge base. Unlike routine design that just applies existing knowledge such as best practices to construct an information system, DSR addresses unsolved problems or solved problems in more effective or efficient ways. Therefore, the results of DSR contribute to the existing knowledge base. The grounding as well as the additions to the knowledge base represent the rigor cycle. (Hevner, March, et al., 2004; Hevner, 2007)

2.2.1. Design Science Research Guidelines

Hevner, March, et al. (2004) additionally presented seven guidelines that DSR should follow. The following part briefly explains these seven guidelines according to Hevner, March, et al. (2004).

1. **Design as an artifact** The result of DSR must be a viable artifact in the form of a construct, model, method, or instantiation.
2. **Problem relevance** The designed artifacts must provide a solution to an important and relevant problem.
3. **Design evaluation** It is necessary to rigorously demonstrate, using appropriate evaluation methods, how the designed artifact solves the problem addressed.
4. **Research contributions** The results of the DSR must be presented in the form of clear and verifiable contributions.
5. **Research rigor** The design and evaluation of the artifact must be done using rigorous methods.
6. **Design as a search process** The iterative design of an appropriate artifact as a solution to the given problem must use the available resources and take into account the constraints and circumstances of the environment.
7. **Communication of research** The DSR must be prepared in an appropriate manner for a scientifically and economically oriented audience.

These guidelines summarize the character of DSR. DSR aims to design a useful solution to an important and relevant problem using scientific rigor that delivers value to both the science and the affected application environment.

2.2.2. Design Science Research Contribution Types

Gregor and Hevner (2013) categorized DSR contributions into three types or levels. In the following part, these types are presented with examples for the contribution type according to Gregor and Hevner (2013). They also noted that Level 1 contributions are generally more specific and therefore limited, while Level 3 contributions are more abstract and therefore complete.

Level 3. Well-developed design theory about embedded phenomena: Design theories (mid-range and grand theories).

Level 2. Nascent design theory - knowledge as operational principles/ architecture: Constructs, methods, models, design principles, technological rules.

Level 1. Situated implementation of artifact: Instantiations (software products or implemented processes).

According to Gregor and D. Jones (2007), a design theory can be defined as a prescription of guidelines that can be used for future artifacts of the same type. A design theory is based on knowledge of technology and human behavior and provides the principles inherent in the design of an artifact that serves a particular purpose. Artifacts, in turn, can be constructs, models, methods, or instantiations (i.e. software). Gregor and D. Jones (2007) argued that such a design theory should include the following components: (1) the purpose and scope, (2) the constructs, (3) the principles of form and function, (4) the artifact mutability, (5) testable propositions, (6) justificatory knowledge, (7) principles of implementation, and (8) expository instantiation.

Design principles are important components of an elaborated design theory. In themselves, they can provide meaningful value. Gregor, Kruse, and Seidel (2020) defined design principles simply as prescriptive statements that show how to do something to achieve a goal. In more detail, they presented a schema to use in formulating design principles. The schema includes the following components: (1) aim, implementer and user, (2) context, (3) mechanism and enactors, and (4) rationale. The structure to use these components is as follows: For implementer I to achive or allow aim A for user U in context C employ mechanisms M1, M2, M3,... involving enactors E1, E2, E3,... because of rationale R.

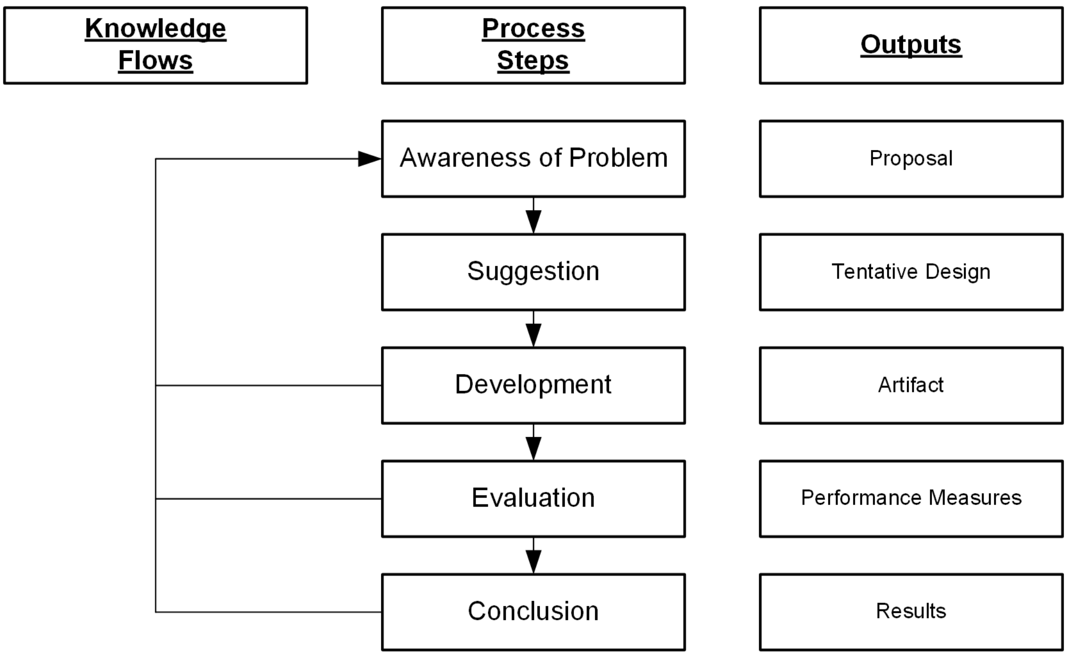
For completeness, it should be noted that Baskerville et al. (2018) suggested a slightly different categorization of DSR contributions: (1) technology and science evolutions, (2) design artifacts, (3) design theories, (4) DSR processes, and (5) DSR impacts. In addition, vom Brocke et al. (2020) suggested that the three dimensions of (1) projectability in the problem space, (2) fitness in the solution space, and (3) confidence in the evaluation should also be considered.

2.2.3. Design Science Research Process Model[12]

Several process models for conducting DSR can be found in literature (e.g., Vaishnavi and Kuechler, 2004; Peffers et al., 2006). Vaishnavi and Kuechler (2004) proposed a process model (see Figure 2.3) consisting of five process steps with defined outputs: (1) awareness of problem (output: proposal), (2) suggestion (output: tentative design), (3) development (output: artifact), (4) evaluation (output: performance measures), and (5) conclusion (output: results). This process model can be seen as an elaboration of a knowledge-using and knowledge-building process (Vaishnavi and Kuechler, 2004).

Figure 2.3.

Design Science Research Process Model (Vaishnavi and Kuechler, 2004)



Peffers et al. (2006) proposed a process model with six phases: (1) problem identification and motivation, (2) objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. The

[12]This section has already been published in: Beer (2022a)

process model is a nominal process sequence and provides four possible starting points for research: (1) problem centered approach (beginning with problem identification and motivation), (2) objective centered solution (beginning with objectives of a solution), (3) design and development centered approach (beginning with design and development), and (4) observing a solution (beginning with demonstration) (Peffers et al., 2006).

Strohmann (2020) noted that Vaishnavi and Kuechler (2004) emphasized reflecting on design results and the iterative, evaluation-driven approach. The defined knowledge flows and defined outputs of each step of the process reflect this. In contrast, Peffers et al. (2006) seemed to emphasize demonstration and communication. Regarding demonstration, they explicitly separated evaluation and demonstration. Regarding communication, they explicitly suggested that results should be shared with other researchers and practicing professionals. However, while Vaishnavi and Kuechler (2004) referred to the final step more generally as a "conclusion", they also emphasized the importance of communicating the results.

2.3. Technology Acceptance[13]

In IS research, the question of how and why people choose to adopt new technologies has always been an important topic (Schaupp, Carter, and McBride, 2010; Platzer, 2011). Platzer (2011) explained this by saying that people have always wanted to predict whether a technology will be successful and understand what causes the acceptance. Especially from a business perspective, this is understandable. Information technology systems have the potential to increase the competitiveness of an organization (Leyton, Pino, and Ochoa, 2015). However, for a variety of reasons, workers may choose not to accept or use the available systems (Davis, 1989; Leyton, Pino, and Ochoa, 2015). According to Leyton, Pino, and Ochoa (2015), this can lead to significant financial losses; therefore, it is convenient to be able to predict the acceptance of the technology in advance. Davis (1989) also saw great practical utility in such a prediction.

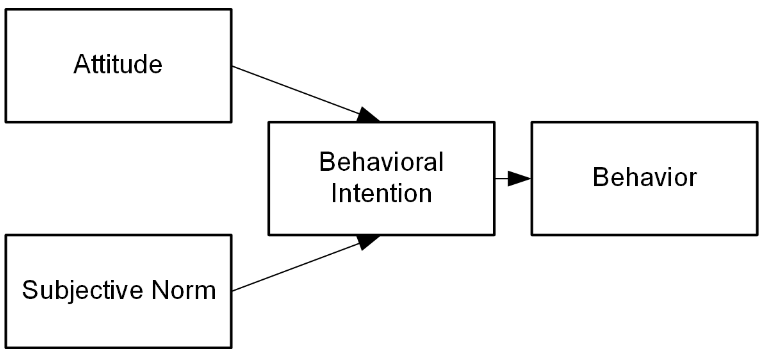
[13] This section has already been published in: Beer (2022a)

In the literature, many theories and models have been presented that can be applied to predict technology acceptance, such as the Theory of Reasoned Action (Fishbein, 1967; Ajzen and Fishbein, 1980), the Theory of Planned Behavior (Ajzen, 1985), the Technology Acceptance Model (Davis, 1986; Davis, Bagozzi, and Warshaw, 1989; Venkatesh and Davis, 1996), the Technology Acceptance Model 2 (Venkatesh and Davis, 2000), the Technology Acceptance Model 3 (Venkatesh and Bala, 2008), and the Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, et al., 2003). The Theory of Reasoned Action and the Theory of Planned Behavior can be seen as the most fundamental theories in this field.

Fishbein (1967) developed the Theory of Reasoned Action (TRA), which was later refined by Ajzen and Fishbein (1980) (see Figure 2.4). According to Al-Mamary et al. (2016), TRA is a fundamental theory of human behavior. Olushola and Abiola (2017) argued that the theory is well researched and used to explain various human behaviors. The theory assumes that behavioral intentions lead to behavior and that these intentions are influenced by personal feelings (attitude) and perceived social pressures (subjective norm) (Ajzen and Fishbein, 1980).

Figure 2.4.

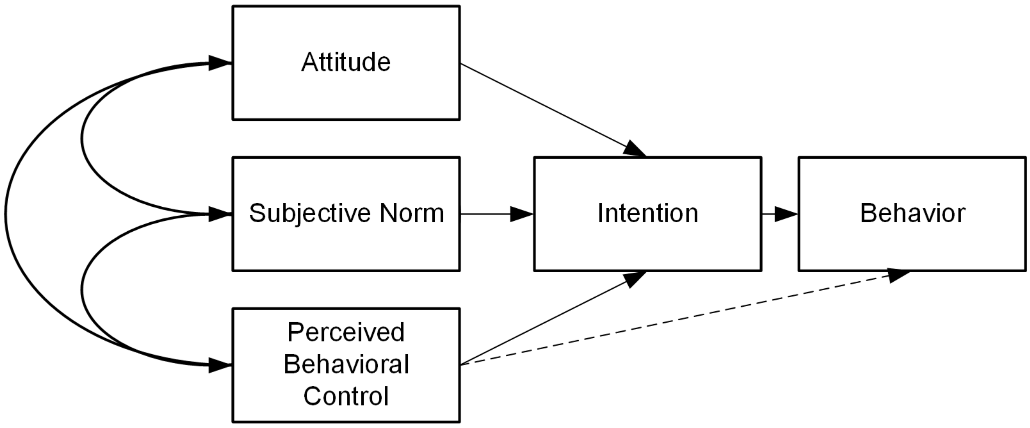
Theory of Reasoned Action (Ajzen and Fishbein, 1980)



Ajzen (1985) extended TRA and proposed the Theory of Planned Behavior (TPB) (see Figure 2.5) by adding another construct named perceived behavioral control. TPB is one of the most frequently cited and applied behavior theories (Al-Mamary et al., 2016) and has been significantly supported by empirical research on the prediction of behavior in IS and other domains (Olushola and Abiola, 2017). Compared to TRA, this theory involves situations in which individuals do not have substantial control over their behavior, for example, due to lack of skills or lack of opportunities and resources to use a system. Therefore, the TBP assumes that, in addition to attitude and subjective norm, perceived behavioral control also influences behavior. (Ajzen, 1985)

Figure 2.5.

Theory of Planned Behavior (Ajzen, 1985)



2.3.1. Technology Acceptance Model[14]

The Technology Acceptance Model (TAM) (Davis, 1986; Davis, Bagozzi, and Warshaw, 1989; Venkatesh and Davis, 1996) is a very well-known and widely used model for predicting the acceptance of technologies by individual users. It can be said that TAM is the dominant and most widely used model for determining technology acceptance (Leyton, Pino, and Ochoa, 2015; Marangunić and Granić, 2015; Al-Mamary et al., 2016; Olushola and Abiola, 2017). Olushola and Abiola (2017) argued that the strengths of TAM are that it is a robust, powerful and simple model that has been used in many

[14] This section has already been published in: Beer (2022a)

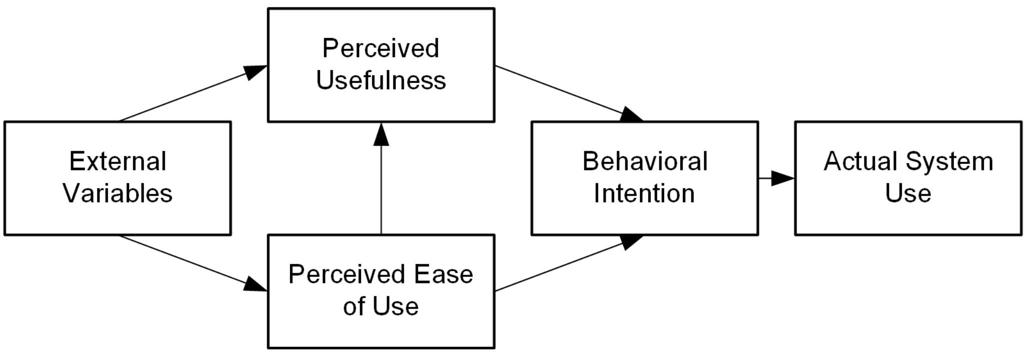
empirical studies and has proven to be of high quality and statistically reliable.

Davis (1986) first introduced the TAM in his PhD thesis. Based on TRA, he proposed a model specifically tailored to fit technology adoption and use. In this originally proposed model, he hypothesized that a potential user's actual use (AU) of a system is highly dependent on their attitude toward using the system. He went on to say that this attitude depends on two important beliefs: perceived usefulness (PU) and perceived ease of use (PEOU). PU is defined as the degree to which a potential user believes that using the given system improves his or her job performance (Davis, 1986; Davis, Bagozzi, and Warshaw, 1989; Davis, 1989). PEOU is defined as the degree to which a potential user believes that using the given system is free of effort (Davis, 1986; Davis, Bagozzi, and Warshaw, 1989; Davis, 1989). Davis (1986) also described that PEOU should causally influence PU. Finally, he argued that design features, as external variables, i.e. other constructs, do not directly influence attitudes or the AU of the system. However, according to Davis (1986), they have a direct impact on PU and PEOU.

Davis, Bagozzi, and Warshaw (1989) extended the original TAM by including the theory from TRA that behavioral intention (BI) determines AU. However, in contrast to TRA, they theorized that PU and attitude jointly determine BI. They also defined the originally included design features in a more general way as external variables.

Figure 2.6.

Technology Acceptance Model (Venkatesh and Davis, 1996)



Venkatesh and Davis (1996) later proposed what they called the final TAM (see Figure 2.6) without the attitude construct, arguing that attitude has very limited ability to explain BI or AU (Y. J. Kim, Chun, and Song, 2009; C. M. Jones et al., 2010).

According to Olushola and Abiola (2017), some researchers see the purpose of external variables in TAM as providing a better understanding of what influences PU and PEOU. Therefore, different external variables have been considered by different researchers. Venkatesh and Davis (1996) proposed that external variables should include system characteristics, training, user involvement in design and the nature of the implementation process. Other external variables considered in the literature are for example tool functionality, tool experience, task technology fit and task characteristics (Dishaw and Strong, 1999), individual factors, social factors and organizational factors (S. Y. Park, 2009), and functionality and usability (Mlekus et al., 2020).

2.3.2. Other Theoretical Frameworks

Although, or perhaps because, the TAM is a dominant model in the field of technology acceptance (Leyton, Pino, and Ochoa, 2015; Marangunić and Granić, 2015; Al-Mamary et al., 2016; Olushola and Abiola, 2017), researchers have extended the TAM, included additional key determinants, and established new theories or models. Three important theories and models are briefly discussed below.

First, a well-known extension of the TAM is the TAM2 by Venkatesh and Davis (2000). They added theoretical constructs of two processes: (1) social influence processes (subjective norm, voluntariness, and image), and (2) cognitive instrumental processes (job relevance, output quality, result demonstrability, and PU). Furthermore, the model includes experience as an additional moderator (Venkatesh and Davis, 2000).

Second, three years later, Venkatesh, Morris, et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT). This theory integrates elements of eight prominent theoratical models and attempts to provide a unfied view on technology acceptance, hence the name. The model assumes four determinants of behavioral intention and usage: (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions. In addition, four key moderators are included in the model: (1) gender, (2) age, (3) experience, and (4) voluntariness of use. (Venkatesh, Morris, et al., 2003).

Third, Venkatesh and Bala (2008) combined TAM2 and a model of determinants of PEOU by Venkatesh (2000) into an integrated model of technology acceptance, called TAM3. The model includes four determinants of PU: (1) subjective norm, (2) image, (3) job relevance, and (4) result demonstrability. In addition, the model includes six determinants of PEOU: (1) computer self-efficacy, (2) perceptions of external control, (3) computer anxiety, (4) computer playfulness, (5) perceived enjoyment, and (6) objective usability. Finally, the model uses (1) experience, (2) voluntariness, and (3) output quality as moderators. (Venkatesh and Bala, 2008)

Olushola and Abiola (2017) explained that the main purpose of the TAM is to find factors that cause people to accept or reject a technology. The TAM uses only two key determinants for acceptance: PU and PEOU. The model explains that different external variables under different circumstances determine these two constructs. The models and theories described in this section attempt to determine these external variables for generality and/or provide unified, generally valid, yet more specific theories. However, although these models have provided good results, Saliza and Kamil Md. (2012) added an interesting point of view to the discussion: *"There is no universal UTAUT that can explain all situations of acceptance."*

2.3.3. Design Science Research and Technology Acceptance

Section 2.2 described that Hevner, March, et al. (2004) proposed a conceptual framework (DSR) to combine the complementary nature of behavioral and design science. The goal is to use IS theories (behavioral science) to create IS artifacts (design science) and in turn use them to test and justify new theories (behavioral science), which in turn can be used to create new IS artifacts (design science), and so on. However, as far as theories of technology adoption in DSR projects are concerned, there seems to be a lack of clear and holistic approaches that show exactly how this cycle plays out. To better understand this gap, this section discusses three representative research approaches that apply a model of technology adoption in a DSR project.

First, Golding and Donaldson (2009) used DSR by Hevner, March, et al. (2004) to design a mobile service. As part of the project, they used a consumer-centric approach to develop the mobile application. More specifically, they used a quantitative research approach to determine the demand for nine potential mobile commerce applications. Based on this, they selected the application that respondents were most interested in and designed that application as an artifact. Finally, they used an adapted version of the TAM to evaluate whether the designed mobile application was accepted. This approach shows that if one can design different potential artifacts, such a consumer-centric approach can lead to an accepted artifact and TAM can further explain this acceptance. However, the researchers did not clearly show how the new mobile application was designed and especially how constructs of TAM used to evaluate the artifact were implemented in the artifact. Thus, the existing theory of behavioral science (TAM) was not used to create a new artifact in design science, but "only" to evaluate that artifact.

Second, Haugstvedt and Krogstie (2012) followed the DSR guidelines of Hevner, March, et al. (2004) to design a mobile augmented reality system and a specific TAM for this kind of applications. In their research, they reviewed similar solutions and gathered requirements through interviews with various stakeholders. Based on this, they developed a prototype and evaluated it for usability. These results were used to create another design that was evaluated using a specially developed technology acceptance research model. This model explains the usage intentions for such systems. Although this approach used design science to create a new artifact through which a new theory of behavioral science can be tested and proven, again, the existing theory of behavioral science was not used to guide the design science.

Third, Bider et al. (2012) used DSR to develop a method for improving system use (acceptance) during an ongoing introduction process. Their framework is based on existing theories of change management and technology acceptance. In simple terms, the framework defines various parameters, including measurement methods, that determine system use. The framework also defines corresponding means (strategies, tools, and actions) that can positively influence these parameters. Thus, in applying the framework, existing theories of behavioral science are used to increase acceptance of an already designed artifact during the implementation process. This process in turn can provide inferences to the existing theories of behavioral science. But again, the actual design of the artifact was not influenced by the existing theories of behavioral science, so the full cycle between behavioral and design science was not represented.

One could argue that using existing theories of technology acceptance in the design of new artifacts does not have a positive impact on the acceptance of the final artifact because the models can only evaluate but not predict acceptance. For example, Platzer (2011) argued that technology acceptance models are static, but perceptions can change. This means applying a TAM at the beginning of a design may yield results that are no longer valid when the designed artifact is actually used. However, Davis and Venkatesh (2004) used the TAM to evaluate a system during three stages of the design process without changing the initial system design ideas in order to determine how well the TAM can predict acceptance in early stages of a system design. Their findings showed that BI and PU measured prior to hands-on experience with the test software product were highly correlated and not significantly different from results after one month and three months of hands-on experience with the system. This implies that technology acceptance models may well predict the acceptance of a future artifact and thus positively influence the design of an artifact.

2.4. Conclusion

This chapter provided the necessary theoretical foundation for this thesis. The first section provided an overview of TEL. The section described the history, terminology, benefits, and TEL approaches, as well as instructional design considerations for TEL and the required competencies. As such, this section provided the content context for the e-service eCampus designed in this thesis. The sections on the benefits of TEL and possible TEL approaches help select relevant content for the e-service. The section on ID and required competencies helps structure the content. In addition, the section provided an overview of similar e-services to allow for comparison with the e-service eCampus.

The second section discussed the DSR approach in detail. The section explained the theoretical background and provided an overview of guidelines, contribution types, and process models. In addition, the third section explained the theoretical background of technology acceptance research and discussed the well-known TAM and other theories and models. This section also discussed how researchers currently use theories and models of technology acceptance in a DSR approach. It showed that there is a lack of clear and holistic approaches that show exactly how theories and models of technology acceptance can be used in a DSR approach to influence the design process with these behavioral science theories. The thesis used all these theoretical considerations to provide an answer to this methodological challenge in the next chapter.

3. Methodology

This chapter offers a response to the methodological challenge (see Section 1.2) of designing new accepted artifacts within a funded research project at higher educational institutions (HEIs) by combining the theoretical knowledge of design science and technology acceptance research from the previous chapter. The first section of this chapter describes the theoretical considerations of how to specifically address technology acceptance as a challenge within a Design Science Research (DSR) methodology. Furthermore it explains the proposed approach to conduct such research. The second section then demonstrates the specific application of the approach in this thesis.

The chapter thus provides the methodological basis for answering the research question of this thesis, which was:

> *RQ.* How can we design an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

3.1. Acceptance-Driven Design Science Research[1]

While DSR has become an established research paradigm in information systems (IS) research (Gregor and Hevner, 2013), and technology acceptance is of major interest in IS research (Schaupp, Carter, and McBride, 2010; Platzer, 2011), the author of this thesis misses a clearly structured and holistic approach to questions of user acceptance in DSR projects. In practice, researchers use DSR to design new artifacts and theories or models of

[1]This section has already been published in: Beer (2022a)

technology adoption to evaluate the influence of acceptance constructs on the designed artifacts (e.g., see Golding and Donaldson, 2009; Haugstvedt and Krogstie, 2012). Although this is an acceptable approach to DSR, Hevner (2007) pointed out regarding the rigor cycle of DSR that it does not fully account for the complementary nature of design and behavioral science (see Figure 2.1) underlying DSR by Hevner, March, et al. (2004). In terms of technology acceptance and DSR, Golding and Donaldson (2009) and Haugstvedt and Krogstie (2012) used design science to create an artifact that provides utility and behavioral science to evaluate a theory and provide truth. However, they did not clearly outline how they used existing theories of technology adoption in the artifact design process.

Hevner, March, et al. (2004) argued that a justified theory must be useful to the environment in order to contribute. In their 5th guideline, they further explained that the construction and evaluation of artifacts require knowledge of behavioral theories, e.g. evaluation methods are likely to be those that justify or test behavioral theories. Although Hevner (2007) mitigated the need for design science to be grounded in existing theories, and Hevner, March, et al. (2004) emphasized that the principal aim is to determine how well an artifact works and not why it works, both still contribute significantly to scientific rigor. Moreover, since the acceptance of a designed artifact cannot be guaranteed, the author of this thesis believes that it is necessary that appropriate theories of behavioral science are considered in the design and tested during evaluation in such DSR projects to contribute to the knowledge base.

Hence, this thesis proposes an Acceptance-Driven Design Science Research (AD-DSR) approach. AD-DSR is not a new research methodology or a fundamentally new approach. AD-DSR is the application of a research design pattern that proposes specific process steps to address technology acceptance in the design of new artifacts within a DSR project, fully incorporating the complementary nature of design and behavioral science.

The following sections explain the basic idea, how and why AD-DSR uses the Technology Acceptance Model (TAM), and how the AD-DSR research design pattern is conceived.

3.1.1. Acceptance-Driven Design Science Research and the Technology Acceptance Model[2]

The AD-DSR approach suggests that, to fully incorporate the complementary nature of design and behavioral science in DSR projects with user acceptance as a challenge, theories or models of technology adoption must be used in both worlds. First, behavioral science provides grounded theories and models of technology acceptance that identify which constructs have an impact on user acceptance of respective artifacts. Second, such constructs must be explicitly considered in the design of a new artifact for the theories and models to have practical value and to achieve the artifact's intended utility of being accepted. Third, to provide new theories that can be used in a subsequent design science project, we need to evaluate which of the considered constructs have an impact on the acceptance of the designed artifact from a behavioral science perspective. At the same time, we also need to evaluate whether the target audience accepts the designed artifact from a design science perspective.

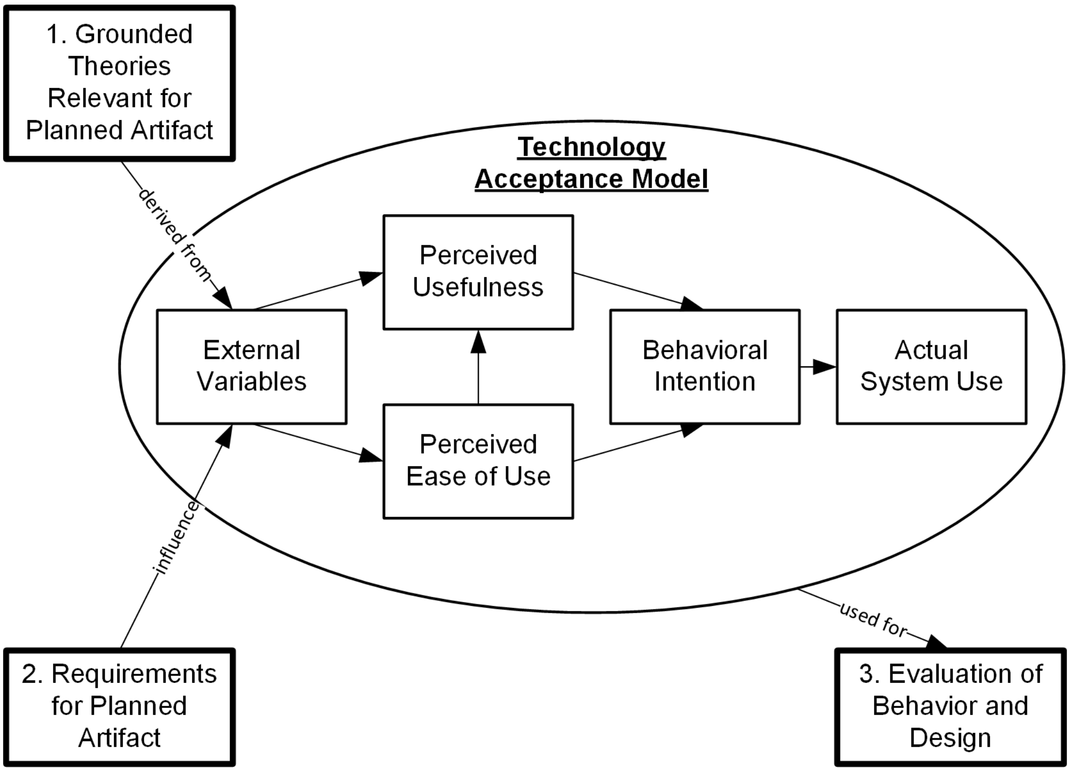
AD-DSR uses the TAM by Venkatesh and Davis (1996) to link behavioral and design science in this way. TAM is by far the most prominent model of technology acceptance in the literature, and a plethora of studies provide external variables influencing perceived usefulness (PU) and perceived ease of use (PEOU) for different systems. Therefore, compared to more holistic theories and models, TAM can be better adapted to the conditions of the application domain and is thus a justified choice.

Figure 3.1 shows the main idea of using TAM in AD-DSR. In TAM, external variables determine PU and PEOU. Furthermore, PU and PEOU affect behavioral intention and subsequently the actual use of a system. Prior versions of the TAM (see Davis, 1986; Davis, 1993) used the term design features with direct impact on PU and PEOU. Davis, Bagozzi, and Warshaw (1989) and Venkatesh and Davis (1996) used the more generic term external variables instead, unequivocally to include factors that were external to the system design. However, this clearly highlights the importance of design features and their influence as external variables on PU and PEOU. Therefore, in AD-DSR the first step is to derive external variables with influence on PU

[2] This section has already been published in: Beer (2022a)

Figure 3.1.

Using the Technology Acceptance Model by Venkatesh and Davis (1996) in Acceptance-Driven Design Science Research



and PEOU from grounded theories with relevance to the planned design artifact (behavioral science). The second step is to define and implement requirements for the artifact that positively influence these external variables, if possible, to indirectly increase PU and PEOU (design science). The third step evaluates which previously derived external variables influence the acceptance of the design artifact (behavioral science) and whether the consideration of these external variables in the design process leads to an accepted artifact (design science). This last step shows the crucial difference between behavioral and design science. In behavioral science, we ask questions like "Does the quality of the system affect perceived usefulness?" to evaluate the underlying theory and provide truth. In design science, we ask questions like "Is the quality of the system high?" and "Is the system useful?" to evaluate the design and the utility provided.

3.1.2. Research Design Pattern for Acceptance-Driven Design Science Research[3]

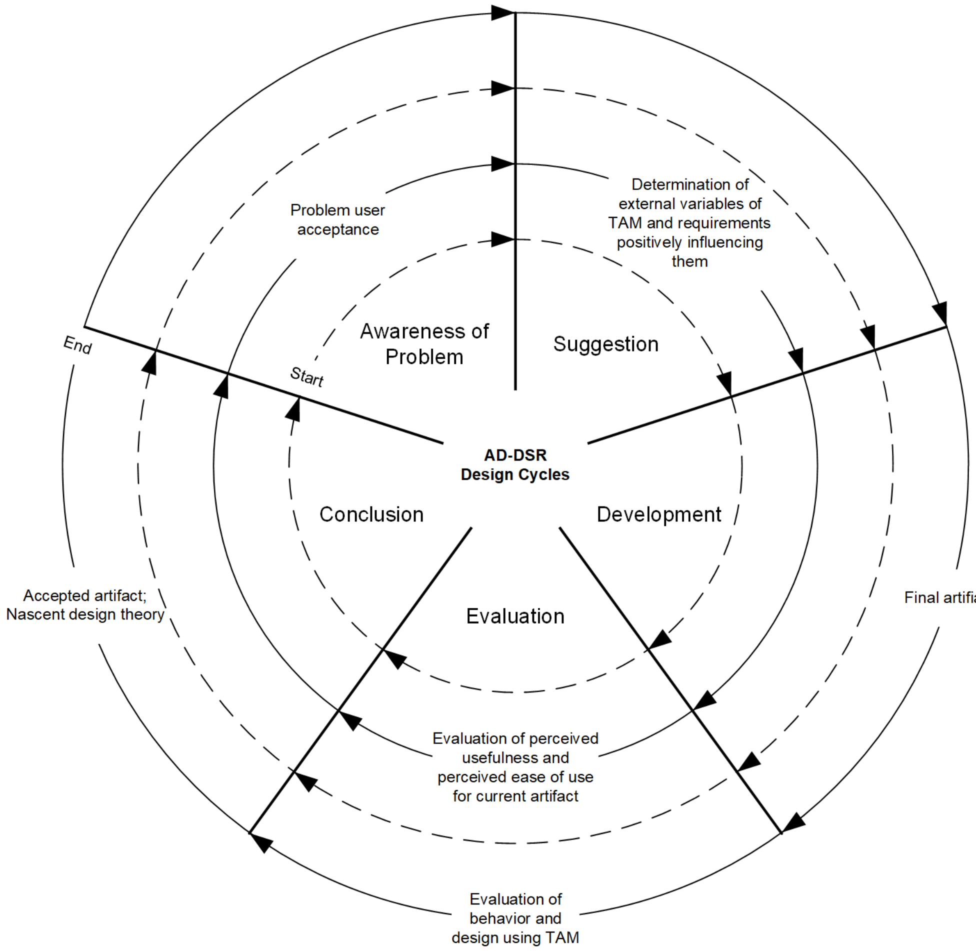
To better understand and assist in the execution of DSR projects where technology acceptance is a challenge, the AD-DSR approach proposes a specific research design pattern that encompasses the main idea behind AD-DSR of using TAM in DSR. For this purpose, the research design pattern for AD-DSR provides necessary steps to ensure the incorporation of behavioral and design science with respect to technology acceptance. The pattern should guide DSR researchers in terms of design science to create utility through the design of accepted artifacts and, in terms of behavioral science, to create truth through understanding the acceptability of the artifact.

Figure 3.2 shows the proposed research design pattern for AD-DSR. The pattern follows the five process steps proposed by Vaishnavi and Kuechler (2004) in their DSR process model. As explained earlier, the DSR process model by Vaishnavi and Kuechler (2004) emphasizes reflection on design results and an iterative, evaluation-oriented approach. For the design of accepted artifacts, this focus seems to be beneficial. Therefore, the model

[3]This section has already been published in: Beer (2022a)

Figure 3.2.

Research Design Pattern for Acceptance-Driven Design Science Research based on Vaishnavi and Kuechler (2004)



proposed by Vaishnavi and Kuechler (2004) is preferred over the model by Peffers et al. (2006) as the core process model.

During the execution of the core process model in the iterative design cycles of a DSR project, researchers may encounter issues with user acceptance of the planned artifact. This may occur in the first iteration or in later iterations and it is the starting point for the specific process steps proposed in the research design pattern for AD-DSR. Awareness that there are user acceptance issues can be gained through a variety of research methods (e.g., literature research/review, expert interviews, survey) or by reflecting on evaluation results from previous design cycles. However, following the second guideline for conducting DSR (Hevner, March, et al., 2004), user acceptance must be a relevant and unsolved problem in the artifact environment in order to gain new knowledge and understanding.

After being aware of user acceptance issues, the next phase should have researchers identify relevant constructs that influence acceptance of similar artifacts based on proven theories. As mentioned earlier, AD-DSR proposes to use TAM and identify external variables influencing PU and PEOU. It is strongly recommended that the existing knowledge base be thoroughly examined by conducting a literature review in this step. The result should be a TAM with certain external variables. Subsequently, these external variables should be used to define requirements that positively influence them. For example, Venkatesh and Davis (1996) suggested that system characteristics and training may be relevant external variables. In this case, the requirements should be defined in such a way that they have a positive impact on the system characteristics and the training provided, and thus indirectly on PU and PEOU. Following the DSR framework by Hevner, March, et al. (2004), this should be done in the artifact environment, e.g. by conducting expert interviews. It should be noted, however, that for some relevant constructs of user acceptance, this may be nearly impossible. Dishaw and Strong (1999), for example, consider tool experience as a relevant external variable. It is hardly possible to influence a person's prior experience in the DSR project. Such external variables are not interesting for the design science perspective of AD-DSR but for the behavioral science perspective. Therefore, researchers should consider such constructs later in the evaluation, but exclude them here for the definition of requirements.

In the evaluation phase, researchers should evaluate the iteratively created artifact according to the criteria they established in the problem awareness phase (Vaishnavi and Kuechler, 2004). In the case of AD-DSR, this means that PU and PEOU of the current artifact are evaluated in each design iteration. This evaluation is part of the design science perspective of AD-DSR and ensures that defined and implemented requirements contribute to user acceptance in the given environment or are modified in subsequent iterations. Therefore, these evaluations should be conducted in the field, e.g. through field tests and test user interviews. The focus in the iterative design cycles should also be on qualitative rather than quantitative evaluation. At these points, the aim is to improve the design, i.e., to collect qualitative feedback and suggestions for improving the design. At the same time, the reference to the defined requirements should not be lost, as they later represent potential design principles.

After the deployment of the completed artifact, the final evaluation should be twofold, from a design and behavioral perspective. For both, a quantitative survey conducted in the environment is the recommended research method in AD-DSR, because this is no longer about suggestions for improvement, but about quantitative evidence. In terms of design science, the survey should evaluate whether the target audience accepts the designed artifact, i.e., the design was successful, and the artifact provides the desired utility. In terms of the constructed TAM, this means that survey items assess whether target users (1) actually use the artifact, (2) intent to use the artifact, (3) perceive the artifact as useful, (4) perceive the artifact as easy to use and (5) are satisfied with the implementation of external variables. In terms of behavioral science, the survey should evaluate which constructs influence the acceptability of the artifact, i.e., the underlying theory is evaluated, and truth is provided. To this end, structural equation modeling should be used to evaluate the constructed TAM based on survey data.

The final conclusion of an AD-DSR project should ideally contribute to the knowledge base in two ways. First, the accepted artifact itself, which solved a relevant and unsolved problem in the environment, constitutes a contribution. Second, a nascent design theory (NDT) can be derived based on the two evaluations from the perspective of the design and behavioral sciences. In terms of the contribution types defined by Gregor and Hevner (2013), the accepted artifact is a Level 1 contribution (i.e. a situated implementation of an artifact), and the NDT is a Level 2 contribution. Unfortunately, success in designing accepted artifacts is never guaranteed, so neither is a contribution in the form of an accepted artifact and a NDT. The underlying theories used may not be applicable to the novel artifact or an artifact of this type may simply not be accepted by the target audience regardless of its design. However, such findings also represent relevant contributions to the knowledge base and can be used in future AD-DSR projects.

3.2. Research Design[4]

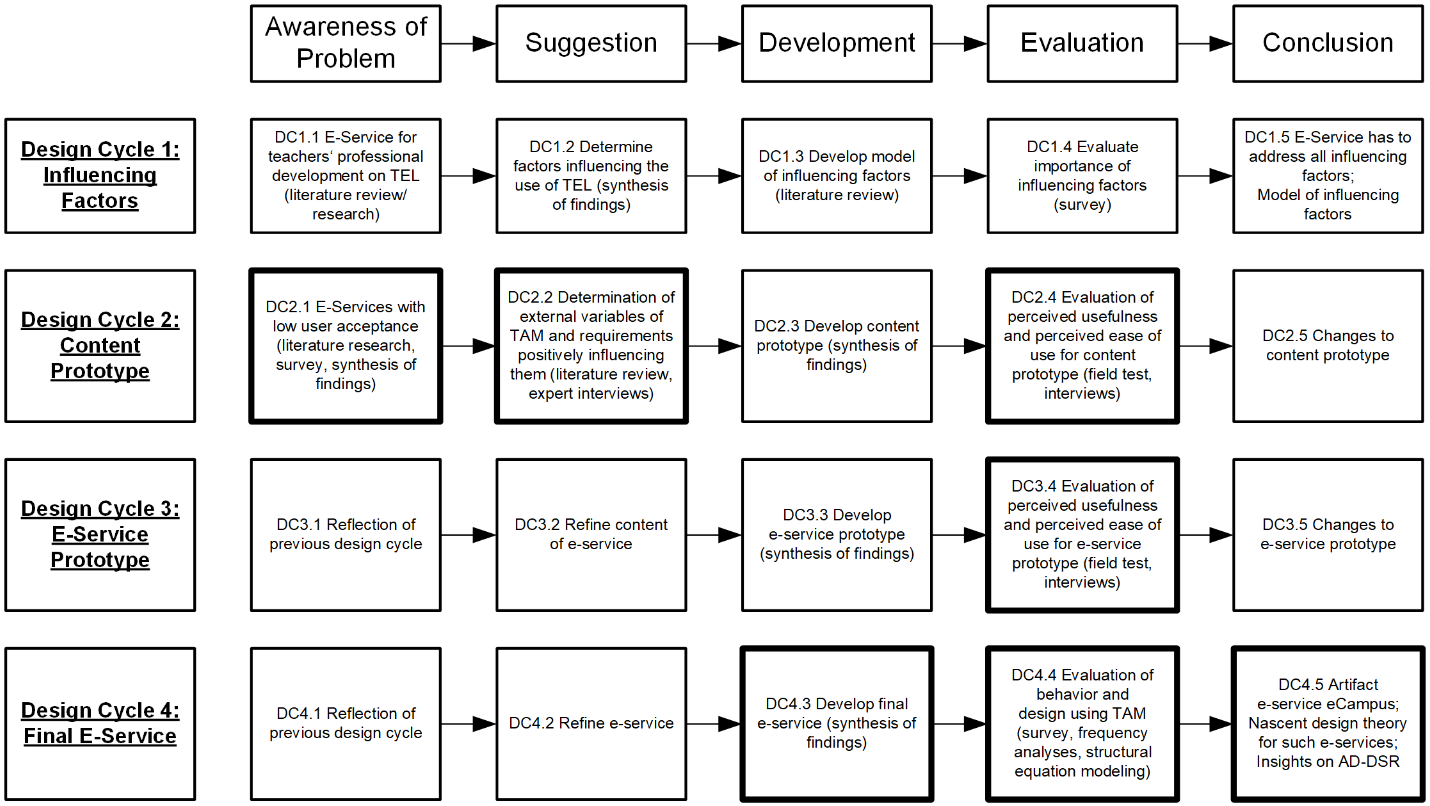
After the theoretical description of the AD-DSR approach, this section presents the concrete application of the proposed research design pattern in the context of the present thesis. Figure 3.3 shows the research design following AD-DSR for the preliminarily described problem of designing an accepted e-service to support teachers in the Styrian higher education (HE) sector in using technology-enhanced learning (TEL). The specific process steps of AD-DSR, as an extension of the DSR process model, are highlighted in the figure and are referenced in the following description.

A total of four design cycles were carried out. In the first cycle, a model was designed that included relevant and important factors influencing the use of TEL in HE teaching. In the first phase of the second cycle, it was then recognized that user acceptance is a relevant problem for the planned e-service (DC2.1). From this point on, AD-DSR was used, and this was also the starting point for the eCampus research project (see Section 3.2.4). Relevant constructs influencing user acceptance of similar e-services were identified by conducting a literature review and summarized in a TAM as external variables (DC2.2). These external variables were used as categories to identify requirements using expert interviews. A total of nine expert interviews were conducted with those responsible for TEL at the nine Styrian HEIs (DC2.2). The focus of the second design cycle was then the design of a content prototype. This prototype was made available to nine teachers at Styrian HEIs from different departments, and interviews were used to evaluate PU and PEOU (DC2.4).

[4] Parts of this section have already been published in: Beer (2022a)

Figure 3.3.

Research Design



In the third design cycle, the results of this evaluation were incorporated and a complete prototype of the e-service, called eCampus, was designed. For the evaluation, the prototype was again made available to teachers at the Styrian HEIs, and by means of interviews PU and PEOU were also surveyed here. A total of 28 teachers participated in this evaluation (DC3.4).

In the last and fourth design cycle, the findings were again incorporated and the final artifact, the e-service eCampus, was deployed and thus made available to all teachers in the Styrian HE area (DC4.3). Six months later, the final evaluation was conducted in terms of design and behavior. For this purpose, a survey based on the previously constructed TAM was sent out to teachers in the Styrian HE area. Structural equation models were calculated to evaluate the behavioral science part and frequency analyses were used for the design science part (DC4.4).

Finally, in the last step, conclusions were drawn from the whole thesis and the results on the three planned contributions (accepted artifact eCampus, NDT for such e-services, the AD-DSR approach) were prepared for the return to the knowledge base. (DC4.5).

3.2.1. Research Design in Design Science Research Framework[5]

Figure 3.4 additionally shows how the individual process steps of the research design correspond to the DSR framework by Hevner (2007). Again, the specific process steps of AD-DSR are highlighted in the figure.

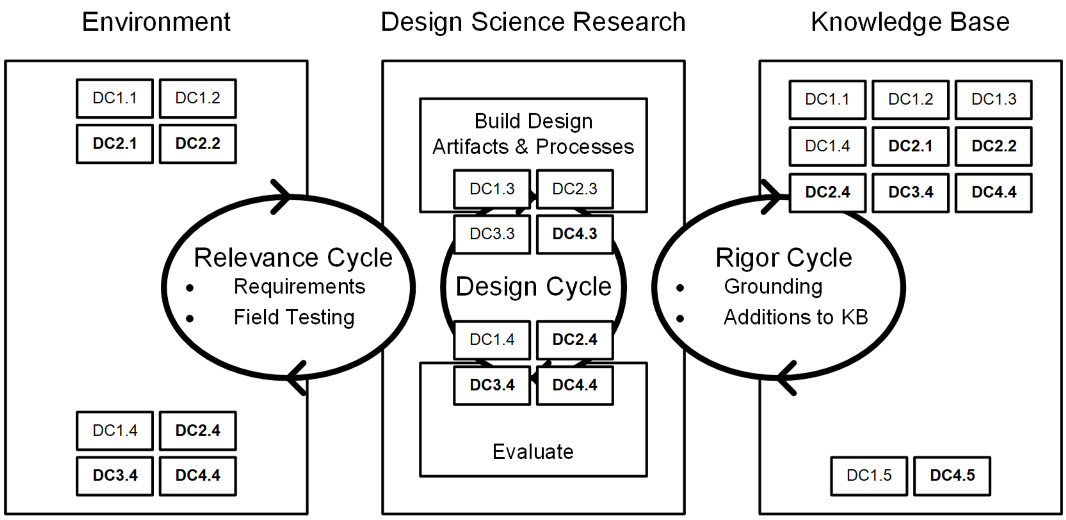
The figure shows how the individual steps of the five phases of the process model can be assigned to the three areas of the framework. Phase 1 (awareness of problem) and Phase 2 (suggestion) analyze the environment and the existing knowledge base. Phase 3 (development) mainly concerns the creation of the artifact. Of course, the existing knowledge base can and should be accessed here as well, for example, to use scientific methods in the development. Phase 4 (evaluation) essentially concerns the corresponding lower part of the design cycle. However, the knowledge base is also accessed

[5] This section has already been published in: Beer (2022a)

here for methods and evaluation takes place in the environment for the necessary relevance. In Phase 5 (conclusion), relevant results are then finally added to the knowledge base.

Figure 3.4.

Research Design in Relation to the Design Science Research Framework by Hevner (2007)



3.2.2. Design Science Research Guidelines in Research Design

The research design also followed the DSR guidelines by Hevner, March, et al. (2004) (see Section 2.2.1). The following part briefly describes how the seven guidelines were implemented in the thesis.

1. **Design as an artifact** Both the e-service eCampus and the AD-DSR approach were viable artifacts.
2. **Problem relevance** Both the e-service eCampus and the AD-DSR approach addressed important and relevant problems. The e-service eCampus should provide an accepted e-service to support teachers in the Styrian HE sector in using TEL. The AD-DSR approach should

provide a solution to the methodological challenge of designing new accepted artifacts within a funded research project at HEIs.

3. **Design evaluation** The e-service eCampus has been thoroughly evaluated over the cycles and especially in the last cycle. For the AD-DSR approach, a first impression can be given after this first project, but further projects are needed to rigorously evaluate the approach.
4. **Research contributions** In total, this thesis attempted to make three contributions (see Section 3.2.3).
5. **Research rigor** The overall methodology and research methods for each step, especially the final evaluation, followed strictly the application of rigorous methods.
6. **Design as a search process** In total four design cycles were conducted in an iterative process to design the artifacts. Even within the design cycles, the best design solution was sought iteratively, using the available resources and taking into account the given constraints, even for intermediate problems.
7. **Communication of research** The results are presented through this thesis and various papers (see Section 1.5) to the scientific community. In addition, the eCampus project itself was presented with events, e-mails, a press conference and several articles in regional media[6].

3.2.3. Design Science Research Contribution Types in Research Design

The thesis was intended to make three contributions. In regard to the research design, all three contributions were finally finished in the last design cycle (DC4.5). In the following, these three contributions are listed in relation to their respective level (see Section 2.2.2) according to Gregor and Hevner (2013).

Level 3. Well-developed design theory about embedded phenomena: No contribution on this level.

[6]e.g., Der Standard (2021-06-21), Die Presse (2021-05-29), Der Grazer (2021-05-26), orf.at (2021-05-26)

Level 2. Nascent design theory - knowledge as operational principles/ architecture: NDT for similar e-services.

Level 1. Situated implementation of artifact: The accepted e-service eCampus and the AD-DSR approach.

3.2.4. The eCampus Project

The design cycles 2 to 4 of the research design were largely carried out within the eCampus research project. The project was a cross-HEI research project funded by the province of Styria and carried out between February 2019 and April 2021, with the last evaluation starting approximately six months later. The goal was to implement an e-service for teachers in the Styrian HE area, which would support them in the use of TEL.

The project partners involved were the University of Graz, Graz University of Technology and CAMPUS 02 University of Applied Sciences. The University of Graz was mainly responsible for the content of the so-called use cases, which described examples for the use of TEL. The Graz University of Technology was responsible for the technical implementation of the e-service. The University of Applied Sciences CAMPUS 02 took care of the design, testing and evaluation of the e-service. The main focus was on the acceptance of the e-service.

The author of this thesis was not only in charge of the tasks concerning the University of Applied Sciences CAMPUS 02, he was also the project manager and took over some activities in the sense of coordination and harmonization during the content and technical implementation in order to guarantee the acceptance of the e-service in the best possible way during the implementation.

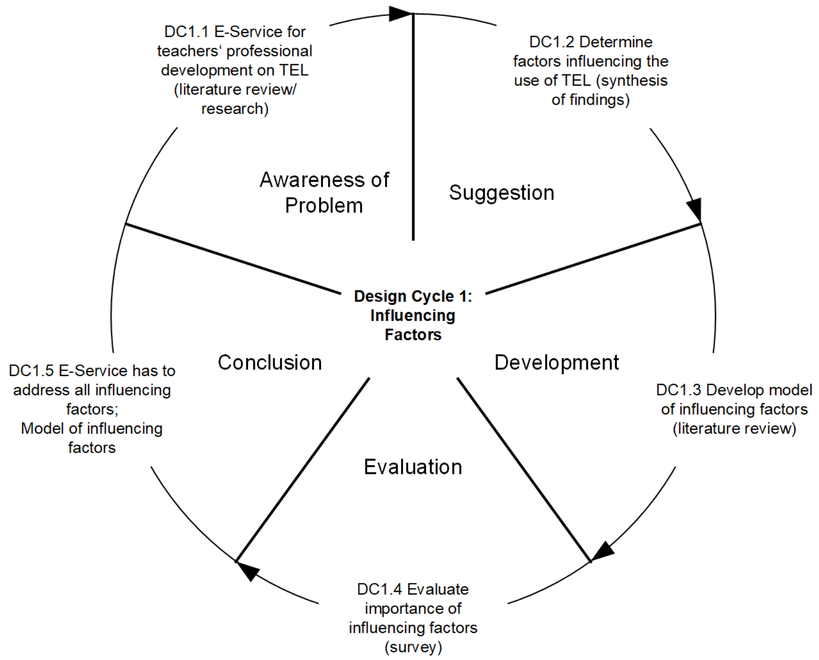
3.3. Conclusion

This chapter provided an answer to the methodological challenge of this thesis. The first section discussed the theoretical considerations provided in Chapter 2 in relation to this challenge. Thereby, the section showed the importance of fully considering the complementary nature of design and behavioral science in DSR projects. After that, the section described the proposed AD-DSR approach as a research pattern that encompasses the main idea of using TAM in DSR. Finally, the second section demonstrated the specific application of this approach in the context of this thesis. Therefore, it provided an overview of how the AD-DSR approach has been carried out in four design cycles. The following four chapters present these design cycles in detail.

With the AD-DSR approach and the research design derived from it, the chapter also provided the methodological basis for the answer to the research question of this thesis, which was:

> *RQ.* How can we design an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

4. Design Cycle 1: Influencing Factors



The first design cycle looked for factors that are relevant and need to be considered when using technology-enhanced learning (TEL) in higher education (HE). If these factors are considered and described for TEL approaches, relevant and important competencies for the meaningful and successful use of these approaches can be taught. This design cycle thus provided the basis for the structure of the eCampus content.

For this, the first section describes again the initial situation: We need an e-service that helps teachers to acquire competencies for the use of TEL (awareness of problem). Therefore, we must first determine the factors that are relevant to the use of TEL and thus represent necessary competencies for teachers (suggestion). The next section describes the chosen research methods of a structured literature review and a survey. Those were conducted to identify influencing factors as completely as possible and to understand which of these influencing factors are important and relevant from the teachers' point of view (suggestion). The result of the structured literature review, a model of the influencing factors relevant to the use of TEL, is then presented (development). The following section shows the results of the survey used to determine the importance and relevance of each influencing factor to the target audience (evaluation). Finally, the results of the literature review and the survey are critically discussed and a conclusion for future research and the further design cycles is provided (conclusion).

4.1. Introduction[1,2]

As concluded in Section 1.1, teachers at higher educational institutions (HEI) need the necessary competencies to use TEL. Various professional development programs have attempted to impart these competencies in face-to-face courses. Even though e.g. the eDidactics program can be seen as very successful in this line, such programs do have problems. However, those can be solved through the use of e-services that allow teachers to build necessary competencies through self-study.

When designing such an e-service, it must first be clarified which competencies are to be taught in detail. Section 2.1.3 discussed existing approaches of instructional design (ID) with influencing factors considered in the process, which together represents the necessary competencies for the successful use of TEL. However, the conclusion in Section 2.1.3 also shows that the existing models are not consistent, complete, and do not have the level of detail needed for this thesis.

[1]Parts of this section have already been published in: Schweighofer, Weitlaner, et al. (2019)

[2]Parts of this section are based on the following already published work: Schweighofer and Ebner (2015)

Moreover, it is not enough to consider relevant influencing factors related to ID; to be successful with a TEL approach it is necessary to consider critical success factors (CSFs). In general, CSFs are characteristics, conditions, or variables that can determine whether a company succeeds (Leidecker and Bruno, 1984). In addition, according to Pinto and Slevin (1987), considering such factors can also improve the chances of success of different project implementations, while Cheawjindakarn, Suwannatthachote, Theeraroungchaisri, et al. (2013) pointed out that identifying CSF is particularly important in educational institutions. They defined CSF as factors that need attention for online distance learning to be successful, efficient, and effective. This thesis applies the same definition of CSF to TEL approaches.

To show the diversity of CSFs for TEL approaches and to provide a selection of such CSFs mentioned in the literature, a search was conducted in Google Scholar using the search term "critical success factors" in combination with the terms "technology-enhanced learning", "e-learning", and "online learning". Eleven studies were selected that preferentially identified different CSFs. Table 4.1 contains the selection of studies and their identified CSFs. The list is thereby not intended to be exhaustive.

Five of these studies (Frydenberg (2002); Joo, Lim, and E. K. Kim (2011); McGill, Klobas, and Renzi (2014); Selim (2007); Sun, R. J. Tsai, et al. (2008)) identified CSFs for e-learning and online courses in general. Frydenberg (2002) presented a literature review and McGill, Klobas, and Renzi (2014) described the results of a survey of authors who had written articles on e-learning initiatives. The remaining three articles reported the results of surveys in which students identified CSFs. The results of these five studies are quite diverse, as there is not one CSF that appeared in all five studies, and greater consensus exists only for CSFs related to acceptance. These CSFs are perceived usefulness and ease of use (Sun, R. J. Tsai, et al., 2008; Joo, Lim, and E. K. Kim, 2011), and students like the innovation, innovation is easy for students to use, and innovation is easy for teachers to use (McGill, Klobas, and Renzi, 2014).

Table 4.1.

Selection of Studies identifying Critical Success Factors for Technology-Enhanced Learning

Source	Description	CSF
Alsabawy, Cater-Steel, and Soar (2016)	A survey conducted with 720 students of online courses at an Australian university to determine the impact of IT infrastructure services and IT quality on perceptions of usefulness	(1) IT infrastructure services, (2) system quality, (3) information quality
Y.-C. Chen et al. (2013)	A survey conducted with 306 students using web-based language learning at a university in Taiwan to test hypotheses based on the social cognitive theory in order to determine how different factors influence learners' satisfaction	(1) system characteristics, (2) possibilities of interaction
Cochrane (2010)	Feedback (qualitative and quantitative) from students and teachers participating in three mobile learning projects at a higher educational institute in New Zealand to identify CSF for mobile learning	(1) the importance of the pedagogical integration of the technology into the course assessment, (2) lecturer modeling of the pedagogical use of the tools, (3) the need for regular formative feedback from lecturers to students, (4) the appropriate choice of mobile devices and software to support the pedagogical model underlying the course
Frydenberg (2002)	A literature review on quality standards for e-learning in the USA	(1) executive commitment, (2) technological infrastructure, (3) student services, (4) design and development, (5) instruction and instructor services, (6) program delivery, (7) financial health, (8) legal and regulatory requirements, (9) program evaluation
Henrich and Sieber (2009)	Lessons learned from using different approaches to enhance courses about information retrieval with technology at a university in Germany to identify CSF for TEL approaches	(1) concept, (2) creation, (3) maintenance, (4) utilization, (5) participation
Joo, Lim, and E. K. Kim (2011)	A survey with 709 students of online courses at a South Korean online university to test hypotheses in order to determine how different factors influence learning satisfaction	(1) teaching presence, (2) cognitive presence, (3) perceived usefulness and ease of use

(continued)

Table 4.1.

Selection of Studies identifying Critical Success Factors for Technology-Enhanced Learning (continued)

Source	Description	CSF
McGill, Klobas, and Renzi (2014)	A survey conducted of 70 authors of articles about e-learning initiatives, conducted to identify factors which influence the success, continuation or sustainability of e-learning initiatives	(1) students like the innovation, (2) innovation is easy for students to use, (3) innovation is consistent with approach to teaching, (4) technology is sufficiently mature/stable, (5) management supports e-learning, (6) innovation improves student learning, (7) technology is inexpensive, (8) innovation is easy for teachers to use, (9) technology is up to date
Selim (2007)	A survey conducted with 538 students at a university in the United Arab Emirates to identify important factors for successful e-learning	(1) instructors' attitude toward and control of the technology, (2) instructors' teaching style, (3) student motivation and technical competency, (4) student interactive collaboration, (5) e-learning course content and structure, (6) ease of on-campus internet access, (7) effectiveness of information technology infrastructure, (8) university support of e-learning activities
Soong et al. (2001)	Interviews with instructors, a survey conducted with students and the analysis of archival records (logs) in order to identify CSF for using online learning resources at an university in Singapore	(1) human factors pertaining to the instructors, (2) the instructors' and students' technical competency, (3) the instructors' and students' mind-set (about learning), (4) the level of collaboration intrinsic in the course, (5) the level of perceived IT infrastructure and technical support
Stacey and Gerbic (2008)	Based on the literature and personal practices at two universities in New Zealand and Australia, the article described success factors for blended learning	(1) institutional success factors (e.g. needs), (2) success factors regarding teachers (e.g., workload, fears), (3) success factors regarding students (e.g., readiness, expectations), (4) pedagogic considerations (e.g. course design)
Sun, R. J. Tsai, et al. (2008)	A survey conducted with 295 students at two universities in Taiwan to test literature-based hypotheses in order to determine how different factors influence learners' satisfaction in e-learning courses	(1) learner computer anxiety, (2) instructor attitude toward e-learning, (3) e-learning course flexibility, (4) e-learning course quality, (5) perceived usefulness, (6) perceived ease of use, (7) diversity in assessments

Regional differences could be a possible reason why such different results are obtained. Richter and Pawlowski (2007) described differences in e-learning between Germany and South Korea. For example, they pointed out differences in the role of teachers, the value of making mistakes, and the preferred learning style. Furthermore, Paulsen (2003) also discussed regional differences in Europe regarding the use of learning management systems.

The remaining six studies (Alsabawy, Cater-Steel, and Soar, 2016; Y.-C. Chen et al., 2013; Cochrane, 2010; Henrich and Sieber, 2009; Soong et al., 2001; Stacey and Gerbic, 2008) identified CSFs that relate to more specific TEL approaches or specific aspects of TEL approaches such as blended learning, m-learning, or technical infrastructure aspects. Overall, it appears that different CSFs are relevant to different TEL approaches, but some CSFs appear to be relevant to TEL approaches in general.

Furthermore, only two of the selected studies examined faculty perspectives (Cochrane, 2010; Soong et al., 2001). However, in HE professional practice, faculty or their leadership decide which TEL approaches to implement and which influencing factors to consider. In addition, the time required to consider these factors during implementation is also important. If faculty or leadership do not believe in the importance of an influencing factor or do not want to spend time considering such a factor, the fact that students consider it a CSF is irrelevant because decision makers will not investigate or consider that factor.

In summary, the insights led to three assumptions and conclusions:

1. Regional differences determine the CSF for TEL approaches. Therefore, the research should be regionally restricted.
2. Some CSF are relevant to TEL approaches in general. Therefore, in order to identify these CSF, the research should not be restricted to specific TEL approaches.
3. Professionals in HE determine which influencing factors they will consider when implementing TEL approaches. Therefore, the research should address the opinion of these professionals.

These points led to the detailed purpose of this design cycle. Although Styria is the target region in this thesis, it was deliberately expanded, so that the results can be placed in a compareable context. First, it was intended to show in broad outline which influencing factors are important for professionals at Austrian and German HEIs and how much additional time they would spend considering these factors. This information helps to select influencing factors that need to be described in the e-service because the professionals would actually consider them. Second, the research should identify influencing factors that are important to professionals even though they would not want to spend much time considering them. These factors should also be included in the e-service, but it should be considered that professionals do not want to spend much time on them. Third, the research should identify influencing factors that professionals do not consider important. These factors can be included in the e-service, but if this is done, the importance must also be explained to professionals. In addition, this information should help identify areas where more explanation is needed to highlight the importance of these influencing factors.

Thus, the first design cycle should answer the first subordinate research question of this thesis, which was:

> *RQ1.* What influencing factors have to be considered when describing technology-enhanced learning approaches?

As previously described, in answering the research question, a regional restriction was made and the perspective of professionals was used. Furthermore, the research was not limited to individual TEL approaches, but attempted to provide a generally valid view.

4.2. Research Method

Two research methods were used to conduct this design cycle. In the first step, a structured literature review was used to identify potential influencing factors that should be considered when using TEL. The results should provide as broad a picture as possible. In the second step, the relevance from the perspective of professionals at HEIs in Austria and Germany was determined with a survey. As a result, it is ensured that a comprehensive selection of possible influencing factors is available and that from this selection it is determined regionally from the point of view of the professionals which influencing factors are most relevant and should therefore be taken into account in the e-service. The following two sections describe the two research methods in detail.

4.2.1. Literature Review on Influencing Factors[3]

The specific type of structured literature review applied is based on W.-H. Wu et al. (2012). The method thus consists of the following steps: (1) defining TEL, (2) defining inclusion/exclusion criteria, (3) defining data sources and search strategies, and (4) performing data analysis.

Definition of Technology-Enhanced Learning

To fulfill the purpose of this design cycle, the term TEL was defined as the set of all approaches that use technology to support the learning or teaching process (Dror, 2008) (see also Section 2.1). Based on this definition, the literature review was not limited to a specific area of TEL. Web-based learning or game-based learning were considered, as well as computer-assisted learning environments, the simple use of animation or computer-generated images and movies, and any other way of using technology to enhance the learning or teaching process.

Inclusion/Exclusion Criteria

The inclusion/exclusion criteria for publications to be part of this study were as follows:

- The publication had to have a relation to the field of TEL as it was defined for the purpose of this design cycle.

[3] This section has already been published in: Schweighofer and Ebner (2015)

- The purpose of the publication had to address one or more factors that could possibly be considered when implementing TEL approaches. Publications that introduced new approaches in the field of TEL without explicitly addressing one or more factors were not taken into account.
- The publication had to be published between 2009 and 2014 (request date November 2013).
- The publication had to be downloadable in full-text at the authors' home HEI[4].
- The publication had to be in English.

Data Sources and Search Strategies

Due to the research purpose of finding factors that could potentially be considered in the implementation of TEL approaches, a search strategy based on search terms alone was not appropriate as it would have limited the range of factors to the selected search terms. Instead, two large bibliographic databases were used to search all publications from high-impact journals in education to ensure that a wide range of possible aspects were considered and that there were no limitations imposed by the selected search terms. The two databases used were SCOPUS and Web of Knowledge. In Web of Knowledge, all journals from the Education & Educational Research category with a five-year impact factor greater than 1.5 (based on the 2012 JCR Social Sciences Edition) were considered, and in SCOPUS, all journals with "Education", "Learning", or "Teaching" in the journal title, excluding machine learning journals, with an SCImago Journal Rank greater than 1.0 were considered. Finally, only journals that allowed full-text download and were accessible at the authors' home HEI were considered. In total, 12 journals with a total of 4,567 publications were initially considered in this study.

[4] CAMPUS 02 University of Applied Science in Graz, Austria

Data Analysis

Of these 4,567 publications, a total of 412 examined at least one factor that could be considered in implementing TEL approaches. In the analysis, these factors were collected, clustered, and reviewed again for quality assurance. The clustering itself, as well as the definition of hypernyms, was not limited to the use of existing models, but was based solely on the similarity of the identified factors. Specifically, the following steps led to the final categorization (an example of the process can be seen in Appendix A):

1. Collecting: Based on the research question and the purpose of the publications, the terms for factors that could be considered in the implementation of TEL approaches, as used in the publications, were collected.
2. Ordering: The collected original terms were sorted according to their similarity.
3. Defining: Hypernyms for similar terms were defined.
4. Assigning: The publications were assigned to the defined hypernyms.

The method chosen to identify relevant factors covered a broad field. The main purpose of this chosen method was to create a broad database, since journals with a TEL focus cover other factors than journals that specialize in psychology, science, or education, for example. However, this method has its limitations; relevant publications not found in the two databases were excluded, as were publications from other journals.

4.2.2. Survey on Relevance for Professionals[5]

It should be noted that the survey was part of a research project that had two different target groups (educational institutions and businesses). The same survey was used for both. Although this thesis focuses exclusively on a part of the second group (HEIs), the research design for the entire research project is described below for accuracy. The research project used a cross-sectional design, the most commonly used survey design. This means

[5]This section has already been published in: Schweighofer, Weitlaner, et al. (2019)

that units of analysis were studied either at a specific point in time or within a short period of time (Straits and Singleton, 2011).

Overall Description of the Study

The study population included: employees of Styrian companies operating in either the manufacturing or the service sector, schools (from secondary school upwards), university extensions, and HEIs in the German-speaking DACH region (Germany, Austria and Switzerland). Due to the broad spectrum of the study population, an online survey seemed to be an appropriate and resource-efficient method to collect empirical data. An electronic mailing list and a suitable questionnaire were created. The electronic mailing list was created with reference to a marketing database to obtain data from Austria. This database contains information from the Austrian Company Register and the Creditor Protection Association. To obtain data from Germany and Switzerland, publicly available lists of German and Swiss HEIs were reviewed and e-mail contact addresses were manually obtained. These two data sets were supplemented with information from personal contact lists, resulting in the creation of an electronic mailing list with approximately 19,000 entries. Of these, around 1,300 entries were attributable to the group of HEIs in the German-speaking DACH region.

Survey Details

The development of the questionnaire was an iterative process. A first draft of the questionnaire was created based on the previously proposed model of influencing factors (see Section 4.3) and the question of interest. After several cycles of linguistic refinement, an online form of the questionnaire was created (using EFS Survey software). Pilot testing further improved the questionnaire, resulting in the creation of an adapted and shortened version based on testers' comments.

In summary, the final instrument can be described as follows. The questionnaire consists of three blocks using the 20 categories of the influencing factors model as survey items:

- the categories considered so far along with a satisfaction rating (or reasons for not considering them)
- a general assessment of the importance of each category and the amount of time respondents would spend considering the factors in those categories
- the top five categories ranked by each respondent based on their assessment of importance and time spent

The full questionnaire can be seen in Appendix B. To limit the scope for interpretation, the names of the 20 categories of influencing factors were accompanied by keyword descriptions in parentheses (see Figure 4.1).

The survey was available online in two versions: a personalized and an anonymous version. In this way it was possible to treat personal contacts individually and to use the mass mailing function of the system. Information letters were sent directly, providing a web link to the personalized version of the questionnaire, explaining the research purpose, and assuring confidentiality of personal contact information. The contact persons were additionally asked to forward the message to teachers, lecturers and other interested parties. In addition, the web link to the anonymized version of the questionnaire was substituted, with the risk that individuals could respond multiple times and skew the results. Since it was possible to monitor the response behavior of each personal contact, reminders were sent to non-respondents one month after the first mail was sent. Of course, these measures could not be applied in the other cases, since it was not possible to track who responded or to determine whether contacts forwarded the invitation.

Following the collection of questionnaire responses, data from 319 fully completed questionnaires were analyzed between March and April 2015. The data were subjected to pre-processing, which excluded incomplete data sets and data from schools, university extensions and Switzerland due to insufficient group sizes. The final dataset consisted of 276 records. As described, the focus of this thesis is on the subpopulation from HE, which further reduced the sample to 120 usable questionnaires. Table 4.2 shows the demographic data for this data set; this information was entered by respondents at the beginning of the questionnaire. All analyses were performed using IBM SPSS Statistics 22.0.

Table 4.2.

Demographic Data of Survey Influencing Factors

Item	*n*	%
Age (years)		
< 25	1	0.8
25 - 30	10	8.3
31 - 40	33	27.5
41 - 50	35	29.2
> 50	41	34.2
Organization		
University of applied science	59	49.2
University	45	37.5
College of education	16	13.3
Country/state		
Germany	28	23.3
Austria (only Styria)	62	51.7
Austria (without Styria)	30	25.0
Function in university of applied science		
Head of degree program	6	5.0
Full-time lecturer/teacher	24	20.0
Part-time lecturer/teacher	16	13.3
Responsible for online learning and/or didactics	9	7.5
Other function	4	3.3
Function in university		
Rector, faculty director, head of institute	6	5.0
Professor, assistant professor, lecturer	19	15.8
Responsible for online learning and/or didactics	7	5.8
Other function	13	10.8
Function in college of education		
Rector, faculty director, head of institute	3	2.5
Professor, assistant professor, lecturer	11	9.2
Responsible for online learning and/or didactics	1	0.8
Other function	1	0.8
Time in position (years)		
< 1	5	4.2
1 - 3	25	20.8
4 - 6	31	25.8
7 - 10	21	17.5
> 10	38	31.7
Field of work		
Natural science	15	12.5
Engineering and technology	43	37.5
Agricultural, medical and health science	6	5.0
Social sciences	51	42.5
Humanities	36	30.0
Experiences with TEL in teaching		
Yes	97	80.8
No	23	19.2

4.3. Model of Influencing Factors[6]

The identified factors that could be considered in the implementation of TEL concepts were grouped into 20 categories. Each category consists of factors that have a high degree of similarity. For example, the category "demographic differences" groups together all factors that relate to the general circumstances of the learners, such as the age and cultural background. The following sections briefly describe the identified categories. In each category selected publications are presented as examples to provide greater insight. However, the aim is not to discuss the methods and results of the publications in detail, but rather to explain the investigated factors.

Acceptance Aspects The study of acceptability of TEL approaches or the technology itself is widespread. This category therefore includes all publications that deal with acceptance factors related to TEL. The publications addressed not only learner acceptance, but also acceptance by instructors and other stakeholders, such as parents. In total, 36 publications dealt with factors of acceptance. For example, Bourgonjon et al. (2011) examined the reasons why parents often have negative perceptions, especially toward game-based learning. They contended that the lack of parental acceptance often has a negative impact on teachers, students, and policy makers, and is therefore a barrier to game-based learning scenarios. Furthermore, in their work they showed a hypothetical path model that helps explain and predict parental acceptance. Regarding teacher acceptance, Pynoo et al. (2012) used two sources to determine whether teachers accept educational portals or not. First, they analyzed the extent of use, i.e., the number of logins, downloads, uploads, responses, and pages viewed. Second, they used an online questionnaire. Results from two surveys conducted 22 months apart showed that attitude and perceived usefulness were the strongest predictors of behavioral intentions. Chow et al. (2012) showed how they used the Technology Acceptance Model (TAM) to assess learner acceptance of a learning scenario in the Second Life virtual environment.

[6] This section has already been published in: Schweighofer and Ebner (2015)

Business Aspects A total of 38 articles dealt with economic aspects of TEL. These studies were mainly concerned with the holistic effectiveness and efficiency of TEL approaches. They also considered value and benefits, as well as difficulties and organizational influences. In addition, a few papers addressed cost reduction, quality assurance, and ethical dimensions. Regarding cost reduction, Ho and Dzeng (2010) in their study on safety training through online learning in organizations showed how much organizations can save by using online learning scenarios to train their employees. However, their study was unable to clarify a reciprocal relationship between the cost and effectiveness of online learning. Using qualitative and quantitative methods, Czerniewicz and C. Brown (2009) examined the organizational influence of policy and culture on online learning in four South African universities. Their findings showed a relationship between policies and the use of technology for teaching and learning. In addition, the findings confirmed a critical relationship between organizational culture and the importance and use of online learning at the universities studied. T. Wang (2009) explored the general benefits and difficulties of implementing technology to enhance architectural education. One difficulty is that both learners and instructors must learn how to use TEL approaches effectively before any benefits can be realized. Nevertheless, T. Wang (2009) also mentioned the benefits of TEL approaches, especially when it comes to lifelong learning.

Cognitive Aspects This category includes cognitive aspects such as cognitive load, cognitive abilities, cognitive processes, and factors that affect learner attention. Of the publications analyzed, 39 addressed these factors. For example, Austin (2009) examined the impact of individual cognitive differences on performance. Specifically, her study addressed the effects of multimedia combinations, and the results showed that display design affects attention and cognitive load. Annetta et al. (2009) evaluated in their study the cognitive effects on students when playing a video game created by teachers. Their study showed that while no impact on learning outcomes could be measured, the impact on participant engagement was significant. One way to track and explore learner attention was shown by Boucheix and Lowe (2010). They used eye-tracking to investigate learner attention in learning scenarios with complex animations in two experiments.

Course-Related Aspects Course-related aspects are factors related to the design of the course, the delivery method, the time allotted for each assignment, the purpose or teaching discipline itself, and the relevance of the course to learners.The literature review identified 13 publications that addressed such factors. One of these 13 articles examined the impact on the development of a research community when different amounts of time are provided. Specifically, the effects were measured on a single course taught by the same instructor for 13 weeks or for six weeks. The results of the study primarily showed differences in the development of cognitive presence (Akyol, Vaughan, and Garrison, 2011). In addition, Arbaugh et al. (2009) found in a literature review that the scope and quality of online and blended learning approaches differ in terms of teaching discipline. The results showed that few online or blended learning approaches had been implemented in subjects such as finance and economics. Klašnja-Milićević et al. (2011) presented in their work a recommendation module of a programming tutoring system called Protus. Among other factors, the system recommends learning content based on relevance to students.

Demographic Differences Demographic differences are learner's age, cultural and ethnic background, socioeconomic status and general background, and gender differences. A total of 27 publications were identified that examined the impact of demographic differences on various factors of TEL. Ke and Kwak (2013), for example, examined the relationship between age and ethnic background of learners and their participation, interaction, perception, and learning satisfaction in online courses in their study. Specifically, they collected data from students enrolled in 28 online courses. The effects of national and cultural background on technology acceptance were also examined by Sánchez-Franco, Martínez-López, and Martín-Velicia (2009). For example, regarding the impact of gender differences on learning satisfaction, González-Gómez et al. (2012) provided evidence that female students are more satisfied with online learning than male students.

Influences from Prior Knowledge and Experience In total 39 of the publications dealt with the influence of prior knowledge and experience on TEL approaches. They addressed the digital literacy of learners and instructors, the knowledge level of learners, and their prior experiences with TEL scenarios. Paechter, Maier, and Macher (2010) investigated the influence of learners' prior experiences on learning success and learning satisfaction in their study with 2,196 students from 29 HEIs. The results showed that students' learning satisfaction and learning success in online courses were highly dependent on instructors' use of the technological learning approach and support during the online course. In another study, S. I. Park, G. Lee, and M. Kim (2009) observed the impact of students' prior knowledge on concept understanding, cognitive load, and learning efficiency, among other factors. Specifically, their study showed a positive impact on these variables through the use of highly interactive simulations when learners' prior knowledge is high. Finally, regarding learners' digital literacy, the term "digital natives" was widely used. However, Margaryan, Littlejohn, and Vojt (2011), for example, showed in their study that young people, so-called digital natives, differ only quantitatively, but not qualitatively, in their technology use in learning.

Instruction Aspects Twenty of the analyzed articles addressed instructional aspects in their research. They addressed the influence of instruction and the effects of different instructional designs and strategies, as well as the effectiveness of instruction. For example, Inan et al. (2010) identified in their work different instructional strategies used by teachers in TEL approaches. Their work showed that in most cases, the technology was used as a learning tool rather than for delivering instruction. In the study of Borup, West, and Graham (2012), which focused on instructional strategies, different video-based instructions were compared. Their results showed that video-based instruction is similar to face-to-face instruction from the learners' perspective. Regarding the effectiveness of instruction, especially in virtual worlds, Mayrath et al. (2011) used a case study integrating Second Life into an English course to show what was experienced.

Learners' Learning Aspects This category includes all factors that affect learners' learning, i.e., all publications that dealt with factors such as learning behavior and process, learning strategy and style, and interaction and participation. In total, 102 publications examined such factors. Falloon (2013) observed the impact of using iPads in learning scenarios for five-year-old students on learning trajectories. The results revealed several critical factors, e.g., participation and interaction. Oliveira, Tinoca, and Pereira (2011) investigated the different types of collaborative practices, especially in discussion forums. In summary, their results showed that different work patterns have an impact on learning outcomes. Finally, Latham et al. (2012) proposed a conversational intelligent tutoring system that adapts to learners' learning styles. They claimed that this will improve the learning experience and effectiveness.

Learners' Requirements In addition to learners' learning aspects, this category addresses their requirements. In total, there were 24 identified articles that examined learners' requirements and preferences in a TEL environment. In addition, publications that addressed learners' readiness to learn and use technology were also part of this category. For example, Darab and Montazer (2011) investigated whether students are ready for online learning scenarios. They conducted a survey to determine existing skills and deficits. Regarding learners' preferences, a survey by Lawlor and Donnelly (2010) investigated what type of podcast formats learners prefer. Their results indicated that a mix of key-point slides and explanatory voice-over best meets learners' preferences. Another issue related to learners' requirements is identity in online learning systems. F.-Y. Yu and C.-P. Wu (2011) studied preferences related to the following four different types of identity disclosure: always show real name, always show nickname, always be anonymous, and decide between real name, nickname, and anonymity in each situation.

Learning Success Most of the publications analyzed, namely 186, dealt with factors of learning success. The articles dealt with factors such as learning effectiveness, learning efficiency, learning quality and learning performance. As a representative, Eow, Baki, et al. (2009) investigated in their paper the relationship between learning success and the time students spend playing computer games. However, their results showed only weak correlations. Furthermore, Hong et al. (2013) in their study on game-based learning found that game-based learning is more effective for boys than for girls. The result was based on an experiment with a developed embodied interactive video game. P. Kim et al. (2011) showed in their work how team learning outcomes are affected by Web 2.0 environments. They additionally claimed that collective reflection and critical thinking are even more important.

Mind-set & Feelings before TEL The category "mind-set & feelings before TEL" includes 23 publications that addressed factors such as beliefs, perceptions, and expectations before implementing or using TEL approaches. For example, Prestridge (2012) examined how teachers' beliefs influence their use of technology in learning scenarios. Findings were based on interviews, surveys, and document analysis. Terzis, Moridis, and Economides (2013) looked at the other side, learners' expectations, in their study. Their work included an investigation of the influence of learners' expectations on the acceptance of computer-based assessment without coercion. C.-C. Tsai (2009) showed differences between learners' perceptions of learning and web-based learning. The study was based on the survey of 83 Taiwanese college students. The results showed that the perceptions of web-based learning are often more nuanced.

Mind-set & Feelings during TEL Compared to the "mindset & feelings before TEL" category, this category addresses factors such as attitudes, perceptions, perspectives, satisfaction, and emotions while using TEL approaches. 102 publications were identified that addressed these factors. For example, Şad (2012) postulated an instrument to measure students' attitudes toward the use of smart boards in the classroom. The instrument is called the Smart Board Attitude Scale and asks, among other things, about students' enjoyment or willingness to go to school because of smart board instruction. Dziuban et al. (2013) also addressed student satisfaction, in their case with online courses. They also provided an instrument to measure student satisfaction, including stimulation of interest, pace, and feedback given. Regarding teachers' feelings about the use of technology in their learning scenarios, Regan et al. (2012) presented the results of a qualitative study on teachers' feelings about teaching in an online learning environment.

Motivational Aspects 74 publications addressed motivational aspects such as intention, engagement, and self-efficacy. The articles addressed both learners' motivation and teachers' motivation. Teo (2011) presented a model that explains teachers' intention to use technology in learning scenarios. The model addresses perceived usefulness, perceived ease of use, subjective norm, enabling conditions and attitudes toward use, and behavioral intention. Regarding student motivation, Liping Deng and Tavares (2013) conducted a qualitative study to investigate motivating and inhibiting factors that influence student engagement in online discussions. Their results showed that the technical tools used, subjective perceptions, and rules for participation, among other factors, influence student engagement. Chatzoglou et al. (2009) addressed the intentions of employees in organizations to use web-based training scenarios. In doing so, they extended the TAM to include factors such as management support, enjoyment, and self-efficacy.

Requirements on Teachers Only three publications, the smallest number of articles in any category, dealt with requirements on teachers. They were all published in the journal Teaching and Teacher Education. First, Guasch, Alvarez, and Espasa (2010) examined the requirements placed on university teachers for teaching in virtual learning environments. Second, I. Han, Eom, and Shin (2013) specifically addressed how teachers can improve their technological and pedagogical knowledge to use technology in their teaching and how to improve subsequent knowledge integration. Finally, Polly et al. (2010) also addressed the requirements on teachers to use technology in their teaching by analyzing the results of several projects from a U.S. initiative. To do so, they used the framework of technological pedagogical content knowledge.

Self-Regulation Aspects Self-regulation aspects formed the research purpose of 36 identified publications. Self-regulated learning, i.e., flexibility in terms of pace and sequence, learning effort and time management, and computer and Internet self-efficacy are among the factors studied. Fulton et al. (2013) showed correlations between learners' control over pace and their learning performance in an experiment. They compared two groups with weekly and monthly deadlines. The results showed that learners with less control over pace performed better in learning. Hodges and Murphy (2009) also studied learners' self-efficacy in an asynchronous, technology-intensive mathematics course. However, they focused more on learners' self-efficacy beliefs. Finally, Shen et al. (2013) identified five dimensions of self-efficacy in online learning in their work. These dimensions are: Self-efficacy to complete an online course, self-efficacy to interact socially with classmates, self-efficacy to interact with tools in a course management system, self-efficacy to interact with faculty in an online course, and self-efficacy to interact with classmates for academic purposes.

Social Aspects Only four publications, the second smallest number of articles in any category, dealt directly with social aspects such as social behavior and competencies. Krause, Stark, and Mandl (2009) investigated in their study the influence of the social context of individual vs. cooperative learning and of feedback interventions on learning outcomes. Their results showed, among other things, that group learning especially increases perceived learning performance and learning outcomes. Furthermore, Pérez-Mateo and Guitert (2012) investigated social expression. In their work, they proposed indicators classified as formal, attitudinal, emotional, and informal. A particular problem was addressed by Cheng and J. Ye (2010). They used a virtual learning environment to help improve the social skills and interaction of people with autism spectrum disorders.

Support Processes Factors of support processes were part of 27 identified articles. The articles dealt with topics such as feedback, learning observation, and help-seeking. Jara and Mellar (2010) considered the aspect of feedback. Specifically, they examined how student feedback on online learning courses can be used for quality assurance. De Wever et al. (2010) compared the differences in learning outcomes between tutor-supported online discussions and role-based online discussions. Their results showed that the level of knowledge acquisition is higher in the tutor-supported group. In addition, Mäkitalo-Siegl and Fischer (2011) provided an overview of the research field of help-seeking processes.

Teachers' Teaching Aspects The category "teachers' teaching aspects" includes topics such as teaching style, teacher behavior, teacher self-reflection, teaching performance, and teaching strategy. A total of 12 articles examined such factors. For example, in their experiment, N.-S. Chen, Wei, C.-C. Liu, et al. (2011) analyzed the impact of teaching strategies appropriate for different learning styles on learning outcomes. The experiment included three teaching strategies suitable for three thinking styles. A similar experiment was conducted by Hsieh et al. (2011). They too observed the influence of teaching and learning styles in their case in relation to u-learning. With respect to web-based digital videos, Krauskopf, Zahn, and Hesse (2012) specifically investigated the teaching style required to teach with digital videos.

Technical Infrastructure Aspects A total of 18 publications were identified that addressed aspects of the technical infrastructure. Among others, the accessibility of the technical infrastructure, reliability and factors of the learning environment, such as usability, were addressed. Regarding technical infrastructure, T. Seufert, Schütze, and Brünken (2009) observed the effects of different presentation options in a multimedia learning environment in two experimental studies. In addition, Lehman, D'Mello, and Graesser (2012) claimed that confusion can increase learning success because confusion can provide opportunities for deep learning. Here they examined four computer learning environments that create confusion in the minds of learners. Liang and Sedig (2009) were also concerned with factors that affect the learning environment. In their study, they observed the navigation process in interactive learning environments and propose a framework to help design an interactive learning environment to avoid difficulties in finding information in the learning environment.

Technology-Related Aspects The last category includes technology-related aspects. A total of 30 publications dealt with such factors. The publications dealt with two topics in particular: the process of integrating technology and the use of technology in learning and teaching scenarios. For example, Ketelhut and Schifter (2011) proposed in their paper a theoretical model that helps with the integration of technology in learning scenarios, especially in relation to game-based learning. Furthermore, Peeraer and Van Petegem (2012) described a questionnaire to measure the integration of technology in education. On the other hand, Eynon and Malmberg (2011) observed how young people use the Internet in non-school settings in a survey of more than 1,000 learners. Based on the results, they made suggestions about how the Internet can be used to improve learning and education.

In addition to the 20 categories, a total of 76 subcategories were also formed (see Figure 4.1). The figure also shows that the categories were divided into four main areas depending on which stakeholders are addressed. Thus, a category may address the organization, the learner, the teacher, or more than one of these areas. In summary, Figure 4.1 shows all factors considered in the implementation of TEL approaches in the research analyzed. A category dealing with the technological development of new TEL approaches is missing, as all publications presenting new approaches in TEL without explicitly addressing one or more factors were not included. However, when planning and developing new TEL approaches, the factor of technological development must of course also be taken into account.

Figure 4.1.

Model of Influencing Factors

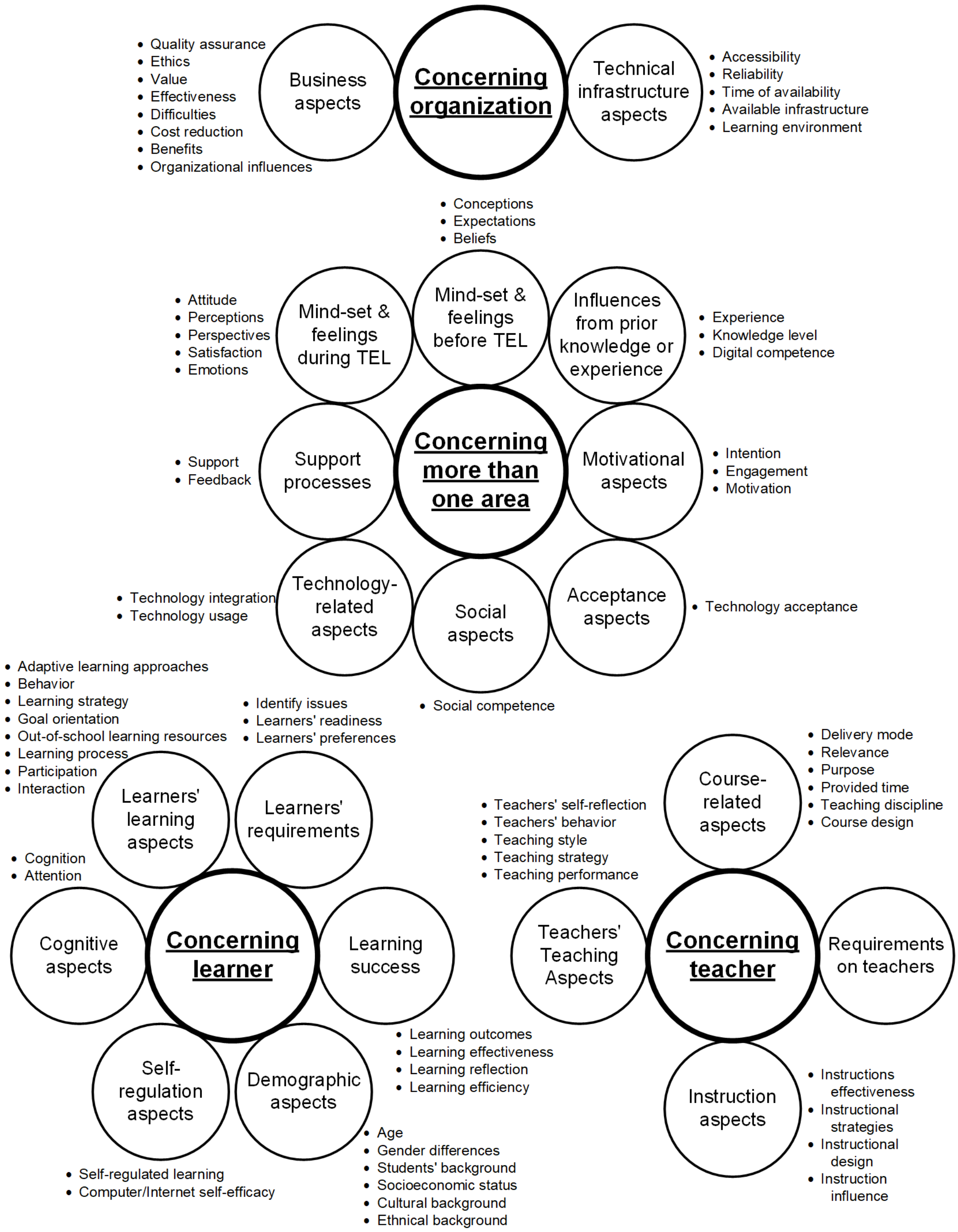
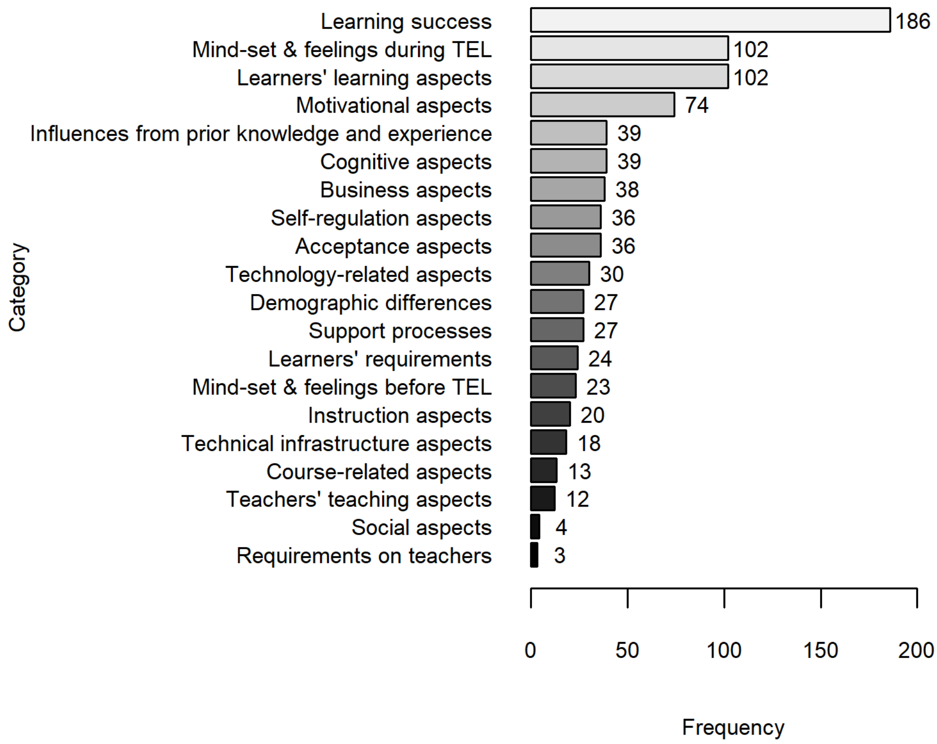


Figure 4.2 shows the number of publications that addressed factors from a category. Thus, the diagram is ordered by frequency. The "learning success" category was addressed most frequently, while the "requirements on teachers" category was addressed least frequently. Figure 4.3 shows how frequently categories from the four main areas were addressed.

Figure 4.2.

Frequency of Publications assigned to Categories



Finally, Table 4.3 shows the frequency of the categories per year, and Table 4.4 gives an overview of the categories that were considered in the journals. In addition, the table shows the number of articles analyzed and how many of them contained factors that could be considered (added in parentheses). Both tables are arranged alphabetically. Because most articles examined more than one factor, often from different categories, the total number of influencing factors is higher than the number of publications.

Figure 4.3.

Frequency of Publications assigned to Main Areas

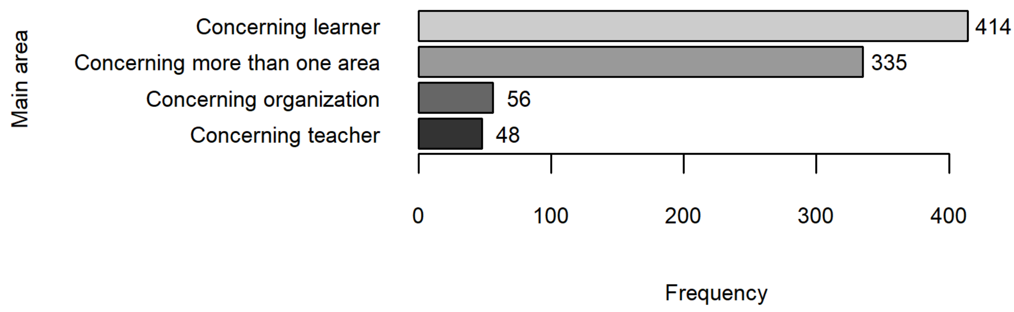


Table 4.3.

Categories of Influencing Factors per Year

Category	Year 2009	2010	2011	2012	2013	2014	Total
Acceptance aspects	10	4	7	9	6	-	36
Business aspects	7	10	6	11	4	-	38
Cognitive aspects	8	10	6	8	7	-	39
Course-related aspects	4	3	3	2	1	-	13
Demographic differences	6	6	5	3	7	-	27
Influences from prior knowledge and experience	7	5	12	9	6	-	39
Instruction aspects	3	8	2	3	4	-	20
Learners' learning aspects	20	25	15	26	15	1	102
Learners' requirements	3	6	6	5	4	-	24
Learning success	44	40	28	37	37	-	186
Mind-set & feelings before TEL	6	4	2	3	8	-	23
Mind-set & feelings during TEL	14	21	19	23	25	-	102
Motivational aspects	17	17	12	12	16	-	74
Requirements on teachers	-	2	-	-	1	-	3
Self-regulation aspects	8	9	7	3	9	-	36
Social aspects	2	1	-	1	-	-	4
Support processes	3	6	6	6	6	-	27
Teachers' teaching aspects	2	3	3	3	1	-	12
Technical infrastructure aspects	7	3	5	3	-	-	18
Technology-related aspects	5	3	6	6	10	-	30
Total	176	186	150	173	167	1	853

Table 4.4.

Categories of Influencing Factors per Journal

	Journal												
Category	Computers & Education (253/1201)	Contemporary Educational Psychology (3/149)	Early Childhood Research quarterly (1/235)	Economics of Education Review (1/484)	Educational Research Review (3/87)	Interactive Learning Environments (52/150)	Internet and Higher Education (47/167)	Journal of Research in Science Teaching (3/273)	Learning and Instruction (30/253)	Physical Review Special Topics - Physics Education research (7/172)	Science & Education (0/713)	Teaching and Teacher Education (12/683)	Total (412/4567)
Acceptance aspects	31	-	-	-	-	4	1	-	-	-	-	-	36
Business aspects	21	-	-	-	-	13	2	-	1	-	-	1	38
Cognitive aspects	22	1	-	-	-	6	1	-	9	-	-	-	39
Course-related aspects	6	-	-	-	-	1	5	-	-	-	-	1	13
Demographic differences	21	-	-	-	-	1	5	-	-	-	-	-	27
Influences from prior knowledge and experience	23	-	-	-	-	5	8	-	1	-	-	2	39
Instruction aspects	6	-	-	-	-	6	3	1	3	-	-	1	20
Learners' learning aspects	62	1	-	-	2	19	10	-	7	1	-	-	102
Learners' requirements	16	-	-	-	-	4	4	-	-	-	-	-	24
Learning success	117	3	1	1	2	20	14	3	17	7	-	1	186
Mind-set & feelings before TEL	15	-	-	-	-	-	2	-	1	-	-	5	23
Mind-set & feelings during TEL	67	-	-	-	-	7	26	-	1	-	-	1	102
Motivational aspects	52	-	-	-	-	8	10	-	2	-	-	2	74
Requirements on teachers	-	-	-	-	-	-	-	-	-	-	-	3	3
Self-regulation aspects	23	1	-	-	-	3	7	-	2	-	-	-	36
Social aspects	3	-	-	-	-	-	-	-	1	-	-	-	4
Support processes	14	-	-	-	-	4	1	-	8	-	-	-	27
Teachers' teaching aspects	9	-	-	-	-	1	-	-	-	-	-	2	12
Technical infrastructure aspects	7	-	-	-	-	2	6	-	2	-	-	1	18
Technology-related aspects	20	-	-	-	-	1	3	-	1	-	-	5	30
Total	535	6	1	1	4	105	108	4	56	8	0	25	853

Note. In the header, the values in parentheses indicate the number of articles with factors and the number of articles analyzed.

4.4. Evaluation[7]

The following section presents the results of the analyses conducted based on the survey data. The results show which influencing factors were considered important by HE professionals and how much time they would have invested in considering these factors during implementation. The survey included the following six questions that directly addressed these issues (see also Appendix B).

> Q_{IF}*8.* How important (unrelated to your position) is the consideration of the following aspects during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching for you?

> Q_{IF}*9.* How much time would you spend (in your position) when considering the following aspects during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching?

> Q_{IF}*10.* Please choose those five aspects from the following list which are most important for you (unrelated to your position) during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching.

> Q_{IF}*11.* Now arrange these aspects in descending order based on their priority.

> Q_{IF}*12.* Please choose those five aspects from the following list on which you (in your position) would spend the most time during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching.

> Q_{IF}*13.* Now arrange these aspects in descending order based on the expenditure of time.

The combined results for all questions on the importance of influencing factors are shown in Table 4.5 and Table 4.6, and the results about the time invested in considering these factors can be found in the Table 4.7 and Table

[7]This section has already been published in: Schweighofer, Weitlaner, et al. (2019)

4.8. These tables report the corresponding frequencies and medians for the data. The median was used, because it is considered the best measure of central tendency for ordinal scaled variables and is also generally not as affected by outliers and skewed data (Quatember, 2011).

Table 4.5.

Frequency Distribution of the Importance of Influencing Factors

	Very unimportant (1)		Unimportant (2)		Important (3)		Very important (4)		
Category	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Acceptance aspects	2	1.7	25	20.8	60	50.0	33	27.5	3.0
Business aspects	14	11.7	37	30.8	51	42.5	18	15.0	3.0
Cognitive aspects	2	1.7	14	11.7	64	53.3	40	33.3	3.0
Course-related aspects	1	0.8	9	7.5	55	45.8	55	45.8	3.0
Demographic differences	12	10.0	41	34.2	45	37.5	22	18.3	3.0
Influences from prior knowledge and experience	3	2.5	33	27.5	60	50.0	24	20.0	3.0
Instruction aspects	4	3.3	28	23.3	50	41.7	38	31.7	3.0
Learners' learning aspects	1	0.8	5	4.2	62	51.7	52	43.3	3.0
Learners' requirements	2	1.7	7	5.8	66	55.0	45	37.5	3.0
Learning success	2	1.7	6	5.0	40	33.3	72	60.0	4.0
Mind-set & feelings before TEL	8	6.7	45	37.5	50	41.7	17	14.2	3.0
Mind-set & feelings during TEL	6	5.0	30	25.0	56	46.7	28	23.3	3.0
Motivational aspects	2	1.7	8	6.7	52	43.3	58	48.3	3.0
Requirements on teachers	1	0.8	9	7.5	63	52.5	47	39.2	3.0
Self-regulation aspects	2	1.7	26	21.7	57	47.5	35	29.2	3.0
Social aspects	14	11.7	48	40.0	33	27.5	25	20.8	2.0
Support processes	2	1.7	13	10.8	51	42.5	54	45.0	3.0
Teachers' teaching aspects	2	1.7	7	5.8	50	41.7	61	50.8	4.0
Technical infrastructure aspects	3	2.5	10	8.3	56	46.7	51	42.5	3.0
Technology-related aspects	5	4.2	34	28.3	52	43.3	29	24.2	3.0

Table 4.6.

Frequency Distribution of the Ranking of the Importance of Influencing Factors

	Voted into top five		Rank 1 (1)			Rank 2 (2)			Rank 3 (3)			Rank 4 (4)			Rank 5 (5)			
Category	*n*	%	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*Mdn*
Acceptance aspects	22	18.3	4	3.3	18.2	1	0.8	4.5	5	4.2	22.7	5	4.2	22.7	7	5.8	31.8	4.0
Business aspects	14	11.7	2	1.7	14.3	0	0.0	0.0	4	3.3	28.6	4	3.3	28.6	4	3.3	28.6	4.0
Cognitive aspects	21	17.5	1	0.8	4.8	5	4.2	23.8	6	5.0	28.6	3	2.5	14.3	6	5.0	28.6	3.0
Course-related aspects	47	39.2	13	10.8	27.7	7	5.8	14.9	11	9.2	23.4	9	7.5	19.1	7	5.8	14.9	3.0
Demographic differences	13	10.8	4	3.3	30.8	0	0.0	0.0	2	1.7	15.4	3	2.5	23.1	4	3.3	30.8	4.0
Influences from prior knowledge and experience	11	9.2	2	1.7	18.2	2	1.7	18.2	4	3.3	36.4	1	0.8	9.1	2	1.7	18.2	3.0
Instruction aspects	18	15.0	2	1.7	11.1	4	3.3	22.2	2	1.7	11.1	1	0.8	5.6	9	7.5	50.0	4.5
Learners' learning aspects	62	51.7	16	13.3	25.8	20	16.7	32.3	8	6.7	12.9	12	10.0	19.4	6	5.0	9.7	2.0
Learners' requirements	40	33.3	3	2.5	7.5	12	10.0	30.0	11	9.2	27.5	7	5.8	17.5	7	5.8	17.5	3.0
Learning success	85	70.8	34	28.3	40.0	19	15.8	22.4	15	12.5	17.6	12	10.0	14.1	5	4.2	5.9	2.0
Mind-set & feelings before TEL	9	7.5	1	0.8	11.1	2	1.7	22.2	1	0.8	11.1	2	1.7	22.2	3	2.5	33.3	4.0
Mind-set & feelings during TEL	12	10.0	0	0.0	0.0	1	0.8	8.3	2	1.7	16.7	5	4.2	41.7	4	3.3	33.3	4.0
Motivational aspects	51	42.5	16	13.3	31.4	14	11.7	27.5	8	6.7	15.7	12	10.0	23.5	1	0.8	2.0	2.0
Requirements on teachers	30	25.0	6	5.0	20.0	2	1.7	6.7	5	4.2	16.7	10	8.3	33.3	7	5.8	23.3	4.0
Self-regulation aspects	21	17.5	3	2.5	14.3	5	4.2	23.8	4	3.3	19.0	3	2.5	14.3	6	5.0	28.6	3.0
Social aspects	17	14.2	3	2.5	17.6	2	1.7	11.8	5	4.2	29.4	5	4.2	29.4	2	1.7	11.8	3.0
Support processes	38	31.7	2	1.7	5.3	9	7.5	23.7	7	5.8	18.4	8	6.7	21.1	12	10.0	31.6	4.0
Teachers' teaching aspects	38	31.7	4	3.3	11.4	3	2.5	8.6	5	4.2	14.3	9	7.5	25.7	14	11.7	40.0	4.0
Technical infrastructure aspects	35	29.2	4	3.3	10.5	8	6.7	21.1	11	9.2	28.9	8	6.7	21.1	7	5.8	18.4	3.0
Technology-related aspects	16	13.3	0	0.0	0.0	4	3.3	25.0	4	3.3	25.0	1	0.8	6.3	7	5.8	43.8	3.5

Note. For the columns labeled "%T5", *N* is the number of respondents who ranked the category among the top five (column 2).

Table 4.7.

Frequency Distribution of the Time Spent on Influencing Factors

	Very little (1)		Little (2)		Much (3)		Very much (4)		
Category	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Acceptance aspects	22	18.3	43	35.8	37	30.8	18	15.0	2.0
Business aspects	42	35.0	37	30.8	29	24.4	12	10.0	2.0
Cognitive aspects	13	10.8	41	34.2	47	39.2	19	15.8	3.0
Course-related aspects	7	5.8	17	14.2	47	39.2	19	15.8	3.0
Demographic differences	44	36.7	55	45.8	11	9.2	10	8.3	2.0
Influences from prior knowledge and experience	25	20.8	54	45.0	28	23.3	13	10.8	2.0
Instruction aspects	12	10.0	37	30.8	44	36.7	27	22.5	3.0
Learners' learning aspects	10	8.3	27	22.5	59	49.2	24	20.0	3.0
Learners' requirements	12	10.0	43	35.8	41	34.2	24	20.0	3.0
Learning success	6	5.0	15	12.5	50	41.7	49	40.8	3.0
Mind-set & feelings before TEL	34	28.8	52	43.3	26	21.7	8	6.7	2.0
Mind-set & feelings during TEL	23	19.2	53	44.2	32	26.7	12	10.0	2.0
Motivational aspects	11	9.2	26	21.7	49	40.8	34	28.3	3.0
Requirements on teachers	9	7.5	31	25.8	50	41.7	30	25.0	3.0
Self-regulation aspects	21	17.5	49	40.8	34	28.3	16	13.3	2.0
Social aspects	25	20.8	48	40.0	38	31.7	9	7.5	2.0
Support processes	14	11.7	18	15.0	59	49.2	29	24.2	3.0
Teachers' teaching aspects	6	5.0	22	18.3	48	40.0	44	36.7	3.0
Technical infrastructure aspects	25	20.8	27	22.5	46	38.3	22	18.3	3.0
Technology-related aspects	25	20.8	40	33.3	44	36.7	11	9.2	2.0

Table 4.8.

Frequency Distribution of the Ranking of the Time Spent on Influencing Factors

	Voted into top five		Rank 1 (1)			Rank 2 (2)			Rank 3 (3)			Rank 4 (4)			Rank 5 (5)			
Category	*n*	%	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*n*	%	%T5	*Mdn*
Acceptance aspects	23	19.2	2	1.7	8.7	6	5.0	26.1	1	0.8	4.3	5	4.2	21.7	9	7.5	39.1	4.0
Business aspects	13	10.8	1	0.8	7.7	2	1.7	15.4	2	1.7	15.4	3	2.5	23.1	6	5.0	46.2	4.0
Cognitive aspects	20	16.7	1	0.8	5.0	2	1.7	10.0	5	4.2	25.0	9	7.5	45.0	3	2.5	15.0	4.0
Course-related aspects	41	34.2	8	6.7	19.5	12	10.0	29.3	10	8.3	24.4	8	6.7	19.5	3	2.5	7.3	3.0
Demographic differences	11	9.2	4	3.3	36.4	1	0.8	9.1	2	1.7	18.2	2	1.7	18.2	2	1.7	18.2	3.0
Influences from prior knowledge and experience	12	10.0	2	1.7	16.7	4	3.3	33.3	2	1.7	16.7	1	0.8	8.3	3	2.5	25.0	2.5
Instruction aspects	22	18.3	4	3.3	18.2	2	1.7	9.1	6	5.0	27.3	5	4.2	22.7	5	4.2	22.7	3.0
Learners' learning aspects	63	52.5	17	14.2	27.0	16	13.3	25.4	10	8.3	15.9	11	9.2	17.5	9	7.5	14.3	2.0
Learners' requirements	40	33.3	5	4.2	12.5	15	12.5	37.5	11	9.2	27.5	3	2.5	7.5	6	5.0	15.0	2.5
Learning success	79	65.8	33	27.5	41.8	17	14.2	21.5	9	7.5	11.4	5	4.2	6.3	15	12.5	19.0	2.0
Mind-set & feelings before TEL	8	6.7	1	0.8	12.5	1	0.8	12.5	3	2.5	37.5	3	2.5	37.5	0	0.0	0.0	3.0
Mind-set & feelings during TEL	15	12.5	1	0.8	6.7	2	1.7	13.3	4	3.3	26.7	2	1.7	13.3	6	5.0	40.0	4.0
Motivational aspects	41	34.2	12	10.0	29.3	8	6.7	19.5	8	6.7	19.5	7	5.8	17.1	6	5.0	14.6	3.0
Requirements on teachers	28	23.3	7	5.8	25.0	3	2.5	10.7	5	4.2	17.9	9	7.5	32.1	4	3.3	14.3	3.0
Self-regulation aspects	22	18.3	0	0.0	0.0	3	2.5	13.6	6	5.0	27.3	10	8.3	45.5	3	2.5	13.6	4.0
Social aspects	18	15.0	2	1.7	11.1	2	1.7	11.1	6	5.0	33.3	5	4.2	27.8	3	2.5	16.7	3.0
Support processes	42	35.0	5	4.2	11.9	7	5.8	16.7	11	9.2	26.2	8	6.7	19.0	11	9.2	26.2	3.0
Teachers' teaching aspects	55	45.8	9	7.5	16.4	14	11.7	25.5	11	9.2	20.0	16	13.3	29.1	5	4.2	9.1	3.0
Technical infrastructure aspects	30	25.0	3	2.5	10.0	3	2.5	10.0	4	3.3	13.3	5	4.2	16.7	15	12.5	50.0	4.5
Technology-related aspects	17	14.2	3	2.5	17.6	1	0.8	5.9	4	3.3	23.5	3	2.5	17.6	6	5.0	35.3	4.0

Note. For the columns labeled "%T5", *N* is the number of respondents who ranked the category among the top five (column 2).

As can be seen in Table 4.5 and Table 4.6, the categories "learning success" and "teachers' teaching aspects" appear to include the most important influencing factors (*Mdn* = 4.0). In addition, more than 90% of the participants considered the categories "motivational aspects", "learners' learning aspects", "learners' requirements", "course-related aspects" and "requirements on teachers" to be (very) important[8]. The fact that these categories were most frequently ranked among the top five categories in terms of importance (with the exception of "requirements on teachers") confirms these results. More than 70% of the respondents ranked the category "learning success" among the top five results. However, at the same time, at least 5% of the respondents considered these categories to be (very) unimportant.

The category of influencing factors with the least importance is "social aspects" (*Mdn* = 2.0). More than 50% of the respondents considered this category to be (very) unimportant. In addition, at least a third of the respondents deemed the categories "business aspects", "mind-set & feelings before TEL" and "demographic differences" to be (very) unimportant. Nevertheless, some respondents ranked these four categories among the top five most important categories and, at least once, each was ranked first. Also more than 14% of the respondents thought that these categories were very important.

With regard to time investment, Table 4.7 and Table 4.8 show that the respondents would spend the most time considering the influencing factors of the category "learning success". Specifically, 82.5% of the respondents thought they would spend much or even very much time considering influencing factors of this category. At least two-thirds of the respondents would also spend the same amount of time on the categories "motivational aspects", "support processes", "learners' learning aspects", "course-related aspects", "requirements on teachers" and "teachers' teaching aspects". Again, the results show that all these categories were ranked among the top five categories except "requirements on teachers", which confirms these findings. The respondents indicated that they would spend the most time considering factors of the category "learning success" (41.8% ranked this category in the first place). However, at least 5% of the respondents also indicated they would spend very little time considering these seven categories.

[8] Includes important and very important

According to the data, the respondents would spend the least amount of time (more than two-thirds said they would spend only (very) little time) considering factors in the categories "mind-set & feelings before TEL" and "demographic differences". Despite these results, these categories were also ranked among the top five by a few participants, each was ranked in first place at least once and more than 6% of the respondents indicated they would spend very much time considering factors in these categories.

In general, the results indicate that all categories seem to be important for professionals in HE since, for each category (except "social aspects"), more than 50% of the respondents and, in part, much more than 50%, stated that the category was (very) important. In addition, more than 50% of the respondents indicated they would invest (a great deal of) time considering factors of more than half of the categories. However, it has to be noted that less than 50% would spend (a great deal of) time considering factors in the categories "acceptance aspects", "business aspects", "demographic differences", "influences from prior knowledge and experience", "mind-set & feelings before TEL", "mind-set & feelins during TEL", "self-regulation aspects", "social aspects", and "technology-related aspects".

4.5. Discussion

In the following two subsections, the model of factors influencing the use of TEL and the results of the survey are discussed respectively. In the first section, special attention is paid to whether the model meets the requirement of completeness. The second section discusses and clarifies which factors are important to professional, which they would invest time in, and why this might be so.

4.5.1. Discussion of Model of Influencing Factors[9]

The structured literature review provided an overview of influencing factors that could be considered in the implementation of TEL approaches, based on

[9]This section has already been published in: Schweighofer and Ebner (2015)

their occurrence for research purposes in a total of 4,567 publications. The identified factors were classified into four main ares and 20 categories.

The category "learning success" was addressed 186 times, making it the largest category. However, due to the fact that most publications presenting new TEL approaches evaluated the new concepts to show how to achieve better learning outcomes or better learning performance, this is not surprising.

The least covered influencing factors in the analyzed literature were in the categories "requirements on teachers" and "social aspects", which is quite surprising for the author of this thesis. Requirements on teachers, i.e. what they should know in order to make the best use of technology in the classroom, as well as social aspects, especially related to online collaboration, are important for the successful implementation of TEL approaches and should therefore be studied more frequently. In addition, all three articles addressing requirements on teachers were published in a single journal, namely Teaching and Teacher Education. This also results in the absence of an article on this topic in the analyzed journals that specialize in TEL, namely Computers & Education, Interactive Learning Environments, and Internet and Higher Education.

Furthermore, only two of the analyzed publications claimed that the teaching discipline itself has an impact on the success of the TEL approach. Again, although the literature review was limited to the journals analyzed, the author believes this issue should be explored more frequently.

Figure 4.3 shows the number of influencing factors identified from the four main areas. Significantly, and in the context of the unusual study of requirements on teachers, the smallest main area deals with teacher issues. There seems to be a research gap, at least when considering the journals analyzed in this review. The main area "concerning organization" is also a small area, especially when compared to the other two areas. From this area, the category "business aspects" is in the top third, although most of the identified publications in this category hardly covered these factors, but mainly dealt with other factors. In addition, overall benefits and value and cost issues were addressed in only four publications.

As can be seen in Table 4.4, the frequency of categories addressed was stable over the years. No category was addressed significantly more or less in any year between 2009 and 2014. Therefore, it can be said that the defined categories seem to have had the same importance for the research community over these five years.

Of the 12 journals that were part of this literature review, the most factors, 535 in total, were identified in the journal Computer & Education. In contrast, zero factors were identified in the journal Science & Education, and only one factor was identified in the journals Early Childhood Research Quarterly and Economics of Education Review. Although all three journals deal with education topics, the use of technology in education is only discussed in a few articles in these journals.

This also shows some limitations of this study. First, although the number of publications analyzed was large, it was still limited to the selected journals. Second, the selected journals also seem to limit the identified influencing factors, as only three of them (Computers & Education, Interactive Learning Environments, and Internet and Higher Education) are specialized in the TEL field and only TEL-related publications were considered. For this reason, these three journals considered the most factors, although they provided only one-third of all 4,567 articles analyzed, with a total of 1,518 articles analyzed. However, the different journals cover different research areas. Even though they are not specialized in TEL, when the articles in these journals deal with TEL-related topics, they cover topics that may not be covered in journals specialized in TEL. In summary, the restriction to 12 high-ranking journals from across the education field may seem like a limitation because only three of them specialize in TEL. However, the selection of these specific journals provided the broad base necessary to identify the various influencing factors that might be considered when implementing TEL approaches. Although only journals that can be downloaded in full text and were accessible at the authors' home HEI were included in the study, this broad base was not further limited as all publications from the finally selected journals were accessible, and with 12 highly ranked journals and a total of 4,567 publications, a considerable number were included in this literature review.

The results can be seen in Figure 4.1. The identified influencing factors cover a broad field from different research areas, such as learning psychology, pedagogy, and computer science. However, the terms chosen in the model could be reviewed and, if necessary, narrowed down by experts from these different fields in future work to create a more accurate model.

Comparing existing ID approaches and the influencing factors they address (see Section 2.1.3), it can be said that all factors can be found in the defined categories of the proposed model. Moreover, firstly, more categories and factors are addressed in the model, and secondly, the proposed categories are more detailed. Table 4.9 shows the detailed comparison between the addressed influencing factors of the existing approaches and the categories of the proposed model. For this reason, the pedagogical aspects that are frequently addressed in the existing approaches are not explicitly listed, as these factors can be found in several categories of the proposed model.

Finally, Table 4.10 shows how the discussed CSF fit into the suggested categories. The table shows that most of the CSF identified are course-related, but other categories show also a high count of CSF. Furthermore, only two categories ("demographic differences" and "requirements on teachers") do not include CSF with reference to the provided literature.

Both Table 4.9 and Table 4.10 clearly show that the existing literature on both influencing factors in ID models for TEL and CSF in TEL is not only represented in the model, but also added to. The model should therefore have lived up to its claim to be as complete as possible.

Table 4.9.

Comparison of the proposed Model of Influencing Factors with existing Approaches

Factor in existing approaches	Category of proposed Model
Alonso, Manrique, and Viñes (2009)	
Perception	Mind-set & feelings during TEL
Attention	Cognitive aspects
Cognitive load	Cognitive aspects
Coding	Cognitive aspects
Retrieval/transfer	Cognitive aspects, learning success, learners' learning aspects
Metacognition	Cognitive aspects, learning success, self-regulation aspects
Granić, Mifsud, and Ćukušić (2009)	
Assessment techniques	Support processes, learning success, course-related aspects
Teacher training	Requirements on teachers
Q. Wang (2009)	
Social aspects	Social aspects
Technological aspects	Technical infrastructure aspects, technology-related aspects
Ćukušić et al. (2010)	
Learning outcomes	Learning success
Rovai and Downey (2010)	
Marketing and recruitment	Business aspects, acceptance aspects, motivational aspects
Financial management	Business aspects
Quality assurance	Business aspects
Student retention	Learning success
Faculty development	Requirements on teachers
Online course design	Course-related aspects, technical infrastructure aspects
Fink et al. (2013)	
Economic aspects	Business aspects
Technical aspects	Technical infrastructure aspects, technology-related aspects
Didactical aspects	Teachers' teaching aspects, course-related aspects, instruction aspects
Organizational general conditions	Business aspects, technical infrastructure aspects
Technological aspects	Technical infrastructure aspects, technology-related aspects

Table 4.10.

Assignment of the Critical Success Factors to the proposed Model of Influencing Factors

Category of proposed Model	CSF
Acceptance aspects	(1) utilization (Henrich and Sieber, 2009), (2) perceived usefulness and ease of use (Joo, Lim, and E. K. Kim, 2011), (3) students like the innovation, (4) innovation is easy for students to use, (5) innovation is easy for teachers to use (McGill, Klobas, and Renzi, 2014), (6) perceived usefulness, (7) perceived ease of use (Sun, R. J. Tsai, et al., 2008)
Business aspects	(1) information quality (Alsabawy, Cater-Steel, and Soar, 2016), (2) executive commitment, (3) financial health, (4) legal and regulatory requirements (Frydenberg, 2002), (5) management supports e-learning, (6) technology is inexpensive (McGill, Klobas, and Renzi, 2014), (7) institutional success factors (e.g. needs) (Stacey and Gerbic, 2008), (8) e-learning course quality (Sun, R. J. Tsai, et al., 2008)
Cognitive aspects	(1) cognitive presence (Joo, Lim, and E. K. Kim, 2011)
Course-related aspects	(1) lecturer modeling of the pedagogical use of the tools (Cochrane, 2010), (2) design and development, (3) program delivery, (4) program evaluation (Frydenberg, 2002), (5) concept, (6) maintenance (Henrich and Sieber, 2009), (7) e-learning course content and structure (Selim, 2007), (8) pedagogic considerations (e.g. course design) (Stacey and Gerbic, 2008), (9) diversity in assessments, (10) e-learning course flexibility, (11) e-learning course quality (Sun, R. J. Tsai, et al., 2008)
Demographic differences	-
Influence from prior knowledge and experience	(1) student motivation and technical competency (Selim, 2007), (2) the instructors' and students' technical competency (Soong et al., 2001)
Instruction aspects	(1) instruction and instructor services (Frydenberg, 2002)
Learners' learning aspects	(1) possibilities of interaction (Y.-C. Chen et al., 2013), (2) participation (Henrich and Sieber, 2009), (3) student interactive collaboration (Selim, 2007), (4) success factors regarding students (e.g., readiness, expectations) (Stacey and Gerbic, 2008)
Learners' requirements	(1) success factors regarding students (e.g., readiness, expectations) (Stacey and Gerbic, 2008)
Learning success	(1) innovation improves student learning (McGill, Klobas, and Renzi, 2014)

(continued)

Table 4.10.

Assignment of the Critical Success Factors to the proposed Model of Influencing Factors (continued)

Influencing Factor from Model	CSF
Mind-set & feelings before TEL	(1) perceived usefulness and ease of use (Joo, Lim, and E. K. Kim, 2011), (2) the instructors' and students' mind-set (about learning) (Soong et al., 2001), (3) learner computer anxiety, (4) perceived usefulness, (5) perceived ease of use (Sun, R. J. Tsai, et al., 2008)
Mind-set & feelings during TEL	(1) instructor's attitude toward and control of the technology (Selim, 2007), (2) learner computer anxiety, (3) instructor attitude toward e-learning (Sun, R. J. Tsai, et al., 2008)
Motivational aspects	(1) student motivation and technical competency (Selim, 2007), (2) the level of collaboration intrinsic in the course (Soong et al., 2001)
Requirements on teachers	-
Self-regulation aspects	(1) e-learning course flexibility (Sun, R. J. Tsai, et al., 2008)
Social aspects	(1) the level of collaboration intrinsic in the course (Soong et al., 2001)
Support processes	(1) the need for regular formative feedback from lecturers to students (Cochrane, 2010), (2) student services (Frydenberg, 2002), (3) university support of e-learning activities (Selim, 2007)
Teachers' teaching aspects	(1) teaching presence (Joo, Lim, and E. K. Kim, 2011), (2) innovation is consistent with approach to teaching (McGill, Klobas, and Renzi, 2014), (3) instructor's teaching style (Selim, 2007), (4) human factors pertaining to the instructors (Soong et al., 2001), (5) success factors regarding teachers (e.g., workload, fears) (Stacey and Gerbic, 2008)
Technical infrastructure aspects	(1) IT infrastructure services, (2) system quality (Alsabawy, Cater-Steel, and Soar, 2016), (3) system characteristics (Y.-C. Chen et al., 2013), (4) technological infrastructure (Frydenberg, 2002), (5) ease of on-campus internet access, (6) effectiveness of information technology infrastructure (Selim, 2007), (7) the level of perceived IT infrastructure and technical support (Soong et al., 2001)
Technology-related aspects	(1) the appropriate choice of mobile devices and software to support the pedagogical model underlying the course, (2) the importance of the pedagogical integration of the technology into the course assessment (Cochrane, 2010), (3) creation (Henrich and Sieber, 2009), (4) technology is sufficiently mature/stable, (5) technology is up to date (McGill, Klobas, and Renzi, 2014), (6) instructor's attitude toward and control of the technology (Selim, 2007)

4.5.2. Discussion of Importance and Time Investment[10]

The results of the study show that influencing factors of the categories "learning success", "teachers' teaching aspects", "motivational aspects", "learners' learning aspects", "course-related aspects", and "requirements on teachers" were identified as the most important by the 120 respondents. The respondents also tended to spend more time considering factors in these categories. CSF in five of these categories also appeared in the literature investigated (see Table 4.10). Thus, it can be concluded that professionals in HE considered influencing factors in the six categories mentioned as generally important when implementing TEL approaches, independent of the approach itself. Therefore, in general it can be suggested to consider the following questions when implementing TEL approaches:

- How does the approach increase learning success, effectiveness and efficiency?
- How does the approach fit to teachers' teaching style?
- How does the approach increase learners' motivation and engagement?
- How does the approach fit to learners' learning behavior?
- How does the approach fit the purpose of the course and the teaching discipline?
- What are the requirements on teachers to use the approach?

It must be noted, however, that the reviewed literature of CSF did not mention CSF in the category "requirements on teachers" and a CSF in the category "learning success" appeared only once. Although this literature review was not exhaustive, especially with regard to CSF in the category "learning success", this result is surprising since this category was identified as the most important one in this survey. In addition, the proposed model of influencing factors emphasizes the importance of this category because it contains by far the largest number of factors identified in the structured literature review.

Although the six categories mentioned above appear to be most important, in general, all categories were ranked as important by a majority of

[10] This section has already been published in: Schweighofer, Weitlaner, et al. (2019)

the respondents. Even categories like "demographic differences" or "social aspects", which show the weakest average results, were deemed very important by at least a small group of the respondents.

Bloom's Taxonomy provides one possible explanation for the category "social aspects" (Bloom et al., 1956) in that it describes different levels of knowledge acquisition. Thereby, collaborative learning scenarios, like collaborative tagging, can be used to attain higher levels of applied and metacognitive knowledge in the hierarchy (Bateman et al., 2007). It seems like factors in the category "social aspects" that are especially relevant in collaborative learning scenarios are, therefore, more important in courses that address these higher levels. The majority of the respondents may not have addressed these high levels and used collaborative learning scenarios, leading to the result of the low (on average) importance assigned to the category "social aspects". However, those who rated this category as very important might have addressed such levels and used such scenarios. In order to verify this assumption, further research is necessary.

A possible explanation for the varying results in the category "demographic differences" is the fact that these factors are only relevant if there are any demographic differences to be considered. It is obviously not important to consider demographic differences in courses that have a homogeneous group of students (with similar age, socioeconomic status, and cultural and/or ethnic backgrounds). Therefore, it can be assumed that these factors were only relevant to a minority of the respondents who had to deal with heterogeneous groups of students. To confirm this assertion, additional data needs to be gathered, and further research has to be conducted.

In summary, it can be concluded that, in addition to factors in the six most important categories, depending on varying circumstances such as the course, its goals and students, different influencing factors are relevant and should be considered when implementing TEL approaches. This was also emphasized by White (2007), who claimed that CSF vary and local circumstances need to be identified in order to use existing strengths.

On the basis of the last conclusion, exploring which circumstances could affect the considerations of importance and time investment in the given data set was necessary. Consequently, the initially proposed analysis was extended and an additional aspect in order to consider potential moderators was added. It was generally hypothesized that the importance of the influencing factors was ranked according to the personality of the respondent. This idea is based on Keller and Karau (2013), who conducted a survey with 250 students to investigate how the "Big Five" personality dimensions (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) influenced five specific types of online course impressions (engagement, value to career, overall evaluation, anxiety/frustration and preference for online courses).

It seems to be a personal decision whether professionals in HE consider a factor to be influencing. Several moderators affect such decisions. First, positive experiences based on decisions made in the past may influence subsequent decisions in similar situations (Juliusson, Karlsson, and Gärling, 2005). Second, negative experiences can also affect future decisions, since people try to avoid making decisions that led to negative experiences (Sagi and Friedland, 2007).

Another moderator that potentially affects decisions is personal commitment, because people tend to invest more time and effort if they feel personally committed to a decision (Juliusson, Karlsson, and Gärling, 2005). Furthermore, according to Acevedo and Krueger (2004), feelings of personal relevance affect decisions as well. For example, if people believe something matters, they tend to invest more time on it.

Finally, demographic characteristics and environmental circumstances such as age or socioeconomic status can be important moderators of the decision process as well. This is consistent with the influence of experience, as people may have had different experiences depending on their age and/or socioeconomic status, which may influence their decisions, as mentioned earlier (Bruine de Bruin, Parker, and Fischhoff, 2007; Finucane et al., 2005).

In conclusion, a personal decision such as whether an influencing factor will be considered can be affected by experiences, personal commitment and relevance, and demographic characteristics and environmental circumstances. Therefore, the following hypotheses were tested:

> *$H_{IF}1$.* Experiences made have an impact on the personal evaluation of the importance of influencing factors and the time spent on them.

$H_{IF}2$. The personal evaluation of the importance of influencing factors has an impact on the time spent on them.

$H_{IF}3$. Demographic characteristics and environmental circumstances have an impact on the personal evaluation of the importance of influencing factors and the time spent on them.

Various correlation analyses were performed with the available data. In order to determine whether a correlation was strong, the classification scheme of Brosius (1998) was used: 0 to .199 very weak, .2 to .399 weak, .4 to .599 substantial, .6 to .799 strong and .8 to 1 very strong. The following three sections show the results of these analyses. It should be noted that the use of a multiple regression would have been preferable but the (sub-)sample size and the conditions for the regression analysis with regard to predictors and the criteria prevented its use.

Influence of Experiences

As part of the survey, the survey asked the respondents whether they had had experience with TEL in teaching. As can be seen in Table 4.2, 97 respondents had had such experience. The survey also asked these 97 respondents whether they had already considered the factors belonging to the 20 categories. Based on the answers received, Cramér's V was calculated to determine the influence on the importance of the categories and the time people would spend considering factors in these categories. Cramér's V is a measure of the degree of association between two nominal variables that have two or more levels, which is equal to the *phi* coefficient in the case of a 2×2 contingency table. It is used in the analysis of this study because it is robust where nominal and ordinal data are present.

The evidence indicates that, regardless of a few exceptions, significant weak or substantial correlations were observed between the importance of a category and whether someone had already considered the influencing factors in this category. All these correlations indicate that someone who has already considered factors of a category believes it is still important to consider these influencing factors. In this study, the highest correlations observed were: "business aspects" (φ_c = .520, $p < .01$), "social aspects" (φ_c = .445, $p < .01$) and "cognitive aspects" (φ_c = .440, $p < .01$).

In addition, the calculation revealed many significant weak or substantial correlations between the amounts of time the respondents would currently spend considering factors according to their considerations of factors in the past. Again, the findings indicate that someone who had already considered factors of a category would spend more time considering factors in this category. The only exception was seen in the category "mind-set & feelings before TEL" (φ_c = .408, $p < .01$). In this category, the findings revealed that respondents who had already considered the category in the past would spend less time to do so now.

Overall, the findings indicate that experiences affect human behavior in such a way that the factors that have been considered previously are judged to be more important, and more time is invested during the consideration of these factors. Moreover, both positive (Juliusson, Karlsson, and Gärling, 2005) and negative (Sagi and Friedland, 2007) experiences in the past have the potential to determine personal decisions such as whether an influencing factor would be important in the future. Therefore, $H_{IF}1$ was supported with the findings of this study.

In detail, the respondents of this study seem to have had predominantly positive experiences while considering influencing factors in the past and, hence, indicated that they would be willing to invest time to consider these factors in the future. In contrast, with regard to the category "mind-set & feelings before TEL", it could be inferred that the respondents could have had negative experiences in the past while considering these factors and, as a result, indicated that they did not want to invest much time to consider these either now or in the future.

However, the strength of this claim requires further investigation. First, additional research on this topic could prove whether the assumptions are accurate. Second, if these assumptions are supported by evidence, additional research could identify positive and negative experiences and provide professionals in HE with better methods for consideration of these factors in the future.

Influence of Personal Commitment and Relevance

To determine whether personal commitment and judged relevance influenced the results, Spearman's rank correlation was calculated between the importance of a category and the time people would spend considering factors in this category. This analysis made it possible to evaluate whether the importance of one category affects the time considering factors in other categories.

The results revealed that significant weak to strong positive correlations existed between the importance of a category and the time people were willing to spend considering factors in this category. This is valid for the entire set, meaning that the more important a category was considered to be, the more time the person was willing to spend considering factors in this category. In this context, the highest correlations observed were: "demographic differences" (r_S = .646, $p < .01$), "mind-set & feelings before TEL" (r_S = .616, $p < .01$) and "social aspects" (r_S = .605, $p < .01$).

These three categories also displayed significant and substantially strong correlations among each other. The more important the category "demographic differences" was ranked, the more time the respondents were willing to spend considering the categories "mind-set & feelings before TEL" (r_S = .501, $p < .01$) and "social aspects" (r_S = .412, $p < .01$). Also, the more important the category "mind-set & feelings before TEL" was ranked, the more time the respondents were willing to spend considering the categories "demographic differences" (r_S = .499, $p < .01$) and "social aspects" (r_S = .448, $p < .01$). Finally, the more important "social aspects" was ranked, the more time the respondents were willing to spend considering the category "demographic differences" (r_S = .448, $p < .01$).

Overall, many of the substantial to strong correlations identified reveal that the more important a category was ranked by the respondent, the more time the respondent was willing to spend considering factors in this category. Therefore, it can be inferred that personal commitment and judged relevance influence the results and $H_{IF}2$ was supported.

Furthermore, the evidence indicates that the categories that were considered to be important only to a small group seem to be interrelated. For instance, respondents who thought that it was important to consider factors in the category "demographic differences" also tended to spend more time considering factors in the category "social aspects". This supposition needs to be investigated; however, it can be assumed that collaborative learning scenarios are often used in courses with demographic differences, whereby the factors in the category "social aspects" would become more relevant.

Influence of Demographic Characteristics and Environmental Circumstances

Finally, Spearman's rank correlation (only for ordinal scales) and Cramér's V were used to analyze whether the demographic data (see Table 4.2) affect the importance of each category and the time respondents would spend considering factors in each category.

Concerning the importance, correlations between the descriptive variables and the importance of each category ($Q_{IF}8$), the choice of the top five categories ($Q_{IF}10$) and the ranking within the top five categories ($Q_{IF}11$) were calculated. The analysis results show that the first two areas of interest were related by only a few significant but weak to very weak correlations. With regard to the ranking within the top five, the analysis allowed the identification of stronger correlations but none were significant because the relevant data set for these high correlations was too small (n = 2–22).

With regard to the time invested, the calculation revealed similar correlations. It can be concluded that the tested demographic characteristics and environmental circumstances did not affect the ranked importance of categories and the time respondents would be willing to spend considering factors in these categories. Therefore, $H_{IF}2$ was not supported. It seems as though other characteristics (e.g., the course subject, the level of knowledge acquisition and the heterogeneity of the students) should be tested in the future to verify whether these circumstances result in an influence on relevance and, therefore, inferred importance.

Limitations of the Study

This study had several recognizable limitations. The subsample of 120 respondents included in this study represented only a small fraction of the defined subpopulation. High non-response rates can bias the data set (Frohlich, 2002) which can jeopardize the generalizability and validity of the results of the study. However, it is difficult to test for the presence of this bias, as this would have required the collection of a comprehensive data set from all professionals from all Austrian and German HEIs.

Such information theoretically might have been obtained from marketing databases or through manual searches. However, commercial databases display certain weaknesses: they cannot guarantee the absolute accuracy of the data because complete coverage of the institutions defined in the population does not exist and the number of employees indicated includes administrative, scientific and teaching staff but frequently does not include lecturers that give classes and are employed on a part-time basis. For these reasons, it was not economically possible to precisely calculate the size of the (sub)population or to compare the basic characteristics of the populations with those of the sample in this study.

Because an electronic mailing strategy to disseminate the questionnaires was used, the composition of the sample may have shifted in favor of the authors' contact coverage. Moreover, because the survey was carried out in part anonymously, the possibility that certain respondents responded multiple times cannot completely be ruled out, although no apparent abnormalities in the data set were detected.

Finally, surveys are typical types of studies that rely, according to their definition, on the participant's ability to read questions and select responses on the questionnaire by themselves without interference from the researcher. To that effect, the empirical data may have suffered from different cognitive biases such as acquiescence or social desirability. This especially concerns the interpretation of the 20 categories, which is why the questionnaire provided additional keyword descriptions.

4.6. Conclusion[11]

In this design cycle, first, a structured literature review was conducted to identify influencing factors that could potentially be considered when implementing TEL approaches. To this end, a total of 4,567 articles were analyzed and factors were collected. Finally, these identified factors were clustered and 20 categories associated with four main areas were defined in a model showing which influencing factors could potentially be considered when implementing TEL approaches.

Second, a survey was conducted showing which influencing factors of this model professionals at Austrian and German HEIs consider important and how much time these professionals would invest to consider these factors when implementing TEL approaches.

A research gap for the future regarding the proposed model of influencing factors is the relationship between individual influencing factors. This could show which factors are typically researched together. Since the model covers a broad field of factors from different research areas, further steps could likewise verify the chosen terms and the model by experts from these areas and, if necessary, narrow them down and check their practicality.

The main result of the structured literature review shows a large number of factors that can be considered when implementing TEL approaches. However, the results also show that some important factors were not frequently addressed in the journals analyzed. For example, only three publications addressed factors in the category of "requirements on teachers," and only one of 4,567 publications analyzed addressed cost issues. These issues should be explored further in future work. A way to further explore this finding might be to conduct another literature search using the identified factors as search terms without limiting to journals. In addition, expanding the number of publications analyzed by considering more journals and databases is a possible and necessary way to further verify the results.

Although some important factors do not seem to be frequently addressed in research, the proposed model shows a combination of several influencing

[11] Parts of this section have already been published in: Schweighofer and Ebner (2015), Schweighofer, Weitlaner, et al. (2019)

factors that could potentially be considered when implementing TEL approaches. Therefore, at the current state of affairs, the model could help in the development of successful TEL approaches by providing this overview and helping to identify factors that need to be considered. In addition, future research should add methods to the model that address these factors in detail. These methods can specialize in different types of education (e.g., schooling, HE, vocational education) to create a holistic model. For this reason, the model provides an overview of the influencing factors to be considered and provides methods for addressing these factors. Thus, the model can be used to develop TEL approaches in a structured way.

The results of the survey conducted indicate that influencing factors in the six categories of "learning success", "teachers' teaching aspects", "motivational aspects", "learners' learning aspects", "course-related aspects" and "requirements on teachers" are generally considered important by 120 professionals. In addition, at least a small group of these respondents also considered the remaining factors important.

Therefore, the present data set was reanalyzed to identify possible moderating effects. Results indicate that experience and personal relevance appear to have a strong influence on how HE professionals selected the influencing factors they were willing to consider. However, the descriptive variables tested (i.e., age, type of organization, country, function in the organization, time in position, field of work, and experience with TEL in general) did not influence these choices.

For this reason, future research should focus on the relationships between different moderating variables and relevant influencing factors. The research should identify which factors are relevant under the given circumstances. A qualitative research approach involving interviews with multiple experts and teachers seems to be an appropriate research method for this purpose. This approach can also address some limitations of the present study, such as the possibility of different interpretations of the survey items. Relevant circumstances that affect the relevance of influencing factors could include course subject, Bloom's Taxonomy level addressed, available technical infrastructure, experience and knowledge with TEL approaches, number of students, and more.

Based on this research, it is possible to develop a framework that better supports the implementation of TEL approaches. This framework should include two steps: (1) identifying relevant circumstances and (2) identifying relevant influencing factors that should be considered under the circumstances. Using such a framework should be more efficient because only relevant influencing factors will be considered when implementing TEL approaches. In addition, the implemented TEL approaches should also be more successful as CSFs would have been considered. For example, the results of this study have shown that it is generally not very important to consider demographic differences in German or Austrian HEIs, but if a course includes a very heterogeneous group of learners, this factor could become a CSF and should be taken into account.

The purpose of the whole design cycle was to find influencing factors when using TEL and determine whether and in what way they should be described in the designed e-service. First, influencing factors that are important and for which time will be spent must be described. Second, influencing factors that are important but for which less time will be spent should be described, considering the fact that professionals do not want to spend much time on them. Third, influencing factors that are not important can be described, but it should be explained why they are important.

Table 4.11.

Classification of the Influencing Factors into Description Types

Must be described	Should be described but consider little time investment	Can be described but explain why important or inconspicuous
Cognitive aspects	Acceptance aspects	Social aspects
Course-related aspects	Business aspects	
Instruction aspects	Demographic differences	
Learners' learning aspects	Influences from prior knowledge and experience	
Learners' requirements	Mind-set & feelings before TEL	
Learning success	Mind-set & feelings during TEL	
Motivational aspects	Self-regulation aspects	
Requirements on teachers	Technology-related aspects	
Support processes		
Teachers' teaching aspects		
Technical infrastructure aspects		

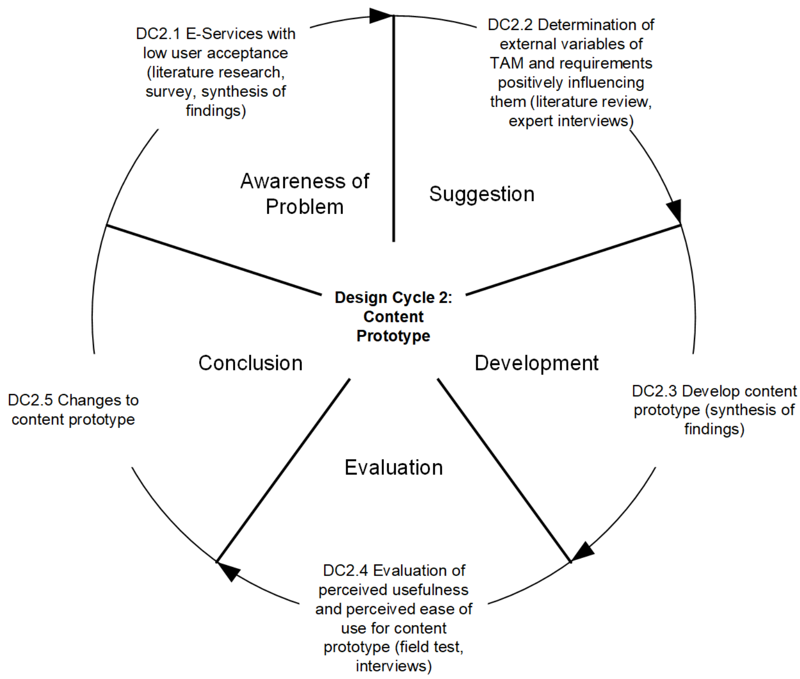
Table 4.11 concludes this chapter by mapping the identified categories of

influencing factors to the types of description. As described in Section 4.1, this result is (1) regionally restricted to Austria and Germany with a focus on the region of Styria, (2) relevant to all types of TEL approaches, and (3) from the perspective of professionals at HEIs. Table 4.11 thus also conclusively provides the answer to the first subordinate research question of this thesis, which was:

> *RQ1.* What influencing factors have to be considered when describing technology-enhanced learning approaches?

When designing the content for the e-service in subsequent design cycles, the findings of this design cycle will be considered accordingly. In addition, the impact of prior experience and personal evaluation on the importance and time investment of influencing factors will be considered too.

5. Design Cycle 2: Content Prototype



The eCampus project started with the second design cycle (see Section 3.2.4). The goal of this design cycle was to design a first content prototype. In doing so, the findings of the first design cycle were used. The reason for starting with the content prototype was that acceptance could be tested for it independently of the entire e-service. The prototype should clarify which technology-enhanced learning (TEL) approaches should be described at the eCampus and in which way they should be described.

Since this was the first design cycle in the project, the requirements for the e-service also had to be collected in this design cycle. However, since the acceptance of such e-services seems to be rather low, from this design cycle onwards the special steps of the Acceptance-Driven Design Science Research (AD-DSR) proposed with this thesis were applied instead of the Design Science Research (DSR) process steps according to Vaishnavi and Kuechler (2004).

In detail, the first section of this chapter again addresses the low acceptance for similar e-services (awareness of problem). Due to this low acceptance, AD-DSR was applied. Specifically, this design cycle identified constructs of a Technology Acceptance Model (TAM) that should influence user acceptance of such e-services, and requirements were elicited for these constructs (suggestion). The second section describes the research methods that were used in the design cycle: (1) structured literature review for the creation of the TAM, (2) expert interviews for requirements elicitation, and (3) design and evaluation method for the content prototype (suggestion). Then, the following sections describe the defined TAM, the collected requirements (suggestion), and the designed content prototype (development). The next section shows the results of the first evaluation regarding perceived usefulness (PU) and perceived ease of use (PEOU) of the content prototype (evaluation). Finally, the last sections discuss the design cycle and draw a conclusion for the next cycles (conclusion).

5.1. Introduction

Section 1.1 already showed that e-services for professional development in TEL for teachers, although they are mostly freely available, are hardly used and many teachers do not even know about these e-services. The acceptance (actual use) of technologies, especially TEL, is a large area of research and many studies showed the influence of various constructs on acceptance. However, as discussed in Section 1.2, designing new accepted artifacts is challenging, especially in the setting of a funded scientific research project. In this environment, agile methods are often more difficult to implement than plan-driven ones.

To overcome the methodological challenge, the AD-DSR approach was proposed in this thesis (see Section 3.1). The approach attempts to address the complementary nature of design and behavioral science in DSR projects that have user acceptance as a challenge by using theories and models of technology acceptance for both.

Specifically, AD-DSR uses the TAM by Venkatesh and Davis (1996). The first step is to identify the external variables of the TAM that should influence PU and PEOU of the artifact to be designed. Then, in the second step, requirements are sought that should positively influence these constructs and therefore should increase PU and PEOU. After that, the PU and PEOU of the current artifact is evaluated in each design cycle. Finally, for the finished artifact, it is evaluated what influence the constructs have on the acceptance of the artifact (behavior) and whether the target audience accepts the designed artifact (design).

This design cycle concerned the first two steps and an initial evaluation of PU and PEOU for the e-service eCampus content prototype. The design cycle thus began to address the following two subordinate research questions of this thesis, although a complete answer to the research questions can only be given at the end of the last cycle.

> *RQ2.* What requirements define an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

> *RQ3.* What constructs influence the acceptance of an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

This design cycle was also used to design the content prototype for the e-service. Among other things, the results of the first design cycle were used, since they provided a basis for determining which influencing factors must be described, should be described, and could be described.

5.2. Research Method

This section describes the research methods used in this design cycle. First, a structured literature review was conducted to identify the constructs that were expected to influence e-service adoption. Second, expert interviews were used to elicit requirements that should positively influence these constructs. If the requirements positively influence the constructs and the constructs positively influence acceptance as expected, the requirements can eventually lead to design principles of such e-services. Third, this design cycle used various methods in an iterative search process to design the content prototype, which was finally evaluated through a field test and interviews. This was the first time that PU and PEOU of the resulting artifact were evaluated.

5.2.1. Literature Review on Acceptance Constructs[1]

As in design cycle one, the structured literature review followed the method used by W.-H. Wu et al. (2012). Therefore, it was first defined what is understood by acceptance constructs in the course of the research and what kind of artifacts can be considered relevant for the e-service eCampus in this context. Afterwards, inclusion/exclusion criteria as well as data sources and search strategies were defined and the data analysis was conducted.

Definition of Acceptance Constructs and Relevant Artifacts

As described in Section 2.3.1, the purpose of external variables in TAM is to understand more precisely which constructs influence PU and PEOU (Olushola and Abiola, 2017). However, some other models and theories do not use these two constructs at all and directly describe constructs that influence acceptability. Therefore, as part of this structured literature review, all constructs that influence acceptance were taken into account. The restriction took place via the target technology. Only publications that dealt

[1]Parts of this section are based on the following already published work: Beer and Hatzl (2022)

with acceptance constructs for relevant artifacts were considered. These were defined as platforms, e-services, websites and the like. Thus, there was no content-related restriction to TEL, but the acceptance constructs have a general validity and were subsequently examined for the more specific case.

Inclusion/Exclusion Criteria

For this literature review, the following inclusion/exclusion criteria were defined:

- The publication confirmed or at least hypothesized that a specific construct influences the acceptance of the target system.
- The publication had to be downloadable in full-text at the authors' home higher educational institution (HEI).
- The publication had to be in English or German.

Data Sources and Search Strategies

Search terms were determined, i.e., keywords and synonyms for acceptance ("acceptance", "adoption", "intention", "use", and "usefulness") and the relevant target artifact ("platform", "web platform", "learning platform", "digital service", "e-service", "website", and "learning management system"). These search terms were applied to the accessible databases EBSCO, Emeralds, Springer, Hanser and Google Scholar. Based on the identified theories most relevant acceptance constructs were deductively derived, whereby the TAM with the key determinants PU and PEOU formed the starting point. The TAM is a widely used model to explain acceptance, which was reflected in the frequency of search results according to this literature review.

Data Analysis

Data analysis was conducted similarly to the structured literature review for influencing factors (see Section 4.2.1). The acceptance constructs of the selected publications were collected and grouped. Then, uniform terms were chosen or defined for the groups as a proxy. In addition, categories of acceptance constructs were also identified and collected, grouped, and named in the same manner. In total, 88 publications were analyzed in this way.

5.2.2. Expert Interviews for Requirements[2]

The research method of expert interviews with content analysis according to Meuser and Nagel (2009) was chosen to determine the requirements for the e-service. The following sections therefore describe the selection of experts, the structure of the interview guide used, and the procedure for content analysis. The approach of Meuser and Nagel (2009) was chosen because this approach focuses on the content rather than the exact wording. The aim was to extract what was typical and what was common from the interviews. Therefore, this approach seemed to be well suited for the elicitation of requirements, as it should make it possible to identify the most important requirements that apply to the large target group of teachers at Styrian HEIs.

Selection of Experts

According to Meuser and Nagel (2013) there are different approaches how to define the term "expert". Meuser and Nagel (2013) defined experts as people who *"(1) are somehow responsible for designing, implementing, or controlling a solution to a problem, or (2) have privileged information about groups of people or decision-making processes."* The e-service eCampus was intended to support all teachers in the Styrian higher education (HE) area in the use of technology in teaching. For this purpose and in accordance with the definition of the term "expert" according to Meuser and Nagel (2013), persons who were responsible for the area of TEL at each of the nine Styrian HEIs were defined as experts for the purpose of determining the requirements. Accordingly,

[2]Parts of this section are based on the following already published work: Beer and Hatzl (2022)

interviews were conducted with nine experts in the period from March to April 2019.

Interview Guide

An interview guide was developed for conducting the interviews. This was to ensure that the results of the interviews were comparable and that common and typical requirements could be identified. The interview guide consisted of a total of nine modules. Eight of these represented the acceptance constructs that were identified in the previously conducted structured literature review (results see Section 5.3). These constructs should influence the acceptance of an e-service such as eCampus. When determining the requirements, care was taken to identify requirements that affect these constructs and influence them positively so that the acceptance of the e-service will also be correspondingly high. The detailed interview guide can be found in Appendix C. The nine modules are briefly described below.

Greeting and Explanation The experts were welcomed and the interview process was explained. It was pointed out that the experts should give answers as such, taking into account the target group of all teachers in the Styrian HE area, especially those of their own HEI. Furthermore, the goal of the e-service eCampus was explained. Accordingly, the experts were informed that the e-service should be for all teachers of the Styrian HE area and that they should be able to acquire competencies for the use of technologies in teaching and learning processes in self-study. It was also pointed out that the technologies should not be in the foreground, but the use cases in which technologies are used and can support.

Job Relevance Regarding the construct "job relevance (JR)", the experts were asked in summary about what the e-service has to offer and how it has to be structured in general to be relevant for teachers and their tasks.

System Quality With regard to the construct "system quality (SYSQ)", the experts were asked about necessary functionalities, quality features, visual design, navigation, structuring, filtering and recommendation systems.

Service Quality The acceptance "service quality (SERVQ)" concerns all services and processes that are to be offered in addition to the actual e-service. In this module, the experts were therefore asked which services and processes should be offered. It was specifically asked which organizational and technical support services are necessary, how and whether training is required, and via which processes the users of the e-service, i.e. the teachers, could participate through their own contributions.

Information Quality For the construct "information quality (INFQ)", the experts were asked in which way the individual use cases for technologies in teaching should be described, which detailed contents are relevant, and which terminology should be used.

Personal Innovativeness The construct "personal innovativeness (PI)" can only be influenced in part by implementable requirements, since this construct is very strongly related to the individual persons themselves. The higher a person's PI, the more likely that person will also try out a new e-service. However, the e-service could be designed in such a way that the barriers to trying the e-service are as low as possible and interest in the e-service is increased as much as possible in advance. Accordingly, the questions in this module addressed these two points.

Subjective Norm The construct "subjective norm (SN)" can also only be partially influenced by the design of the e-service. It is about whether an individual person perceives that important and relevant people in the personal environment think that a technology, in this case the e-service eCampus, should be used or not. Of course, this perception cannot be directly influenced. However, it could be ensured that individuals talk positively about the e-service and thus motivate others to use it. The questions in this module aimed to identify requirements that ensured just that.

Social Image For the construct "social image (SI)", the experts were asked what the e-service should offer so that the teachers feel that their social image is enhanced by using it.

Policy Quality The construct "policy quality (PQ)" was about determining what legal, organizational, and other frameworks need to be in place for instructors to use the e-service.

Content Analysis

As mentioned before, the content analysis was conducted according to Meuser and Nagel (2009). The focus was on finding out commonalities and what is typical in order to identify requirements that are relevant and valid for the entire target group of all teachers in the Styrian HE area. Meuser and Nagel (2009) suggested the following steps for the content analysis, which were applied in the analysis: (1) paraphrasing, (2) thematic ordering, (3) thematic comparison, (4) conceptualization, and (5) theoretical generalization.

In the fourth step, the requirements were formulated and divided into three higher-level requirement areas for each acceptance construct: (1) content-relevant requirements, (2) system-relevant requirements, and (3) service- and process-relevant requirements. In the fifth and last step, the requirements were finally combined across the acceptance constructs into the three requirement areas to achieve a further reduction of requirements that occur more than once. However, the reference to the acceptance constructs was still documented.

5.2.3. Methods for Designing the Content Prototype

The design of the content prototype followed the 6th guideline of Hevner, March, et al., 2004 (see Section 2.2.1), i.e. the design was done in the form of a search process. Iteratively, taking into account the defined requirements from the expert interviews and the findings from the first design cycle, the following areas were designed: (1) type of presentation, i.e., via which medium and in which appearance should the individual TEL approaches be described, (2) structure, i.e., which TEL approaches should be described and in which overall structure should they be embedded, (3) key data, i.e., which factors, should be addressed by the description of individual TEL approaches, and (4) filter and recommendation criteria, i.e., which filter and recommendation criteria should enable the search of the TEL approaches. The following paragraphs describe the approach for these areas, combining topics (3) and (4).

Type of Presentation

This area dealt with the question of how the presentation of eCampus should be designed, i.e. via which medium and in which visual appearance. The experts were asked directly about this in the interviews to determine the requirements. Based on these opinions, the project team discussed several times which media should be used. As Hevner, March, et al. (2004) described, the general conditions of the environment, i.e. available resources, constraints and laws were also taken into account. After the project team had finally decided on a medium, individual prototypes for the visuals were created and discussed until the final content prototype was designed.

Structure

As concluded in Section 2.1.2, there are a variety of different TEL approaches. Moreover, the structure of these is not uniform. In order to clarify the question of which TEL approaches should be described on eCampus and embedded in which overall structure, a search process was also carried out here in the sense of the DSR according to Hevner, March, et al. (2004). This began in a preliminary phase before the eCampus project was launched. The results of this preliminary phase were further refined with the results of the expert interviews, in which these topics were directly queried. After further iterations and discussions in the project team, the final version was created. One restriction specified in the funding application from the start was that at least 50 use cases should be described.

Key Data, Filter and Recommendation Criteria

The definition of the key data, i.e., the factors that should be included in the description of a TEL approach, as well as the filter and recommendation criteria that should be used to search for TEL approaches, were also determined in an iterative search process according to Hevner, March, et al. (2004) in the course of several coordination meetings by the project team. The experts were also asked directly about this in the interviews. In addition, the results from the first design cycle were taken into account. The

20 categories of influencing factors identified there and their classification according to description types formed the basis. For the filter and recommendation criteria, the 20 categories were further analyzed to determine whether they can be clearly and unambiguously defined for TEL approaches or are better described by subjective recommendations from the teachers themselves. In the first case, these factors should be defined at the design stage. In the second case, teachers should make their recommendations for these factors when using eCampus. The factors were finally refined by the project team and a vote was held to determine which factors should be used as key data, filter criteria, and recommendation criteria.

5.2.4. Methods for Evaluating the Content Prototype

The evaluation of the content prototype in this design cycle was limited to the design of two use cases that described two TEL approaches according to the defined design criteria. Accordingly, only the type of presentation and the key data were evaluated for the content prototype in this design cycle. The two constructs of PU and PEOU of the defined TAM were used as evaluation criteria. As suggested in AD-DSR, the evaluation was conducted qualitatively to elicit suggestions for improvement.

Selection of Test Subjects

Nine test subjects were included for this first evaluation. The three HEIs involved in the project each designated three test persons for this purpose. Care was taken to ensure that the test subjects taught in different subject areas and also had different experiences with TEL. Thus, three test persons with a lot of experience, three with a little experience and three with no experience at all in the use of technologies in teaching could be interviewed. The subject areas covered were marketing, physics, computer science, electronics, philosophy and theology, accounting and management accounting, history, business management and organization, and pharmaceutical sciences.

Interview Guide

In a field test, the selected nine teachers first received the two content prototypes and were able to analyze them for about one month. After that, individual interviews were conducted with the test subjects. The interviews were conducted between November and December 2019. The interview guide used contained five open-ended questions, two of which related to PU and two of which related to PEOU. The last question was an open-ended question for further unrestricted feedback. At the beginning, as with the expert interviews to determine the requirements, the purpose and goal of eCampus was also explained. The five questions were:

> $Q_{DC2}1$. What did you generally like or dislike about the use cases in terms of content and design? (PU)
>
> $Q_{DC2}2$. What was not understandable for you in the description of the use case? (PEOU)
>
> $Q_{DC2}3$. What do you understand by the terms used for the headings and key data? (PEOU)
>
> $Q_{DC2}4$. Can you get started or do something with this description? Are they missing anything? (PU)
>
> $Q_{DC2}5$. Do you have any other feedback on this content prototype or the project as a whole?

Content Analysis

The method according to Meuser and Nagel (2009) was also used for this content analysis, because the focus here was also on working out commonalities and what is typical. The aim was to find out which changes are ultimately necessary for the broad target group of all teachers in the Styrian HE area.

5.3. Technology Acceptance Model for E-Service[3]

The TAM describes that the acceptance of a technology (actual use (AU) and behavioral intention (BI) to use) is determined by PU and PEOU. These two factors are determined by other external variables, i.e. constructs. (Venkatesh and Bala, 2008) The results of the conducted structured literature review show that there are many studies that investigated the influence of different constructs on PU, PEOU, or even directly on adoption in similar systems such as eCampus. Based on these results, ten constructs with potential influence on PU and PEOU were determined and hypotheses for these influences were formed. The hypotheses stated here were tested as part of the fourth design cycle (see Chapter 7).

Figure 5.1 shows the resulting specific TAM with the formulated hypotheses for the acceptance of the e-service eCampus. The figure also shows that the constructs were grouped into three areas: (1) system characteristics, (2) individual characteristics, and (3) organizational characteristics. The following sections each briefly describe the particular constructs, cite selected literature examples from which the influence was derived, and formulate the associated hypotheses.

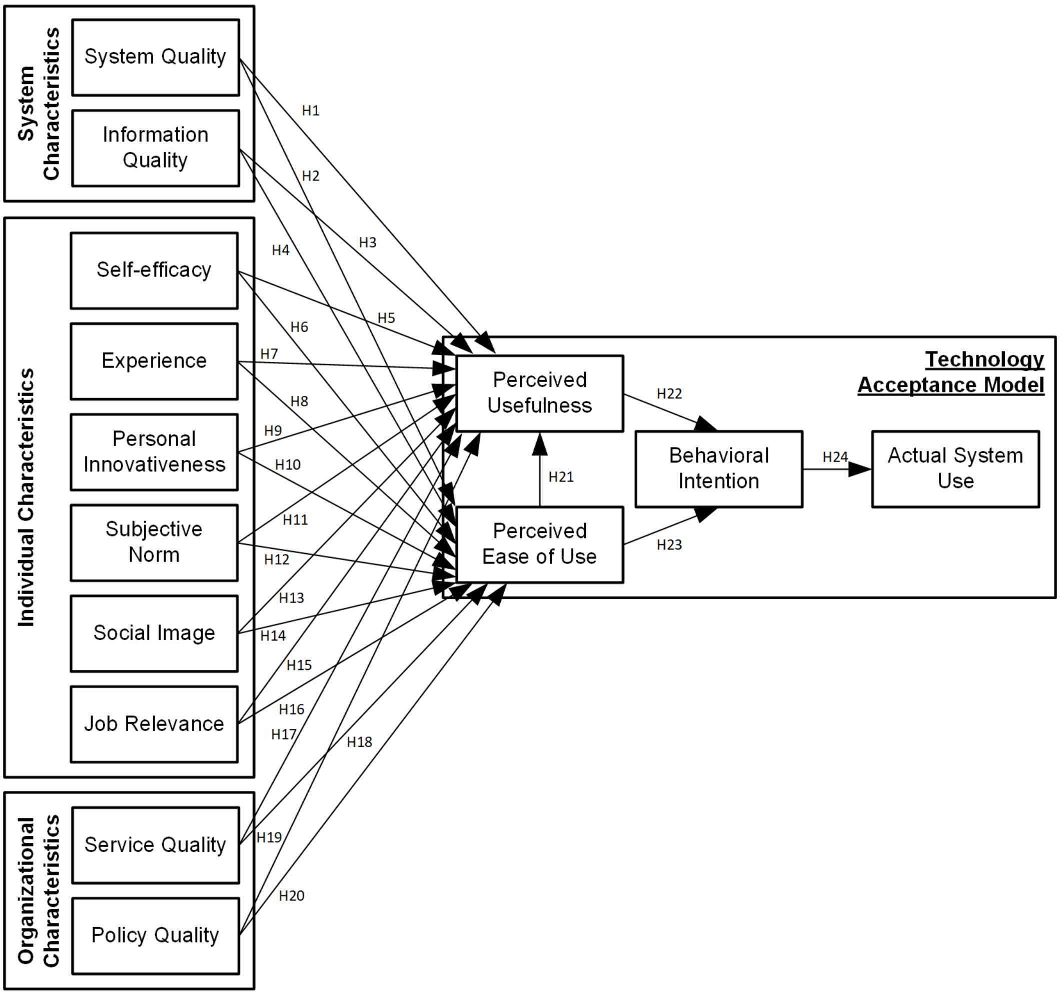
Influence of System Quality

SYSQ concerns various characteristics of the system (Al-Busaidi and Al-Shihi, 2010), including the functionalities, reliability, and flexibility of the system (Hsu et al., 2016). Al-Busaidi and Al-Shihi (2010) hypothesized regarding learning management systems that SYSQ has an impact on PU and PEOU. Barhoumi (2016) found support for the impact of open access on PU in the context of e-library systems and J.-A. Kim (2006) for the impact of accessibility on PEOU for web-based information databases. For the influence of SYSQ and especially navigation on PU and PEOU of e-library systems, Khan and Qutab (2016) found support. In addition, Nov and C. Ye (2009) investigated the influence of screen design on the effort

[3]Parts of this section are based on the following already published work: Beer and Hatzl (2022), Beer (2022b)

Figure 5.1.

Specific TAM with Hypotheses for the E-Service



expectation of a digital library. The user interface is also said to influence PU, according to Mouakket and Bettayeb (2015), and to influence PEOU, according to I.-F. Liu et al. (2010). Basoglu, Daim, and Polat (2014) found support for the impact of adaptivity on PU and customization on PEOU in mobile service platforms. Regarding social network websites, Hsu et al. (2016) hypothesized that SYSQ influences PU and PEOU. Regarding lifelong learning platforms, Liao and S.-H. Liu (2012) investigated the influence of course flexibility, interaction with others, system functionality, and system response on PU and PEOU and found partial support for such an influence. Finally, Y.-C. Lee (2006) investigated the influence of course attributes and S. Kim, H. Kim, and S. Han (2013) investigated the influence of user control and freedom, error prevention, flexibility and efficiency of use, and aesthetic and minimalist design in m- and e-learning systems, respectively. From these findings, the following hypotheses concerning SYSQ were derived for the e-service eCampus:

> *H_{TAM}1.* System quality (SYSQ) positively influences perceived usefulness (PU) of the eCampus system.

> *H_{TAM}2.* System quality (SYSQ) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Information Quality

INFQ describes the quality of the content of an e-service (Barhoumi, 2016). The influence of INFQ on PU and PEOU in learning management systems (Al-Busaidi and Al-Shihi, 2010), social network websites (Hsu et al., 2016), the use of Wikipedia in HE (Meseguer-Artola et al., 2016), e-libraries (Barhoumi, 2016), web-based information database (J.-A. Kim, 2006), lifelong learning website (Liao and S.-H. Liu, 2012), online learning communities (I.-F. Liu et al., 2010), and e-learning systems (Y.-C. Lee, 2006) was examined by several sources. More specifically, Barhoumi (2016) as well as Basoglu, Daim, and Polat (2014) investigated the influence of information architecture and information completeness. Khan and Qutab (2016), J.-A. Kim (2006), S. Kim, H. Kim, and S. Han (2013), and Nov and C. Ye (2009) also found support for the influence of used terminology on PU and PEOU. The following hypotheses were therefore formed for the e-service eCampus:

$H_{TAM}3$. Information quality (INFQ) positively influences perceived usefulness (PU) of the eCampus system.

$H_{TAM}4$. Information quality (INFQ) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Self-Efficacy

Self-efficacy (SE) describes whether individuals have the confidence and belief to complete specific tasks (Bandura, 1986). So in the context of e-services, the issue here was whether users believe they have the ability to use the e-service. Al-Busaidi and Al-Shihi (2010) hypothesized that SE has an influence on PU and PEOU in learning management systems. Barhoumi (2016), Khan and Qutab (2016), and Nov and C. Ye (2009) found support for such an influence in regard to e-libraries, and Y.-C. Lee (2006) in regard to e-learning systems. Therefore, the following hypotheses were made with respect to the e-service eCampus:

$H_{TAM}5$. Self-efficacy (SE) positively influences perceived usefulness (PU) of the eCampus system.

$H_{TAM}6$. Self-efficacy (SE) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Experience

Experience (EX) with similar systems can also have an impact on the acceptance of a system. Thus, Al-Busaidi and Al-Shihi (2010) investigated this influence on PU and PEOU in relation to learning management systems. Khan and Qutab (2016) found support for the influence on PEOU in the context of e-library systems, and I.-F. Liu et al. (2010) for the influence on PU and PEOU in online learning communities. Therefore, the following hypotheses were formulated:

$H_{TAM}7$. Experience (EX) positively influences perceived usefulness (PU) of the eCampus system.

$H_{TAM}8$. Experience (EX) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Personal Innovativeness

PI describes how much a person is willing to try new and innovative things (Al-Busaidi and Al-Shihi, 2010). In the context of learning management systems, Al-Busaidi and Al-Shihi (2010) studied the impact of PI on PU and PEOU. Basoglu, Daim, and Polat (2014) was able to find support for the influence on PU in relation to mobile service platforms. Dang, Y. G. Zhang, and J. Morgan (2017) (learning management systems) as well as Nov and C. Ye (2009) (e-libraries) looked at the influence from the other side and investigated whether resistance to change or perceived switching costs have an influence on PU and PEOU. The following hypotheses were derived for the e-service eCampus in the course of this thesis:

$H_{TAM}9$. Personal innovativeness (PI) positively influences perceived usefulness (PU) of the eCampus system.

$H_{TAM}10$. Personal innovativeness (PI) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Subjective Norm

SN describes the perceived social pressure of individuals regarding a certain behavior (Ajzen and Fishbein, 1980). Y.-C. Lee (2006) found support that the SN in the context of e-learning systems has an influence on PU. J.-A. Kim (2006) found support for such an influence in web-based information databases. The author of this thesis additionally assumed that SN could also have influence on PEOU, as social pressure could also change the perception of simplicity. Therefore, the following hypotheses were made:

$H_{TAM}11$. Subjective norm (SN) positively influences perceived usefulness (PU) of the eCampus system.

$H_{TAM}12$. Subjective norm (SN) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Social Image

SI is a construct that describes how much a person believes social status is affected by using a system (Moore and Benbasat, 1991). Meseguer-Artola et al. (2016) found support that when using Wikipedia in HE, the construct SI has an impact on PU and PEOU. Venkatesh and Bala (2008) also found support for the influence of the construct on PU and therefore included this influence in the Technology Acceptance Model 3 (TAM3) (see Section 2.3.2). The following hypotheses were therefore formed for the e-service eCampus:

> $H_{TAM}13$. Social image (SI) positively influences perceived usefulness (PU) of the eCampus system.

> $H_{TAM}14$. Social image (SI) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Job Relevance

JR is defined as the personal perceived relevance of using a system for one's own tasks (Venkatesh and Davis, 2000). In the context of e-libraries, Khan and Qutab (2016) as well as Heinrichs et al. (2007) found support for the influence of JR on PU and PEOU. Barhoumi (2016) found support for the influence on PU and Nov and C. Ye (2009) found support for the influence on PEOU in the same context. When using Wikipedia in HE, there is also an impact of JR on PU and PEOU, according to Meseguer-Artola et al. (2016). In the case of web-based information databases, J.-A. Kim (2006) found support for an influence on PU. Therefore, in this thesis, the following hypotheses were made:

> $H_{TAM}15$. Job relevance (JR) positively influences perceived usefulness (PU) of the eCampus system.

> $H_{TAM}16$. Job relevance (JR) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Service Quality

SERVQ concerns the quality of supporting services for the actual system (Al-Busaidi and Al-Shihi, 2010). Al-Busaidi and Al-Shihi (2010) hypothesized in this context for learning management systems that organizational support, technical support, training, and SERVQ in general have an impact on PU and PEOU. Mouakket and Bettayeb (2015) was able to find support for the impact of training and technical support on PU. For e-libraries, Khan and Qutab (2016) demonstrated support for the influence of SERVQ on PU and PEOU, whereas Heinrichs et al. (2007) found support only for the influence on PU. Hsu et al. (2016) found support for the impact of SERVQ on PU and PEOU among social network websites. For web-based information databases, J.-A. Kim (2006) studied the influence of user training on PU and PEOU, and in the context of m-learning and e-learning, S. Kim, H. Kim, and S. Han (2013) analyzed the influence of help and documentation on PU and PEOU. Thus, the following hypotheses were formulated:

> H_{TAM}*17.* Service quality (SERVQ) positively influences perceived usefulness (PU) of the eCampus system.
>
> H_{TAM}*18.* Service quality (SERVQ) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Policy Quality

The construct PQ is defined by the author of this thesis as the quality of the guidelines, principles and strategies that an organization establishes and adheres to for the use of a system. In this context, Al-Busaidi and Al-Shihi (2010) hypothesized regarding learning management systems that the alignment of technologies by organizations has an impact on PU and PEOU. Al-Busaidi and Al-Shihi (2010) further believe that motivational actions by the organization to use the learning management system also has an impact on PU and PEOU. A study by Schweighofer and Zullus (2019) also showed that teachers often do not use TEL because they are not given enough time or payment to use it. So these factors also seem to have an influence on adoption. Therefore, in the context of PQ in general, the following hypotheses were made:

H_{TAM}19. Policy quality (PQ) positively influences perceived usefulness (PU) of the eCampus system.

H_{TAM}20. Policy quality (PQ) positively influences perceived ease of use (PEOU) of the eCampus system.

Influence of Perceived Ease of Use, Perceived Usefulness and Behavioral Intention

Finally, hypotheses were also formed to test the influences described in the TAM for the eCampus e-service. Venkatesh and Davis (1996) thereby described the influence of PEOU on PU, PU and PEOU on BI, and BI on AU.

H_{TAM}21. Perceived ease of use (PEOU) positively influences perceived usefulness (PU) of the eCampus system.

H_{TAM}22. Perceived usefulness (PU) positively influences the behavioral intention (BI) to use the eCampus system.

H_{TAM}23. Perceived ease of use (PEOU) positively influences the behavioral intention (BI) to use the eCampus system.

H_{TAM}24. The behavioral intention (BI) to use the eCampus system positively influences the actual use (AU) of the eCampus system.

5.4. Requirements for E-Service[4]

This section shows the results of the requirements survey, which was conducted by means of expert interviews. In doing so, the survey was guided by the constructs of the TAM developed for the e-service. The theoretical reasoning of the proposed and used AD-DSR states that there are constructs that influence the acceptance of an artifact (behavioral science) and that the design of these constructs can positively influence the constructs and thus

[4]Parts of this section are based on the following already published work: Beer and Hatzl (2022)

the acceptance (design science). However, if we look at the ten constructs identified, we find that not all of them can be influenced by design or that this is only possible in a roundabout way. In the sense of the AD-DSR, they are important from a behavioral science perspective because they could have an influence on acceptance, but not from a design science perspective because they cannot be influenced by design.

Thus, from the point of view of the author of this thesis, the constructs SE and EX cannot be influenced by the design of the e-service eCampus, as they are purely determined by the individual and his or her past. If a person had difficulties using similar e-services in the past, this person will tend not to have the confidence to use the e-service eCampus (SE). No matter how simple the e-service may be designed, this personal feeling can hardly be influenced. It is similar with the experiences that a person had with comparable systems (EX). If these were positive, the attitude towards the e-service eCampus will be positive. However, if they were negative, the attitude towards the e-service eCampus will also be negative. From the point of view of the author of this thesis, this attitude cannot be changed by the design either. These two constructs were therefore not considered in the requirements elicitation, and subsequently in the design-oriented evaluation.

The constructs PI and SN are also very strongly determined by the individual and cannot be changed directly by the design. However, it is possible to influence them in a roundabout way. On the one hand, e-services could be designed in such a way that they arouse interest and have low entry barriers in order to increase the willingness to try out new things (PI). On the other hand, it could also be ensured that others speak positively about the e-service, thus influencing an individual more strongly to use the e-service (SN). The two constructs were considered in this sense in the requirements survey. All other constructs can be directly influenced by the design and were accordingly analyzed in this sense as well.

During the analysis, the identified requirements were divided into three categories and summarized accordingly: (1) content-relevant requirements, (2) system-relevant requirements, and (3) service- and process-relevant requirements. The following sections describe the requirements of these three categories and the respective constructs that should be influenced by the requirements according to the experts' statements. Appendix D contains a detailed list of all requirements including the assignment to the constructs that should be influenced by them.

5.4.1. Content-Relevant Requirements[5]

Content-relevant requirements relate to (1) the structure of each use case, (2) a general topic focus of use cases, (3) the overall structure for the use cases on eCampus, and (4) miscellaneous topics.

Structure of each Use Case

Aspects of the structure of a use case primarily influence INFQ and JR according to expert interviews. According to the experts, the use cases should be presented in a clear and visually appealing manner and contain certain uniform basic information. Media such as PDF or videos should be included to describe use case content. It is important that videos should be rather short with subtitles. Likewise, INFQ can be improved by self-tests and links to external content. The latter can have an impact on SN too. For JR, it is necessary that not only videos but also the use cases themselves are short and concise with step-by-step instructions. Recommended technical tools should also be explained and not just mentioned. For SYSQ, according to interview data, it can contribute if use cases contain initial experience reports and filter criteria. For PQ, content must be published under CC-by licensing, with videos being created on Youtube and then embedded on eCampus.

For this subcategory it has to be noted that due to resource limitations the project team decided to omit the creation of video-content. Regarding step-by-step instructions, especially for tools, the project team decided not to provide these instructions because the risk that they would quickly become outdated was considered too high. The added value of self-tests was also not really seen and thus none were created.

[5]This section has already been published in: Beer and Hatzl (2022)

General Topic Focus

The purpose of defining focal points in use cases is to ensure JR. As a result of the expert interviews, the following requirements should be implemented in this regard:

- Focus on topics of knowledge transfer and knowledge verification but administrative issues should also be addressed
- Focus on basic functionalities of TEL on the one hand and more innovative capabilities on the other, both tailored to the needs and conditions of the respective HEI
- Focus on content with regard to a practical relevance and institutional relevance
- Focus on didactic considerations (e.g. environments in which use cases work), supported by scientific evidence
- Focus on support for the creation of an overall concept for courses
- Focus on free tools or tools available at the HEIs and on the topics of open education resources (OER), data protection and copyright

High content quality and relevance can also strengthen SN. However, the implementation of use cases or parts specifically relevant to individual HEI did not appear feasible to the project team, which is why this aspect was discarded from the requirements.

Overall Structure

In addition to defining focus areas, the overall structure on eCampus can make a significant contribution to JR. In this sense, tool-independent didactic concepts are to be described at eCampus, to which individual use cases refer. In addition, entire course concepts should be available that also refer to didactic concepts and individual use cases. The eCampus should also deal with general TEL-relevant topics. In order to ensure SYSQ, use cases must be incorporated into the overall structure accordingly.

Miscellaneous

Most of the requirements in this subcategory mainly relate to SERVQ. According to the experts, an online documentation, information about the eCampus team and the use case creators, information about relevant events and publications, contact details, information about maintenance intervals, and information about data protection should be provided on eCampus. The latter should also positively influence the quality of the policy and information about the team should have an influence on PI. In addition, contact options to the responsible persons at the individual HEIs should increase INFQ.

However, the individual HEIs did not agree to such a contact option, which is why the requirement was not implemented. Likewise, the use case creators were not named at their own request. It should also be noted here that the online documentation was implemented only after the final evaluation of acceptance in this thesis.

5.4.2. System-Relevant Requirements[6]

The system-relevant requirements were assigned to those aspects which, according to the expert interviews, concern (1) structure and navigation, (2) use cases, (3) general design, (4) general system requirements, and (5) interaction with and among users in the system. At this point, it should also be noted that it was already determined before the requirements elicitation that the basic technical system of the e-service would be a Moodle system, which would be expanded to include other necessary functionalities.

Structure and Navigation

To ensure both JR and SYSQ, content structuring must be mapped in the system, i.e., use cases must be able to be assigned to multiple categories. PI and SYSQ should be positively influenced by the search function. On

[6]This section has already been published in: Beer and Hatzl (2022)

the one hand, this includes the possibility of a free-text search, which takes into account headings, contents, experience reports, feedbacks and forum contributions, and on the other hand, fixed and variable filter criteria. Further requirements concerning the structure and navigation, which should have a positive influence on SYSQ, are:

- tree structure and image tiles as two alternative navigation options
- display of the top five most viewed use cases
- already seen use cases should be able to be marked by the user
- notification function via mail for new use cases

Use Cases

PI shall be positively influenced by freely accessible use cases. The requirement for the creation of use cases positively influence SN and JR as well as SYSQ, SERVQ and INFQ. In other words, use cases must be able to be created independently by users on the basis of templates (guarantee standards), which then only need to be released by an administrator. In order to improve SYSQ, it should be possible to create experience reports and give feedback (if necessary, administrator-checked). To increase the JR it should be possible to refer to use cases among each other.

PDFs, videos (e.g. via YouTube channel) and text modules must also be able to be embedded in the use cases to increase JR and INFQ. However, as stated before the project team omitted the idea of providing content via videos.

General Design

Regarding the general design, there is a requirement on the system to refer to relevant publications and events to improve JR. Recommendations for use cases should be displayed based on previous history, thus influencing SYSQ. In addition to SYSQ, PI shall be influenced by a uniform, clear, plain and simple optical design that is oriented towards a current style (i.e., slight changes to the standard Moodle design). Colors should be based on the eCampus logo.

General System Requirements

Access that is as barrier-free as possible, a responsive design, high availability (in terms of time and technology) and a simple login should be provided to ensure SYSQ. A glossary in connection with a mouse-over effect should influence INFQ. In addition, INFQ should be influenced by bilingualism (i.e., German and English) of the contents (at least a translation should be technically possible) and an introductory information to clarify basic terms and goals. In order to strengthen PI, the system should be expandable and capable of being integrated into existing system structures at HEIs. PQ shall be improved by the requirement of GDPR conformity.

Interaction with and among Users

The last aspect relating to system-relevant requirements is that of interaction with and among users. The expert interviews show that these requirements are mainly intended to increase SYSQ and SN. A feedback function on the e-service should strengthen SN, while regular, unobtrusive reminders to provide feedback (e.g. experience reports) should improve SYSQ. A recommendation function for use cases is also intended to strengthen SN. Both SN and SYSQ can be positively influenced by rewarding (e.g., nomination of the teacher of the month, invitation to events) contributions (e.g., experience reports, use cases, etc.). This means that users who make a contribution should be visible to others in the community or publicly.

In order to promote SN but also PI, positive experience reports should be published on the homepage with the consent of the authors (i.e. visible for everyone, not only the community). Furthermore, PI should be influenced by a reminder function via mail, which attracts the attention of inactive users. Both for the release of information (e.g. publication of testimonials) and the receipt of information (e.g., reminder function, newsletter, recommendation, and feedback), users are asked for consent in advance or personalized settings can be made.

According to the interviews, the requirements for improving SYSQ, SERVQ, SN, and PI were interaction possibilities between users. Communication should be possible both among users (via experience reports, discussion forums) and with use case creators and support personnel (e.g., via use cases or e-mail). In both cases the profile should be linked to the email address. However, for privacy reasons, contact via email was only implemented to official eCampus email addresses. It was mentioned that the possibility to create a user profile can positively influence SERVQ, SN and SI. However, this requirement was not implemented due to limited resources and data privacy concerns too. For the same reasons, a reminder function by e-mail, rewards or special visibility for contributing users and the recommendation function were not implemented.

5.4.3. Service- and Process-Relevant Requirements[7]

The service- and process-relevant requirements were assigned to the following subcategories: (1) support, (2) maintenance, (3) marketing, (4) user participation, and (5) miscellaneous.

Support

Technical and content support (i.e., personal contact persons) should be available both centrally and decentrally (at each HEI), which according to the experts increases JR, SERVQ and SYSQ as well as PI. SYSQ and JR should be positively influenced by content support, ideally provided by use case creators.

Maintenance

Filters and information in use cases should be regularly maintained to ensure SYSQ. The need for regular security-updates was in addition identified in the consensus process.

[7]This section has already been published in: Beer and Hatzl (2022)

Marketing

In order to ensure PI, SERVQ and PQ, information about the eCampus should be provided regularly and on a long-term basis (internal and external marketing) via complementary mass media and interpersonal communication channels (i.e., print media, social media, events, website and other HE systems, internal e-mail distribution lists, HE support service/contact person, or personal contacts). In the long term, a certification system of individuals who continue their education through eCampus can be developed to increase PI. However the results indicate that this is only the case for younger teachers who can use such a certification for career advancement. Therefore, this requirement was not implemented during the project.

User Participation

In order to positively influence SI, SERVQ and SYSQ, it was suggested in the expert interviews to establish an incentive system for the voluntary participation of teachers (i.e., rewards such as honors or non-cash benefits via competitions with official, media-effective awards). Rules for mandatory participation such as cooperation agreements, involvement of training participants, and monetary compensation for participation services or officially certified training measures can improve the SERVQ as well as the PQ. In addition, SERVQ can be positively influenced by the implementation of standardized and supervised processes for the creation of use cases. In the context of strengthening PI, the involvement of multipliers in the further development of eCampus was also mentioned in respect to this category.

During the thesis, the requirements of this subcategory were not pursued further. The responsible team for operating the eCampus after the project ends have further investigated such services and processes. However, the requirements are not relevant for the final evaluation in this thesis.

Miscellaneous

The integration of various third-party services on eCampus is also mentioned with the aim of influencing SN. To influence SERVQ, discounts for technologies could also be offered as a service. However, neither requirement was implemented, both in the project and afterwards, because the people involved did not see much added value in it.

5.5. Content Prototype

This section describes the content prototype designed in this design cycle. The following subsections describe three core areas of the content prototype: (1) overall structure, i.e. which TEL approaches are described in which overall structure at eCampus, (2) key data, filter and recommendation criteria, i.e. which key data is addressed in all use cases and which filter and recommendation criteria enable the search, (3) type of presentation, i.e. via which medium and in which visual design the use cases are presented. The requirements elicited in the expert interviews formed an essential basis for this, specifically, the requirements that were categorized as content-relevant requirements (see Section 5.4.1). The descriptions therefore also refer to the respective addressed requirements, which can be found in Appendix D.

5.5.1. Overall Structure

This part of the content prototype was about defining which 50 TEL approaches the e-service eCampus should describe and in which overall structure they should be embedded. The basis for this were the requirements previously described in Section 5.4.1 under General Topic Focus and Overall Structure.

In a first approach, eight main categories were formed so that the content foci knowledge transfer, knowledge verification, administration (Req_1_C_F_JR_-Topics-focus), overall concepts for courses (Req_5_C_F_JR_Overall-concepts, Req_2_C_St_JR_Overall-concepts) and general overarching TEL-relevant topics (Req_7_C_F_JR_Other-topics, Req_3_C_St_JR_Other-topics) are mapped. As described in section 2.1.2, there are a variety of TEL approaches but no unified and complete structuring of them. The structure defined here attempts to cover situations and tasks in which TEL can be used from the perspective of teachers, i.e. the target group of the e-service. In addition, these were supplemented by entire course concepts supported with TEL as well as other overarching topics. The resulting eight main categories were (1) administering the course, (2) creating teaching and learning materials, (3) conducting face-to-face teaching in a teacher-centered manner, (4) conducting face-to-face teaching in a student-centered manner, (5) conducting online teaching, (6) conducting performance assessments, (7) technology-enhanced course concepts, and (8) other topics.

Within the main categories, use cases were defined to describe generally valid and tool-independent didactic considerations (Req_4_C_F_JR_Content-alignment-2, Req_1_C_St_JR_Didactical-considerations, Req_4_C_St_SYSQ_-Integration). The description of specific tools relevant to the use case should be provided below for each HEI (Req_2_C_F_JR_Topics-focus-2, Req_3_-C_F_JR_Content-alignment, Req_4_C_St_SYSQ_Integration). This should ensure that only tools that are freely available at the HEI or in general are described for each HEI (Req_6_C_F_JR_Free-and-available-tools). The descriptions of the tools were integrated if appropriate under several use cases (Req_4_C_St_SYSQ_Integration) and the descriptions of the overall concepts and other topics should refer to the use cases and tools if appropriate (Req_1_C_St_JR_Didactical-considerations, Req_2_C_St_JR_-Overall-concepts, Req_3_C_St_JR_Other-topics).

However, the separation of the use cases and the tools, in order to be able to describe the latter individually for each HEI and thus deliver increased practical relevance, was discarded in the course of this design cycle (Req_2_C_F_JR_Topics-focus-2, Req_3_C_F_JR_Content-alignment). The implementation would have required an enormous amount of coordination with all nine Styrian HEIs in order to find out which tools are used at which HEIs and how. In addition, it was recognized that the maintenance of these tool descriptions would also be difficult to implement in the future, since every change at the individual HEIs would also have to be entered into eCampus, which would otherwise always present outdated information.

Therefore, it was decided that the tool descriptions should be done in a generic way directly with the use cases.

For the final content prototype, the main categories were also revised again and finally reduced to six main categories. Essentially, this step combined the two main categories previously defined for face-to-face teaching into one main category and omitted the category for other. The latter is justified by the fact that the topics planned here were classified in other main categories or were described directly in use cases. The use cases were assigned to the main categories accordingly and some use cases were also incorporated into several main categories. Figure 5.2 contains the complete structure with the assigned use cases of the content prototype (translated from German to English).

5.5.2. Key Data, Filter and Recommendation Criteria

In this part of the search process, the key data, filter and recommendation criteria were determined. The starting point for this was, on the one hand, the 20 categories of influencing factors and their classification of the necessary description type (see Chapter 4) and, on the other hand, parts of the requirements described in Section 5.4.1 under Structure of each Use Case and Miscellaneous. From the latter it was derived that the use cases should contain certain uniform basic information (Req_1_C_SUC_INFQ_JR_Key-data), descriptions of technical tools (Req_2_C_SUC_JR_Core-content), as well as name and contact address of the use case creator (Req_2_C_Misc_PI_-SERVQ_Team). The need to determine filter and recommendation criteria in terms of content resulted from the requirement described in Section 5.4.2 under Structure and Navigation that the e-service must have a search function with filter and recommendation criteria (Req_2_S_SaN_SYSQ_PI_Search).

Figure 5.2.

Content Prototype: Overall Structure of Use Cases

Manage the Course

- Plan course structure and set "semester timetable“
- Organize learning materials and activities
- E-Moderation: supervise and accompany students online
- Establish communication rules for digital communication
- Observe basic rules for digital accessibility and inclusion
- Observe copyright aspects in teaching
- Use and create Open Educational Resources (OER)

Create Teaching and Learning Materials

- Create a script
- Create an e-book
- Create a "classic" presentation
- Create a presentation with Pecha Kucha as a presentation technique
- Create a presentation with storytelling as a presentation technique
- Create graphics/diagrams/mind maps
- Create a screencast (screen recording)
- Create an instructional video (plan, record, and edit)
- Create a lecture recording
- Enhance an instructional video with interactive elements
- Create simulations (3D elements)
- Formulate work tasks or assignments

Conduct Face-to-Face Teaching

- Designing a round of introductions
- Ice-Breaker methods: Use warm-up activities as introductory methods
- Presenting a lecture
- Work with multimedia content (incorporate audio/video, podcasts, animations, interviews into teaching)
- Use "backchannel": Enable student participation in the lecture hall or seminar room
- *Collaborative writing: students create texts together*
- *Brainstorming to come up with ideas or topics*
- *Brainstorming to collect prior knowledge*
- Planning and leading discussions
- Create and conduct learning objective assessments
- *Design and use polls/mood barometers*
- *Create evaluation/instructor feedback and have students complete it*

Conduct Online Teaching

- Have students create texts and media products
- *Collaborative writing: students create texts together*
- Create a collection of terms (e.g. with glossary)
- (Joint) creation of literature and link lists / collection of resources
- *Brainstorming to come up with ideas or topics*
- *Brainstorming to collect prior knowledge*
- Planning and leading (asynchronous) discussions
- Synchronous communication: communicate live with students (e.g. chat)
- Hold video conference
- *Design and use polls/mood barometers*
- *Create evaluation/instructor feedback and have students complete it*

Feedback on formative and summative Performance Assessments

- Conduct learning objective assessments during the course in progress
- Use closed question types (e.g. multiple choice, cloze with choices, drag and drop)
- Use open question types (e.g. short answers, cloze without choices)
- Guiding and evaluating homework / seminar work
- Presentations: students take the floor
- (E-)Portfolios: students document and/or reflect on learning progress and/or complete work assignments
- Constructive feedback: teachers give feedback to learners
- Flash feedback: learners give ad hoc feedback on the performance of others or on the teacher
- Use peer feedback as a method: Learners evaluate each other
- Teacher feedback: teachers receive feedback from learners

Technology-Enhanced Course Concepts

- Plan, design and implement blended learning scenarios.
- Planning, designing and implementing flipped classrooms as a teaching method.
- Problem-based learning: learning with cases and projects using media.
- Gamification: incorporating game elements (such as rewards, levels, points) into teaching
- Game-based learning: using (online) games for knowledge transfer
- Bring Your Own Devices: Learners bring their own smartphones, tablets & co. into the classroom.
- Use social media in the classroom

Note. Use cases that appear in multiple categories are written in italics. The prototype also suggests more than 50 use cases, from which a selection was then made.

The key data finally defined for the content prototype, which make up the structure of a single use case, were the following, with optional key data that should not be relevant for all use cases shown in italics:

- Title of the use case
- Subtitle of the use case
- Name of use case creator
- Contact possibility to the use case creator (Email, optional phone number)
- Date of current version
- General key data (The filter criteria with the selected values)
- Short introduction of the use case
- Objectives of the use case
- *Role of the teacher*
- *Preparation* (What preparation is necessary for me to use the particular approach?)
- Description of the use case (e.g., of the embedding of the method in the course, the steps that are necessary for the implementation)
- *Follow-up* (What follow-up, e.g. documentation, may be necessary?)
- Time expenditure (Statement with time in hours or minutes for average preparation effort, average effort for implementation from instructor's point of view, and average effort for application by students)
- Implementation tips
- Advantages/Challenges
- *Statement how learning success is influenced*
- *Statement how motivation is influenced*
- *Legal aspects*
- Tools for implementation (links, hints and very short explanations of the tools, costs of the tools, if necessary further specific information from individual HEIs, if necessary links to explanatory videos)
- Application example
- Further literature and examples
- Cited sources

The following were set as filter criteria for the content prototype:

- Social form (multiple choice):
  Individual work - Partner work - Group work - Plenary

- Group size (multiple choice):
  Individuals - Smaller groups - Larger groups - Mass teaching
- Average time required for preparation teachers (single choice):
  0-4 hours - 5-8 hours - 9-16 hours - 17-40 hours - 41 or more hours
- Average time spent on implementation teachers (single choice):
  Less than 30 minutes - 31-120 minutes - more than 120 minutes
- Average time required for application students (single choice):
  Less than 30 minutes - 31-120 minutes - More than 120 minutes
- Learning Objective Level/Bloom's Taxonomy (multiple choice):
  Remember - Understand - Apply - Analyze - Evaluate - Create
- Supports collaborative processes/Supports working together (single choice):
  Yes - Rather yes - Rather no - No
- Allows feedback to be given to students (single choice):
  Yes - Rather yes - Rather no - No
- Enables monitoring and review of learning progress (single choice):
  Yes - Rather yes - Rather no - No

As recommendation criteria, i.e. criteria to be set by users in the course of use, the following criteria were defined for the content prototype:

- Overall impression (single choice):
  1 to 5 stars
- Difficulty level for teachers (single choice):
  Easy - Medium - Hard
- Difficulty level for students (single choice):
  Easy - Medium - Hard
- Contributes to the improvement of the grades (single choice):
  Yes - Rather yes - Rather no - No
- Students accept the approach (single choice):
  Yes - Rather yes - Rather no - No
- Students are motivated by the approach (single choice):
  Yes - Rather yes - Rather no - No
- Increases the attention of the students (single choice):
  Yes - Rather yes - Rather no - No
- Enables individual learning paths (single choice):
  Yes - Rather yes - Rather no - No

Table 5.1.

Categories of Influencing Factors in Content Prototype

Description Type Category	Implementation
Must be described	
Cognitive aspects	Recommendation criteria and addressed in several key points
Course-related aspects	Filter criteria and addressed in several key points
Instruction aspects	Addressed in several key points
Learners' learning aspects	Recommendation criteria, filter criteria and addressed in several key points
Learners' requirements	Recommendation criteria, filter criteria and addressed in several key points
Learning success	Recommendation criteria, filter criteria and addressed in several key points and own key point
Motivational aspects	Filter criteria, addressed in several key points and own key point
Requirements on teachers	Recommendation criteria, filter criteria, addressed in several key points and own key point
Support processes	Filter criteria and addressed in several key points
Teachers' teaching aspects	Recommendation criteria, filter criteria, addressed in several key points and own key point
Technical infrastructure aspects	Addressed in several key points
Should be described	
Acceptance aspects	Recommendation criteria and partially addressed in key points
Business aspects	Own key point and partially addressed in key points
Demographic differences	Partially addressed in key points
Influences from prior knowledge and experience	Recommendation criteria
Mind-set & feelings before TEL	Partially addressed in key points
Mind-set & feelings during TEL	Partially addressed in key points
Self-regulation aspects	Recommendation criteria
Technology-related aspects	Own key point
Can be described	
Social aspects	Filter criteria and partially addressed in key points

Finally, Table 5.1 shows how the defined key data, filter and recommendation criteria correspond to the 20 categories of influencing factors and their description types. In general, it can be stated that the majority of the previously defined description types were adhered to during implementation.

5.5.3. Type of Presentation

The last part of the content prototype concerns the way of presentation, i.e. the implementation of a concrete use case prototype. This was defined based on the requirements described in section 5.4.2 under Use Cases and General Design as well as in section 5.4.1 under Structure of each Use Case.

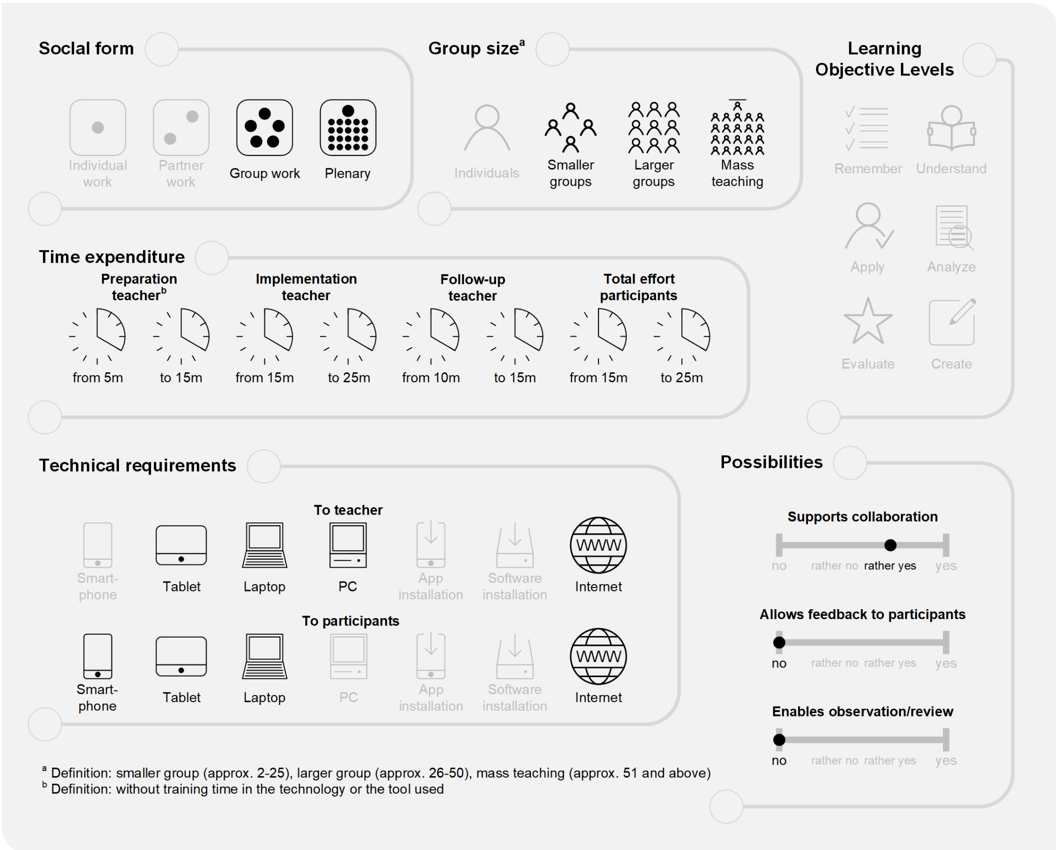
According to these requirements, the presentation must be clear, appealing, and consistent (Req_3_S_GD_SYSQ_PI_Optical-design, Req_6_C_SUC_-INFQ_Visual-design), and must be implemented using a variety of appropriate media types, including video (Req_5_S_UC_INFQ_JR_Embedding-other-formats, Req_3_C_SUC_INFQ_JR_Media, Req_7_C_SUC_INFQ_Videos). In addition, the requirement of high content quality (Req_8_C_F_SN_General-content-requirements) was also included in the considerations.

In the search process for the definition of the type of presentation, the longest discussions were held on the question of whether videos are necessary. Disagreement could already be seen here during the expert interviews. Some felt that videos were necessary, while others thought that text would be more suitable. Accordingly, the requirements were also formulated as optional. Finally, after several discussions on the topic, the project team decided not to use videos at all.

The requirement for high content quality and uniformity was weighted very highly, and it became clear that the creation of videos for 50 use cases was not possible with the available resources in the project. Instead, the media type text in the three media formats PDF (for download), WORD (for own further processing for experts in the field) and directly in Moodle (i.e. in the e-service) was determined as the type of presentation. These three formats also have the advantage that transforming the content from one format to the other can be done very easily.

Figure 5.3.

Content Prototype: Example Key Data Graphic of Use Case



A graphic of key data (i.e. the filter criteria with slight adaptations) was created to meet the required visual demand (see the example translated into English in Figure 5.3). The key data itself, which determined the structure of the use case, was implemented in a very simple but clear manner. Appendix E shows one of the two resulting use case prototypes.

5.6. Evaluation

From the point on when it was recognized that acceptance is a relevant issue in the design of the artifact, the evaluation in the AD-DSR should take place in every cycle but the last in terms of PU and PEOU in a qualitative manner (see Section 3.1.2). It is precisely to this end that the evaluation of the content prototype, more specifically the use case prototype and its mode of presentation as well as its key data, was conducted in this cycle with nine field tests and interviews. The defined filtering and recommendation criteria, as well as the overall structure, have not yet been evaluated in this design cycle.

Through the results of the qualitative content analysis, one can generally conclude a high PU and PEOU. In the following, the answers of the interviewees to the five questions are summarized. Content analysis according to Meuser and Nagel (2009) was used.

> $Q_{DC2}1$. What did you generally like or dislike about the use cases in terms of content and design? (PU)

The thematic arrangement revealed several themes in this question. Two test subjects directly stated their preferences regarding media type. One emphasized that text is definitely more suitable, while the other would like to see videos or at least more images. Regarding the length of the text, six test persons stated that it is suitable. However, one suggested a shortening. When it came to the simply designed format, the test persons disagreed. For four, it was very appropriate, one person said it was fine but needed links to videos, and three people wanted a visual improvement. Six test persons liked the graphical representation of relevant key data, although one of them would have liked additional explanations for better understanding.

One person was not satisfied with the presentation and would have liked a more modern version. The chosen way of describing tools was very suitable for five persons. However, two people also noted that more emphasis should be placed on open source tools. The section on legal aspects was too general for two people. In terms of content, eight out of nine people were very satisfied with the description of the one use case. Only one person wished for a more detailed description. For the other use case, five people were satisfied with the description, two people were missing various parts, one person found the descriptions partially cumbersome and one person also wished for more in-depth descriptions here.

> $Q_{DC}22$. What was not understandable for you in the description of the use case? (PEOU)

In this question, seven out of nine test subjects stated that everything had basically been clear and understandable for them. One person noted that the abbreviations were somewhat confusing in some places. For another person, the links to the tools described were not entirely comprehensible. Another person felt that the content was partly redundant or not suitable for the use cases. A short explanation of the use of tools or at least a link to such explanations would have been the wish of another person.

> $Q_{DC}23$. What do you understand by the terms used for the headings and key data? (PEOU)

This question asked about the understanding of the headings of the individual chapters and the terms and icons in the graphical representation of the key data. The distinction between group size and social form in the graph was clear for four subjects. One saw no difference in the terms. The footnote, which should provide clarity here, was not perceived by five test subjects. The terms and icons for the learning objective levels were clear to six test subjects. For one person, the icons were not understandable. The presentation of the time required was only completely clear to three test subjects. For the other test subjects, headings were not seen or terms were interpreted differently. The interpretation of the technical requirements was also misinterpreted by the majority. There were no misunderstandings regarding the headings of the chapters.

> $Q_{DC}24$. Can you get started or do something with this description? Are they missing anything? (PU)

Seven of the nine test persons stated in response to this question that they could get started immediately, but that the assurance of support must be given in order to be able to clarify content-related questions for the concrete implementation directly, if necessary. One person said that in part independent implementation would be possible, but in part support would be necessary. Another person would call the support directly to get faster into the implementation.

> $Q_{DC}25$. Do you have any other feedback on this content prototype or the project as a whole?

Regarding the eCampus project itself, three people stated that marketing and support will be important factors for success. One person added that support must be available by telephone. Another person was rather skeptical and was afraid of additional effort. One person asked for additional experience reports from teachers who have already used the use cases. From the point of view of one test person, an integration into existing continuing education programs makes sense. This person would also consider a forum on eCampus to be useful. The lack of videos was again criticized at this point by one person, who already noted this in the first question. One person also referred to the necessity of constantly creating and adding new use cases.

5.7. Discussion

The following three subsections discuss the essential elements of this design cycle. First, the structured literature review and the resulting specific TAM are discussed. Then, the elicitation of requirements with expert interviews based on the TAM is analyzed. Finally, the result, the content prototype, and its evaluation are critically reflected.

5.7.1. Discussion of Technology Acceptance Model for E-Service

The goal of the structured literature review was to identify constructs that should influence the acceptance of an e-service such as eCampus (behavioral science), and based on these constructs, to identify requirements that can positively influence these constructs and thus acceptance (design science). As shown in Section 2.3, there are many models that describe technology acceptance behavior through a wide variety of constructs. Recognized models, such as the Technology Acceptance Model 3 (TAM3) (Venkatesh and Bala, 2008) or the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, et al., 2003), generally have high validity for all possible types of technologies.

However, there are some studies that have found significant support for the influence of constructs on adoption for specific technologies that are not present in these generalized models. For instance, J.-A. Kim (2006) found support for the influence of accessibility and terminology clarity in web-based information databases. For online learning communities, I.-F. Liu et al. (2010) showed the influence of online course design and user interface design. Nov and C. Ye (2009) provided significant results for the influence of terminology, screen design and resistance to change in digital libraries. Furthermore, Mouakket and Bettayeb (2015) found support for the influence of training and technical support in learning management systems. Thus, one can infer that for certain specific use cases, other constructs are additionally relevant that are not included in the generally applicable models.

Comparing the result of the structured literature review, a specific TAM for the e-service eCampus, with TAM3, we see that some constructs appear in both: (1) EX, (2) SN, (3) SI, (4) JR, and (5) (computer) SE. However, other constructs that should have an impact would be missing if only the TAM3 was used: (1) SYSQ, (2) INFQ, (3) SERVQ, (4) PQ, and (5) PI. TAM3, on the other hand, contains constructs such as computer anxiety or computer playfulness, which seem to be too detailed for the specific use case of the e-service eCampus and are therefore not relevant. A comparison with the UTAUT shows similar results.

Even using the IS Success Model by DeLone and McLean (2003), which specializes in information systems, would not fully include all relevant constructs. The constructs INFQ, SYSQ and SERVQ would be considered, which are not specifically present in TAM3, but many other relevant constructs would be missing again. This is certainly due to the fact that the IS Success Model has a stronger focus on design rather than actual acceptance behavior.

Thus, for the bipartite goal of this structured literature review, the combination of multiple models was essential. This enabled the identification of constructs specifically relevant to an e-service such as eCampus, which are of interest to both design science but also behavioral science. The TAM was used as a basis precisely because it does not specify any constructs except PU, PEOU, BI, and AU. Furthermore, according to Olushola and Abiola (2017), the goal is even to find specific constructs that influence the acceptance of a specific technology. The TAM also allows for evaluation of PU and PEOU in each design cycle. According to Davis and Venkatesh (2004) (see section 2.3.3), such an evaluation can already provide information on the final acceptance and is thus a suitable tool for iteratively deriving improvements during the design cycles.

The structured literature review, of course, also had limitations mainly due to the influence of various biases (Baird, 2018). First, the major limitation occured due to selection bias. The selected search terms and used databases have a significant impact on the final results of a literature review. For example, due to missing search terms or unused databases, publications that contained important constructs specifically relevant to an e-service such as eCampus might not be included in the results. Second, due to publication bias, relevant constructs might not be found by the method because they were never published due to lack of statistical significance. For this very reason, the specific TAM for the e-service eCampus deliberately included constructs for which an influence was only hypothesized. Third, an influence on the results by selective outcome reporting cannot be ruled out, because it was decided during the analysis which constructs and which artifacts can be considered relevant.

5.7.2. Discussion of Requirements for E-Service

Expert interviews were conducted to determine the requirements for the e-service. The interview guide used the influenceable constructs of the specific TAM created for the eCampus e-service as the basis for the topic areas, since the requirements were intended to positively influence the respective constructs and thus acceptance.

With regard to the results, i.e. the derived requirements, it can first be stated that the method has provided a very complete picture and that no further requirements had to be added during implementation. The results also show that the method made it possible to define specific requirements for all influenceable constructs. Thus, at the end of this DSR, it is in principle possible to derive corresponding design principles if a construct influences acceptance.

When conducting the content analysis, however, it should be noted that some requirements were mentioned more frequently in individual interviews. This was due to the fact that, according to the experts interviewed, these requirements should have an influence on various constructs. For example, a requirement concerning necessary support was discussed four times in one interview without any significant additional insights. This additional time is certainly a disadvantage of this method. However, it can be deduced from this that a requirement, i.e. a potential design principle, can have an influence on several constructs. If these constructs have an influence on the acceptance of a specific technology, these design principles become even more important.

Another challenge of the method was posed by different and partly contradictory requirements of the experts. As Hevner, March, et al. (2004) described with the sixth guideline of DSR, an iterative search process was necessary here, i.e. requirements were defined by the project team in case of contradiction and an iterative, if necessary, later adjustment was to be ensured by evaluations in the individual design cycles. However, the possibility that this nevertheless means that relevant design principles for the acceptance of such an e-service were not implemented cannot, of course, be ruled out.

The restriction to nine expert interviews may also mean that relevant requirements were not elicited. The nine experts selected each represented one of the nine HEIs defined as the target group and they were each responsible for their own HEI as an expert in the field of TEL. Although they were asked to do so, this is not necessarily a guarantee that they reflected the opinion of the teaching staff at their HEI. However, the experts were selected according to the definition of Meuser and Nagel (2013) and should accordingly be representative of the target group of teaching staff in the Styrian HE area. Of course, a certain influence by the interviewer himself also arises during interviews. In order to keep this influence as low as possible, an attempt was made to ask only the previously defined questions of the interview guide and to provide supplementary information only in case of ambiguities.

5.7.3. Discussion of Content Prototype and Evaluation

The design of the prototype for the content of the e-service eCampus based on the relevant requirements was influenced by the sixth guideline of the DSR by Hevner, March, et al. (2004). Based on the available resources and considering the constraints and circumstances present in the application environment, the design was carried out iteratively. In the process, when conflicting requirements were encountered, the project team had to repeatedly make assumptions and finally reach a decision. Some requirements from the expert interviews ultimately had to be dropped altogether, mostly due to a lack of resources in the project. According to Hevner, March, et al. (2004), this is also typical for DSR and the design can only be done with the available means. For the behavior-oriented evaluation, i.e. evaluation whether the defined constructs have influence on the acceptance of the e-service, this does not play a role. However, it does for the design-oriented evaluation, i.e., evaluation of whether the e-service is accepted and whether the design of the individual constructs was successful. Relevant design principles may not have been identified because the corresponding requirements were not implemented. In general, this could also have reduced the acceptance of the e-service.

However, the initial evaluation of the use case prototype delivered positive results. Through the feedback of the nine test persons, it can be concluded that there was probably a high PU and PEOU, related to the use case prototype. This in turn, according to Davis and Venkatesh (2004) as mentioned before, should be an indication that this part of the e-service should also end up with high PU and PEOU. Mainly the construct INFQ was affected here and at the end of the second design cycle it could accordingly be assumed that the implemented requirements for the construct have a positive effect on the construct and that this has a positive influence on PU and PEOU. However, it must be emphasized at this point that this was still an assumption and a test of the hypotheses was not conducted until the end of the AD-DSR. The qualitatively conducted evaluation with nine test subjects would also not be suitable for this purpose.

The results of the first evaluation must be interpreted accordingly due to the limitation to nine test persons (three of each of the HEIs involved in the project). Although it was possible to identify essential findings for the further design cycles, the sample of nine test persons was rather small. When selecting the nine test persons, however, care was taken to ensure a high degree of diversification and the test persons were thus intended to cover a broad field. The fact that the feedback was nevertheless very uniform is a further indication that the definition of the requirements and their implementation with regard to the use case prototype was suitable for the target group of all teachers in the Styrian HE area.

5.8. Conclusion

With the second design cycle, not only the eCampus project started, but also the actual AD-DSR procedure. In a first step, a structured literature review was conducted to identify constructs that should influence the acceptance of an e-service like eCampus. The result was a specific TAM with ten external variables, i.e. constructs that should influence PU and PEOU.

Of these ten constructs, eight could be influenced by the design of the e-service. They served as the topics of an interview guide, and with nine expert interviews requirements were identified that should positively influence the design of the constructs. These requirements were finally grouped into three categories and formed the basis for the further design of the e-service in this and subsequent design cycles.

Then, the content prototype was designed in an iterative search process. More specifically, (1) the overall structure of the eCampus was determined, i.e. which TEL approaches should be described, (2) key data, filtering and recommendation criteria were determined, and (3) the way individual use cases should be presented was defined.

Two use case prototypes were then designed for the first evaluation phase. Nine test subjects received these in advance for analysis. Guided interviews were then conducted to collect qualitative feedback on the prototype and, in particular, in relation to PU and PEOU. The feedback was then analyzed using content analysis. From the results it can be concluded for the further design cycles that it is necessary to analyze the following points:

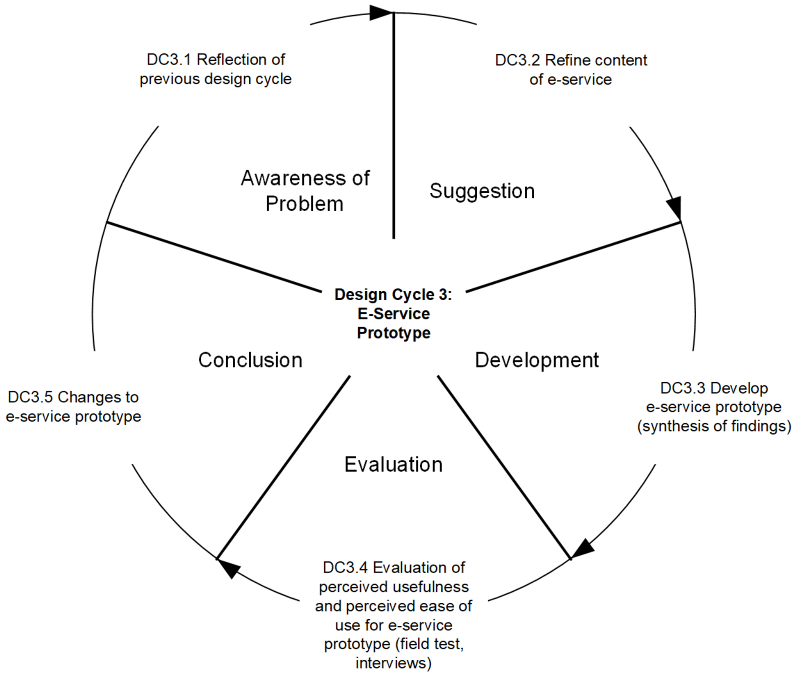
- Visual design of the use case prototype
- Graphic of key data regarding clarity and visual presentation
- Section on legal aspects in the use case prototype
- Stronger focus on open source tools in the use case prototype
- Use of abbreviations in the use case prototype
- Offering a content support

As mentioned in the introduction of this chapter, the design cycle also addressed the following two subordinate research questions of this thesis:

> *RQ2.* What requirements define an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?
>
> *RQ3.* What constructs influence the acceptance of an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

Neither, of course, can be answered at the end of the second design cycle without final evaluation and full implementation of the e-service. However, the requirements shown in Appendix D and the ten defined constructs of the specific TAM are the possible answers to these two questions. They also provide the basis for the further design cycles.

6. Design Cycle 3: E-Service Prototype



The third design cycle had two tasks. On the one hand, the content prototype that was designed and evaluated in the second design cycle was refined, and on the other hand, a complete e-service prototype was created and evaluated. The latter already contained all the finally implemented requirements of the categories "content-relevant requirements" (see Section 5.4.1) and "system-relevant requirements" (see Section 5.4.2). The requirements of the category "service- and process-relevant requirements" (see Section 5.4.3), which is the third and final category, were not fully implemented until the last design cycle.

To represent the design cycle, this chapter first reflects on the results concerning the content prototype of the second design cycle (awareness of problem) in order to provide a basis for refining the content prototype (suggestion). Furthermore, the essential requirements for the e-service prototype are addressed (suggestion). Then, the following section describes the research methods that were used to refine the content prototype and to design and evaluate the e-service prototype (suggestion). The resulting refinement of the content prototype and the resulting design of the e-service prototype are described in the next section (development). Then, the results of the evaluation in terms of perceived usefulness (PU) and perceived ease of use (PEOU) of the e-service prototype are presented (evaluation). Finally, the last two sections discuss the design cycle and provide a conclusion for the following final design cycle (conclusion).

6.1. Introduction

The foundation for the refinement of the content prototype in this design cycle was formed by the results of the evaluation (see Section 5.6) and the resulting conclusions (see Section 5.8) of the second design cycle. The basis for the design of the complete e-service prototype in this design cycle were the requirements that were elicited in the second design cycle with expert interviews (see Section 5.4) based on the Technology Acceptance Model (TAM) that was created (see Section 5.3).

The evaluation of the content prototype, or more precisely the use case prototype, with nine test subjects initially showed that the visual design of the prototype elicited different reactions. Some were satisfied with the simple visual design, but some wished for a more modern design or at least a visual improvement. The latter should be implemented accordingly in this design cycle. The graphical representation of the key data was generally viewed positively. However, it also became apparent here that a (visual) improvement was necessary because there were some ambiguities in the interpretation of the graphic. The section on legal aspects was too general for a few and should therefore also be revised in this design cycle. A few also wished for a stronger focus on open source tools in the description of the tools, which should also be taken into account when creating further use cases. One test person also noted that the abbreviations used in the descriptions were sometimes confusing. This should also be reviewed in this design cycle. Last but not least, the results also clearly showed that content support for eCampus needs to be established. However, this will only be considered in the next and last design cycle.

In addition to the requirements of the category "content-relevant requirements", which were relevant for refining the content prototype and for creating the complete content of the e-service prototype, the requirements of the category "system-relevant requirements" were particularly relevant for designing the e-service prototype. These were divided into five subcategories. The subcategory "structure and navigation" contained requirements that define how the structure of the use cases is implemented in the system, which search functions are necessary, and which navigation options should be available. The requirements of the subcategory "use cases" basically specified that it must be possible to create use cases in the system based on a template, and which elements a use case should contain in the system. The subcategory "general design" defined the visual design of the system. Furthermore, requirements of this subcategory specified that there should be an area to refer to relevant publications and events and that the system should have a recommendation system for use cases based on previous usage. The subcategory "general system requirements" specified general requirements for the system, such as high availability, a responsive design, a simple login, and the embedding of a glossary. Finally, the subcategory "interaction with and among users" defined which communication options the system should offer.

6.2. Research Method

Several research methods were used for this design cycle. This section first describes the methods used to refine the content prototype. Then, it describes the methods that were used to design the e-service prototype.

Finally, the section describes the approach used to evaluate the e-service prototype in terms of PU and PEOU.

6.2.1. Methods for Refining the Content Prototype

The refinement of the content prototype followed, like the design of the content prototype in the second design cycle, the 6th guideline of Hevner, March, et al. (2004), that is, an iterative search process. The conclusions from the second design cycle formed the basis and in several coordination meetings the project team discussed whether and how changes should be implemented and whether the results of the implemented changes were appropriate.

Therefore, the following questions, which arose from the conclusions of the second design cycle, were discussed in this design cycle:

- Should the visual design of the use cases be adapted, and if so, how?
- Should the key data graphic be adapted, and if so, how?
- Should the section on legal aspects be expanded and go into more detail about the specific use case?
- Should there be a stronger focus on open source tools in the tool descriptions?
- Should the use of abbreviations in the use case descriptions be changed because it leads to confusion, and if so, how?

6.2.2. Methods for Designing the E-Service Prototype

The design of the e-service prototype also followed the 6th guideline of Hevner, March, et al. (2004) and was therefore also an iterative search process. The starting point for the design were the requirements of the category "system-relevant requirements" as described before and the decision already made at the beginning that a Moodle system should be the basis, which will be extended with the additional functionalities.

In order to ensure that the requirements were implemented accordingly by the developers and therefore positively influence PU and PEOU as assumed, mockups of the user interface were first created. Furthermore, texts and terms that were to be embedded in the system were also provided in advance. Finally, several feedback loops and intermediate tests were incorporated during the development phase.

6.2.3. Methods for Evaluating the E-Service Prototype

The 3rd guideline of Hevner, March, et al. (2004) for Design Science Research (DSR) prescribes that an evaluation of the artifact must be an essential part of the design process and that this should be done in the application environment, since this is also where the requirements for the artifact come from. The use of purely descriptive evaluation methods should be an exception if evaluations in the field are not possible for the artifact. (Hevner, March, et al., 2004)

Hevner (2007) reemphasized the importance of field testing in DSR and, accordingly, next to requirements elicitation, field testing is the second point of the relevance cycle (see Figure 2.2). According to Hevner, March, et al. (2004), the evaluation criteria should also come from the application environment. In the case of Acceptance-Driven Design Science Research (AD-DSR), these are PU and PEOU until the last design cycle.

In this sense, the evaluation of the e-service prototype was also carried out in the third design cycle. 28 test persons had the chance to test the e-service prototype for one month. They had to complete predefined tasks and answer related questions about PU and PEOU in writing. In addition, further qualitative feedback was obtained by means of interviews. This was necessary to obtain concrete qualitative suggestions for improvement and to clarify ambiguities in the written feedback. Interviews were conducted online due to limitations imposed by COVID-19.

In the following, the selection of the test subjects, the structure of the field test, the interview guide used and the content analysis conducted are described.

Selection of Test Subjects

A total of 28 test subjects participated in this evaluation. All nine higher educational institutions (HEIs) in the Styrian higher education (HE) area had to nominate three test persons each, with one HEI ultimately nominating four test persons. As with the selection of test persons in the second design cycle, care was taken to ensure that the test persons at each HEI differed in terms of their prior knowledge in the area of technology-enhanced learning (TEL).

Field Test

For the field test, the test subjects received access data to the e-service in advance by e-mail, as the access actually planned via ACOnet had not yet been implemented. The test subjects also received an e-mail with detailed instructions for the testing phase, which lasted from mid-October to mid-November 2020.

The test subjects had to complete 13 tasks in dealing with the e-service prototype and answer one to four associated questions, each of which had to be answered with (1) no, (2) rather no, (3) rather yes, or (4) yes. The 13 tasks were designed to cover as much of the e-service prototype as possible, i.e. implemented functionalities and provided content. The associated questions were aimed at assessing PU and PEOU.

In addition, the survey also asked whether the design of certain features could contribute to positive talk about eCampus. This was to indicate whether the design was also successful for the construct subjective norm (SN), as this can only be partially influenced by the design (see Section 5.2.2).

The test subjects also had the opportunity to provide general feedback or further feedback with each question. The tasks and associated questions were sent in an Excel file. All tasks and questions are listed in Appendix F.

Interview Guide

After the field test, individual interviews were conducted with the test subjects via MS Teams in November and December 2020. The main objective was to identify qualitative suggestions for improvement in terms of PU and PEOU. For system-relevant requirements and content-relevant requirements, the focus of the interview was on the implementation of the e-service prototype, while for service- and process-relevant requirements, which were not fully implemented until the last design cycle, the focus was more on future demands of the test persons.

The interview guide designed for this purpose had seven modules, with a few questions not asked in the interview when not necessary based on previously collected survey feedback. The detailed interview guide can be found in Appendix F. The seven modules are briefly described below.

Greeting and Explanation The test subjects were welcomed and the interview process was explained. It was pointed out that it was mainly about their personal experience with the e-service eCampus in the testing phase.

Introductory Questions Prior experience (EX) and self-efficacy (SE) should have influence on PU and PEOU according to the developed specific TAM (see Section 5.3) for the e-service eCampus. However, both cannot be influenced by the design of the e-service. In order to be able to better classify the results of the interviews in this respect, questions were asked in this module about EX and SE of the test person.

Technical Implementation The focus of this module was the technical implementation, e.g., performance, usability, accessibility, navigation and search options.

Support and Maintenance Looking ahead to the next design cycle, this module asked questions about future support and maintenance behavior.

Additional Services and Processes Also related to the next design cycle, this module addressed possible future services and processes.

Use Cases The focus in this module was the actual content of the eCampus, i.e. the use cases provided. The test persons were asked, for example, how useful they are, whether there should be other main topics, and whether the descriptions could be improved.

Miscellaneous Finally, miscellaneous topics in this module were discussed, such as the visual design, the types of media used, and general functionalities of the e-service.

Content Analysis

As in the evaluation of the use case prototype (see Section 5.2.4), the method according to Meuser and Nagel (2009) was used for the content analysis. This made it possible to identify necessary and commonly valid improvement suggestions for the broad target group of all teachers in the Styrian HE area. In addition to the interview results, the feedback of the previously conducted survey on the 13 tasks was also included. The quantitative results of this survey were used as an additional unified context.

6.3. E-Service Prototype

This section describes the e-service prototype, which was designed in this design cycle. The first part describes the results of refining the content prototype and finalizing the complete content of the eCampus. It answers the questions that arose as a conclusion of the second design cycle, addresses open content-relevant requirements that were not worked on in the second design cycle, and presents the final results regarding (1) overall structure, (2) key data, filter and recommendation criteria, and (3) type of presentation.

Then, the second part describes the e-service prototype, i.e. the technical implementation of the system-relevant requirements. For this purpose, the implementation of the key requirements from the subcategories (1) "structure and navigation", (2) "use cases", (3) "general design", (4) "general system requirements", and (5) "interaction with and among users" is presented.

6.3.1. Refinement of the Content Prototype

The evaluation results of the second design cycle ultimately provided five open questions that were addressed by the project team in this design cycle. With regard to the visual design of the use cases and the key data graphic, it was decided that they needed to be revised and a modern design should be aimed for. It was also decided that the content of the key data graphic should be reconsidered. According to feedback from the test persons, the section on legal aspects should be expanded and go into more detail. It was also decided to revise this section. However, a stronger focus on open source tools was not set for the further creation of use cases because this is already very pronounced from the point of view of the use case creators. Right from the start, it was decided to emphasize open source and typically available tools in the descriptions. Feedback regarding confusing abbreviations was also discussed, but no changes were made in this regard. All use cases typically use only two abbreviations, each of which was defined the first time it was used.

In addition to refining the content prototype, the entire eCampus content was finalized in the third design cycle. In the process, the overall structure and the selection of associated use cases, as well as the key data, filter and recommendation criteria were also slightly revised. In some cases, testimonials were added to the use cases (Req_4_C_SUC_SYSQ_Initial-testimonials) and the filter and recommendation criteria were filled in for all use cases (Req_5_C_SUC_SYSQ_Filter-criteria). Information on how to obtain technical and content support with two e-mail addresses (Req_4_C_-Misc_SERVQ_Contact-details) and information according to GDPR (Req_6_-C_Misc_SERVQ_PQ_GDPR) were added. Furthermore, a glossary (Req_8_-C_Misc_INFQ_Glossary) for common terms at eCampus was created and essential terms were explained on the homepage and after the first login (Req_9_C_Misc_INFQ_PI_Core-terms). According to the requirements, the eCampus team and use case creators should also be presented on eCampus with their names and short profiles (Req_10_C_Misc_PI_Team-2). However, the persons concerned did not want to agree to this, which is why this requirement was not implemented.

The following three sections show how (1) the overall structure, (2) the key data, filter and recommendation criteria, and (3) the type of presentation were finally designed.

Overall Structure

The final version of the overall structure contained 51 use cases. Compared to the content prototype, a few use cases were discarded, others added, and some renamed. These changes occurred during the creation of the use cases. Five of six categories remained the same in name and content. The category "feedback on formative and summative performance assessment" was renamed "feedback and performance assessment" as the shorter title was preferred by the project team, but again no changes were made to the content. Figure 6.1 (translated from German to English) shows the complete structure with the 51 use cases. As with the content prototype, some use cases were assigned to multiple categories in the final version.

Key Data, Filter and Reccomendation Criteria

There were only minor changes in the key data compared to the content prototype. Compared to the version after the second design cycle (see Section 5.5.2), the name of the use case creator and his contact details were removed because the use case creators did not give their consent to this. A table of contents and a section on technical infrastructure recommendations were added. The section on legal aspects was not expanded as requested by the test persons. Instead, it was standardized and now refers specifically in a short and concise form to the relevant legal topics that concern the use case. For detailed legal information, reference is made to the relevant offices at the user's own HEI. The project team, which did not consist of legal experts, did not want to make any incorrect statements here, which is why this form of description was chosen.

Figure 6.1.

E-Service Prototype: Overall Structure of Use Cases

Manage the Course

- E-Moderation
- Set rules for digital communication
- Set up online learning spaces
- Open Educational Resources in teaching
- Digital accessibility and inclusion

Create Teaching and Learning Materials

- Create a presentation with alternative techniques
- Formulate work tasks or assignments
- *Create closed question types*
- Enrich an instructional video with interactive elements
- Create a classic presentation
- Create an instructional video
- *Create open question types*
- Using screencasts in teaching
- Visualizations
- Recordings of a teaching lecture
- Use simulations and 3D elements in teaching
- Use Moodle question type STACK
- Create (interactive) digital scripts for teaching

Conduct Face-to-Face Teaching

- Audience response systems
- Use "Backchannel"
- Digital brainstorming to test prior knowledge in face-to-face classes
- Obtain digital feedback in the face-to-face unit
- Digital ice-breaker methods in classroom teaching
- *Collaborative writing*
- *Working with multimedia content*
- *(Collaborative) creation of literature and link lists*
- *Have students create media products*
- Designing a round of introductions with digital tools
- Present a lecture
- Enriching discussions with digital media and tools
- *Implement digital term collections in face-to-face and online teaching*
- *Digital brainstorming for idea generation*

Conduct Online Teaching

- Votes and sentiment barometer
- Obtain digital feedback in online teaching
- *Collaborative writing*
- *Working with multimedia content*
- *(Collaborative) creation of literature and link lists*
- *Have students create media products*
- Synchronous online communication
- Asynchronous work and discussion
- Hold an interactive videoconference in teaching
- *Implement digital term collections in face-to-face and online teaching*
- *Digital brainstorming for idea generation*

Performance Assessments and Feedback

- E-Portfolios
- Formative e-assessment
- *Create closed question types*
- Constructive feedback digitally and efficiently
- *Create open question types*
- Using peer feedback as a method
- Summative e-assessment
- Plan, create, and conduct an open-book exam
- Multimedia presentations in face-to-face and online teaching
- Digital flash feedback

Technology-Enhanced Course Concepts

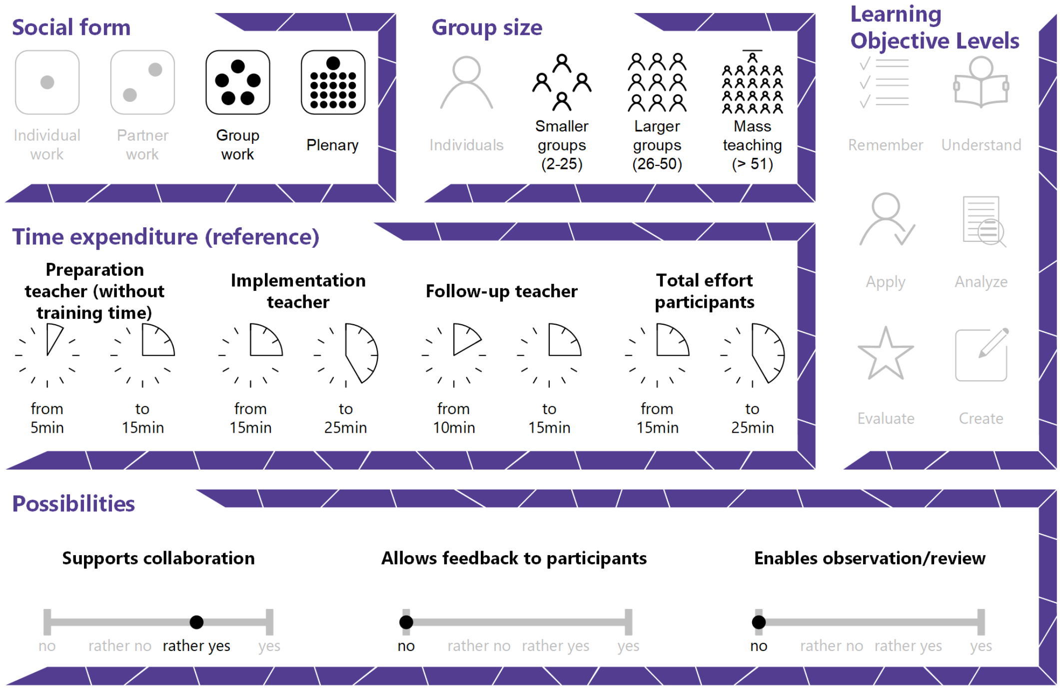
- Blended learning
- Flipped classroom as a teaching method
- Gamification
- Using blogs in teaching
- Problem-based learning
- Use social media in courses

Note. Use cases that appear in multiple categories are written in italics. The final version contained 51 use cases.

Only minor changes were also made to the filter criteria. For the group size, the number of participants for the respective category was added directly in parentheses because almost no one saw the associated footnote in the key data graphic during the first evaluation. In the filters concerning time expenditure, a category for the time expenditure for follow-up by the teacher was added. In addition, the fixed time intervals were supplemented by flexible ones. With regard to the recommendation criteria, there were no changes to the content prototype.

Figure 6.2.

E-Service Prototype: Example Key Data Graphic of Use Case



Type of Presentation

In regard to the type of presentation of a use case, the visual design and the key data graphic were revised in the third design cycle. The technical requirements section of the key data graphic was also removed, as it was difficult to define clear values for many use cases. Instead, the separate section in the use case description was added as described above. This made it possible to describe in more detail what technical infrastructure is necessary or useful for teachers and students when using the use case. The revised key data graphic can be seen in Figure 6.2 (translated from German to English). The final version of a use case, the same as in the second design cycle, can be found in Appendix G. The main changes were a uniform color scheme and visual frame elements that refer to the respective category(ies). Both should lead to the more modern visual design we were aiming for.

6.3.2. Design of the E-Service Prototype

This section shows how the main requirements of the e-service prototype were implemented. The corresponding requirements from the category "system-relevant requirements" can be found in Appendix D. The requirements as well as the description of the implementation of these are divided into the following five subcategories: (1) structure and navigation, (2) use cases, (3) general design, (4) general system requirements, and (5) interaction with and among users.

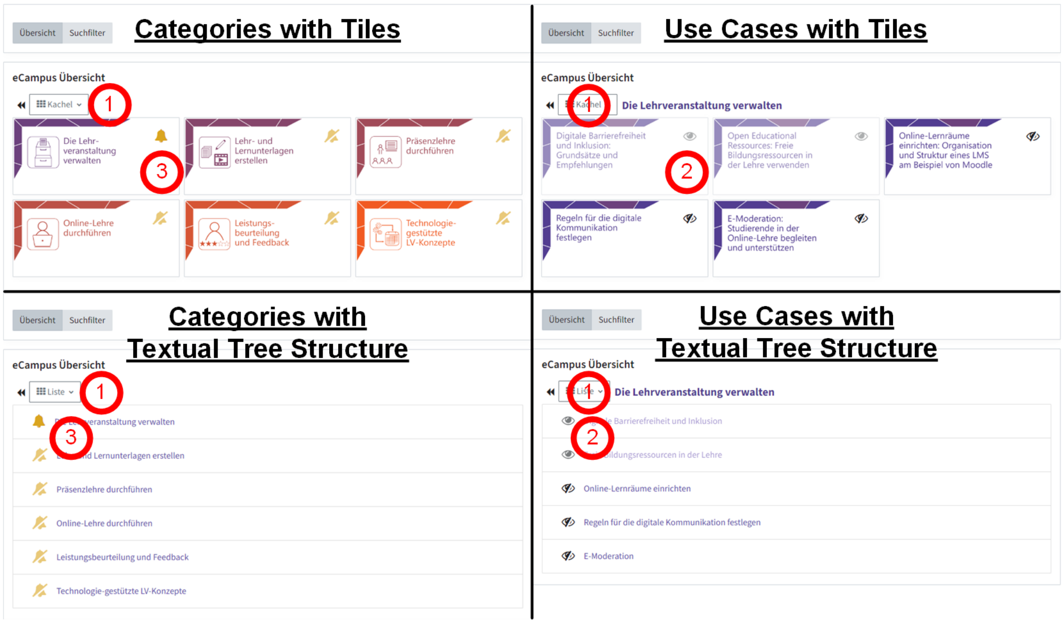
Structure and Navigation

The mapping of the content structure, i.e., the categories and assigned use cases, and navigation within this structure are important elements of the e-service according to the expert interviews conducted in the second design cycle. Individual use cases, which were mapped as Moodle courses, also had to be potentially contained in several categories (Req_1_SaN_SYSQ_JR) according to the overall structure (see Figure 6.1). For this, the Moodle standard functionality had to be extended.

Basic navigation within the structure was implemented in two ways (Req_3_-S_SaN_SYSQ_Navigation). On the one hand, navigation was implemented along a textual tree structure and on the other hand, visually appealing tiles were created that mapped categories and use cases. Figure 6.3[1] shows both navigation options. Users can switch between the views via a button (see marker (1) in the figure).

Figure 6.3.

E-Service Prototype: Navigation



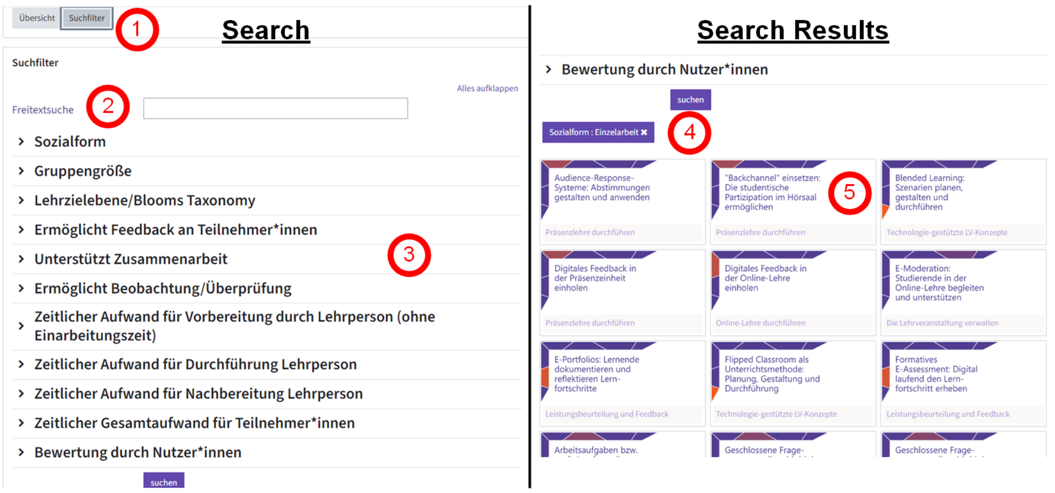
In addition to the navigation just described, a search function was implemented (Req_2_S_SaN_SYSQ_PI_Search). This includes a free-text search, which searches headlines and content but also posts in the associated discussion forums, and a search via the defined filter and recommendation criteria. Figure 6.4 shows the main elements of this search. A button allows users to switch between navigation and search (see marker (1) in the figure). In the search, the free-text search (see marker (2) in the figure) is listed first, followed by the individual filter criteria and finally the recommendation criteria, which can also be used for filtering (see area at marker (3) in the figure). The individual filters can be expanded and collapsed for a better

[1]Note that all screenshots are in German, because the e-service is only available in German.

overview. The selected filters (except for the terms in the free-text search) are also displayed to the user (see marker (4) in the figure). After pressing the button for the search, the individual matching use cases including category are displayed (see area at marker (5) in the figure), whereby only the display with tiles was implemented here.

Figure 6.4.

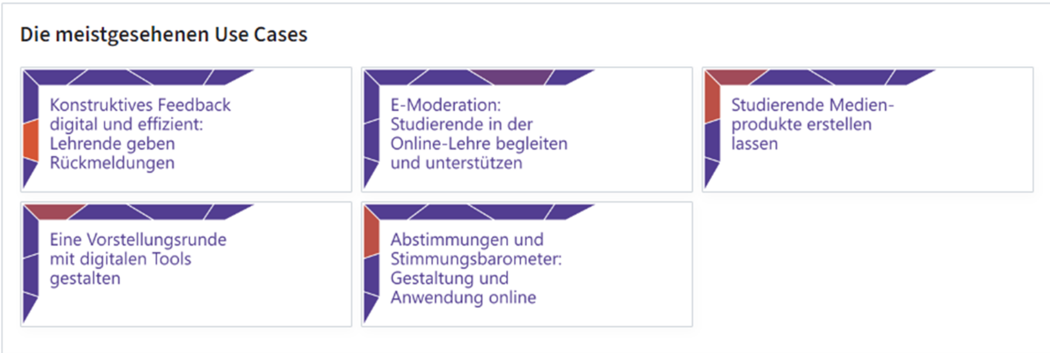
E-Service Prototype: Search



In accordance with the requirements, further functionalities were implemented in this context. On the one hand, the five currently most viewed (opened) use cases are always displayed under the navigation or search (see Figure 6.5) and can also be opened by clicking on the tiles (Req_4_S_-SaN_SYSQ_Top5). Users also have the option to mark use cases that they have already seen. This is possible in the navigation via an eye icon (see marker (2) in Figure 6.3). The use case is grayed out or displayed normally in the navigation accordingly (Req_5_S_SaN_SYSQ_Already-seen). For the categories, users can activate a reminder via a bell icon (see marker (3) in Figure 6.3), which informs users via e-mail when new use cases are added in this category.

Figure 6.5.

E-Service Prototype: Top5



Use Cases

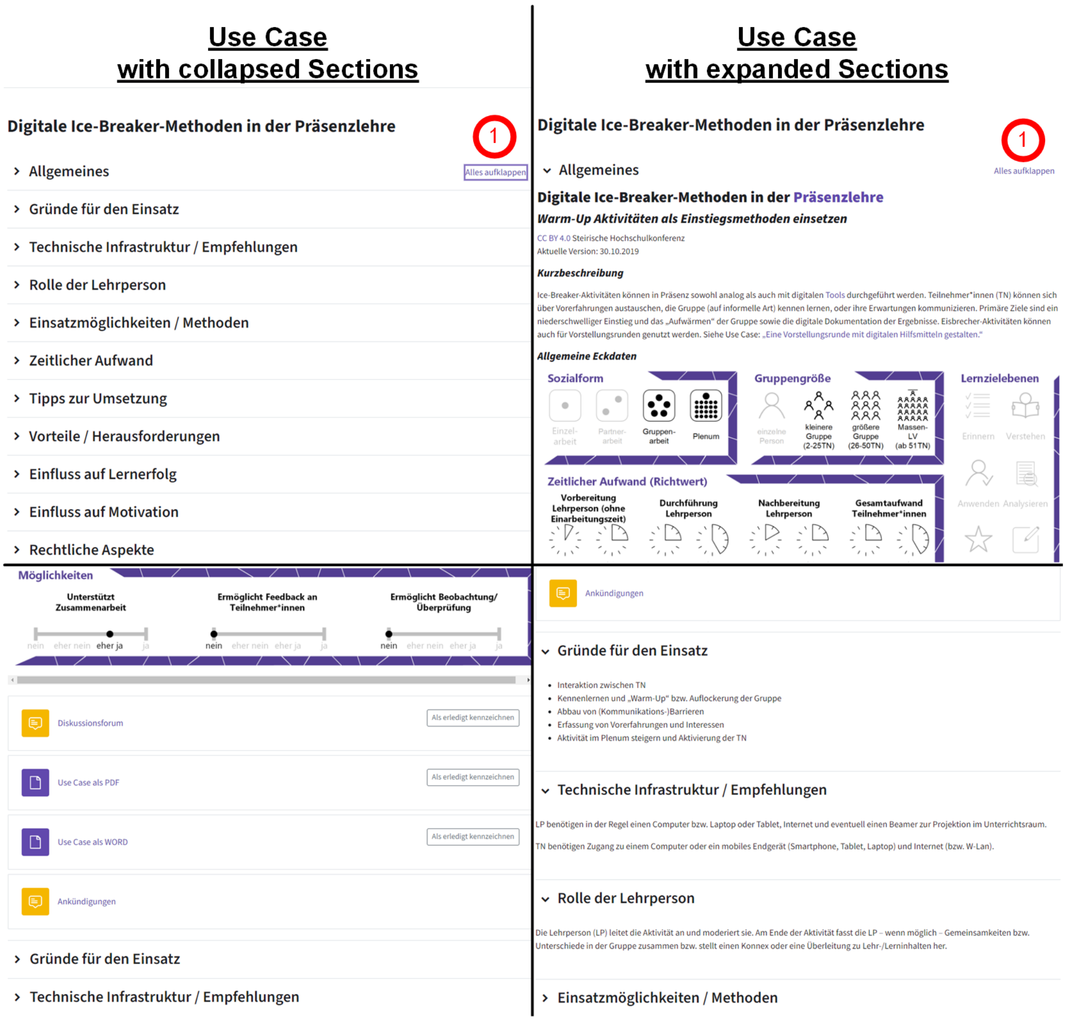
Core of the eCampus are certainly the individual use cases. To ensure that all use cases are presented in the same way, templates were created (Req_2_-S_-UC_-SYSQ_-INFQ_-SN_-JR_-SERVQ_-Create-use-cases). These include the defined key data (see Section 5.5.2 and Section 6.3.1) and the intended form of presentation (e.g., prose or bullet points), as well as a discussion forum and space for embedding the use case in WORD and PDF format (Req_5_-S_UC_INFQ_JR_Embedding-other-formats). In the system, a selected user group can create new use cases based on these templates. Figure 6.6 shows four excerpts of a finished use case. Using a button (see marker (1) in the figure), it is also possible to expand or collapse the individual key data.

Since the individual use cases are presented as Moodle courses, they also have their own Id accordingly and linking from one use case to another is supported (Req_4_S_UC_JR_Reference-to-other-use-cases).

To allow selected use cases to be viewed without logging in, a guest account was created which was automatically used and allowed access to selected use cases. However, it is not possible to create experience reports or feedback with this account (Req_1_S_UC_PI_Freely-accessible-use-cases). This is only possible for logged in users (Req_3_S_UC_SYSQ_Experience-reports-feedback). Experience reports can be added directly in the forum or via a

Figure 6.6.

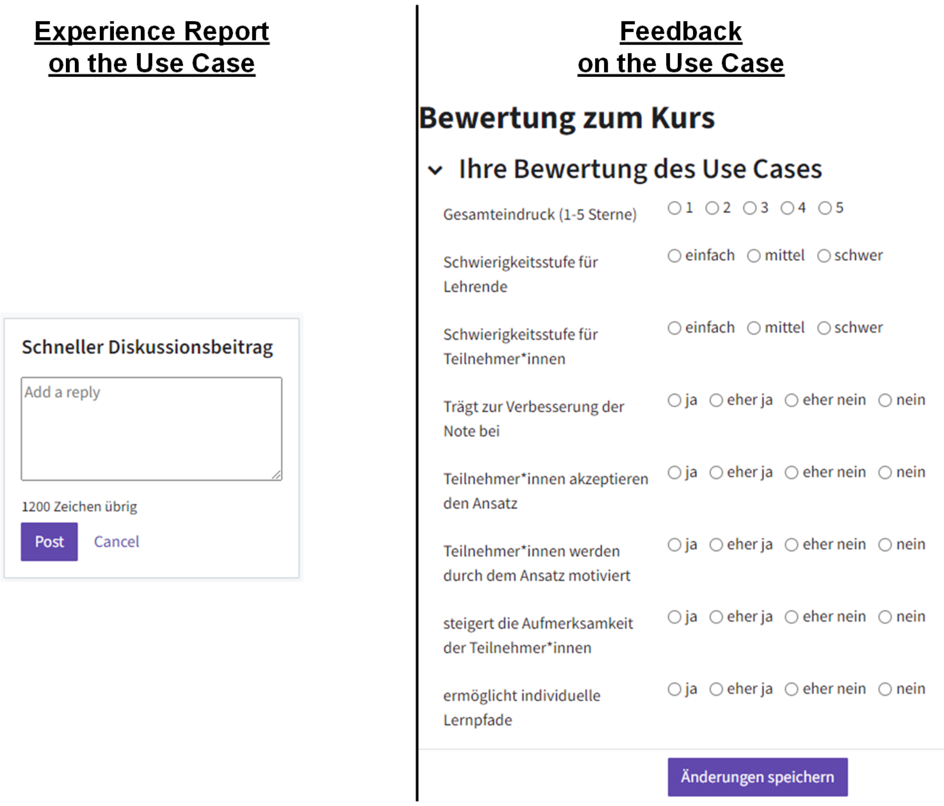
E-Service Prototype: Use Case



separate function directly in the use case for creating posts (see left side of Figure 6.7). Feedback can also be created directly in the use case, where the defined recommendation criteria (see Section 5.5.2 and Section 6.3.1) can be assessed (see right side of Figure 6.7).

Figure 6.7.

E-Service Prototype: Experience Reports and Feedback



General Design

As the previous screenshots show, the visual design of eCampus has been kept simple but consistent and modern (Req_3_S_GD_SYSQ_PI_Optical-design). Its color is based on the designed eCampus logo (see Figure 6.8).

Figure 6.8.

E-Service Prototype: eCampus Logo

Figure 6.9.

E-Service Prototype: Others also saw

If you open a use case, other use cases are also recommended on the page (see Figure 6.9). These are use cases that other users have viewed who have also viewed the opened use case (Req_2_SGD_SYSQ_Others-also-saw).

To be able to point out relevant publications or events, a block with announcements has been added on the right side of the main page (Req_1_S_-GD_JR_Blog). Behind this is a global forum where administrators can post articles that will be linked here.

General System Requirements

In regard of general system requirements, complete barrier-free access could not be implemented. However, alternative texts were added to images, for example, to simplify access (Req_1_S_GSR_SYSQ_Barrier-free-access). The entire eCampus also has a responsive design (Req_2_S_GSR_SYSQ_Responsive-design) and attention was paid to high performance and availability (Req_3_-SGSR_SYSQ_Availability/Performance).

In the background, multi-language capability was also prepared in principle (Req_5_S_GSR_INFQ_Bilingualism) and text blocks can be provided in several languages. However, a translation was not carried out within the scope of the project. The system is also GDPR-compliant (Req_7_S_GSR_-PQ_GDPR) and the additional functionalities have been embedded in such a way that future extensions and updates are easily possible (Req_6_S_-GSR_PI_Extensibility). An integration into the technical infrastructure of the individual HEIs is also possible (Req_10_S_GSR_PI_Technical-integration), but depends on the individual HEIs. Among other things, a login via the ACOnet system was implemented for this purpose[2], which should also ensure the simplest possible login (Req_8_SGSR_SYSQ_Login).

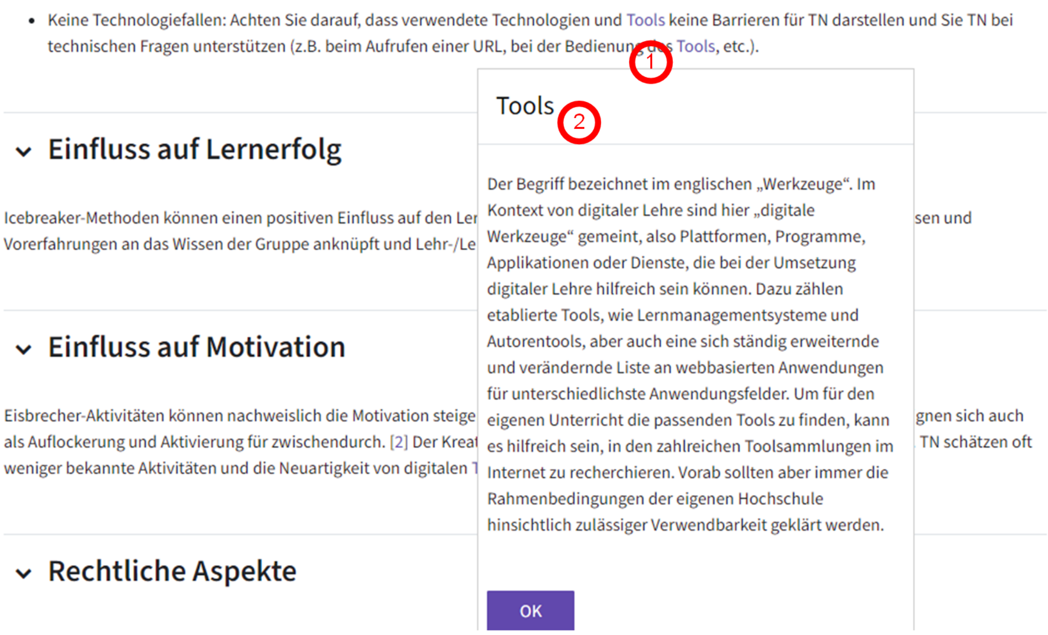
A glossary with 24 entries was also created to define selected terms used on eCampus. As Figure 6.10 shows, the glossary is referenced directly within the use cases with a mouse-over effect. The respective term (see marker (1) in the figure) is highlighted, a mouse-over effect indicates a respective

[2]Note that the login via the ACOnet system was implemented only after the testing phase in the third design cycle.

entry in the glossary, and the glossary entry (see marker (2) in the figure) is displayed after clicking on the term (Req_4_S_GSR_INFQ_Glossary).

Figure 6.10.

E-Service Prototype: Glossary



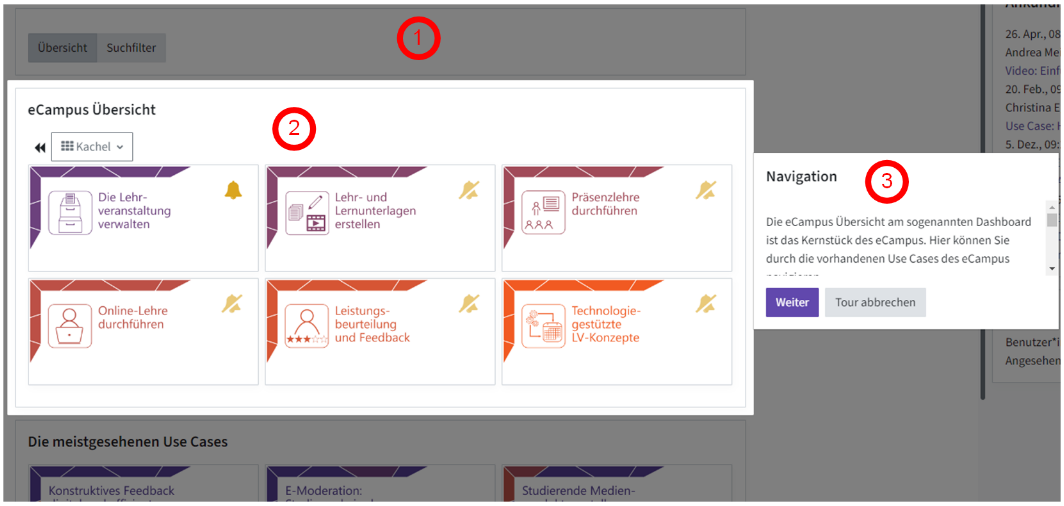
To make it easier for new users to get started, a user tour has also been created that appears automatically the first time a user logs in and can also be accessed later (Req_9_S_GSR_INFQ_Entry-information). It explains the goals of eCampus, generally used terms and essential areas. As shown in Figure 6.11, areas that are not relevant are darkened (see area at marker (1) in the figure), the essential areas are highlighted (see area at marker (2) in the figure), and explanatory texts for the areas are provided (see area at marker (3) in the figure).

Interaction with and among Users

Interaction with and among users was also an important part of the requirements surveyed. With this in mind, users were given the opportunity

Figure 6.11.

E-Service Prototype: User Tour



to provide general feedback on eCampus on the main page (Req_1_S_IU_-SN_Feedback-to-eCampus). Contact to use case creators or other users is implemented via experience reports in the discussion forum or via the feedback option (Req_2_S_IU_SYSQ_PI_SN_SERVQ_Networking-contact). To obtain additional feedback, users are also prompted every three months with a small message at the top of the screen to provide feedback or testimonials (Req_3_S_IU_SYSQ_Feedback). It is also technically possible for selected experience reports to be displayed directly on the eCampus homepage to create a positive impression before logging in (Req_8_S_IU_PI_SN_Public-experience-reports).

To avoid GDPR or privacy issues, further requirements for interaction with and among users were not implemented. For example, it was originally planned that users could create user profiles (Req_6_S_IU_SN_SI_SERVQ_-User-profile), usage statistics for administrators would be implemented (Req_4_S_IU_SYSQ_SN_Usage-statistics), users could directly refer other users to use cases (Req_5_S_IU_SN_Explicit-recommendations), and inactive users would be reminded of eCampus via e-mail (Req_7_S_IU_PI_Reminder-for-eCampus).

6.4. Evaluation

As in the second design cycle, the focus of the evaluation in the third design cycle was also on qualitative feedback on PU and PEOU in order to derive suggestions for improvement. For this purpose, a content analysis according to Meuser and Nagel (2009) was conducted for the written comments in the survey and the feedback in the interviews. In addition, a quantitative analysis of the conducted survey was performed to obtain an initial quantitative sentiment survey on PU and PEOU, and on the construct SN as described in Section 6.2.3. The following two sections describe first the results of the quantitative evaluation and then those of the qualitative evaluation.

6.4.1. Quantitative Evaluation

As described in Section 6.2.3, after the test phase, the 28 test subjects answered in writing one to four questions for each of the 13 tasks about PU, PEOU, and SN. The detailed questions are listed in Appendix F. Each question could be answered with (1) no, (2) rather no, (3) rather yes, or (4) yes. The questions were related to whether a functionality or content had a positive impact on PU, PEOU, or SN from the subject's perspective. Table 6.1 shows the results of this survey, using an abbreviated form instead of the full questions for better clarity. The construct, i.e., PU, PEOU, or SN, in question is indicated in parentheses. In addition, the median per question is given.

As can be seen in Table 6.1, according to the majority of the 28 test subjects, the functionalities and contents of eCampus had a positive influence on PU, PEOU, and SN (*Mdn* = 4.0). A slightly lower positive influence (*Mdn* = 3.0) was found in eight cases in this evaluation. For example, according to feedback, the introductory information, visual design, discussion forum, general feedback functionality, and references to other use cases only slightly contributed to the ease of use of eCampus. The discussion forum was also only somewhat useful and, according to some test subjects, did not necessarily contribute to positive talk about eCampus, as did the functionality for general feedback. According to the test persons, only the

Table 6.1.

Frequency Distribution of Influence of Functionalities and Content

	No (1)		Rather no (2)		Rather yes (3)		Yes (4)		
Question	*n*	%	*n*	%	*n*	%	*n*	%	*Mdn*
Introductory information useful (PU)	0	0.0	0	0.0	11	39.3	17	60.7	4.0
Introductory information understandable (PEOU)	0	0.0	1	3.6	8	28.6	19	67.9	4.0
Introductory information makes it easier (PEOU)	2	7.4	4	14.8	10	37.0	11	40.7	3.0
Privacy statement useful (PU)	3	11.1	5	18.5	5	18.5	14	51.9	4.0
Privacy statement understandable (PEOU)	0	0.0	0	0.0	9	33.3	18	66.7	4.0
Privacy statement makes it easier (PEOU)	10	37.0	6	22.2	6	22.2	5	18.5	2.0
Glossary useful (PU)	2	7.1	3	10.7	2	7.1	21	75.0	4.0
Glossary easy to use (PEOU)	0	0.0	1	3.6	4	14.3	23	82.1	4.0
Glossary makes it easier (PEOU)	1	3.8	2	7.7	8	30.8	15	57.7	4.0
Visual design useful (PU)	0	0.0	1	3.6	10	35.7	17	60.7	4.0
Visual design makes it easier (PEOU)	1	3.6	2	7.1	13	46.4	12	42.9	3.0
Topics useful (PU)	0	0.0	0	0.0	4	14.3	24	85.7	4.0
Category “Manage the Course” useful (PU)	0	0.0	3	11.5	4	15.4	19	73.1	4.0
Navigation and Search useful (PU)	1	3.6	3	10.7	9	32.1	15	53.6	4.0
Navigation and Search easy to use (PEOU)	0	0.0	6	21.4	7	25.0	15	53.6	4.0
Navigation and Search make it easier (PEOU)	1	3.6	5	17.9	5	17.9	17	60.7	4.0
Use cases useful (PU)	0	0.0	1	3.8	5	19.2	20	76.9	4.0
Use cases understandable (PEOU)	0	0.0	1	3.8	5	19.2	20	76.9	4.0
Use cases contribute to positive talk (SN)	0	0.0	2	7.4	10	37.0	15	55.6	4.0
Described tools useful (PU)	0	0.0	0	0.0	4	15.4	22	84.6	4.0
Discussion forum useful (PU)	1	3.6	5	17.9	11	39.3	11	39.3	3.0
Discussion forum easy to use (PEOU)	0	0.0	0	0.0	5	18.5	22	81.5	4.0
Discussion forum makes it easier (PEOU)	4	14.3	8	28.6	7	25.0	9	32.1	3.0
Discussion forum contribute to positive talk (SN)	1	4.0	5	20.0	9	36.0	10	40.0	3.0
General feedback useful (PU)	0	0.0	5	17.9	7	25.0	16	57.1	4.0
General feedback easy to use (PEOU)	0	0.0	1	3.6	4	14.3	23	82.1	4.0
General feedback makes it easier (PEOU)	1	3.6	9	32.1	11	39.3	7	25.0	3.0
General feedback contribute to positive talk (SN)	2	7.4	3	11.1	9	33.3	13	48.1	3.0
References to other use cases useful (PU)	1	3.6	3	10.7	6	21.4	18	64.3	4.0
References to other use cases easy to use (PEOU)	3	10.7	1	3.6	5	17.9	19	67.9	4.0
References to other use cases make it easier (PEOU)	4	14.3	5	17.9	10	35.7	9	32.1	3.0
Links to external information useful (PU)	0	0.0	0	0.0	10	35.7	18	64.3	4.0
Links to external information easy to use (PEOU)	0	0.0	0	0.0	5	17.9	23	82.1	4.0
Links to external information contribute to positive talk (SN)	0	0.0	4	15.4	6	23.1	16	61.5	4.0

privacy policy did not have a positive impact on the easier use of eCampus (*Mdn* = 2.0), although the explanation itself was understandable for all.

6.4.2. Qualitative Evaluation

The results of the qualitative content analysis according to Meuser and Nagel (2009), which was carried out for the written comments in the survey and the interviews, could be summarized in 16 categories. The following sections describe the main points that emerged for each category.

Pre-Experience

According to their own statements, all 28 test subjects had previous experience with TEL. For some of them, this was due to the COVID-19 pandemic. Mainly previous experience with Moodle, video conferencing systems in the classroom and screencasts were mentioned. A few test persons had also already completed special training in the field of TEL and two were doing research in the field. Thus, as intended, the sample covered different levels of experience with TEL. The motivation to try new things was high for all test persons. This was probably the reason why these persons agreed to participate in the test phase. Finally, it can be noted that the evaluation of the other topics showed a tendency for people with less experience to be more critical of eCampus. However, much of the criticism could be attributed to the lack of digital competence in general.

Homepage, Access and Privacy

The majority of the test persons were satisfied with the homepage, the access options and the privacy policy. The comments referred to minor details. For example, the text on the homepage should be shortened and the term "use case" should be explained on the homepage. The login button (simple text button in the upper right margin) was difficult to find for some test persons and the data protection statement (link in footer) was not visible enough for some. A few test persons also wished for a visual improvement of the homepage, e.g. with images.

Glossary

A high level of satisfaction was found among the test persons with regard to the glossary. The only comments were that for links to the glossary the English term was sometimes used instead of the German term, that the terms “use case” and “Bloom’s Taxonomy” should be included, and that the functionality for alternative terms should be deactivated because it was never used.

Visual Appearance

Regarding the visual appearance, most test persons praised the simple design and clarity. However, the order of the blocks on the main page should be reconsidered. The most viewed use cases should not be embedded before but after the navigation/search. Furthermore, it was noted that the small message with the request to give general feedback (this was shown to all test persons during the test phase) runs into the eCampus logo.

Technical Performance

All test persons were very satisfied with the technical performance and no problems regarding availability or speed were reported. However, according to feedback, the responsive design had some problems because the blocks sometimes overlapped.

User Interface

The test subjects were also all very satisfied with the user interface. The only comments were that the navigation back to the main page was difficult to find as well as the links to the glossary and global feedback.

Navigation and Search

Regarding navigation and search, a few small things became visible during the test phase. In the display, the short names and not the full names were shown for a few use cases. The view as a textual tree structure also sometimes automatically switched back to the view with tiles. It was also noted that expanding the search filters is somewhat cumbersome and that when the button for the search is pressed, the focus is not placed on the search results but back on the search filters.

Use Cases

The use cases were praised by all test persons. For six test persons, however, the use cases were somewhat too long, despite praise. They would like to see a shortened form in order to get a quicker overview.

Networking

Discussion forums have been set up for each use case for networking with other users and use case creators. Most of the test persons considered such discussion forums to be useful. However, it was also noted that this is only the case if an active community also posts regularly and one also receives quick answers to questions. Some also noted that a moderator would probably be necessary for this.

Feedback and Evaluation Possibilities

The feedback and evaluation possibilities were generally assessed positively. However, some test persons did not see any added value in the feedback or evaluations of other users.

Internal/External Links

In the case of links, a few test subjects wished that new tabs would always open automatically. Many test persons also complained that the links within the use cases to other use cases always referred to the homepage. However, it should be mentioned here that it was planned to update these links after the test phase and the test subjects were informed of this in advance.

Support and Maintenance

Regarding maintenance and support, the opinions of the testers were very different. Some would like to have telephone support, for others email contact is sufficient. Some would like to have a contact person at their own HEI, for others a central support for technical and didactical inquiries is sufficient. A few test persons also suggested live sessions on the platform in which the eCampus or the application of individual use cases are shown.

Participation

Again, it was noted that active participation is only interesting if there is also an active community and a moderator. Some would also be willing to create use cases themselves or at least provide input. A certificate system, as confirmation that one has acquired the content, was interesting especially for younger test persons.

Marketing

Regarding marketing, the feedback shows quite clearly that the promotion of eCampus must be done internally at the HEI. Internal channels are trusted the most and therefore embedding eCampus in the HEI's internal infrastructure is apparently essential.

License

The use cases on eCampus were all deliberately published with the CC By license. This allows teachers to reuse the content for their own purposes. As expected, this was not relevant for all test persons, but a few test persons stated that they definitely intend to use the content for their own purposes.

General Feedback

In general, it was noted that the content still had some spelling and grammatical errors. The system also sent out automatically generated e-mails to users very often. However, the general feedback on eCampus was very positive and the test subjects were very satisfied and indicated that they would like to use eCampus more often.

6.5. Discussion

As with the design of the content prototype in the second design cycle, the design of the e-service prototype in the third design cycle was characterized by the 6th guideline for DSR by Hevner, March, et al. (2004). Accordingly, an iterative search process was used to implement the best solutions that were feasible with the available resources, means, and given constraints. Compared to the design of the content prototype, fewer compromises had to be made for the e-service prototype, especially from a technical perspective. The feedback on the use case prototype from the second design cycle could also be fully addressed and implemented accordingly.

The quantitative and qualitative evaluation results show a thoroughly positive picture. Most of the content and functionalities contributed to increased usefulness and/or increased ease of use, according to the 28 test persons. Qualitative feedback was limited to minor suggestions for improvement, most of which were overlooked in internal testing and did not require major changes. Thus, even after the second evaluation of eCampus, it could be assumed that there was high PU and high PEOU. According to Davis and

Venkatesh (2004), this interim evaluation should thus indicate that PU and PEOU of the e-service should also be high for the general target group. However, as with the evaluation in the second design cycle, this was also still an assumption that can only be confirmed or refuted with the last evaluation in the fourth design cycle.

It is also only with the last evaluation in the fourth design cycle that it can be verified whether EX actually has an influence on PU and PEOU. However, the individual results of the quantitative and qualitative evaluation in this design cycle indicate that test subjects with less prior experience, usually coupled with lower digital literacy, also tended to have more problems when using eCampus. As described in Section 5.3, I.-F. Liu et al. (2010) and Khan and Qutab (2016) found support for an influence of EX on PEOU.

With 28 test persons, three to four per Styrian HEI, with different experiences with TEL, a representative sample can be assumed for the qualitative evaluation. However, the results of the quantitative evaluation should only be regarded as indicative, as described above. The field test and the interviews also had limitations that should be taken into account. In the case of the field test, the influence of misinterpretation of the tasks and questions cannot be excluded. This was also confirmed by the fact that hardly any test person had read the note that links within the use cases were not yet correct. Furthermore, a certain influence by the interviewer cannot be excluded. However, the interview guide should have ensured a high degree of uniformity. The fact that the interviews were only conducted online may of course have also influenced the results. In particular, short transmission problems that led to a loss of information may have played a role.

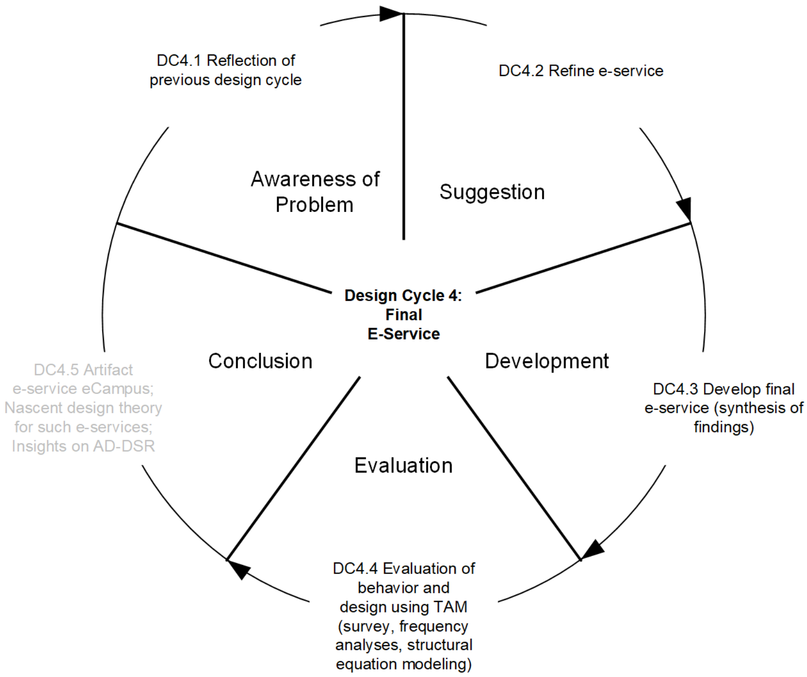
6.6. Conclusion

With the third design cycle described in this chapter, the e-service prototype was created. The first step was to incorporate feedback on the use case prototype from the second design cycle. The visual design of the use cases and the key data graphic was revised and made more modern. After that, the rest of the e-service content was finalized, with hardly any changes in terms of content compared to the content prototype. At the same time, the system-relevant requirements were also implemented, which were divided into the categories "structure and navigation", "use cases", "general design", "general system requirements", and "interaction with and among users".

The evaluation of the e-service prototype was conducted with a field test and interviews with 28 test persons. The focus was on identifying qualitative suggestions for improvement in terms of usefulness and ease of use. The results can generally be described as positive and it can be assumed after the third design cycle that the implemented requirements have a positive impact on PU and PEOU. The derived suggestions for improvement mostly concern minor issues that were overlooked during internal testing. The following is a list of the suggested improvements that should be addressed in the next and final design cycle:

- Shorten text on homepage and explain term "use case"
- Improve homepage visually, e.g. with images
- Make login button more visible
- Make link to privacy policy more visible
- Use German term for glossary
- Include the terms "use case" and "Bloom's Taxonomy" in glossary
- Disable alternative terms in glossary
- Reconsider order of blocks on main page
- Adjust prompt message for feedback
- Check responsive design
- Make navigation to main page, glossary and general feedback more visible
- Use full use case names throughout
- Prevent automatic switch back to tile display
- Reconsider expanding filter criteria
- Set focus correctly for search
- Consider shortening the use cases
- Check measures for an active community and moderator for discussion forums
- Check opening of new tabs for links
- Check support options
- Check possibilities for certificate system
- Check possibilities for advertising eCampus internally by individual HEIs

7. Design Cycle 4: Final E-Service



The fourth and final design cycle had three tasks. First, the e-service prototype designed in the third design cycle was refined. Second, the e-service was finalized and the last open requirements from the requirements category "service- and process-relevant requirements" (see Section 5.4.3) were designed. Third, in this design cycle, the e-service was evaluated one last time. According to Acceptance-Driven Design Science Research (AD-DSR), this evaluation was performed from a design-oriented and a behavior-oriented perspective.

This chapter describes the fourth design cycle as follows. In the first section, the results of the design of the e-service prototype are reflected (awareness of problem) to form the necessary basis for the refinement of the e-service prototype (suggestion). In addition, the open service- and process-relevant requirements are also described in summary form, as they constitute the final part of the design of the e-service (suggestion). The next section describes the research methods used for refining the e-service prototype, designing the final e-service, and especially for evaluating the e-service, which was done with a survey and frequency analyses, correlation analyses, and structural equation analyses (suggestion). Then, the final e-service, i.e., the refinement of the e-service prototype and the implemented service- and process-relevant requirements, is described (development). The fourth section then shows the results of the frequency analyses, correlation analyses, and structural equation analyses performed on the data from the survey (evaluation). Finally, the last two sections discuss and summarize the results of this design cycle (conclusion). This discussion and conclusion refers only to this design cycle and not to the entire thesis. Such a discussion and conclusion will take place in the next two chapters respectively (see Chapter 8 and Chapter 9).

7.1. Introduction

For the refinement of the e-service prototype, the results of the evaluation in the third design cycle and the conclusions drawn from it served as a basis (see Section 6.4 and Section 6.6). For the completion of the final e-service, mainly the open service- and process-relevant requirements (see Section 5.4.3) were relevant.

From the content analysis according to Meuser and Nagel (2009), which was conducted in the third design cycle for the written comments of the survey and the interviews, a total of 21 minor suggestions for improvement could be derived for refining the e-service prototype. These can be grouped into five categories. The first suggestions for improvement concern minor adjustments and corrections to texts and terms. According to the test persons, the text on the homepage should be shortened and the term “use case” should already be explained here. For the glossary, the German term should be used throughout. In addition, the terms “use case” and “Bloom’s Taxonomy” should be explained in the glossary. The partially used short titles of the use cases should also be replaced by the full titles.

The second category of suggestions for improvement concerns minor visual adjustments and the visibility of individual navigation elements. The test persons reported that the login button, the link to the privacy policy, as well as the links to the main page, to the glossary and to the general feedback function were sometimes difficult to find. Feedback was also received that the homepage should be visually improved with images, the arrangement of the blocks on the main page should be reconsidered, the message asking the user for feedback partially covered the logo, and the responsive design did not fit consistently.

Smaller suggestions for improving the behavior of various functions form the third category. It was noted that in the glossary the function for alternative terms should be deactivated because it was never used. The selection of the view on the main page (textual tree structure or tiles) also always automatically switched back to the tile view according to the test persons. Expanding and collapsing the filter criteria was also cumbersome for some test persons and should be reconsidered according to feedback. In addition, according to the test persons, the focus was not placed on the search results after the search, but rather on entering the filter criteria again. A few test persons also suggested that new tabs should always be opened for links.

For the use cases themselves, the fourth category of suggestions for improvement, there was only occasional feedback that a shorter version was desired. The fifth and final category contains suggestions for additional services and processes. It was mentioned several times that the discussion forums need an active community and that a moderator may be necessary. Advertising for the e-service should primarily be done internally at the respective higher educational institutions (HEIs), according to the test persons. In addition, various options for support were pointed out and younger test persons in particular would like to see a certificate system that proves that they have acquired the contents of eCampus.

The open service and process-relevant requirements were also divided into five subcategories. The subcategory “support” describes who should be available for content-related and technical questions and how users should be able to reach this support. The subcategory “maintenance” describes which regular maintenance work must be ensured. The subcategory “marketing” defines which advertising measures should be established for eCampus and the subcategory “user participation” describes which possibilities for user participation should be implemented. The last subcategory “miscellaneous” contains requirements for additional services and processes that could supplement eCampus.

In the introduction of this fourth and final design cycle, it must also be mentioned that the design cycle addresses again the following two research questions that guided this thesis:

> *RQ2.* What requirements define an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?
>
> *RQ3.* What constructs influence the acceptance of an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

RQ3 is finally answered at the end of this chapter. The answer to *RQ2* is given in chapter 8.2 in the context of the proposed nascent design theory presented there.

7.2. Research Method

The final design cycle also used multiple research methods. This section first describes how the refinement of the e-service prototype and the design of the final e-service, i.e. the design of further services and processes, were proceeded. Then, this section describes how the final evaluation of the eCampus was conducted using a survey and associated statistical analyses.

7.2.1. Methods for Refining the E-Service Prototype

The 6th guideline of Hevner, March, et al. (2004) was also considered in the design process when refining the e-service prototype. Suggested changes from the evaluation of the e-service prototype were discussed by the project team. Obvious errors in the implementation that were reported back were passed on to the development team, and for the other suggested improvements, possible changes were discussed considering resources, means, and constraints. In detail, the following issues were discussed:

- Should the text on the homepage be shortened and the term "use case" already explained there?
- Should the homepage be visually adapted and supplemented with images?
- Should the login button as well as the links to the privacy policy, the glossary, the main page and the general feedback function be made more visible?
- Should the terms "use case" and "Bloom's Taxonomy" be added to the glossary?
- Should the alternative terms feature in the glossary be disabled?
- Should the blocks on the main page be arranged differently?
- Should the expand and collapse of filters be replaced with a different display?
- Should the use cases be shortened or should an additional short version be created?
- Should new tabs be opened for links throughout?

The suggestions regarding services and processes were taken into account in the design of the final e-service (see Section 7.2.2).

7.2.2. Methods for Designing the Final E-Service

The design of the final e-service concerned the open service- and process-relevant requirements. The special challenge in designing these requirements was that they could only be implemented after the end of the project and that the funding for maintaining these services and processes was outside the project budget and was also not secured at the beginning of the project.

Based on the requirements of the category "service- and process-relevant requirements" elicited in the second design cycle (see Section 5.4.3) and the suggestions that could be derived from the evaluation in the third design cycle, implementation proposals were developed in the project team in several iterative sessions. The nine Styrian HEIs were also involved in this process through their responsible persons for technology-enhanced learning (TEL), who also served as experts in the requirements elicitation in the second design cycle. Finally, the proposals for services and processes to be implemented, including their running costs, were presented to the rectorates of the nine HEIs, which ultimately decided which services and processes should be implemented.

This part of the design is thus also in line with the 6th guideline of Hevner, March, et al. (2004). The design was an interactive search process and was strongly influenced by resources, means, and constraints of the application environment.

7.2.3. Methods for Evaluating the Final E-Service[1]

This section describes how the final evaluation of the e-service eCampus was conducted. The goal of the evaluation was twofold. From a design-oriented perspective, it was analyzed whether the developed e-service eCampus was accepted by the teachers of the Styrian HEIs and whether the target group was satisfied with the design of individual constructs that were supposed to positively influence acceptance. From a behavioral point of view it was analyzed which constructs influenced the acceptance of the designed e-service eCampus, i.e. the Technology Acceptance Model (TAM) created in the second design cycle and the associated formulated hypotheses (see Section 5.3) were tested. A quantitative survey was conducted as an instrument for the evaluation. The following sections describe how the data was collected, the questionnaire was structured, the data was analyzed, and which data sets were finally available for the analysis.

Data Collection

The online survey was created with Unipark and sent out to the target group, the teachers of the Styrian higher education (HE) area. For this purpose,

[1]Parts of this section have already been published in: Beer (2022b)

the survey link was made available to those responsible for TEL at the nine Styrian HEIs, who distributed the link to teachers via newsletters and other methods. The survey was available from the beginning of November 2021 until the end of February 2022.

Measurement

The questionnaire for the survey was divided into the following five sections. The items for individual constructs were largely derived from relevant literature and adapted accordingly. The complete questionnaire can be found in Appendix H.

- Introduction (greeting, short description of eCampus, privacy policy)
- Demographic data (experience with TEL, teaching experience, higher educational institution)
- Baseline data (awareness of eCampus, intention to use eCampus, actual use of eCampus)
- Acceptance constructs for all participants
- Acceptance constructs for participants who had already used eCampus

Table 7.1 shows which items were measured for the demographic data[2]. The construct "experience with TEL" was measured with a 7-point Likert scale ranging from (1) very low to (7) very high. The construct "teaching experience" was also measured with seven levels ranging from (1) less than one year to (7) more than 11 years. The construct "higher educational institution" represented the nine HEIs of the Styrian HE area.

Table 7.2 shows the constructs and associated items for the baseline data. For the construct "awareness" the response options were (1) yes and (2) no. The construct "actual use (AU)" was measured with three items. All were measured with seven levels. Item AU1 ranged from (1) never to (7) more than ten times. Item AU2 ranged from (1) never logged in to (7) more than two hours. Item AU3 was measured with a 7-point Likert scale ranging from (1) very little/never to (7) very much. The construct "behavioral intention (BI)" was also measured with three items, all of which were mapped as a

[2]Note that all items are translated from German to English for presentation in this thesis.

7-point Likert scale ranging from (1) strongly disagree to (7) strongly agree. The items for the constructs AU and BI were derived from the items used by Venkatesh and Bala (2008).

Table 7.1.

Measurements of Demographic Data Final Evaluation

Construct	Item
Experience with TEL	(D1) How would you rate your experience with TEL? Note: very low: You have never used technologies in teaching before. medium: You can use typical tools such as PowerPoint and Moodle without any problems. very high: You are doing research in the area of TEL.
Teaching experience	(D2) How long have you been teaching?
Higher educational institution	(D3) At which higher educational institution do you mainly teach?

Table 7.2.

Measurements of Baseline Data Final Evaluation

Construct	Item
Awareness	(K1) I have already heard about eCampus.
Actual use (AU)	(AU1) How many times have you logged in to eCampus? (AU2) On average, how much time do you spend on eCampus when you are logged in? (AU3) How intensively have you used eCampus so far? Note: very little: Logged in for a short time at most. medium: Read one use case. very much: Read several use cases and tried them out in teaching.
Behavioral intention (BI)	(BI1) I plan to log in to eCampus in the future. (BI2) I plan to read use cases on eCampus in the future. (BI3) I plan to use information from eCampus to improve my teaching.

The acceptance constructs were each queried with three to four items. A 7-point Likert scale ranging from (1) strongly disagree to (7) strongly agree was used for each measurement. The constructs SE, EX, PI, SN, SI, JR, PQ, and PU were measured for all participants. The constructs PEOU, SYSQ, INFQ, and SERVQ were only measured for participants who had already used eCampus, as these constructs can only be assessed if eCampus has already been used. Table 7.3 shows the items used for each construct.

Table 7.3.

Measurements of Acceptance Constructs Final Evaluation

Construct	Item
Self-efficacy (SE)	(SE1) I am able to operate an e-service such as eCampus with no support and assistance. (SE2) I am confident that I can overcome any obstacles when using an e-service such as eCampus. (SE3) I believe that I can use different e-services such as eCampus.
Experience (EX)	(EX1) I have experience with e-services such as eCampus. (EX2) I know e-services similar to eCampus. (EX3) I have used e-services similar to eCampus before.
Personal innovativeness (PI)	(PI1) It is very attractive for me to try new e-services such as eCampus. (PI2) I prefer that others have used a new e-service before I try it. (PI3) I often feel a bit uncomfortable to try out new e-services, even though it may be beneficial to me.
Subjective norm (SN)	(SN1) People who influence my behavior think that I should use eCampus. (SN2) People who are important to me think that I should use eCampus. (SN3) People in my working environment think that I should use eCampus.
Social image (SI)	(SI1) Colleagues like to see you use eCampus. (SI2) People in my organization who use eCampus have more prestige than those who do not. (SI3) People in my organization who use eCampus have a high profile.
Job relevance (JR)	(JR1) In my job, usage of eCampus is important. (JR2) In my job, usage of eCampus is relevant. (JR3) The use of eCampus is pertinent to my job-related tasks.
Policy quality (PQ)	(PQ1) My organization motivates me to use eCampus. (PQ2) My organization has integrated eCampus into its own systems (technical and/or organizational). (PQ3) My organization gives me time to use eCampus. (PQ4) My organization pays me to use eCampus.
Perceived usefulness (PU)	(PU1) I find an e-service like eCampus to be useful. (PU2) Using eCampus improves my teaching performance. (PU3) Using eCampus enhances my effectiveness.
Perceived ease of use (PEOU)	(PEOU1) I find eCampus to be easy to use. (PEOU2) I find the navigation on eCampus easy. (PEOU3) The operation of eCampus is clear and understandable.
System quality (SYSQ)	(SYSQ1) The eCampus is user-friendly. (SYSQ2) The eCampus operates reliably. (SYSQ3) I like the functionalities of eCampus.
Information quality (INFQ)	(INFQ1) I understand most of the terms used throughout eCampus. (INFQ2) The use cases on eCampus are up to date. (INFQ3) The use cases on eCampus have a high quality. (INFQ4) The use cases on eCampus are comprehensive.
Service quality (SERVQ)	(SERVQ1) There is technical support that helps me use eCampus. (SERVQ2) There is training that helps me use eCampus. (SERVQ3) There is content support that helps me implement use cases.

For the construct SN, the items from Venkatesh and Bala (2008) were adopted. In addition, one item was added here. For the construct SI, two items were taken from Venkatesh and Bala (2008) and one from Meseguer-Artola et al. (2016). The items for the construct JR were taken entirely from Venkatesh and Bala (2008). The items for the constructs PU and PEOU were also adopted from Venkatesh and Bala (2008). For the construct SE, the items used by Y.-C. Lee (2006) were slightly adapted. For the construct EX, the items were derived from I.-F. Liu et al. (2010). Two items for the construct PI were slightly adapted from Basoglu, Daim, and Polat (2014) and one from Nov and C. Ye (2009). It should be noted here that items PI2 and PI3 were inverted before evaluation so that they point in the same direction as item PI1. The items for the construct SYSQ were adapted from Mouakket and Bettayeb (2015) and Hsu et al. (2016). For the construct INFQ, several different detailed aspects were combined. Therefore, the items were derived from several sources that focused on these individual aspects (Y.-C. Lee, 2006; J.-A. Kim, 2006; Venkatesh and Bala, 2008; Nov and C. Ye, 2009; I.-F. Liu et al., 2010; Basoglu, Daim, and Polat, 2014; Meseguer-Artola et al., 2016; Hsu et al., 2016). For the construct SERVQ, the items were derived from J.-A. Kim (2006), Mouakket and Bettayeb (2015), and Hsu et al. (2016). For the construct PQ, the items were self-generated based on findings from Al-Busaidi and Al-Shihi (2010) as well as Schweighofer and Zullus (2019).

Data Analysis

R and RStudio were used to conduct the data analysis. For the evaluation from a design-oriented perspective, frequency analyses were performed to answer the questions whether the e-service eCampus was accepted by the teachers of the Styrian HE area and whether the target group was satisfied with the design of individual constructs that were supposed to positively influence acceptance. Means, standard deviations and the confidence intervals, which were determined with a confidence level of 95%, were calculated for the items that used a 7-point Likert scale or a 7-point ordinal scale. This means to 95% the true mean of the population lies also in these ranges. For the verbal interpretation of these items, a linear transformation was used to give greater significance to the marginal values. For the other items, the relative and absolute frequencies were determined.

For the evaluation from a behavioral perspective, correlation analyses were performed and structural equation models were calculated. The primary goal was to find out which constructs influenced the acceptance of the designed e-service eCampus. Thus, the 24 hypotheses that were established in the second design cycle and modeled in the specifically created TAM (see Section 5.3) were tested. In addition, a relationship between survey demographics and acceptance, i.e. baseline data, was also examined.

Pearson's correlation coefficient and Cramér's V were calculated for the correlations between demographic data and baseline data. In the case of Cramér's V, significance was tested using a chi-square test, *t* test or ANOVA, depending on the type of characteristic.

A two-stage approach adapted from J. C. Anderson and Gerbing (1988) was used to test the hypotheses, i.e. the specific TAM. In the first step, the measurement model was analyzed to ensure reliability and validity, and in the second step, the structural model was tested to identify the structural relationships. For both steps, the software R and the package lavaan were used. Maximum likelihood (ML) was used as estimation method. In order to test the measurement model and the structural model, a confirmatory factor analysis (CFA) was first performed to check the factor loading of each item on the respective constructs. As recommended in the literature, care was taken to ensure that each construct had at least two items and that the factor loading of each item was greater than 0.4 (Hair, R. E. Anderson, et al., 1998). Then, Cronbach's alpha, which should be greater than 0.7 (Hair, Black, R. E. Anderson, et al., 2006), composite reliability (CR), which should be greater than 0.7 (Hair, Black, Babin, et al., 2006), and average variance extracted (AVE), which should be greater than 0.5 (Hair, Black, Babin, et al., 2006), were calculated and checked for each of the constructs. In addition, the model fit was checked using chi^2/degree of freedom, which should be less than 5 (Bentler and Bonett, 1980), standardized root mean square residual (SRMR), which should be less than 0.08 (Byrne, 1998), root mean square error of approximation (RMSEA), which should be less than 0.1 (J. C. Anderson and Gerbing, 1988), Tucker-Lewis index (TLI), which should be greater than 0.9 (Hu and Jen, 2005), and comparative fit index (CFI), which should be greater than 0.9 (Bentler, 1990). In some cases, individual correlations were tested using Pearson's correlation coefficient in addition to the model.

Data Sets

The responses were divided into four data sets for the evaluation. Data set 1 contained only basic data, which were completed by 79 teachers. Data set 2 contained 68 completed questionnaires. Data set 3 contained the completed questionnaires of the 44 teachers who have already used eCampus. This group answered additional questions about the use of eCampus. Data set 4 contained the completed questionnaires of the 24 teachers who have not yet used eCampus. The total sample was 188 persons. The net participation was 101 people (53.72%). The completion rate was 42.02% for data set 1, 36.17% for data set 2, 23.4% for data set 3, and 12.77% for data set 4. During the time window of the survey, a total of approximately 430 users had logged in to eCampus.

Table 7.4.

Demographic Data of Final Evaluation Part 1

	Data set 1 (N = 79)		Data set 2 (N = 68)		Data set 3 (N = 44)		Data set 4 (N = 24)	
Construct	M	SD	M	SD	M	SD	M	SD
	95% CI		95% CI		95% CI		95% CI	
Experience with TEL (D1)	5.28	1.15	5.34	1.17	5.5	0.90	5.04	1.52
	[5.02, 5.54]		[5.06, 5.62]		[5.23, 5.77]		[4.40, 5.68]	
Teaching experience (D2)	5.18	1.94	5.25	1.90	5.34	1.96	5.08	1.79
	[4.74, 5.61]		[4.79, 5.71]		[4.74, 5.94]		[4.33, 5.84]	

Table 7.4 and Table 7.5 show summarized demographic data for all four data sets. In data sets 1-3, participants' self-assessed average experience with TEL was in the (5) rather high to (6) high range. In data set 4, it was slightly lower in the range (4) medium to (6) high. Pure teaching experience was on average in the range of 7 to 10 years (data set 1-3) and in the range of 5 to 10 years (data set 4). About 50% of the participants taught mainly at the CAMPUS 02 University of Applied Sciences. The Medical University of Graz, the University College of Teacher Education Styria and the University of Graz were each represented with about 10%, the Graz University of Technology with about 7%. The other HEIs showed a very low participation.

Table 7.5.

Demographic Data of Final Evaluation Part 2

	Data set 1 (N = 79)		Data set 2 (N = 68)		Data set 3 (N = 44)		Data set 4 (N = 24)	
Higher educational institution (D3)	n	%	n	%	n	%	n	%
CAMPUS 02 University of Applied Sciences	39	49.36	33	48.54	23	52.28	10	41.67
FH JOANNEUM University of Applied Sciences	3	3.80	1	1.47	0	0.00	1	4.17
Private University College of Teacher Education Augustinum	1	1.27	1	1.47	1	2.27	0	0.00
Medical University of Graz	8	10.13	8	11.76	6	13.64	2	8.33
Montanuniversität Leoben	1	1.27	1	1.47	1	2.27	0	0.00
University College of Teacher Education Styria	9	11.39	8	11.76	4	9.09	4	16.67
Graz University of Technology	6	7.59	5	7.35	3	6.82	2	8.33
University of Music and Performing Arts Graz	1	1.27	1	1.47	1	2.27	0	0.00
University of Graz	11	13.92	10	14.71	5	11.36	5	20.83

7.3. Final E-Service

This section describes the final design of the e-service eCampus before the final evaluation. First, the refinements made to the e-service prototype are described. The relevant improvement suggestions from the third design cycle (see Section 7.2.1) served as a basis. This is followed by a description of how the service- and process-relevant requirements were designed. These were divided into the following five subcategories (see Section 5.4.3): (1) support, (2) maintenance, (3) marketing, (4) user participation, and (5) miscellaneous.

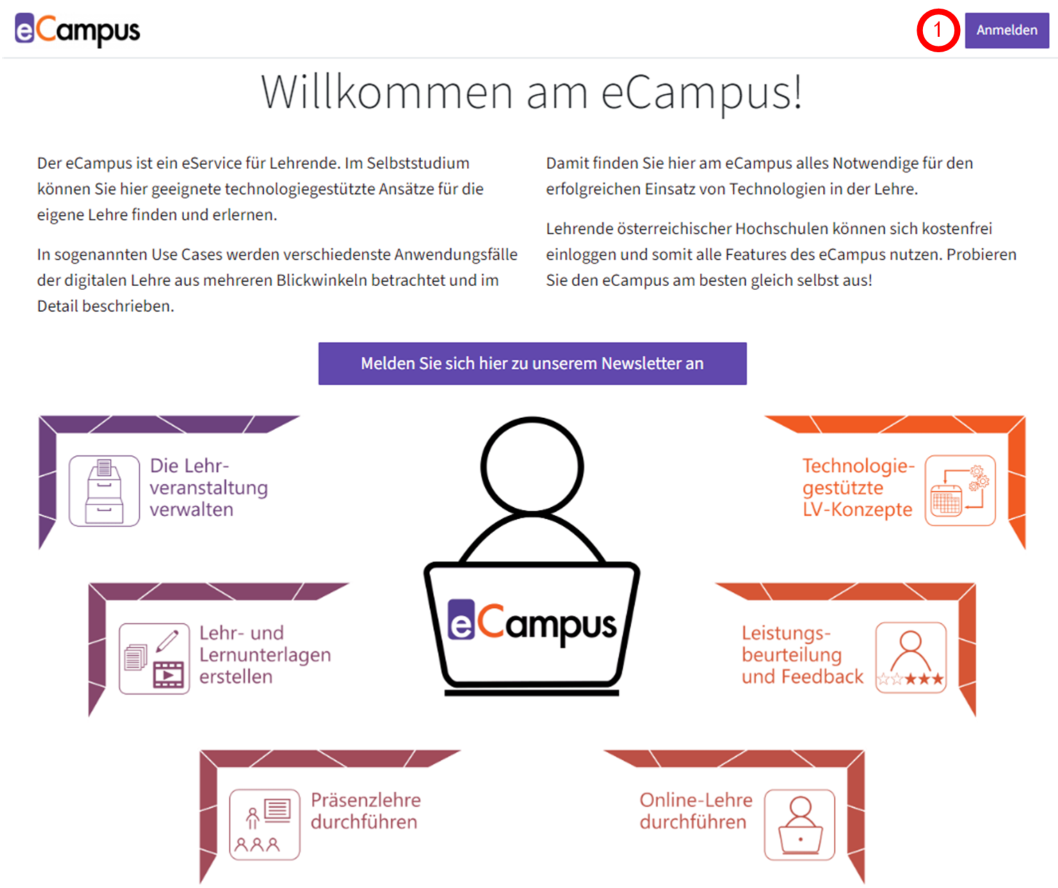
7.3.1. Refinement of the E-Service Prototype

In the fourth and final design cycle, all suggestions for improvement from the evaluation in the third design cycle were analyzed by the project team to decide which of them should be implemented and how. The results of this process are described below.

First, it was decided to shorten the text on the homepage and to briefly describe the term "use case" in the text. In addition, some visual adjustments were made to the homepage and a central image was created showing all the categories. Figure 7.1 shows the main elements of the resulting homepage[3]. The figure also shows how the login button was made visually clearer so that it is quickly visible to all users (see marker (1) in the figure).

Figure 7.1.

Final E-Service: Homepage



The links to the privacy policy, glossary, and general feedback were not changed. The link to the privacy policy is in the footer of the page, as was common at the time of design. The link to the glossary also did not need to be made more visible from the project team's point of view because the

[3]Note that the screenshot is in German, as the e-service is only available in German.

individual terms are linked directly in the use cases. The link to general feedback was not changed either. The linking on the homepage is appropriate in the opinion of the project team. The link back to the main page is located in the eCampus menu bar. This also seemed appropriate to the project team and was therefore not changed.

In the glossary, the terms "use case" and "Bloom's Taxonomy" were added as requested. However, the alternate terms feature was not completely disabled because it was partially used. Instead, the feature was disabled everywhere it was not used.

The arrangement of the blocks on the main page was adjusted as requested. In the e-service prototype, the top 5 most-viewed use cases were first, and only then came the overview with the six categories or the search function. This order was reversed in the fourth design cycle. However, the visual design of the search function was not changed. Even though expanding and collapsing the filter and recommendation criteria was cumbersome for some test subjects, from the project's point of view, the clarity would be lost if all filter options were visible all the time.

A further shortening of the use cases was also not implemented. The use cases all contained a short description in the introduction, which from the project team's point of view gave a good short introduction. It was also decided that a new tab should not open automatically for each link. Users can determine this themselves through their behavior in the browser and eCampus should not restrict this.

7.3.2. Design of the Final E-Service

This section describes how the final requirements for the e-service eCampus, the service- and process-relevant requirements were designed. The requirements cover the areas of (1) support, (2) maintenance, (3) marketing, (4) user participation, and (5) miscellaneous. The basis was the requirements derived from the expert interviews in the second design cycle (see Appendix D) and the suggestions collected during the evaluation in the third design cycle (see Section 6.4.2). However, the final design was strongly influenced by the available resources and funds, as described earlier.

Support

From the expert interviews conducted in the second design cycle, the requirement emerged that support for technical and content-related matters should be available both centrally and decentrally, i.e. individually at each HEI (Req_1_P_Su_SYSQ_PI_JR_SERVQ_Support-central-and-per-university). Contact should be available via email or phone. The evaluation in the third design cycle also showed similar results, in the sense that some subjects would like telephone support and some would like email support, and for some central support is sufficient, while others would like one at their own HEI.

In the design, it was finally decided that there should be a central support for technical and content inquiries, which can be reached via two separate email addresses. This will be staffed by a working group of the nine Styrian HEIs and jointly financed by the nine Styrian HEIs. A decentralized support was not prescribed, but it was open to each HEI to integrate such a support into its own organizational infrastructure. In addition, to help users to get started, it was determined that live sessions would be held on individual use cases, as was suggested during the evaluation in the third design cycle. Four such live sessions were held during the final evaluation period, with a participation of 10 to 15 people each. In addition, a video was created that explains how to use eCampus.

Direct contact with use case creators (Req_2_P_Su_SYSQ_JR_Information-creators) was already excluded in the third design cycle and contact should only be made via the discussion forums of the individual use cases.

Maintenance

Regarding content maintenance, i.e. checking and adjusting filters and information (Req_1_P_M_SYSQ_Content-maintenance), it was decided that this is also the responsibility of the aforementioned working group. The technical maintenance, i.e. hosting and security-relevant updates (Req_2_-P_M_Technical-maintenance), will be carried out directly by employees of Graz University of Technology. These costs are also borne jointly by all nine Styrian HEIs.

Marketing

The requirements survey initially revealed that marketing for eCampus must take place via various channels (Req_1_P_Mar_PI_SERVQ_PQ_Marketing). However, the evaluation results from the third design cycle showed that from the user's point of view, advertising eCampus via internal channels at the respective HEI is more important. Accordingly, eCampus was advertised via different ways. After the go-live in May 2021, a press conference was held on May 26, 2021, through which several regional media reported on eCampus[4]. Advertising via social media, websites, email distribution lists and printed materials, e.g., flyers and folders, was carried out via the individual HEIs, whereby the previously mentioned working group prepared the respective materials for this purpose. The HEIs were also asked to mention and promote eCampus at appropriate events and to refer to it in personal conversations.

The requirement to implement a certification system (Req_2_P_Mar_PI_-Certificate) was discarded for the time being in the fourth design cycle and accordingly not designed. The rectorates of the nine Styrian HEIs decided that the ongoing operation and added value of eCampus should first be ensured before such a system might be designed by the working group in the future.

User Participation and Miscellaneous

As with the requirement to design a certificate system, the rectorates of the Styrian HEIs decided not to implement all requirements regarding user participation in the fourth design cycle for the time being (Req_1_P_-Us_SYSQ_SI_SERVQ_Voluntary-participation, Req_2_P_Us_SERVQ_PQ_-Mandatory-participation, Req_3_P_Us_SERVQ_Use-case-creation-by-user, Req_4_P_Us_PI_Key-user-integration). The working group should analyze such requirements in the future and implement them if necessary. The working group should also moderate the discussion forums and ensure participation, i.e. an active community.

[4] e.g., Der Standard (2021-06-21), Die Presse (2021-05-29), Der Grazer (2021-05-26), orf.at (2021-05-26)

The requirements from the subcategory "miscellaneous" (Req_1_P_Misc_-SN_Third-party-services-offers, Req_2_P_Misc_SERVQ_Discounts) were not designed in the fourth design cycle for the same reasons.

7.4. Evaluation[5]

This section presents the results of the final evaluation of the designed artifact eCampus. First, the results of the frequency analyses are presented for this purpose. These concern mainly the design-oriented view of the evaluation and answer the questions whether the e-service eCampus was accepted by the target group, the teachers of the Styrian HE area, and whether they were satisfied with the design of the individual constructs that were supposed to have a positive influence on acceptance. Afterwards, the results of the correlation analyses and the structural equation analyses are presented. These concern the behavioral perspective of the evaluation and show which constructs influenced the acceptance of the designed artifact eCampus.

7.4.1. Frequency Analyses

Baseline data (awareness of eCampus, intention to use eCampus, actual use of eCampus) were collected in all four data sets. They provide information on whether the designed artifact eCampus was accepted by the target group or not. Table 7.6 and Table 7.7 summarize the results of the data analysis for all four data sets. The construct AU was omitted for data set 4 (eCampus not used), because the 24 persons in this dataset had not yet used eCampus.

For the construct AU, the data sets must be distinguished. In data set 1 (only basic data) and data set 2 (fully completed), participants spent on average less than ten minutes on eCampus each time they logged in, and they logged in one to three times. Looking only at participants who had already used eCampus (data set 3), they logged in two to five times, spending five to

[5]Most parts of this section have already been published in: Beer (2022b)

thirty minutes on eCampus each time. The construct BI shows, on average, that most participants planned to use eCampus in the future.

Table 7.6.

Frequency Distribution of Baseline Data Part 1

	Data set 1 (*N* = 79)		Data set 2 (*N* = 68)		Data set 3 (*N* = 44)		Data set 4 (*N* = 24)	
Construct Item	*M* 95% CI	*SD*	*M* 95% CI	*SD*	*M* 95% CI	*SD*	*M* 95% CI	*SD*
Actual use (AU)								
AU1	2.65	1.70	2.68	1.60	3.59	1.24	-	-
	[2.26, 3.03]		[2.29, 3.06]		[3.21, 3.97]		-	
AU2	2.46	1.41	2.56	1.43	3.41	1.04	-	-
	[2.14, 2.77]		[2.21, 2.90]		[3.09, 3.73]		-	
AU3	2.16	1.39	2.22	1.38	2.87	1.30	-	-
	[1.85, 2.48]		[1.89, 2.55]		[2.49, 3.28]		-	
Behavioral intention (BI)								
BI1	5.05	1.49	5.12	1.52	5.34	1.36	4.71	1.73
	[4.72, 5.38]		[4.75, 5.49]		[4.93, 5.76]		[3.98, 5.44]	
BI2	4.84	1.56	4.94	1.53	5.16	1.46	4.54	1.61
	[4.49, 5.19]		[4.57, 5.31]		[4.71, 5.60]		[3.86, 5.22]	
BI3	4.90	1.51	5.00	1.46	5.32	1.31	4.42	1.56
	[4.56, 5.24]		[4.65, 5.35]		[4.92, 5.72]		[3.76, 5.07]	

Table 7.7.

Frequency Distribution of Baseline Data Part 2

	Data set 1 (*N* = 79)		Data set 2 (*N* = 68)		Data set 3 (*N* = 44)		Data set 4 (*N* = 24)	
Awareness (K1)	*n*	%	*n*	%	*n*	%	*n*	%
Yes	60	75.95	54	79.41	43	97.73	11	45.83
No	19	24.05	14	20.59	1	2.27	13	54.17

Of the participants, most had heard of eCampus prior to the survey. Participants who had already used eCampus had almost entirely heard of eCampus in advance. The one person in data set 3 (eCampus used) who used eCampus but had not heard of it probably tried eCampus after being invited to take the survey and before completing it. Of the participants who had never used eCampus, approx. 50% had also not heard of eCampus in advance.

The acceptance constructs SE, EX, PI, SN, SI, JR, PQ, and PU were queried in data set 2 (fully completed), data set 3 (eCampus used), and data set 4 (eCampus not used), and PEOU, SYSQ, INFQ, and SERVQ were additionally queried in data set 3 (eCampus used). The results provide information on whether the design of the constructs was successful. Exceptions are the constructs SE and EX, which cannot be influenced by the design as explained in Section 5.4. Table 7.8 shows the results for the acceptance constructs in summary.

SE of the participants could be described as high on average. EX with similar e-services was in the medium to slightly high range. PI was rather high to high. SN was rather low, as was SI. Overal and among those who had already used eCampus, JR was rated slightly high. Among those who had not used eCampus, however, JR was rated somewhat lower. In terms of PQ, the items on motivation and integration were in the medium to rather high range, the item on time was in the medium range, while the item on payment was in the rather low range. PU was on average in the rather high range for data set 2 (fully completed) and data set 3 (eCampus used), and in the medium range for data set 4 (eCampus not used). SYSQ, INFQ, and SERVQ were considered rather high, with SERVQ scoring slightly lower. Finally, the participants who had already used eCampus saw a rather high to high PEOU.

7.4.2. Correlation and Structural Equation Analyses

This section describes the results of the correlation and structural equation analyses. The first subsection deals with the correlations between the demographic data and the baseline data in data set 1 (only basic data). Then, the results of the structural equation analyses are presented for each of data set 2 (fully completed), data set 3 (eCampus used), and data set 4 (eCampus not used). Finally, the results are summarized in order to be able to make a statement about the 24 formulated hypotheses, i.e. the TAM created (see Section 5.3).

Table 7.8.

Frequency Distribution of Acceptance Constructs

	Data set 2 (N = 68)		Data set 3 (N = 44)		Data set 4 (N = 24)	
Construct / Item	M	SD	M	SD	M	SD
	95% CI		95% CI		95% CI	
Self-efficacy (SE)						
SE1	5.72	1.39	6.05	1.14	5.13	1.62
	[5.38, 6.06]		[5.70, 6.39]		[4.44, 5.81]	
SE2	6.01	1.18	6.18	1.06	5.71	1.33
	[5.73, 6.30]		[5.86, 6.50]		[5.14, 6.27]	
SE3	6.09	1.13	6.27	1.02	5.75	1.26
	[5.81, 6.36]		[5.96, 6.58]		[5.22, 6.28]	
Experience (EX)						
EX1	5.04	1.78	5.50	1.50	4.21	1.98
	[4.61, 5.48]		[5.04, 5.96]		[3.37, 5.04]	
EX2	4.47	1.83	4.64	1.82	4.17	1.86
	[4.03, 4.91]		[4.08, 5.19]		[3.38, 4.95]	
EX3	4.29	1.96	4.36	1.93	4.17	2.06
	[3.82, 4.77]		[3.78, 4.95]		[3.30, 5.04]	
Personal innovativeness (PI)						
PI1	5.01	1.63	5.20	1.25	4.67	2.16
	[4.62, 5.41]		[4.82, 5.58]		[3.75, 5.58]	
PI2	4.84	1.65	4.80	1.71	4.92	1.59
	[4.44, 5.24]		[4.28, 5.31]		[4.25, 5.59]	
PI3	5.65	1.48	5.61	1.54	5.71	1.40
	[5.29, 6.01]		[5.14, 6.08]		[5.12, 6.30]	
Subjective norm (SN)						
SN1	3.15	1.43	3.18	1.48	3.08	1.35
	[2.80, 3.49]		[2.73, 3.63]		[2.51, 3.65]	
SN2	3.07	1.48	3.07	1.56	3.08	1.35
	[2.72, 3.43]		[2.59, 3.54]		[2.51, 3.65]	
SN3	3.34	1.72	3.39	1.82	3.25	1.57
	[2.92, 3.76]		[2.83, 3.94]		[2.59, 3.91]	
Social image (SI)						
SI1	3.68	1.58	3.84	1.51	3.38	1.69
	[3.29, 4.06]		[3.38, 4.30]		[2.66, 4.09]	
SI2	3.00	1.66	3.09	1.65	2.83	1.69
	[2.60, 3.40]		[2.59, 3.59]		[2.12, 3.55]	
SI3	3.29	1.64	3.48	1.70	2.96	1.49
	[2.90, 3.69]		[2.96, 4.00]		[2.33, 3.59]	
Job relevance (JR)						
JR1	3.99	1.68	4.02	1.70	3.92	1.67
	[3.58, 4.39]		[3.50, 4.54]		[3.21, 4.62]	
JR2	4.21	1.71	4.36	1.70	3.92	1.72
	[3.79, 4.62]		[3.85, 4.88]		[3.19, 4.64]	
JR3	4.34	1.77	4.55	1.80	3.96	1.68
	[3.91, 4.77]		[4.00, 5.09]		[3.25, 4.67]	

(continued)

Table 7.8.

Frequency Distribution of Acceptance Constructs (continued)

	Data set 2 (N = 68)		Data set 3 (N = 44)		Data set 4 (N = 24)	
Construct Item	M 95% CI	SD	M 95% CI	SD	M 95% CI	SD
Policy quality (PQ)						
PQ1	4.43	1.73	4.48	1.75	4.33	1.74
	[4.01, 4.85]		[3.95, 5.01]		[3.60, 5.07]	
PQ2	4.19	1.59	4.16	1.58	4.25	1.62
	[3.81, 4.58]		[3.68, 4.64]		[3.57, 4.93]	
PQ3	3.97	1.78	4.09	1.74	3.75	1.87
	[3.54, 4.40]		[3.56, 4.62]		[2.96, 4.54]	
PQ4	2.81	2.01	3.07	2.10	2.33	1.79
	[2.32, 3.30]		[2.43, 3.71]		[1.58, 3.09]	
Perceived usefulness (PU)						
PU1	4.99	1.68	5.32	1.54	4.38	1.79
	[4.58, 5.39]		[4.85, 5.79]		[3.62, 5.13]	
PU2	4.47	1.55	4.80	1.46	3.88	1.57
	[4.10, 4.85]		[4.35, 5.24]		[3.21, 4.54]	
PU3	4.54	1.50	4.80	1.44	4.08	1.53
	[4.18, 4.91]		[4.36, 5.23]		[3.44, 4.73]	
Perceived ease of use (PEOU)						
PEOU1	-	-	5.36	1.01	-	-
	-		[5.06, 5.67]		-	
PEOU2	-	-	5.34	1.03	-	-
	-		[5.03, 5.65]		-	
PEOU3	-	-	5.45	1.02	-	-
	-		[5.14, 5.77]		-	
System quality (SYSQ)						
SYSQ1	-	-	5.11	0.97	-	-
	-		[4.82, 5.41]		-	
SYSQ2	-	-	5.20	1.02	-	-
	-		[4.89, 5.52]		-	
SYSQ3	-	-	5.11	1.08	-	-
	-		[4.78, 5.44]		-	
Information quality (INFQ)						
INFQ1	-	-	5.52	1.11	-	-
	-		[5.19, 5.86]		-	
INFQ2	-	-	5.16	1.03	-	-
	-		[4.85, 5.47]		-	
INFQ3	-	-	5.11	1.06	-	-
	-		[4.79, 5.44]		-	
INFQ4	-	-	5.14	1.11	-	-
	-		[4.80, 5.47]		-	
Service quality (SERVQ)						
SERVQ1	-	-	4.64	1.22	-	-
	-		[4.26, 5.01]		-	
SERVQ2	-	-	4.84	1.06	-	-
	-		[4.52, 5.16]		-	
SERVQ3	-	-	4.73	1.06	-	-
	-		[4.40, 5.05]		-	

Correlations between Demographic Data and Baseline Data

The following correlations were examined with the data from data set 1 (only basic data):

- between experience with TEL and intention
- between experience with TEL and actual use
- between teaching experience and intention
- between teaching experience and actual use
- between higher educational institution and awareness
- between higher educational institution and intention
- between higher educational institution and actual use
- between awareness and intention
- between awareness and actual use

In the data, there was a positive correlation between teacher experience and average time spent on eCampus ($r(77) = .023$, $p < .05$). According to the data, individuals who were previously aware of eCampus also had a higher intention to use the information from eCampus to improve their teaching (Cramér's V = .23, $t(30) = 2.15$, $p < .05$). They also logged in more frequently (Cramér's V = .40, $t(71) = 7.36$, $p < .001$), spent more time on eCampus (Cramér's V = .38, $t(60) = 7.31$, $p < .001$), and used it more intensively (Cramér's V = .38, $t(63) = 5.50$, $p < .001$).

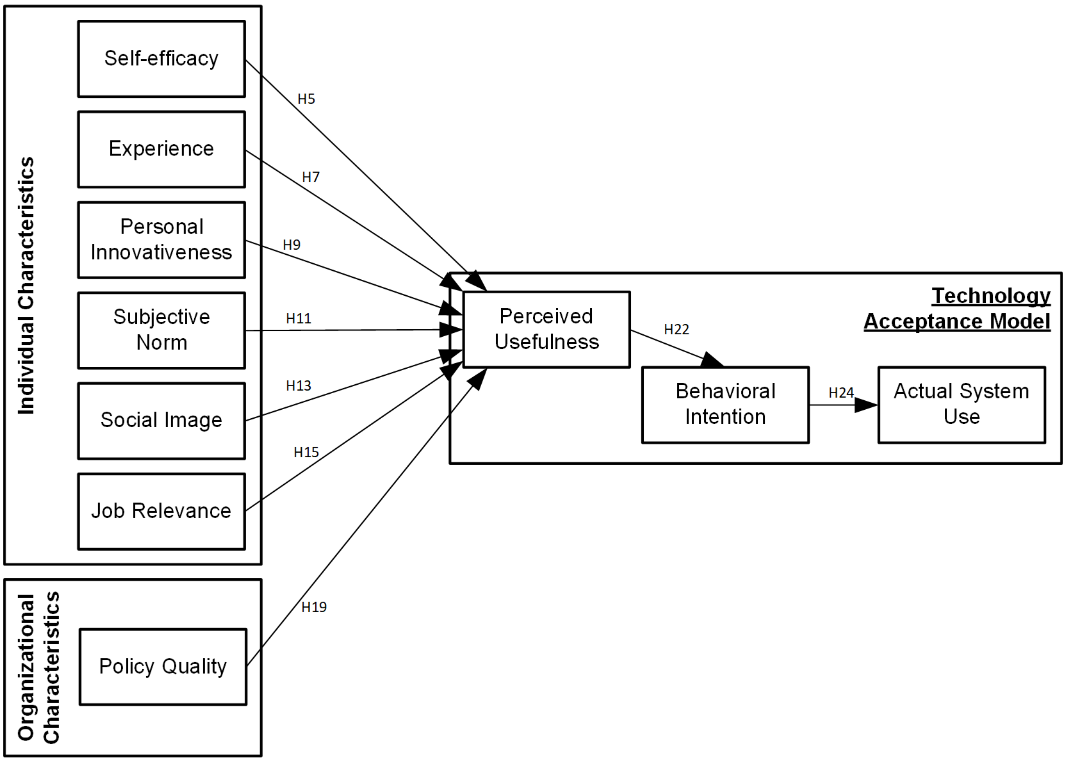
Structural Equation Analyses Data Set 2

Data set 2 (fully completed) contained the responses from all teachers who completed the questionnaire in full. Thereby, in the analysis of these 68 responses, the additional questions on the constructs PEOU, SYSQ, INFQ, and SERVQ were not included because the participants who had not used eCampus did not receive these questions. This resulted in the following (see Figure 7.2) simplified measurement model for the analysis.

As described, a CFA was first conducted for the measurement model. Probably due to the low response rate, the model fit, individual factor loadings as well as Cronbach's alpha, CR, and AVE of individual constructs were not in the recommended range. Therefore, before testing the structural model, the

Figure 7.2.

Measurement Model Data Set 2



constructs EX, PI, and PQ as well as the item BI3 were removed from the model. Table 7.9 and Table 7.10 show the factor loadings of the individual items finally used for the structural model, the reliability indices of the constructs, and the model fit of the final structural model.

Table 7.9.

Reliability Indices/Factor Loadings Data Set 2

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
Self-efficacy (SE)	0.877	0.879	0.708	SE1	0.693
				SE2	0.930
				SE3	0.939
Subjective norm (SN)	0.924	0.929	0.815	SN1	0.873
				SN2	0.978
				SN3	0.864
Social image (SI)	0.896	0.899	0.749	SI1	0.831
				SI2	0.909
				SI3	0.851
Job relevance (JR)	0.950	0.951	0.867	JR1	0.918
				JR2	0.971
				JR3	0.905
Perceived usefulness (PU)	0.924	0.928	0.811	PU1	0.823
				PU2	0.946
				PU3	0.942
Behavioral intention (BI)	0.870	0.867	0.765	BI1	0.871
				BI2	0.878
Actual use (AU)	0.888	0.890	0.731	AU1	0.857
				AU2	0.874
				AU3	0.831

Table 7.10.

Model Fit Data Set 2

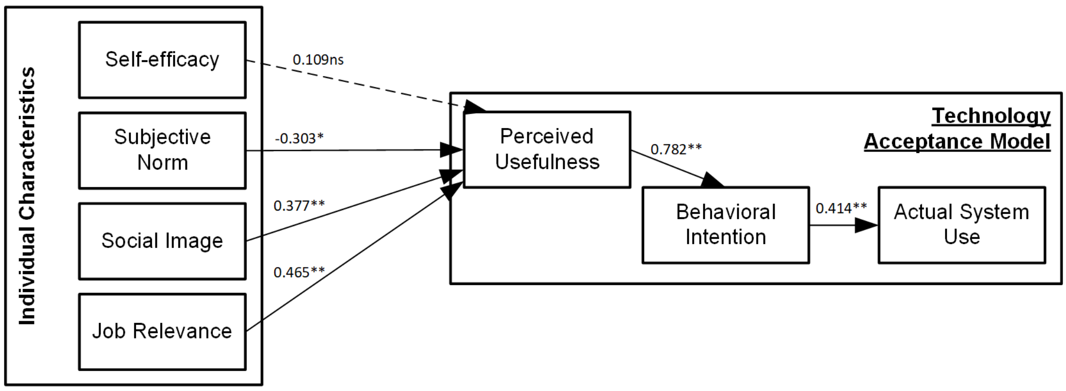
Fit index	Value
chi^2/degree of freedom	1.568
Standardized root mean square residual (SRMR)	0.081
Root mean square error of approximation (RMSEA)	0.091
Tucker-Lewis index (TLI)	0.910
Comparative fit index (CFI)	0.925

As can be seen, all factor loadings were greater than 0.4 as recommended in the literature and each construct had at least two items. The recommended values for the reliability indices were also clearly met for all constructs.

For the model fit, all values except SRMR were in the recommended range. The SRMR of 0.081, however, was only slightly above the recommended 0.08. The structural model thus showed an acceptable overall fit and the items also exhibited corresponding reliability. Figure 7.3 therefore shows the corresponding identified structural correlations in the model for data set 2.

Figure 7.3.

Structural Model Data Set 2



Note. **p* < 0.05; ***p* < 0.01; ns = not significant

Accordingly, hypotheses $H_{TAM}13$, $H_{TAM}15$, $H_{TAM}22$, and $H_{TAM}24$ were supported when analyzing data set 2, while hypotheses $H_{TAM}5$ and $H_{TAM}11$ were not supported. This means that according to the analysis of data set 2, the constructs SI and JR had a positive influence on the construct PU. PU further positively influenced BI, which further positively influenced AU. An influence of the construct SE on PU could not be supported with the data of data set 2, just like the positive influence of the construct SN on PU. This influence was even negative in data.

The constructs EX, PI and PQ were not considered for the calculation of the structural equation model as mentioned before. Extra calculations were performed for these constructs. First, it was checked whether the items of the constructs show a relationship to the construct PU and its items. For this purpose, Pearson's correlation coefficient was calculated between the items of the constructs EX, PI, and PQ and the items of the construct PU. Table 7.11 shows the significant correlations identified.

Table 7.11.

Additional significant Correlations Data Set 2

Item	PU1	PU2	PU3
PI1	0.614**	0.651**	0.611**
PQ1	0.295*	0.252*	
PQ2	0.522**	0.503**	0.489**
PQ3	0.380**		
PQ4	0.287*	0.317**	0.312**

Note. *p < .005; **p < .001

The construct EX did not show any correlations here either. Thus, hypothesis $H_{TAM}7$ could not be supported for data set 2. However, significant correlations were found for the constructs PI and PQ. Therefore, two further structural models were tested, in which the individual items for construct PI on the one hand and the individual items for construct PQ on the other hand were related to the constructs PU, BI and AU. Table 7.12 and Table 7.13 show the factor loadings of the individual items used for the structural model PI, the reliability indices of the constructs, and the model fit.

Table 7.12.

Reliability Indices/Factor Loadings Data Set 2 Model PI

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PI1	1.000
				PI2	1.000
				PI3	1.000
Perceived usefulness (PU)	0.924	0.926	0.807	PU1	0.816
				PU2	0.955
				PU3	0.933
Behavioral intention (BI)	0.870	0.867	0.765	BI1	0.868
				BI2	0.881
Actual use (AU)	AU1	0.888	0.890	0.731	0.858
				AU2	0.873
				AU3	0.831

As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PI, where items were

Table 7.13.

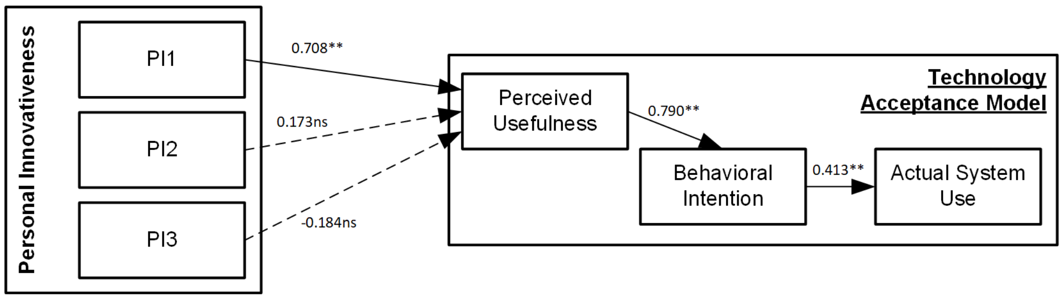
Model Fit Data Set 2 Model PI

Fit index	Value
chi^2/degree of freedom	1.697
Standardized root mean square residual (SRMR)	0.070
Root mean square error of approximation (RMSEA)	0.101
Tucker-Lewis index (TLI)	0.924
Comparative fit index (CFI)	0.946

considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range except for RMSEA. However, the RMSEA of 0.101 was only slightly above the recommended 0.1. This simplified structural model thus showed an acceptable overall fit and the items also exhibited corresponding reliability. Figure 7.4 therefore shows the correspondingly identified structural correlations in the structural model PI for data set 2.

Figure 7.4.

Structural Model PI Data Set 2



Note. *$p < 0.05$; **$p < 0.01$; ns = not significant

Accordingly, hypotheses $H_{TAM}22$ and $H_{TAM}24$ were also supported in this simplified model when analyzing data set 2, while hypothesis $H_{TAM}9$ could not be fully supported. However, the item PI1 not only showed a significant positive relationship to the items of the construct PU as described before, there was also a significant positive influence of the item PI1 on the construct

PU. Thus, it can be cautiously claimed that the data in data set 2 showed that individuals for whom it was attractive to try new e-services such as eCampus also perceived higher usefulness in eCampus.

Table 7.14 and Table 7.15 show the factor loadings of the individual items used for the structural model PQ, the reliability indices of the constructs, and the model fit.

Table 7.14.

Reliability Indices/Factor Loadings Data Set 2 Model PQ

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PQ1	1.000
				PQ2	1.000
				PQ3	1.000
Perceived usefulness (PU)	0.924	0.927	0.809	PU1	0.818
				PU2	0.954
				PU3	0.938
Behavioral intention (BI)	0.870	0.867	0.765	BI1	0.871
				BI2	0.878
Actual use (AU)	0.888	0.890	0.731	AU1	0.858
				AU2	0.874
				AU3	0.831

Table 7.15.

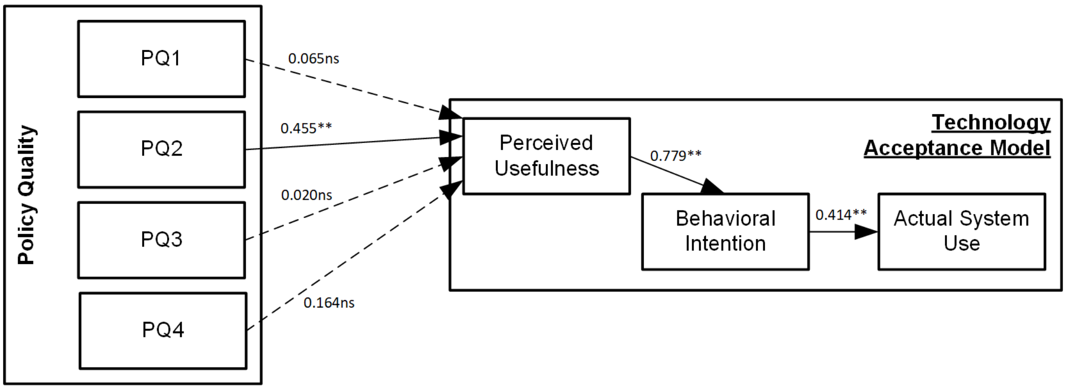
Model Fit Data Set 2 Model PQ

Fit index	Value
chi^2/degree of freedom	1.036
Standardized root mean square residual (SRMR)	0.062
Root mean square error of approximation (RMSEA)	0.023
Tucker-Lewis index (TLI)	0.995
Comparative fit index (CFI)	0.996

As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PQ, where items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range. Thus, this simplified structural model showed an acceptable overall fit and the items also showed corresponding reliability. Figure 7.5 therefore shows the correspondingly identified structural correlations in the structural model PQ for data set 2.

Figure 7.5.

Structural Model PQ Data Set 2



Note. *$p < 0.05$; **$p < 0.01$; ns = not significant

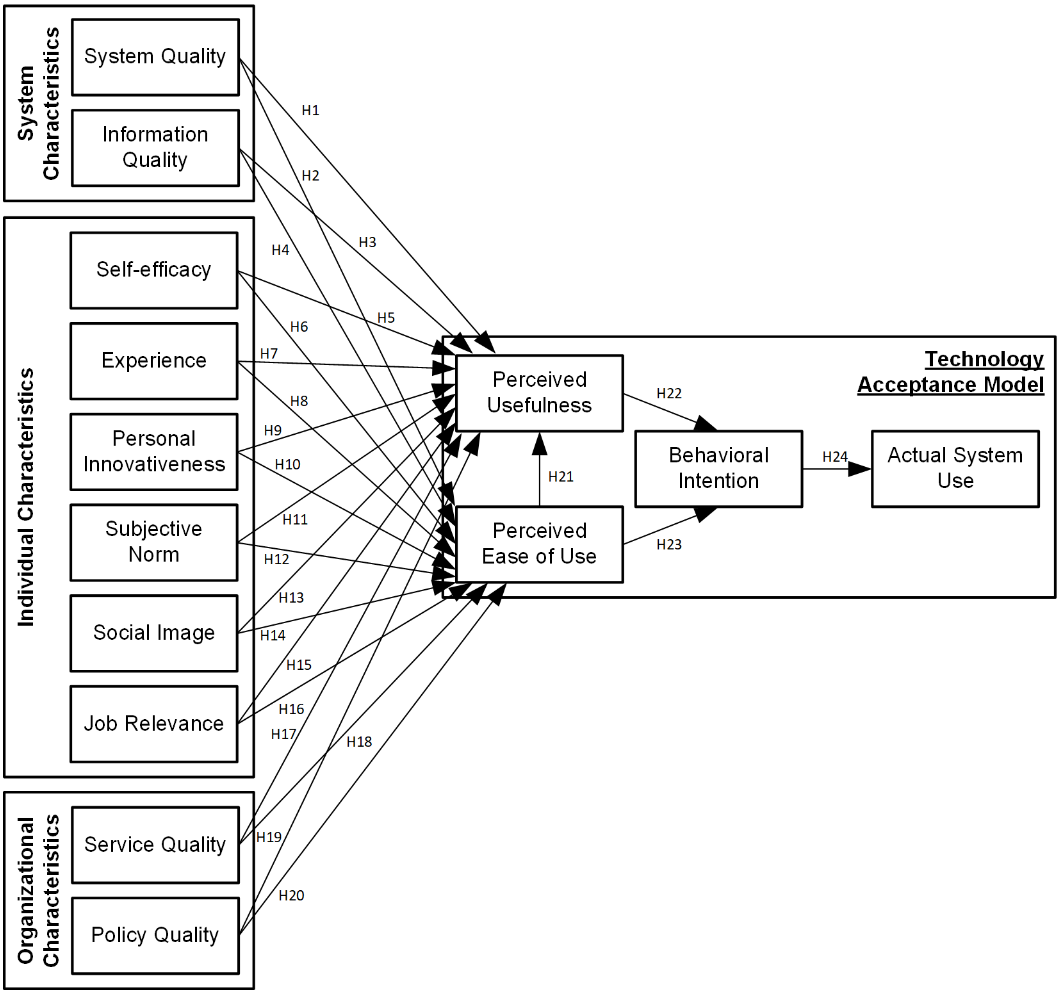
In this simplified model, hypotheses $H_{TAM}22$ and $H_{TAM}24$ were again supported when analyzing data set 2, while hypothesis $H_{TAM}19$ could not be fully supported. Items PQ1, PQ2, PQ3, and PQ4 showed partially significant positive correlation to the items of the construct PU as described before, but only a significant positive influence of item PQ2 on the construct PU was shown in this simplified structural model. Thus, it can be cautiously claimed that the data in data set 2 showed that the integration (technical and/or organizational) of eCampus into own HEI systems had a positive influence on PU of eCampus.

Structural Equation Analyses Data Set 3

Data set 3 (eCampus used) contained the responses from all teachers who completed the questionnaire in full and had already used eCampus. Therefore, in the analysis of these 44 responses all constructs were considered and the complete measurement model (see Figure 7.6) with all 24 hypotheses was tested.

Figure 7.6.

Measurement Model Data Set 3



Again, a CFA was initially conducted for the measurement model. However, due to the low response rate in relation to the large amount of constructs, the model did not converge. Therefore, as with data set 2, the constructs EX, PI, and PQ, as well as the item BI3, were initially removed from the model. However, the model fit, individual factor loadings as well as Cronbach's alpha, CR, and AVE of individual constructs were still not within the recommended range. Therefore, the items PU2 and the constructs SE, SERVQ, AU were additionally removed from the model. Factor loadings as well as Cronbach's alpha, CR, and AVE of individual constructs were now in the recommended range, but the model fit was still not acceptable. The model was therefore split into two models. The first model (structural model SN/SI) included the constructs SN and SI as external variables, while the second model (structural model JR/SYSQ/INFQ) used the constructs JR, SYSQ, and INFQ. The split was done this way because the constructs JR, SYSQ, and INFQ were more determined by the design of the e-service eCampus than the constructs SN and SI.

Table 7.16.

Reliability Indices/Factor Loadings Data Set 3 Model SN/SI

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
Subjective norm (SN)	0.938	0.941	0.843	SN1	0.948
				SN2	0.990
				SN3	0.840
Social image (SI)	0.871	0.878	0.706	SI1	0.815
				SI2	0.895
				SI3	0.806
Perceived usefulness (PU)	0.802	0.807	0.677	PU1	0.853
				PU3	0.787
Perceived ease of use (PEOU)	0.950	0.950	0.863	PEOU1	0.954
				PEOU2	0.924
				PEOU3	0.909
Behavioral intention (BI)	0.811	0.812	0.684	BI1	0.888
				BI2	0.770

Table 7.16 and Table 7.17 show the factor loadings of the individual items finally used for the structural model SN/SI, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4 as recommended in the literature and each construct had at least two items. In terms of model fit, SRMR, RMSEA and TLI were just outside the recommended range. However, the structural model overall

Table 7.17.

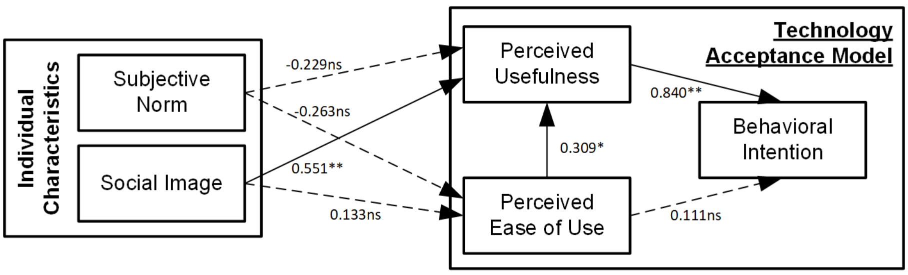
Model Fit Data Set 3 Model SN/SI

Fit index	Value
chi^2/degree of freedom	1.763
Standardized root mean square residual (SRMR)	0.083
Root mean square error of approximation (RMSEA)	0.132
Tucker-Lewis index (TLI)	0.877
Comparative fit index (CFI)	0.910

showed a sufficient fit and the items also showed appropriate reliability. The results could be used with some caution. Figure 7.7 therefore shows the corresponding identified structural correlations in the structural model SN/SI for data set 3.

Figure 7.7.

Structural Model SN/SI Data Set 3



Note. *p < 0.05; **p < 0.01; ns = not significant

Accordingly, with some caution, when analyzing the data from dataset 3, hypotheses $H_{TAM}13$, $H_{TAM}21$, and $H_{TAM}22$ were supported, while no support was found for hypotheses $H_{TAM}11$, $H_{TAM}12$, $H_{TAM}14$, and also $H_{TAM}23$. This means that the construct SI had a positive influence on the construct PU. PEOU also had a positive influence on the construct PU, which further positively influenced the construct BI. The data in data set 3 showed no influence of the constructs SN and SI on PEOU and also no influence of the construct SN on PU. Furthermore, no support for an influence of PEOU on BI could be found either.

Table 7.18 and Table 7.19 show the factor loadings of the individual items finally used for the structural model JR/SYSQ/INFQ, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4 as recommended in the literature and each construct had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, SRMR, RMSEA, TLI, and CFI were just outside the recommended range. However, the structural model overall showed a fit that can be used with some caution and the items also showed appropriate reliability.

Table 7.18.

Reliability Indices/Factor Loadings Data Set 3 Model JR/SYSQ/ INFQ

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
Job relevance (JR)	0.950	0.951	0.867	JR1	0.938
				JR2	0.980
				JR3	0.880
System quality (SYSQ)	0.831	0.850	0.654	SYSQ1	0.905
				SYSQ2	0.814
				SYSQ3	0.718
Information quality (INFQ)	0.928	0.932	0.775	INFQ1	0.738
				INFQ2	0.913
				INFQ3	0.931
				INFQ4	0.933
Perceived usefulness (PU)	0.802	0.807	0.679	PU1	0.873
				PU3	0.765
Perceived ease of use (PEOU)	0.950	0.950	0.862	PEOU1	0.946
				PEOU2	0.912
				PEOU3	0.929
Behavioral intention (BI)	0.811	0.812	0.683	BI1	0.879
				BI2	0.778

Table 7.19.

Model Fit Data Set 3 Model JR/SYSQ/INFQ

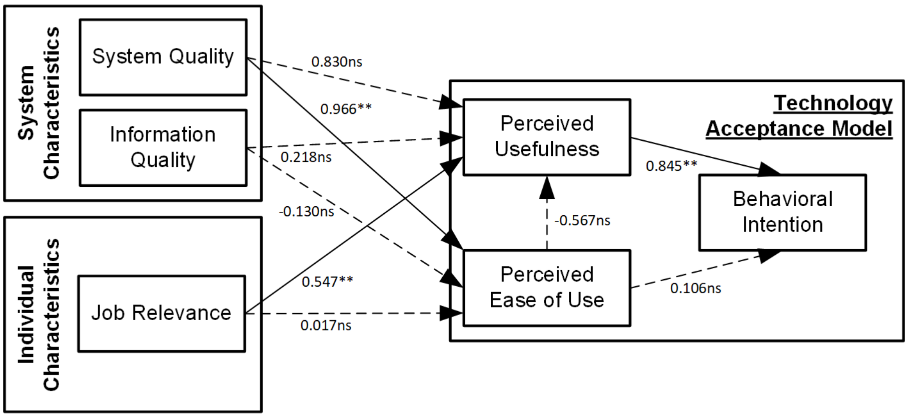
Fit index	Value
chi^2/degree of freedom	1.945
Standardized root mean square residual (SRMR)	0.104
Root mean square error of approximation (RMSEA)	0.147
Tucker-Lewis index (TLI)	0.833
Comparative fit index (CFI)	0.869

Figure 7.8 shows the corresponding identified structural correlations in the

structural model JR/SYSQ/INFQ for data set 3. Accordingly, with some caution, when analyzing the data from data set 3, hypotheses $H_{TAM}2$, $H_{TAM}15$, and $H_{TAM}22$ were supported, while no support was found for hypotheses $H_{TAM}1$, $H_{TAM}3$, $H_{TAM}4$, $H_{TAM}16$, $H_{TAM}21$, and also $H_{TAM}23$. This means that SYSQ seemed to have a positive influence on PEOU but not on PU and JR seemed to have a positive influence on PU but not on PEOU. PU also had a positive influence on BI in this structural model. The construct INFQ had no influence on PEOU or PU.

Figure 7.8.

Structural Model JR/SYSQ/INFQ Data Set 3



Note. *$p < 0.05$; **$p < 0.01$; ns = not significant

As previously mentioned, the constructs SE, EX, PI, PQ, and SERVQ were not considered for the calculation of the structural equation model. Extra calculations were performed for these constructs. First, it was checked whether the items of the constructs showed a relationship to the constructs PU or PEOU and their items. For this purpose, Pearson's correlation coefficient was calculated between the items of the constructs SE, EX, PI, PQ, and SERVQ and the items of the constructs PU and PEOU. Table 7.20 shows the significant correlations identified in this process.

The construct EX did not show any correlations here either. Thus, hypotheses $H_{TAM}7$ and $H_{TAM}8$ could not be supported for data set 3. However, significant correlations were found for the constructs SE, PI, PQ, and SERVQ.

Table 7.20.

Additional significant Correlations Data Set 3

Item	PU1	PU2	PU3	PEOU1	PEOU2	PEOU3
SE1	0.456**			0.388**	0.381*	0.341*
SE2	0.320*					
SE3	0.299*					
PI1	0.559**	0.624**	0.554**		0.359*	
PI3				0.315*		
PQ1	0.315*	0.341*				
PQ2	0.418**	0.468**	0.422**	0.311*	0.336*	
PQ4	0.347*	0.340*	0.429**			
SERVQ1				0.391**	0.377*	0.378*

Note. *$p < .005$; **$p < .001$

Therefore, four additional structural models were tested, in which the individual items for the constructs SE, PI, PQ, and SERVQ were related to the constructs PU, PEOU, and BI. Table 7.21 and Table 7.22 show the factor loadings of the individual items used for the structural model SE, the reliability indices of the constructs, and the model fit.

Table 7.21.

Reliability Indices/Factor Loadings Data Set 3 Model SE

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				SE1	1.000
				SE2	1.000
				SE3	1.000
Perceived usefulness (PU)	0.802	0.833	0.721	PU1	0.954
				PU3	0.710
Perceived ease of use (PEOU)	0.950	0.950	0.863	PEOU1	0.952
				PEOU2	0.925
				PEOU3	0.910
Behavioral intention (BI)	0.811	0.813	0.686	BI1	0.902
				BI2	0.758

As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct SE, where items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range. Thus, this simplified

Table 7.22.

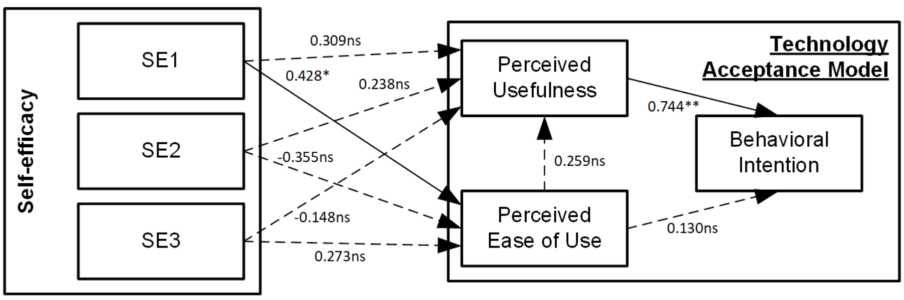
Model Fit Data Set 3 Model SE

Fit index	Value
chi^2/degree of freedom	1.234
Standardized root mean square residual (SRMR)	0.065
Root mean square error of approximation (RMSEA)	0.073
Tucker-Lewis index (TLI)	0.967
Comparative fit index (CFI)	0.981

structural model showed an acceptable overall fit and the items also showed corresponding reliability. Figure 7.9 therefore shows the correspondingly identified structural correlations in the structural model SE for data set 3.

Figure 7.9.

Structural Model SE Data Set 3



Note. *p < 0.05; **p < 0.01; ns = not significant

Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 3. That is, the construct PU positively influenced BI. For hypotheses $H_{TAM}21$ and $H_{TAM}23$, that the construct PEOU positively influenced the constructs PU and BI, no support could be found in the model. For the hypotheses $H_{TAM}5$ and $H_{TAM}6$ no support could be found overall either. That is, the construct SE seemed to have no influence on the constructs PEOU and PU. However, the item SE1 had a positive influence on the construct PEOU. That is, individuals who felt able to use eCampus without assistance also rated eCampus usability higher.

Table 7.23 and Table 7.24 show the factor loadings of the individual items used for the structural model PI, the reliability indices of the constructs, and the model fit.

Table 7.23.

Reliability Indices/Factor Loadings Data Set 3 Model PI

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PI1	1.000
				PI2	1.000
				PI3	1.000
Perceived usefulness (PU)	0.802	0.795	0.662	PU1	0.847
				PU3	0.773
Perceived ease of use (PEOU)	0.950	0.950	0.863	PEOU1	0.954
				PEOU2	0.924
				PEOU3	0.908
Behavioral intention (BI)	0.811	0.811	0.683	BI1	0.872
				BI2	0.784

Table 7.24.

Model Fit Data Set 3 Model PI

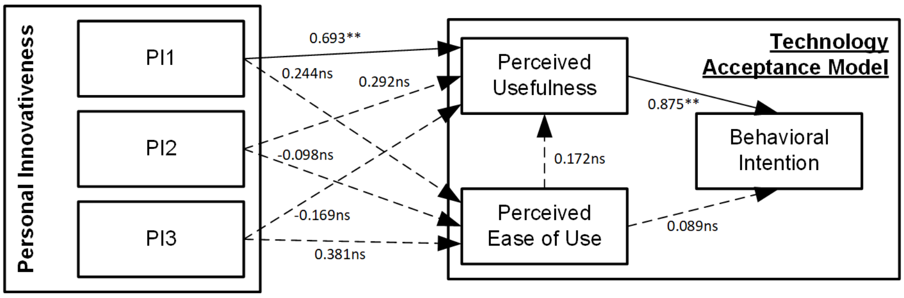
Fit index	Value
chi^2/degree of freedom	1.239
Standardized root mean square residual (SRMR)	0.073
Root mean square error of approximation (RMSEA)	0.074
Tucker-Lewis index (TLI)	0.962
Comparative fit index (CFI)	0.978

As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PI, for which the items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range. Thus, this simplified structural model showed an acceptable overall fit and the items also showed corresponding reliability. Figure 7.10 therefore shows the correspondingly identified structural correlations in the structural model PI for data set 3.

Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 3. That is, the construct PU positively

Figure 7.10.

Structural Model PI Data Set 3



Note. $^*p < 0.05$; $^{**}p < 0.01$; ns = not significant

influences BI. For hypotheses $H_{TAM}21$ and $H_{TAM}23$, that the construct PEOU positively influences the constructs PU and BI, no support could be found in the model. For the hypotheses $H_{TAM}9$ and $H_{TAM}10$ no support could be found overall either. That is, the construct PI appeared to have no influence on the constructs PEOU and PU. However, the item PI1 had a positive influence on the construct PU. That is, individuals for whom it was attractive to try new e-services also rated the usefulness of eCampus higher.

Table 7.25.

Reliability Indices/Factor Loadings Data Set 3 Model PQ

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PQ1	1.000
				PQ2	1.000
				PQ3	1.000
				PQ4	1.000
Perceived usefulness (PU)	0.802	0.813	0.686	PU1	0.859
				PU3	0.792
Perceived ease of use (PEOU)	0.950	0.950	0.863	PEOU1	0.949
				PEOU2	0.928
				PEOU3	0.910
Behavioral intention (BI)	0.811	0.813	0.686	BI1	0.900
				BI2	0.760

Table 7.25 and Table 7.26 show the factor loadings of the individual items

used for the structural model PQ, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PQ, where items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range. Thus, this simplified structural model showed an acceptable overall fit and the items also showed corresponding reliability.

Table 7.26.

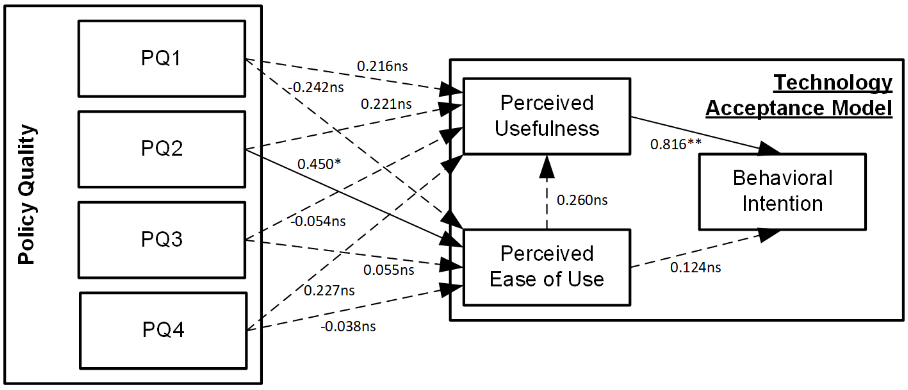
Model Fit Data Set 3 Model PQ

Fit index	Value
chi^2/degree of freedom	1.124
Standardized root mean square residual (SRMR)	0.061
Root mean square error of approximation (RMSEA)	0.053
Tucker-Lewis index (TLI)	0.973
Comparative fit index (CFI)	0.985

Figure 7.11 shows the correspondingly identified structural correlations in the structural model PQ for data set 3.

Figure 7.11.

Structural Model PQ Data Set 3



Note. *p < 0.05; **p < 0.01; ns = not significant

Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 3. That is, the construct PU positively influences BI. For hypotheses $H_{TAM}21$ and $H_{TAM}23$, that the construct PEOU positively influences the constructs PU and BI, no support could be found in the model. For the hypotheses $H_{TAM}19$ and $H_{TAM}20$ no support could be found overall either. That is, the construct PQ did not seem to have any influence on the constructs PEOU and PU. However, the item PQ2 had a positive influence on the construct PEOU. That is, individuals for whom the HEI had integrated eCampus into their own systems also rated eCampus usability higher.

Table 7.27 and Table 7.28 show the factor loadings of the individual items used for the SERVQ structural model, the reliability indices of the constructs, and the model fit.

Table 7.27.

Reliability Indices/Factor Loadings Data Set 3 Model SERVQ

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				SERVQ1	1.000
				SERVQ2	1.000
				SERVQ3	1.000
Perceived usefulness (PU)	0.802	0.742	0.592	PU1	0.800
				PU3	0.733
Perceived ease of use (PEOU)	0.950	0.950	0.863	PEOU1	0.952
				PEOU2	0.925
				PEOU3	0.910
Behavioral intention (BI)	0.811	0.812	0.684	BI1	0.866
				BI2	0.773

Table 7.28.

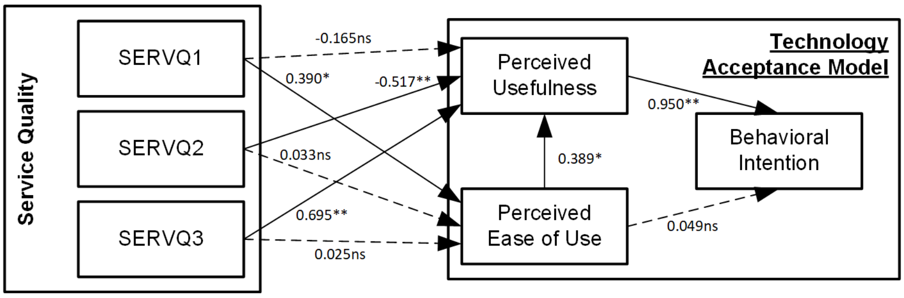
Model Fit Data Set 3 Model SERVQ

Fit index	Value
chi^2/degree of freedom	1.450
Standardized root mean square residual (SRMR)	0.076
Root mean square error of approximation (RMSEA)	0.101
Tucker-Lewis index (TLI)	0.925
Comparative fit index (CFI)	0.957

As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct SERVQ, where items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range except for RMSEA. However, the RMSEA of 0.101 was only slightly above the recommended 0.1. This simplified structural model thus showed an acceptable overall fit and the items also exhibited corresponding reliability. Figure 7.12 therefore shows the correspondingly identified structural correlations in the SERVQ structural model for data set 3.

Figure 7.12.

Structural Model SERVQ Data Set 3



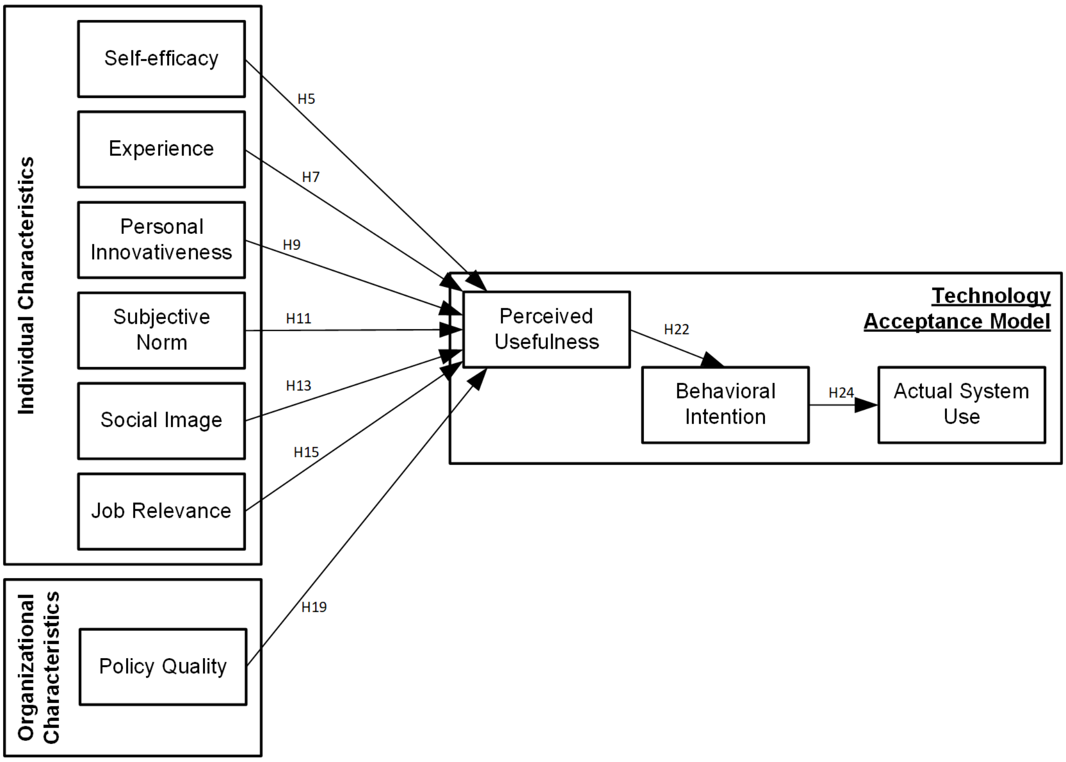
Note. *$p < 0.05$; **$p < 0.01$; ns = not significant

Accordingly, hypotheses $H_{TAM}21$ and $H_{TAM}22$ were supported in this simplified model when analyzing data set 3. That is, the construct PEOU positively influenced the construct PU, which further positively influenced BI. For the hypothesis $H_{TAM}23$ that the construct PEOU had a positive influence on the construct BI, no support could be found in the model. For the hypotheses $H_{TAM}17$ and $H_{TAM}18$ no support could be found overall either. That is, the construct SERVQ did not appear to have any influence on the constructs PEOU and PU. However, the item SERVQ1 had a positive influence on the construct PEOU. That is, individuals who indicated that there was technical support for using eCampus also rated eCampus usability higher. In addition, the item SERVQ3 had positive influence on the construct PU. That is, individuals who indicated that there was content support for using eCampus also rated the usefulness of eCampus higher. Item

SERVQ2 showed a negative impact on the construct PU in the data. That is, individuals who indicated that there was training for the use of eCampus rated the usefulness of eCampus lower.

Figure 7.13.

Measurement Model Data Set 4



Structural Equation Analyses Data Set 4

Data set 4 (eCampus not used) contained the responses from all teachers who completed the questionnaire in full and had not yet used eCampus. This means that in the analysis of these 24 responses, the additional questions on the constructs PEOU, SYSQ, INFQ and SERVQ were not taken into account because the participants who had not yet used eCampus did not receive these questions. Thus, the analysis resulted in the following (see Figure 7.13) simplified measurement model, which was already used in the analysis for data set 2 (fully completed).

Due to the low response rate in this data set, it was not possible to calculate larger structural models as in the other data sets, because the models were not computable. Therefore, on the one hand, the construct AU was removed from the model, since the influence of BI on AU is typical for TAM and it should not be necessary to test it separately, and on the other hand, it was checked directly first whether the items of the constructs show a correlation to the construct PU and its items. For this purpose, Pearson's correlation coefficient was calculated between the items of the constructs SE, EX, PI, SN, SI, JR, and PQ and the items of the construct PU. Table 7.29 shows the significant correlations identified.

Table 7.29.

Significant Correlations Data Set 4

Item	PU1	PU2	PU3
PI1	0.664**	0.693**	0.680**
JR1	0.638**	0.611**	0.702**
JR2	0.718**	0.496*	0.681**
JR3	0.642**	0.509*	0.661**
PQ2	0.760**	0.645**	0.657**
PQ3	0.523**	0.478*	0.509*

Note. *$p < .005$; **$p < .001$

The constructs SE, EX, SN, and SI did not show any correlations here. Thus, the hypotheses $H_{TAM}5$, $H_{TAM}7$, $H_{TAM}11$ and $H_{TAM}13$ could not be supported for data set 4. However, significant correlations were found regarding the constructs PI, JR, and PQ. Therefore, three further structural models were tested, in which the individual items for the constructs PI, JR, and PQ, which showed significant correlations, were related to the constructs PU and BI. For the construct JR, for which all items showed significant correlations, it was tested whether the construct also showed a positive influence in the model.

Table 7.30 and Table 7.31 show the factor loadings of the individual items used for the structural model PI1, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PI, where only item PI1 was considered, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range except for RMSEA. The RMSEA was with 0.183 above the recommended 0.1.

Table 7.30.

Reliability Indices/Factor Loadings Data Set 4 Model PI1

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PI1	1.000
Perceived usefulness (PU)	0.936	0.934	0.826	PU1	0.915
				PU2	0.897
				PU3	0.912
Behavioral intention (BI)	0.949	0.949	0.861	BI1	0.880
				BI2	0.961
				BI3	0.950

Table 7.31.

Model Fit Data Set 4 Model PI1

Fit index	Value
chi^2/degree of freedom	1.800
Standardized root mean square residual (SRMR)	0.076
Root mean square error of approximation (RMSEA)	0.183
Tucker-Lewis index (TLI)	0.906
Comparative fit index (CFI)	0.942

In this simplified structural model, cautiously considered, an acceptable fit was present. In any case, the items showed appropriate reliability. Figure 7.14 therefore shows the correspondingly identified structural correlations in the structural model PI1 for data set 4.

Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 4. That is, the construct PU positively influenced BI. The item PI1 additionally had a positive influence on the construct PU. That is, people for whom it was attractive to try out new e-services also rated the usefulness of eCampus higher.

Figure 7.14.

Structural Model PI1 Data Set 4

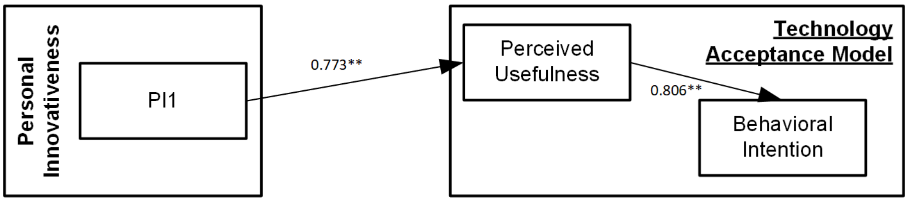


Table 7.32.

Reliability Indices/Factor Loadings Data Set 4 Model JR

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
Job relevance (JR)	0.954	0.955	0.877	JR1	0.893
				JR2	0.960
				JR3	0.952
Perceived usefulness (PU)	0.936	0.937	0.834	PU1	0.932
				PU2	0.884
				PU3	0.918
Behavioral intention (BI)	0.949	0.950	0.863	BI1	0.882
				BI2	0.965
				BI3	0.945

Table 7.33.

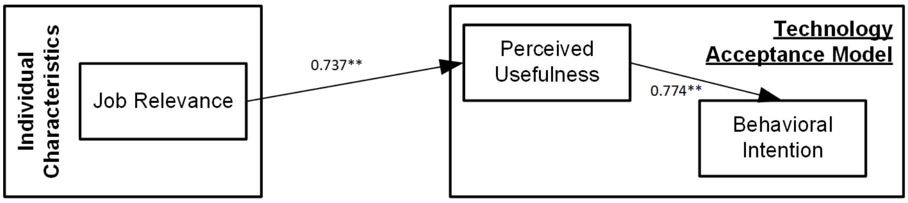
Model Fit Data Set 4 Model JR

Fit index	Value
chi^2/degree of freedom	2.015
Standardized root mean square residual (SRMR)	0.057
Root mean square error of approximation (RMSEA)	0.206
Tucker-Lewis index (TLI)	0.862
Comparative fit index (CFI)	0.904

Table 7.32 and Table 7.33 show the factor loadings of the individual items used for the structural model JR, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4 as recommended in the literature. Each construct also had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range except for RMSEA and TLI. The RMSEA with 0.183 was above the recommended 0.1. The TLI with 0.862 was below the recommended 0.9. In this simplified structural model, cautiously considered, an acceptable fit was nevertheless present. In any case, the items showed appropriate reliability. Figure 7.15 therefore shows the correspondingly identified structural correlations in the structural model JR for data set 4.

Figure 7.15.

Structural Model JR Data Set 4



Note. *$p < 0.05$; **$p < 0.01$; ns = not significant

Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 4. That is, the construct PU positively influenced BI. For the hypothesis $H_{TAM}15$ that the construct JR had a positive influence on the construct PU, support was also found in the model.

Table 7.34 and Table 7.35 show the factor loadings of the individual items used for the structural model PQ2/3, the reliability indices of the constructs, and the model fit. As can be seen, all factor loadings were greater than 0.4, as recommended in the literature. Each construct, except construct PQ, where items were considered individually here, had at least two items. The recommended values for the reliability indices were also clearly met for all constructs. For the model fit, all values were in the recommended range.

Thus, this simplified structural model showed an acceptable overall fit and the items also showed corresponding reliability.

Table 7.34.

Reliability Indices/Factor Loadings Data Set 4 Model PQ2/3

Construct	Cronbach's alpha	CR	AVE	Item	Factor loading
				PQ2	1.000
				PQ3	1.000
Perceived usefulness (PU)	0.936	0.937	0.834	PU1	0.942
				PU2	0.889
				PU3	0.897
Behavioral intention (BI)	0.949	0.949	0.862	BI1	0.881
				BI2	0.961
				BI3	0.950

Table 7.35.

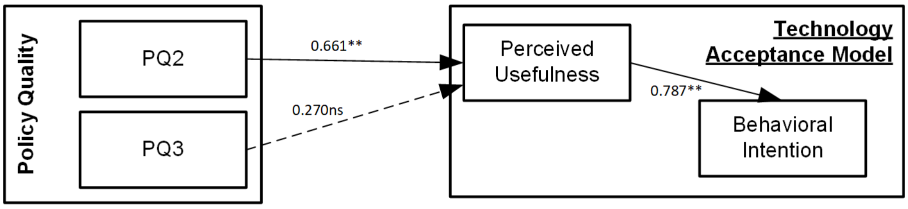
Model Fit Data Set 4 Model PQ2/3

Fit index	Value
chi^2/degree of freedom	1.146
Standardized root mean square residual (SRMR)	0.053
Root mean square error of approximation (RMSEA)	0.078
Tucker-Lewis index (TLI)	0.977
Comparative fit index (CFI)	0.985

Figure 7.16 shows the correspondingly identified structural correlations in the structural model PQ2/3 for data set 4. Accordingly, hypothesis $H_{TAM}22$ was also supported in this simplified model when analyzing data set 4. That is, the construct PU positively influences BI. Item PQ2 also had a positive influence on the construct PU. That is, people who stated that their HEI had integrated eCampus into its own systems also rated the usefulness of eCampus higher. For item PQ3, the data showed no influence on the construct PU. That is, no influence on the usefulness of eCampus from the time a HEI gave instructors to use eCampus could be found in the data.

Figure 7.16.

Structural Model PQ2/3 Data Set 4



Note. *p < 0.05; **p < 0.01; ns = not significant

Table 7.36.

Overview Support for Hypotheses per Data Set

Hypothesis	Data set 2 (N = 68)	Data set 3 (N = 44)	Data set 4 (N = 24)
$H_{TAM}1$ (SYSQ → PU)	x	not supported	x
$H_{TAM}2$ (SYSQ → PEOU)	x	supported	x
$H_{TAM}3$ (INFQ → PU)	x	not supported	x
$H_{TAM}4$ (INFQ → PEOU)	x	not supported	x
$H_{TAM}5$ (SE → PU)	not supported	not supported	not supported
$H_{TAM}6$ (SE → PEOU)	x	partially supported	x
$H_{TAM}7$ (EX → PU)	not supported	not supported	not supported
$H_{TAM}8$ (EX → PEOU)	x	not supported	x
$H_{TAM}9$ (PI → PU)	partially supported	partially supported	partially supported
$H_{TAM}10$ (PI → PEOU)	x	not supported	x
$H_{TAM}11$ (SN → PU)	not supported	not supported	not supported
$H_{TAM}12$ (SN → PEOU)	x	not supported	x
$H_{TAM}13$ (SI → PU)	supported	supported	not supported
$H_{TAM}14$ (SI → PEOU)	x	not supported	x
$H_{TAM}15$ (JR → PU)	supported	supported	supported
$H_{TAM}16$ (JR → PEOU)	x	not supported	x
$H_{TAM}17$ (SERVQ → PU)	x	partially supported	x
$H_{TAM}18$ (SERVQ → PEOU)	x	partially supported	x
$H_{TAM}19$ (PQ → PU)	partially supported	not supported	partially supported
$H_{TAM}20$ (PQ → PEOU)	x	partially supported	x
$H_{TAM}21$ (PEOU → PU)	x	partially supported	x
$H_{TAM}22$ (PU → BI)	supported	supported	supported
$H_{TAM}23$ (PEOU → BI)	x	not supported	x
$H_{TAM}24$ (BI → AU)	supported	x	x

Note. "x" means that the hypothesis was not tested in the data set.

Summary Correlation and Structural Equation Analyses

First, it can be summarized that a correlation between teaching experience and time spent on eCampus on average could be found when analyzing the data. In addition, individuals who were previously aware of eCampus also had a higher intention to use the information from eCampus to improve their teaching. They also logged in more frequently, spent more time on eCampus, and used it more intensively.

Table 7.36 shows the results of the hypotheses tests for the individual data sets. $H_{TAM}21$ could be partially supported through the data. That is, in this case, a significant positive relationship between PEOU and PU was found for the hypothesis in some models and no significant relationship was found in others.

Table 7.37.

Details Partial Support for Hypotheses per Data Set

Hypothesis	Data set 2 (N = 68)	Data set 3 (N = 44)	Data set 4 (N = 24)
$H_{TAM}6$ (SE → PEOU)	x	SE1 (able to use without support)	x
$H_{TAM}9$ (PI → PU)	PI1 (attractive to try out new systems)	PI1 (attractive to try out new systems)	PI1 (attractive to try out new systems)
$H_{TAM}17$ (SERVQ → PU)	x	SERVQ3 (content support)	x
$H_{TAM}18$ (SERVQ → PEOU)	x	SERVQ1 (technical support)	x
$H_{TAM}19$ (PQ → PU)	PQ2 (integration into higher education systems)	x	PQ2 (integration into higher education systems)
$H_{TAM}20$ (PQ → PEOU)	x	PQ2 (integration into higher education systems)	x

For the remaining hypotheses that have the entry "partially supported" in Table 7.36, support for the hypothesis was not found for the construct, but for individual items. Table 7.37 shows the items for which this was the case. At this point, item SERVQ2 must also be mentioned separately. The data here showed a negative influence of the item on the construct PU. That is, people who stated that there was training for the use of eCampus rate the usefulness of eCampus lower.

Figure 7.17 finally shows the conclusions that were drawn in sum for the support of hypotheses based on the individual calculated models. Partial support was assumed if (partial) support was present in some data sets and not in others.

7.5. Discussion[6]

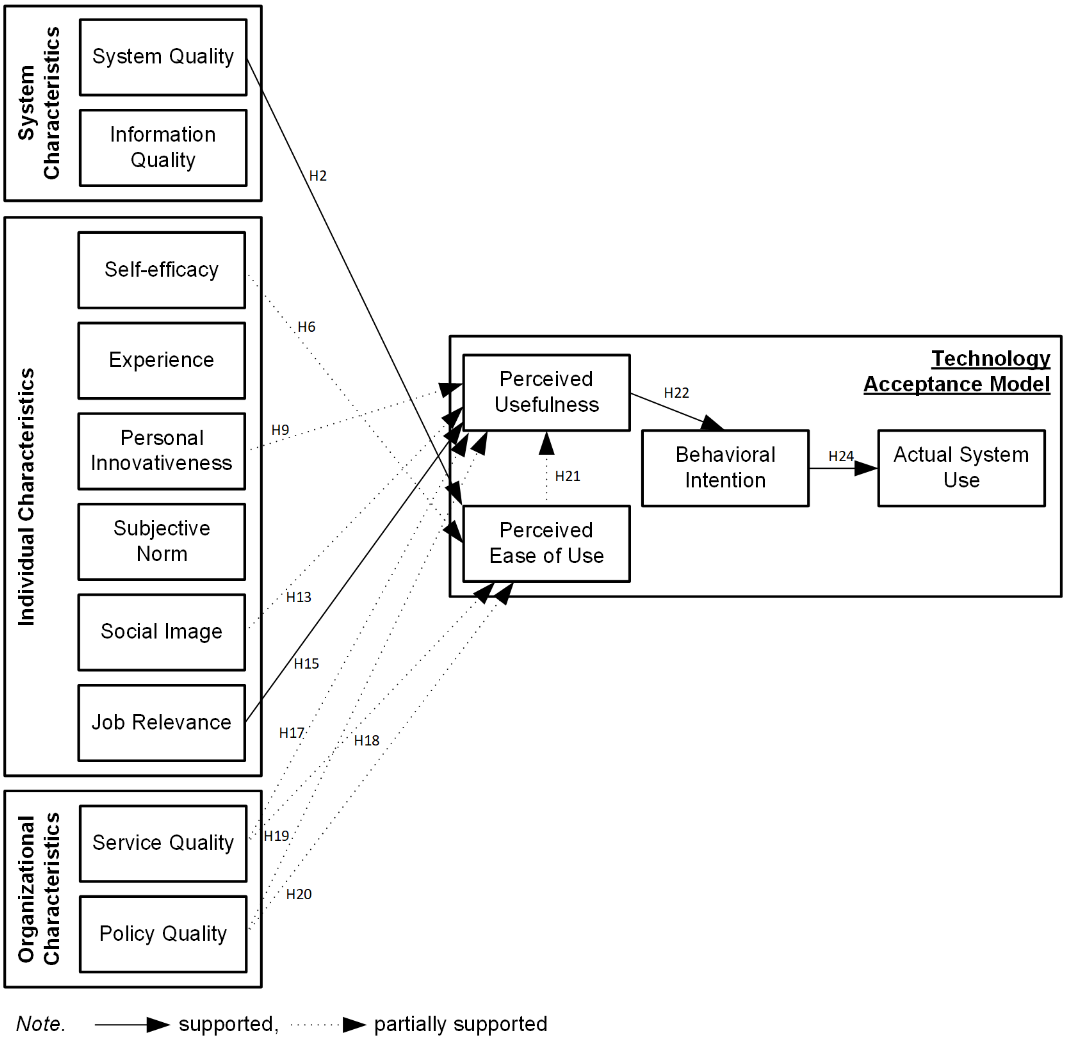
According to Hevner, March, et al. (2004), it is typical for DSR that design is restricted due to a lack of resources and means or due to general restrictions in the application environment. This was also the case in the fourth design cycle, and some service- and process-relevant requirements that were formulated in the second design cycle and, according to experts, have a positive influence on acceptance, were not implemented or only partially implemented. As already discussed in the second design cycle (see Section 5.7.3), this has no influence on the behavior-oriented evaluation of the final e-service.

However, changing or omitting such requirements may have an impact on the design-oriented evaluation. The acceptance of the final e-service might be lower and relevant design principles might not be identified. This probably had the greatest impact on the area of user participation. Here, all requirements were discarded or postponed until later. Active participation in eCampus was accordingly very low. The discussion forums had less than ten posts in total[7], and most of these were individual posts, not a real discussion. A negative impact on PU of eCampus cannot be ruled out here, since according to feedback during the evaluation in the third design cycle

[6]Most parts of this section have already been published in: Beer (2022b)
[7]Last check: 2022-06-24

Figure 7.17.

Results of Hypotheses Tests



(see Section 6.4.2) an active community is necessary for participation and networking functionalities to be perceived as useful.

The remainder of this section discusses the evaluation conducted and its results. Here, the validity of the survey is discussed first. This is followed by a discussion of the design-oriented analysis and then the behavior-oriented analysis, before a summary interpretation concludes the discussion.

7.5.1. Validity of the Evaluation

First of all, when interpreting the results, it must be taken into account that with 79, 68, 44 and 24 responses in the individual data sets, the representation of the population appears rather low. However, the interpretation refers to the confidence intervals for the frequency analyses for the design-oriented view, which were determined with a confidence level of 95%. That is, at 95%, the true mean value of the population also lies in this range and thus the interpretation at 95% is also applicable to the population.

Furthermore, the statements for the behavioral view are based on the results of structural equation models, each of which fulfills several quality criteria, as recommended in the literature. An inference of significant results to the population is therefore also possible. It should also be mentioned at this point, that hypotheses whose described influence could not be supported with the data do not necessarily have no influence. The data simply do not allow any significant conclusions to be drawn. However, when interpreting the results, it must of course also be taken into account that due to the low response rate, the complete structural equation model, i.e. all structural relations, could not be calculated.

It is well known in literature that structural equation models with high numbers of constructs and low numbers of participants can be problematic (Lifang Deng, M. Yang, and Marcoulides, 2018; Rosseel, 2020). It was originally recommended that at least 200 (Gerbing and J. C. Anderson, 1985) or at least 100 (Boomsma, 1985) participants are needed. Bentler and Chou (1987) recognized that the number of participants needed depends on the number of constructs and recommended that there be at least five to ten participants per construct. Thus, for the full structural equation model in this evaluation, this would have been at least 70 to 140 participants.

Newer approaches such as ridge maximum likelihood (Yuan and W. Chan, 2008) or penalized likelihood (Jacobucci, Grimm, and McArdle, 2016; Huang, H. Chen, and Weng, 2017) provide promising results when the number of constructs is high and the number of participants is low but at the same time they still have some problems and further research is still needed (Lifang Deng, M. Yang, and Marcoulides, 2018). Some of the approaches are also not yet fully implemented in software packages and contain experimental features that are not yet reliable (e.g. lessSEM[8]). Therefore, such approaches were not used in this thesis. Instead, as shown, simplified structural equation models were computed for which validity is given according to specified factor loadings, reliability indices, and model fits, although the number of responses was small. Combined with other studies in the literature that also found support for the positive influence of the constructs, inferences were made about the entire model. These inferred statements should be interpreted accordingly.

The sample also largely consists of feedback from one HEI (CAMPUS 02 University of Applied Sciences). It is not possible to make a statement about how much the results differ from the basic population (all teachers at Styrian HEIs). However, it is assumed that the results should also be representative for teachers at other HEIs because, with a few exceptions, the HEI itself, as well as one's own discipline, should not have a major influence on the items surveyed.

Last but not least, with regard to the validity of the evaluation, the results of the two constructs "experience with TEL" and "teaching experience" have to be considered. The construct "experience with TEL" was queried with a 7-point Likert scale ranging from (1) very low to (7) very high. As an explanation, the values (1) very low, (4) medium, and (7) very high were additionally defined in the survey as follows:

(1) very low: You have never used technology in teaching before.

[8]https://cran.r-project.org/web/packages/lessSEM/vignettes/lessSEM.html (last access: 2023-10-20)

(4) medium: You can use typical tools such as PowerPoint and Moodle without any problems
(7) very high: You are doing research in the area of technology-enhanced learning.

In data set 1, data set 2, and data set 3, teachers indicate on average a rather high to high experience with TEL, and in data set 4 a medium to high experience. The mode shows a high experience with TEL in all data sets. Looking at the distribution in the individual data sets, one sees that only 0% to 13% indicate a very low to rather low experience with TEL and 71% to 84% indicate an experience with TEL that is rather high to high. Overall, one must conclude that the interpretation of the survey tends to apply more to teachers who already have more experience with TEL (going beyond the mere use of typical tools such as PowerPoint and Moodle). Furthermore, this also means that interest in a survey about eCampus was significantly lower among teachers with little experience with TEL. A slight tendency that this is also reflected in the use of eCampus can also be seen in the comparison of data set 3 (eCampus used) and data set 4 (eCampus not used). There were no teachers in the survey who had already used eCampus and were self-assessed as having very low to rather low experience with TEL. Among the teachers who have not yet used eCampus, the figure is already 13%. However, this should not be over-interpreted due to the small amount of data.

In the case of teaching experience, it can also be seen that the survey tends to not represent the entire target group. In all data sets, approximately 80% of the teachers' teaching experience is five or more years. The mode is even more than 11 years in all data sets. Thus, the evaluation tends to be more valid for teachers with more teaching experience. It could be interpreted that people with less teaching experience are not (yet) interested in an eCampus survey and thus presumably not interested in eCampus.

In summary, an interpretation for the population can be made despite the rather low response rate. The CAMPUS 02 University of Applied Sciences is reflected the most in the results, but due to the nature of the questions, conclusions can also be drawn for the other eight Styrian HEIs. However, the results tend to reflect only the opinions of teachers who have more experience in teaching and also with the use of TEL.

7.5.2. Discussion of the Design-Oriented Evaluation

In the design-oriented view, the goal of the survey was to determine whether the e-service eCampus is used, i.e. accepted, and whether the target audience is satisfied with the design of the designable constructs that should influence acceptance. The following two parts discuss the results on these two areas.

Acceptance of eCampus

If we look at the construct AU, it can be rated as rather low up to the time of the survey. First of all, it must be noted that at the time of the survey, only about 430 teachers were registered on eCampus. This is a small part of the approximately 6,300 teachers at Styrian HEIs[9]. In data set 1 (only basic data), the data show that eCampus was used very little to never. However, if we look only at the group of teachers who had already used eCampus at least once (data set 3), we also see a higher intensity of use. On average, these teachers had already logged in two to five times, spending five to thirty minutes each time (mode 15-30min) on eCampus. Considering that eCampus is certainly not a tool that is used frequently and regularly, but rather when one currently needs ideas, suggestions, or information for the design of one's own teaching, this can already be seen rather positively.

With regard to the construct BI, which according to the TAM by Venkatesh and Davis (1996) should lead to AU, the situation also looks more positive. For all the items asked about BI, more than 67% of the respondents in all data sets agreed or tended to agree. This means that there is an intention to use eCampus in the future, to read use cases and to use the content in one's own teaching. This is especially true for people who have already used eCampus (data set 3). Here, more than 80% of the agreement is in the range of agree to strongly agree. That is, people who had already used eCampus seemed to be satisfied and would like to use it again. But, the majority of people who had never used eCampus also stated that they would like to use it in the future.

[9] https://unidata.gv.at/ (last access: 2022-09-15 for the year 2021)

In summary, it must be said that the acceptance measured in terms of actual use at the time of the survey is rather low overall. However, the majority of people intended to use eCampus in the future. Even among those who had never used eCampus. The people who had already used eCampus had done so more often and for longer periods of time. They also had a very high intention to continue using eCampus.

Design of eCampus

According to the TAM, the acceptance (AU and BI) of a technology is determined by its PU and PEOU. These two factors are determined by other external variables. This section now interprets the results to determine whether the target audience perceives eCampus to be useful and easy to use, and whether they are satisfied with the design of the designable constructs that should influence adoption. These constructs are:

Social image Has the design of eCampus led teachers to believe that their social image will increase if they use eCampus?

Job relevance Has the design of eCampus led teachers to believe that using eCampus is relevant to their job?

Policy quality Has the design of eCampus resulted in teachers being satisfied with the way their own HEI incorporates eCampus (motivation, integration, time, payment)?

System quality Has the design of eCampus led to teachers being satisfied with the system quality?

Information quality Has the design of eCampus resulted in teachers being satisfied with the information quality?

Service Quality Has the design of eCampus resulted in teachers being satisfied with the quality of services?

Personal innovativeness (partially) Has the design of eCampus led to teachers being attracted to try this new e-service? This can only be partially influenced by the design, as it depends more on personality.

Subjective norm (partially) Has the design of eCampus led teachers to believe that others expect one to use eCampus? This is only partially influenceable by design, as it depends more on personality.

The results show that PU is slightly high overall (data set 2) and among those who had already used eCampus (data set 3). Among those who had not yet used eCampus (data set 4), PU is slightly low. Thus, usefulness is partially perceived. PEOU is in the slightly high to high range. The design of an user-friendly e-service thus seems to have succeeded well.

Designing elements to positively influence SI does not seem to have succeeded, as teachers indicate that using eCampus does not improve SI. JR is rated slightly high overall and among those who had already used eCampus. Among those who had not yet used eCampus, however, JR is rated rather low. JR is thus only seen partially. For the construct PQ, the individual items were rated differently. The HEIs definitely motivate to use eCampus. Integration into their own systems (technical/organizational) also seems to be done. In some cases, sufficient time is given to use eCampus. However, it does not seem that one is paid for the use of eCampus. The teachers are (rather) satisfied with SYSQ, as well as with INFQ. Teachers also tend to be satisfied with SERVQ. So, in these three areas, the design is well done. The majority of teachers also find it slightly attractive (PI) to try out this new e-service, although the design can only have a partial influence here. SN is evaluated rather negatively, i.e. other people do not influence one to use eCampus. Here, too, the design can only have an influence in a roundabout way, but this does not seem to have been successful.

In summary, Table 7.38 shows for which constructs the design is rather not successful, partially successful or rather successful. The usefulness as well as the relevance for the profession are partially perceived by the teachers, but could be higher. The design in terms of usability, system quality, information quality and service quality is good. The teachers who participated in the survey also find it attractive to try such an e-service. The HEIs motivate the teachers to use eCampus at least a little and have also integrated the e-service technically and/or organizationally into the HEI landscape. In some cases, time is also given for the use of eCampus, but apparently the majority does not pay for its use. Presumably, this is especially an issue for external faculty who are not tenured at a HEI. It has also been unsuccessful to design the image of eCampus in such a way that instructors believe that using eCampus brings them higher prestige or that other people even expect you to use eCampus.

Table 7.38.

Evaluation of the Design of the Constructs/Items

Construct/Item	Design successful
Information quality (INFQ)	rather yes
Personal innovativeness (PI)	rather yes
Service quality (SERVQ)	rather yes
Policy quality (Motivation) (PQ1)	rather yes
Policy quality (Integration) (PQ2)	rather yes
System quality (SYSQ)	rather yes
Perceived ease of use (PEOU)	rather yes
Job relevance (JR)	partially
Policy quality (Time) (PQ3)	partially
Perceived usefulness (PU)	partially
Policy quality (Payment) (PQ4)	rather no
Social image (SI)	rather no
Subjective norm (SN)	rather no

7.5.3. Discussion of the Behavior-Oriented Evaluation

The goal of the behavioral analysis was to test the hypotheses describing the influence of individual constructs on the acceptance of eCampus. The results presented in Section 7.4.2 describe which hypotheses can be (partially) supported with the data.

First, as in the TAM by Venkatesh and Davis (1996), the results confirm that PU positively influences BI and that this positively influences AU. That is, when teachers perceive usefulness in e-services such as eCampus, they are more willing to use such e-services, and the higher this intention, the higher the actual use. According to the results, PEOU also has a partial positive influence on PU in the context of the e-service eCampus. That is, the easier a system is to use, the more useful it is perceived. Contrary to the assumption in the TAM, however, here PEOU does not directly influence BI. At least, no support for this could be found in the data from this evaluation. This would mean that just because an e-service like eCampus is user-friendly, users' intention to use it will not directly increase.

For constructs involving system characteristics, it appears that SYSQ influences PEOU, but no support could be found in the data for PU being influenced as well. That is, the higher the quality of the system, the more user-friendly the system appears. However, it cannot be confirmed that a system becomes more useful when the quality of the system is high. The results thus confirm the assumptions by Al-Busaidi and Al-Shihi (2010) that SYSQ in the context of learning management systems has an influence on PEOU, while the assumption that there is also an influence on PU cannot be supported. Also, the results of J.-A. Kim (2006), I.-F. Liu et al. (2010), Liao and S.-H. Liu (2012), Basoglu, Daim, and Polat (2014), and Khan and Qutab (2016) concerning influence of SYSQ on PEOU can be further supported. While no support was found for the results of Liao and S.-H. Liu (2012), Basoglu, Daim, and Polat (2014), Mouakket and Bettayeb (2015), Barhoumi (2016), and Khan and Qutab (2016) concerning influence of SYSQ on PEOU. Regardless, it is definitely important for the acceptance of such an e-service that SYSQ is correspondingly high. However, there is no support in the data that INFQ positively influences PEOU or PU, although these influences have been supported in several studies (see J.-A. Kim, 2006; Y.-C. Lee, 2006; Nov and C. Ye, 2009; Al-Busaidi and Al-Shihi, 2010; I.-F. Liu et al., 2010; Liao and S.-H. Liu, 2012; S. Kim, H. Kim, and S. Han, 2013; Basoglu, Daim, and Polat, 2014; Barhoumi, 2016; Hsu et al., 2016; Khan and Qutab, 2016; Meseguer-Artola et al., 2016). As explained earlier, this does not mean that there is no influence. It is just that the data cannot support this.

For the two constructs on organizational characteristics, SERVQ and PQ, a positive influence on PU and/or PEOU was found in the data for certain items. Thus, the results partially support the assumptions of Al-Busaidi and Al-Shihi (2010) and Schweighofer and Zullus (2019) or the results of J.-A. Kim (2006), Heinrichs et al. (2007), S. Kim, H. Kim, and S. Han (2013), Mouakket and Bettayeb (2015), Hsu et al. (2016), and Khan and Qutab (2016). Accordingly, the presence of content support increases PU of the e-service, while the presence of technical support positively influences PEOU. A positive influence through training could not be confirmed in the data. Thus, it seems to be important for the acceptance of such e-services that both content and technical support is provided, while training may not be necessary. A possible explanation for this would be that teachers prefer to receive support when they need it directly and do not want to undergo training in advance. Furthermore, the integration of the e-service into own HEI systems (technically and/or organizationally) also has a high significance. According to data, this influences PEOU and PU. How this integration needs to look in detail is a topic for further research. According to the data, motivational measures by the HEI to use eCampus, the provision of time for use, and the payment for use have no influence on the acceptance of the e-service. These extrinsic motivational factors thus seem to play a subordinate role in the acceptance of such an e-service.

For constructs of individual characteristics, the data show a similar picture as far as extrinsic motivational factors are concerned. For the construct SN, which describes whether others' expectation of one's use of the e-service has an influence on whether one uses the e-service, the data show no positive influence on PEOU and PU, which is in contrast to the results of J.-A. Kim (2006), and Y.-C. Lee (2006). However, teachers who believe that using the e-service will increase their social standing also partially perceive higher usefulness in the e-service, which supports the results of Venkatesh and Bala (2008), and Meseguer-Artola et al. (2016). Thus, when designing such an e-service, one should also keep in mind that the use can be made visible in some way because teachers want to improve their reputation through it. According to the available data, previous experience of teachers with such e-services in not relevant for acceptance, so the results of I.-F. Liu et al. (2010), and Khan and Qutab (2016) cannot be supported. Here, further research could examine whether positive or negative experience, considered separately, has an influence. However, for teachers who feel able to use the e-service without support, PEOU is higher according to the data (cf. Y.-C. Lee, 2006; Nov and C. Ye, 2009; Barhoumi, 2016; Khan and Qutab, 2016). The data also show that teachers see higher usefulness in the e-service if it is fundamentally attractive to them to try such new e-services, which is consistent with the results of Basoglu, Daim, and Polat (2014). In the design of such e-services, therefore, care should also be taken to ensure that this attractiveness is generated via the degree of novelty of the e-service. It is also essential that JR is conveyed, because this also has a positive influence on PU (cf. J.-A. Kim, 2006; Heinrichs et al., 2007; Barhoumi, 2016; Khan and Qutab, 2016; Meseguer-Artola et al., 2016).

In summary, the data collected confirms that when designing such an e-service, particular attention must be paid to system quality and relevance to the target group's profession. Furthermore, it should be ensured that the novelty of the e-service is communicated, that the social reputation can be increased through use, for example, by making the use visible, that support is offered both technically and in terms of content, and that the e-service is integrated technically and/or organizationally into the HEI's own systems. These findings also conclusively answer the third subordinate research question of this thesis, which was:

> *RQ3.* What constructs influence the acceptance of an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

7.6. Conclusion

This chapter described the fourth and final design cycle in which the e-service was finalized and finally evaluated. In the first step, the results from the evaluation of the third design cycle were used to refine the e-service prototype. Then, the remaining service and process-relevant requirements were implemented to complete the e-service. Approximately six months after the e-service was available to the public, the final evaluation of the e-service and both a design-oriented and behavior-oriented analysis were conducted.

The results of the design-oriented analysis show that the design of the designable constructs/items was mostly successful. The results of the behavioral analysis confirm for some constructs/items the positive influence on perceived usefulness or perceived ease of use and thus further on the intention to use and actual use of eCampus. In detail, the results show that for the acceptance (intention to use and actual use) of such an e-service, it is important in the design that the system quality is high, that the novelty of the e-service is conveyed, that technical and content support is available, and that the e-service is integrated into the systems of one's own HEI. For all these constructs/items, according to the results of the survey, the design was successful, which increased the acceptance. In the case of relevance to the profession, the design is only partially successful, although this would be very important for the acceptance of the e-service. Some teachers who participated in the survey do not see too much relevance of eCampus for their own profession, which also lowers the acceptance of eCampus. Regarding the possibility of increasing one's own SI through the use of the e-service, it must be said that, from the point of view of the participants in the survey, the design does not contribute to this and thus the acceptance of eCampus could not be increased through this construct.

The results of the behavioral view also show that apparently for e-services like eCampus, perceived usefulness has more positive influence on acceptance than perceived ease of use. The importance of perceived usefulness can also be seen when comparing the results of teachers who have already used eCampus with those who have not yet used eCampus. Perceived usefulness is significantly higher for the first group than for the second. Thus, teachers who have not yet used eCampus also perceive less usefulness in it than teachers who have already used eCampus.

In general, the validity of the survey tends to be only for teachers who already have experience with TEL and generally have a lot of teaching experience. Teachers with little teaching experience and little experience with TEL are not really represented in the survey and it stands to reason that these teachers have also not yet used eCampus, i.e. do not accept it. Thus, teachers who had no interest in TEL so far, and thus gained (little) experience with TEL, were also not motivated by eCampus to engage with TEL. The perceived relevance of TEL and the perceived usefulness of this topic are definitely linked to the perceived relevance and usefulness of eCampus. Simply put, as long as TEL is not accepted, eCampus cannot be accepted either. This is also shown by the fact that, taken as a whole, acceptance of eCampus is low, but all those who have already used it, i.e. who seem to have a basic interest in TEL, are very satisfied with the design and accept the e-service. This basic interest must surely be greater than the mere use of common technical tools such as PowerPoint, Moodle, MS Teams, and so on.

8. Discussion of Contributions

This chapter discusses the individual contributions of this thesis. In each case, it is examined whether the contribution can be described as successful. As recommended by Hevner, March, et al. (2004), the evaluation criteria established at the beginning of the process (see Section 1.3) are used for this purpose. The contributions are also discussed in the context of relevant literature and the significance of them is presented. In this sense, the first section deals with the e-service eCampus, the second with the nascent design theory (NDT), and the third with the Acceptance-Driven Design Science Research (AD-DSR) approach.

8.1. The E-Service eCampus

The e-service eCampus[1] is, according to the contribution levels by Gregor and Hevner (2013), a Level 1 contribution. In more detail, the designed eCampus is a situated implementation of a specific software product. At the beginning of this thesis it was specified that the design is viewed successful if the users are satisfied with the design of the e-service and accept it, and more than 10% of the teachers at Styrian higher educational institutions (HEI), i.e. about 630 teachers[2], have used the e-service at least once.

Regarding satisfaction with the design, this can be seen as rather successful overall. The evaluation showed that for five constructs and two items the users are quite satisfied with the design, for two constructs and one item they were partially satisfied and only for two constructs and one item they were rather not satisfied.

[1]Available at https://e-campus.st
[2]https://unidata.gv.at/ (last access: 2022-09-15 for the year 2021)

The acceptance of the e-service eCampus is partially present. At the time of the evaluation, the overall measured actual usage in the survey was rather low. However, the majority of survey participants indicated that they would like to use eCampus in the future, i.e., the intention to use, which should lead to actual use according to Venkatesh and Davis (1996), was high. Actual usage was also significantly higher among those who had already used eCampus prior to the survey, and they also indicated an even higher intention to continue using it.

With 430 users, which logged into eCampus at least once, the target of 10% of all teachers at Styrian HEIs, i.e. approx. 630 teachers, was not reached at the end of the project. In the meantime, eCampus has been opened to teachers at all Austrian HEIs and the number of users has increased to 661[3] from February 2022 to October 2023. During the same period, there was an average of 4,800 logins with an average of 27 unique logins per month. It appears that few teachers are using eCampus, but those teachers then use the e-service more often. However, active participation, as measured by the number of posts in the discussion forums, has not really increased and remains very low.

Thus, measured against the evaluation criteria established at the beginning, it must be stated that this Level 1 contribution, i.e. the e-service eCampus, is only partially successful. The design of the artifact is rather successful. However, the acceptance is only partial, although the intention to use it is high. The targeted number of users was not reached and the interactions are also very low.

As described in the introduction to this thesis, we live in a digital economy (H.-D. Zimmermann, 2000) where new digital platforms and services are constantly emerging (Bukht and Heeks, 2017). However, this does not mean that these platforms and services are all successful. Yoffie, Gawer, and Cusumano (2019) investigated this by looking for as many digital platforms as possible that failed over a 20-year period and compared them to the 43 successful platforms of that time period. In total, they found 209 digital platforms that failed, meaning that out of 252 platforms studied, over 80% failed and only slightly less than 20% of all new digital platforms were actually successful.

[3] Last check: 2023-10-06

One reason why the e-service eCampus is only partially successful could be due to the lack of an ecosystem behind the e-service. Rothe, Taeuscher, and Basole (2018) describes that platforms that actively involve partners in value-adding activities can also achieve higher growth and better competitive performance. They further hypothesize that platforms that have many ecosystem partners who also frequently provide value-added contributions have a competitive advantage.

During the requirements elicitation in the second design cycle, requirements were also identified for the e-service eCampus that would have resulted in the creation of such an ecosystem. It was envisaged that third parties would be able to integrate a wide range of services into eCampus (Req_1_P_Misc_-SN_Third-party-services-offers). It was also intended that users themselves contribute use cases for the eCampus and that incentives are created for this (Req_1_P_Us_SYSQ_SI_SERVQ_Voluntary-participation). However, the rectorates of the Styrian HEIs have decided that these requirements should only be implemented at a later stage, if at all, by the working group overseeing the operation of eCampus.

However, the main reason for a lower number of users than hoped for is probably another. Bratengeyer et al. (2016) showed with their large-scale study that technology-enhanced learning (TEL) is an issue at all Austrian HEIs, and Pausits et al. (2021) confirmed this, showing that most Austrian HEIs had already implemented technical and organizational structures and services for TEL at the onset of the COVID-19 pandemic. However, various studies (see Section 2.1) showed in detail that most teachers only used basic tools that were available and integrated across the HEI (Bratengeyer et al., 2016; Hoffmann, 2016; Bond et al., 2018; Schweighofer and Zullus, 2019). Thus, when looking at TEL in more detail, although it is used very often and by almost every teacher, most of them only use classic widely used tools such as learning management systems and PowerPoint.

The final evaluation of the e-service eCampus also included mostly only the opinions of teachers who already had more experience with TEL, i.e. using more than just PowerPoint and Moodle. This smaller group of teachers is interested in using TEL, therefore used the e-service eCampus, and also participated in the survey. The larger group of teachers who only use common TEL tools do not seem to have this interest and therefore do not use the designed e-service eCampus. So if the goal was that a large number of teachers in the Styrian higher education (HE) area would increasingly use technologies in their own teaching through the new e-service eCampus, it must be concluded that this goal was not achieved and probably could not be achieved. However, for teachers who are already interested in TEL, eCampus seems to be an accepted e-service, which is also used and thus can improve the quality of teaching through meaningful use of technologies.

The e-service also appears to solve, at least in part, problems associated with traditional training programs. Hossain (2010) claimed that teachers are often unable to attend such training programs due to an excessive workload. The e-service eCampus, available online at any time, seems to have at least partially solved this problem. The final evaluation showed that teachers were more likely to report having time to use eCampus. So, Lossman, et al. (2009) as well as Malik, Nasim, and Tabassum (2015) also saw the problem with classical training programs that what is learned is not put into practice afterwards. The evaluation did not ask whether the content of the eCampus had actually been used. However, it was asked how high the intention to do so is. The results showed that for most teachers who had used the eCampus, this intention was rather high to high.

Haug and Wedekind (2009) also noted that many similar e-services failed because they were not visible, did not have a business model, and did not have a plan for how to continue to support and maintain the e-service after the project ended. For the e-service eCampus, a separate working group was established to take care of the operation and further development of the eCampus after the end of the project. This was initially financed by the rectorates of all Styrian HEIs. With the opening of the e-service to the entire Austrian HE sector, the financing was taken over by the province of Styria. The financing, and thus the operation, maintenance and also the further development of the e-service is therefore basically ensured. The next few years will show how the number of users will develop.

8.2. Nascent Design Theory

The second contribution of this thesis is, corresponding to Gregor and Hevner (2013), a NDT, thus a Level 2 contribution. The NDT consists of constructs and design principles (DPs) that should be considered to positively influence user acceptance when designing an e-service to support teachers in the HE sector in using TEL. Based on the initially defined evaluation criteria this contribution is considered successful if significant statements for such a NDT can be given.

With the final evaluation in the fourth design cycle support was found that some constructs of the specified Technology Acceptance Model (TAM) positively influence perceived usefulness and/or perceived ease of use and thus the acceptance of the e-service. Furthermore, the evaluation revealed for which constructs the design was successful according to user feedback. If a construct positively influences acceptance and the construct was successfully designed, the designed requirements for the construct can be used as DPs for the NDT. This is justified by the fact that the design of these requirements formed the construct, which had a positive influence on acceptance.

Accordingly, the second contribution can be viewed successful and a NDT can be formulated. As was described in Section 2.2.2 such a design theory (DT) consists of guidelines that can be used for future artifacts of the same type and it should include as a minimum the following first six core components and should include the last additional two (Gregor and D. Jones, 2007): (1) the purpose and scope, (2) the constructs, (3) the principles of form and function, (4) the artifact mutability, (5) testable propositions, (6) justificatory knowledge, (7) principles of implementation, and (8) expository instantiation. In addition, according to Gregor, Kruse, and Seidel (2020), the description of DPs should inlcude: (1) aim, implementer and user, (2) context, (3) mechanism and enactors, and (4) rationale.

Table 8.1 shows the proposed NDT whose DPs also provide the answer to the second subordinate research question. *RQ2* was stated as:

> *RQ2.* What requirements define an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

Table 8.1.

Nascent Design Theory for accepted E-Service on Technology-Enhanced Learning

Component	Description
Purpose and scope	The aim is to design an accepted e-service that will enable teachers in the HE sector to acquire in self-study the skills necessary to successfully implement TEL approaches.
Constructs	Constructs that should be considered in the design are: (1) system quality, (2) conveying the novelty of e-service, (3) technical support (service quality), (4) content support (service quality), (5) integration in HEI systems, (6) job relevance, and (7) social image.
Principles of form and function	For designers (implementers) to design an accepted e-service (aim) to support teachers (users) in the HE sector in using TEL (context) ensure ... (DP1) ... to provide testimonials from the start (mechanism) because this should positively affect the system quality (rationale). (DP2) ... to fill in all filter and recommendation criteria from the start (mechanism) because this should positively affect the system quality (rationale). (DP3) ... to incorporate the content into a defined structure and to map this structure in the system (mechanism) because this should positively affect the system quality (rationale). (DP4) ... to provide information about the technical and content support service (mechanism) because this should positively affect the service quality (rationale). (DP5) ... to provide a search functionality with free-text search and filter criteria separated from the navigation but with the same visual appearance (mechanism) because this should positively affect the system quality and conveying the novelty of e-service (rationale). (DP6) ... to provide navigation along a textual tree structure and along visually more appealing image tiles with the possibility to switch between these two navigation options (mechanism) because this should positively affect the system quality (rationale). (DP7) ... to display the top five most viewed contents (mechanism) because this should positively affect the system quality (rationale). (DP8) ... to provide a functionality that allows users to mark conent they have already seen (mechanism) because this should positively affect the system quality (rationale). (DP9) ... to provide a functionality that allows users to set reminders for (sub-)categories of the structure that informs them when new content is added to this (sub-)category (mechanism) because this should positively affect the system quality (rationale). (DP10) ... to provide templates for creating new content so that the content has the same structure (mechanism) because this should positively affect the system quality (rationale). (DP11) ... to provide a functionality that allows users to create experience reports or feedback on content (mechanism) because this should positively affect the system quality (rationale). (DP12) ... to display content that other users have also viewed when viewing a particular piece of content (mechanism) because this should positively affect the system quality (rationale).

(continued)

Table 8.1.

Nascent Design Theory for accepted E-Service on Technology-Enhanced Learning (continued)

Component	Description
	(DP13) ... to implement a visual design that provides high usability, is consistent and modern, but rather plain and simple with visual support without losing clarity (mechanism) because this should positively affect the system quality and conveying the novelty of e-service (rationale). (DP14) ... that the e-service is barrier-free if possible (mechanism) because this should positively affect the system quality (rationale). (DP15) ... that the e-service has a responsive design (mechanism) because this should positively affect the system quality (rationale). (DP16) ... to provide a good performance and a high availability (mechanism) because this should positively affect the system quality (rationale). (DP17) ... to provide a simple login (mechanism) because this should positively affect the system quality (rationale). (DP18) ... to provide communication possibilites for users to communicate with other users and content creators (mechanism) because this should positively affect the system quality and conveying the novelty of e-service (rationale). (DP19) ... to implement a non-disruptive and non-intrusive reminder to users to provide feedback and/or testimonials (mechanism) because this should positively affect the system quality (rationale). (DP20) ... to provide technical and content support (mechanism) because this should positively affect the system quality and service quality (rationale). (DP21) ... to maintain the content regularly (mechanism) because this should positively affect the system quality (rationale). (DP22) ... to explain core terms and the advantages of the e-service on the homepage (mechanism) because this should positively affect conveying the novelty of e-service (rationale). (DP23) ... to provide positive experience reports from users on the homepage (mechanism) because this should positively affect conveying the novelty of e-service (rationale). (DP24) ... to promote the e-service via various channels but above all also via HEI's own (mechanism) because this should positively affect conveying the novelty of e-service (rationale).
Artifact mutability	Further DPs for designing elements that have positive impact on job relevance and social image should be added.
Testable propositions	The NDT is based on results collected in the Styrian higher education area. It is assumed that the validity is also given for other regions. The results are based on structural equation analyses that meet several quality criteria.
Justificatory knowledge	Existing theories and models of technology acceptance research form the basis for the NDT.
Principles of implementation	No specific principles of implementation are to be considered.
Expository instantiation	The designed e-service eCampus can assist in the representation of the NDT. The e-service shows how the individual DPs were implemented.

It has to be noted that the NDT is solely based on results achieved in the Styrian HE area. It can be assumed that the theory is valid for other regions too but further testing is necessary to support this assumption and to come closer to defining a DT that would be a Level 3 contribution according to Gregor and Hevner (2013). The NDT presented is consistent with results from the literature that found support for the influence of various constructs on the adoption of similar e-services. In detail, it is important that the system quality is high (cf. e.g., J.-A. Kim, 2006; Al-Busaidi and Al-Shihi, 2010; I.-F. Liu et al., 2010; Liao and S.-H. Liu, 2012; Basoglu, Daim, and Polat, 2014; Khan and Qutab, 2016), the novelty of the e-service is conveyed (cf. e.g., Al-Busaidi and Al-Shihi, 2010; Basoglu, Daim, and Polat, 2014), technical (cf. e.g., Al-Busaidi and Al-Shihi, 2010; Mouakket and Bettayeb, 2015) and content support (cf. e.g. Al-Busaidi and Al-Shihi, 2010) is available, the e-service is integrated into the systems of one's own HEI (cf. e.g. Al-Busaidi and Al-Shihi, 2010), job relevance is high (cf. e.g., J.-A. Kim, 2006; Heinrichs et al., 2007; Barhoumi, 2016; Khan and Qutab, 2016; Meseguer-Artola et al., 2016), and one's own social image is increased through the use of the e-service (cf. e.g., Venkatesh and Bala, 2008; Meseguer-Artola et al., 2016). The presented NDT additionally includes DPs for these constructs if the evaluation for the constructs confirmed a (rather) successful design and associated requirements were defined and also implemented. The DPs are presented in no particular order.

It must be said that the NDT is at an early stage and more research is necessary to refine it. It is also important to note that it is not confirmed that every single DP is relevant for an accepted design. The NDT includes constructs that should be considered because the given research has supported the influence of these constructs on acceptance. If the design of the construct was successful, the implemented requirements related to the constructs were transformed into DPs because the implementation of all these DPs resulted in a successful design of the construct. However, it is plausible that some of these DPs have a greater impact on the successful design than others, and that some have no impact at all. To verify how important an individual DP is, further research needs to evaluate the DPs individually.

Furthermore, looking closely at the proposed NDT and the relationship between the relevant constructs and DPs, the individual constructs are represented differently. For the constructs "job relevance" and "social image" support was found that both influence the acceptance. However, the development of these constructs was unsuccessful, so no DPs concerning only these two constructs were included in the theory and no DP is justified by these constructs.

Conveying the novelty of the e-service also positively influences the acceptance of the e-service. Here it must be taken into account that this represents a part of the construct "personal innovativeness", which describes how much a person is willing to try new and innovative things. The construct can be influenced only in part by the design (see Section 5.2.2). On the one hand, the e-service can be designed to minimize entry barriers to use the e-service, and on the other hand, one can try to increase interest in the new e-service in advance. The final evaluation showed that the design was successful on both counts. However, the evaluation also showed that only the second point, conveying the novelty of the e-service to increase interest, had an impact on acceptance. Therefore, not all requirements assigned to the construct "personal innovativeness" could be used as DPs, but only those that are related to conveying the novelty of the e-service.

Integration in the HEI's own systems also has a positive impact on acceptance, and the evaluation found that users were satisfied with the integration. The requirements survey also defined a requirement that included such integration. However, this was assigned by the experts to the construct "personal innovativeness" because it was intended to minimize the barrier to use the e-service. Therefore, no DP was derived from the requirement here. In the case of integration, however, it must also be noted that the evaluation mainly represents the situation at the CAMPUS 02 University of Applied Sciences (UAS), i.e. the UAS seems to have implemented the integration satisfactorily.

Regarding technical and content support, there were different and sometimes contradictory proposals for the design during the design cycles. The common ground could finally be summarized in two DPs, which show in a simplified way that both technical and content support must be available and that support contact information must be provided.

The vast majority of DPs are related to system quality. This is certainly also due to the fact that most of the implemented requirements are related to system quality. From the point of view of the author of this thesis, however, this result also partially supports the meaning of the IS Success Model by DeLone and McLean (2003), which sees "information quality", "service quality" and "system quality" as essential constructs in the design with influence on the acceptance of information systems. Compared to the constructs "personal innovativeness", "subjective norm", "social image", "job relevance", and "policy quality", these constructs are also "easier" to design, i.e. it is easier to find requirements for these constructs. Thus, even if all these constructs have an influence on the acceptance of an e-service, it is still more efficient to focus on the constructs "information quality", "service quality", and "system quality" purely from a design-oriented point of view. However, it is also interesting to note here that no support for the influence of information quality on acceptance could be found in this thesis. According to the results, the design of the construct is well done, but the analyses showed no influence on perceived usefulness or on perceived ease of use. This is surprising and should be analyzed in further research.

8.3. Acceptance-Driven Design Science Research

The third contribution is, like the first one, according to Gregor and Hevner (2013), a Level 1 contribution, i.e. a situated implementation of an artifact. More precisely, it is an implementation of a specific process, the AD-DSR approach. At the beginning of the thesis, it was defined that the contribution can be considered successful if the approach was carried out according to plan, the artifact designed with this approach is accepted, and/or significant statements can be made about acceptance constructs related to the artifact.

The AD-DSR approach was executed in the thesis as specified with all steps (see Section 3.1.2). First, it was recognized that acceptance is an important issue in the design of the artifact. Therefore, a specific TAM was modeled and requirements were elicited to positively influence the external variables (=acceptance constructs). Then, evaluation was performed in each design cycle in terms of perceived usefulness and perceived ease of use. In the last design cycle, after completion of the artifact, the evaluation was conducted from a design and behavioral perspective. Here, the e-service was found to be partially accepted (see Section 8.1), support for the influence of acceptance constructs could be found, and a NDT could be formulated (see Section 8.2). Thus, the contribution can be judged as successful.

The fundamental idea of the AD-DSR approach is to fully incorporate the complementary nature of design science and behavioral science (Hevner and Chatterjee, 2010) in the design of artifacts where acceptance is a relevant application domain problem. The basis for this is the Design Science Research (DSR) framework by Hevner (2007). Hevner, March, et al. (2004) argued that knowledge of behavioral science theories is essential for the design and evaluation of artifacts. At the same time, however, they emphasized that the focus should be on design. It is more important, they said, to make the artifact work and to know how it works, not why it works. However, in the view of the author of this thesis, if the problem is to design an accepted artifact, the focus should be more on fully incorporating the complementary nature of design science and behavioral science. Indeed, the design of an accepted artifact may not be possible, for example, because of constructs that cannot be influenced by the design. However, a research approach that in such situations shows why an artifact is accepted or not, i.e. which constructs influence acceptance and how, and which design elements contributed to acceptance and how, nevertheless provides important insights for the knowledge base, both from a behavioral and a design science perspective.

In executing the AD-DSR approach in this thesis, it was shown how the complementary nature of behavioral and design science can complement each other in the design of accepted artifacts. From behavioral science, theories of technology acceptance research were used to identify constructs that should influence the acceptance of the artifact being designed. Requirements were then elicited during the design that should positively influence these constructs. In this way, theories of behavioral science were used to contribute to design science. With the evaluation of the designed artifact the approach could provide contributions from a behavioral-oriented point of view, i.e. what constructs influence acceptance, and a design-oriented point of view, i.e. how should these constructs be designed. In this way the designed artifact provided utility to contribute to behavioral science but also to design science. However, as was noted in Section 8.2, the approach does not yet provide individually confirmed DPs, but rather sets of DPs that in sum have positive influence on acceptance constructs. The approach would need to be extended to include another evaluation step to make an even more valuable contribution from the perspective of design science.

Regarding such an approach, Platzer (2011) assumed that designers cannot derive requirements from theories of technology acceptance research because (1) the models are static but perceptions change over time, (2) at least prototypes must be available for necessary evaluations, and (3) the constructs of the models and theories are too imprecise for designers to specifically consider in design. The AD-DSR approach directly addresses the third problem described by Platzer (2011) in that the approach provides not only acceptance constructs but also more concrete DPs for those constructs. Regarding the change in perception over time and the need for a prototype, Davis and Venkatesh (2004) already conducted an experiment. It showed that perceived usefulness and intention to use were very similar before actual use and four months after use. Thus, perception did not really change over this time span. When considering the design of the e-service eCampus, however, the time span between requirement elicitation and the last evaluation was significantly longer with approx. 33 months, which is why the assumption of Platzer (2011) could certainly apply here. However, the evaluations in the individual design cycles consistently showed similarly good results with regard to perceived usefulness and perceived ease of use, i.e. perceptions hardly changed over a period of about 24 months.

However, one limitation of the approach must be taken into account here, which can strongly influence the results: the influence of the selected test persons in the individual design cycles. The results of the last evaluation showed that a majority of people with a lot of previous experience in TEL, thus presumably a lot of interest in TEL, participated in the survey and these people see a high usefulness of the artifact. Even though care was taken in the selection of test subjects in each evaluation to ensure that they had different levels of experience with TEL, it cannot be ruled out that it were mainly those who volunteered for such a test phase who also had an interest in TEL and therefore also perceived higher usefulness of such an e-service. In future applications of the AD-DSR approach, it should therefore be specifically ensured that people who are obviously not interested in the designed artifact also participate in the evaluations, in order to ultimately also be able to gain acceptance from these people.

Looking at the AD-DSR approach and the insights that could be gained from its application, there are further limitations that have to be considered. The modeling of the specific TAM, as well as the use of the TAM as a theory of behavioral science in general, has a major impact on the results of the approach from the very beginning, because it already determines which constructs will be considered at all. As discussed in Section 5.7.1, the AD-DSR approach recommends the TAM, rather than for example the TAM3 (Venkatesh and Bala, 2008) or the IS Success Model (DeLone and McLean, 2003), because it is more flexible and constructs can be determined that seem relevant to the design. However, depending on the artifact, application environment, and goal, it should be reviewed whether other models and theories are more appropriate, efficient, and effective. This might be the case especially in application domains where specific acceptance models have already been defined and confirmed. If the focus is more on design science, the IS Success Model by DeLone and McLean (2003) might also be more suitable, since it focuses more on designable constructs. When designing the eCampus, it would probably also have been relevant to include experience with TEL[4] in the specific TAM, since as previously described this seems to have a decisive influence on the acceptance of the e-service. Although the final evaluation checked whether there was a correlation between experience with TEL and intention to use or actual use, no significant correlation was found. This was probably due to the overrepresentation of teachers with a lot of experience with TEL.

Eliciting requirements with expert interviews for the design of each construct seems to be an appropriate method for this step after the initial use of the AD-DSR approach. For some constructs, this has led to a successful design and the designed artifact has been at least partially accepted. However, this inevitably results in the limitation of the approach that when there are conflicting requirements, the designers or other decision makers have a large influence on the design. This does not affect the behavioral part of the approach, but it very much affects the design-oriented part. According to Hevner, March, et al. (2004), however, this is normal for DSR and designers should try to implement the best solution possible with the available means and resources in an interative search process. Another problem in the ap-

[4]Note that the experience with TEL is not to be confused with the construct "experience", which mapped the experience with similar e-services.

plication of the method was that experts determined which requirements were assigned to which constructs. Since DPs are ultimately derived from the requirements if the assigned construct has an influence on acceptance and has also been successfully implemented, this assignment is essential for the formation of DPs and already requires great care at this stage. This was evident in the requirement regarding integration in HEI systems, which, as noted in Section 8.2, was not included as a DP in the NDT because it was assigned to a construct for which no support was found for an influence on acceptance.

One of the most important steps in the AD-DSR approach is the final evaluation. This should be conducted in the application environment with a quantitative survey in order to be able to provide valid results from a design-oriented and behavior-oriented perspective. The response rate is of great importance here but, as described in Section 7.5.1, the response rate was rather low in the evaluation of eCampus. Support for significant correlations could be found and accordingly an NDT could be formulated, but e.g. due to the underrepresentation of teachers with little experience with TEL further possibly existing relevant correlations could not be substantiated. The low response rate also meant that simplified models had to be calculated, and only inference could be made on the entire model with all structural relations.

To increase user acceptance in the design of artifacts, an agile process model with more frequent iterations and greater user involvement could of course also be successful. According to Boehm and Turner (2003), however, not all project types are suitable for an agile approach, and funded research projects at HEIs in particular seem to call for plan-driven approaches. In the eCampus project, too, an agile approach would have been difficult to implement from the point of view of the author of this thesis due to the division of the work packages among three HEIs. The AD-DSR approach is better suited for such a setting. The approach increases the likelihood of designing an accepted artifact by considering relevant acceptance constructs in the design. However, since artifact acceptance can never be guaranteed, the approach also focuses on ensuring that relevant scientific contributions for design and behavioral science can be delivered to the knowledge base at the end.

9. Conclusion and Outlook

This final chapter provides conclusions to the research questions that guided the thesis and an outlook for future work. Therefore, the first section concludes by providing answers to the individual research questions. Then, the second section describes the contribution of the thesis to the scientific community, the higher education (HE) sector, and other fields, including implications for further work.

9.1. Conclusion to Research Questions

This section provides final conclusions to the research questions of this thesis. In each case, it is described how the research question was answered and what the answer to the research question is according to the knowledge gained during the thesis.

9.1.1. Conclusion to RQ1

The first subordinate research question answered by this thesis was:

> *RQ1.* What influencing factors have to be considered when describing technology-enhanced learning approaches?

The research question was answered in the first design cycle of this thesis. First, a structured literature review was used to identify and cluster influencing factors into 20 categories that could potentially be considered when implementing technology-enhanced learning (TEL) approaches. Afterwards, professionals from German and Austrian higher educational institutions

(HEIs) were asked for which categories of influencing factors they would invest time and how important each category is from their point of view.

Based on these results, it was finally determined that 11 categories of influencing factors need to be considered when describing TEL approaches, eight categories should be considered, and one category can be considered. This classification (see Table 4.11) also represents the final answer to the first research question of this thesis. In the following design cycles, the results formed a basis for which content should be described in which way in the designed e-service eCampus.

9.1.2. Conclusion to RQ2 and RQ3

The second and third subordinate research questions that guided this thesis are closely related. They were:

> *RQ2.* What requirements define an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?
>
> *RQ3.* What constructs influence the acceptance of an e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

To answer the two research questions, a specific Technology Acceptance Model (TAM) was defined in the second design cycle based on a structured literature review, which included constructs that should influence the acceptance of the e-service. Then, expert interviews were used to elicit the requirements for the designable constructs of this TAM to contribute to the successful design of these constructs. After the design of the e-service was completed in the fourth design cycle, i.e. after these requirements were implemented, a survey and a quantitative evaluation were used to determine which constructs were successfully designed and which constructs had an influence on the acceptance of the e-service.

Thus, the third subordinate research question could already be answered. According to the research results, the constructs "system quality", "job relevance" and "social image" have a positive influence on the acceptance of such e-services. Additionally, it has a positive influence on the acceptance if the novelty of the e-service is conveyed, technical and content support is provided, and the e-service is integrated into HEI's own systems.

In order to answer the second subordinate research question, it was additionally verified whether these constructs were successfully implemented according to the results of the survey. If this was the case, design principles (DP) were formulated for the implemented requirements related to the respective constructs and summarized in a nascent design theory (NDT). This NDT (see Table 8.1), or more precisely the DPs contained therein, represents the answer to the second subordinate research question of this thesis.

9.1.3. Conclusion to RQ

Finally, this section provides conclusions and an answer to the main research question of this thesis, which was:

> *RQ.* How can we design an accepted e-service to support teachers in the Styrian higher education sector in using technology-enhanced learning?

The answer to this research question is the Acceptance-Driven Design Science Research (AD-DSR) approach proposed in Chapter 3 and applied in the course of the thesis. The basic idea of the approach is to incorporate the complementary nature of design science and behavioral science, and to use theories of technology acceptance not only for the evaluation but already during the design of artifacts where user acceptance is a relevant problem of the application domain. In this context, AD-DSR is not a new methodology, but a specific application of Design Science Resarch (DSR). At its core, the AD-DSR approach proposes a research design pattern (see Figure 3.2) that includes specific steps within the DSR process model by Vaishnavi and Kuechler (2004) to ensure the incorporation of design science and behavioral science in the context of technology acceptance during a DSR project.

The approach cannot guarantee that the artifact will be accepted in the end, since this may depend on constructs that cannot be influenced by the design. However, as shown in the thesis, the approach can provide significant scientific insights for design science (in the form of DPs) and behavioral science (in the form of acceptance constructs) both consolidated in a NDT. Thus, the application of the approach not only provides the designed artifact, with a higher likelihood of acceptance due to a focus on it, but also further contributions to the knowledge base, regardless of whether the artifact is accepted.

With the application of the AD-DSR approach, the artifact eCampus was designed in this thesis. It is an e-serivce that enables the teachers of the Styrian HE in self-study to build up competencies for the meaningful use of technologies in teaching. Considering the research question, it would have been possible to design other artifacts as well. The design decision was made on the basis of several literature sources and studies that emphasized that teachers need first and foremost the necessary competencies for the meaningful use of technologies in teaching. If the goal had been to design another artifact that also had acceptance problems in the application domain, the AD-DSR approach could have been applied as well, because the approach is generic and not limited to a specific application domain, e.g. HE sector or TEL.

9.2. Implications for Future Work

This section concludes by showing the significance of the contributions of this thesis for individual areas and what future possibilities, among other things for further research work, result from them. First, the scientific community will be addressed, then the HE sector and finally other fields.

9.2.1. Contribution and Outlook: Scientific Community

The most significant contribution of this thesis to the scientific community is the AD-DSR approach. The approach supports the implementation of DSR projects where user acceptance is an application domain problem for the artifact being designed. With the application, researchers cannot guarantee that the designed artifact will be accepted, but the approach can provide valuable contributions for design science and behavioral science.

With the thesis, an artifact was designed using the presented approach and first insights could be gained. To confirm the practicality of the approach and to further improve the approach, more projects using the approach are needed. Due to the generic design of the approach, it is also not limited to specific application domains. Since technology acceptance has always been an important topic in information systems research, there are many potential future research projects where the approach can be applied.

The proposed NDT also represents a valuable contribution to the scientific community. It can serve as a basis for the design of similar e-services. On the one hand, the included acceptance constructs contribute to technology acceptance research (behavioral science) and they can be used in the application of the AD-DSR approach, and on the other hand, the included DPs contribute to design science and they can be used directly when designing such e-services. Such work could also further refine the NDT. However, it should be noted that the individual DPs of the NDT are not individually confirmed. It would be necessary to examine their influence on acceptance individually. For example, a research project could implement the design principles that are related to system quality in the design of a similar e-service. Then it would be necessary to check whether the system quality had an influence on the acceptance of the e-service and whether the system quality as a whole was successfully implemented. If this is the case, it would also have to be examined what influence the individual DPs had on the successful design.

The results of the first design cycle also provide input to the scientific community. The structured literature review conducted in the process summarizes influencing factors that can be considered in the implementation of TEL approaches into 20 categories and 76 subcategories (see Figure 4.1). In doing so, the literature review not only provides an overview of which influencing factors can be considered, but also highlights which influencing factors have been less addressed in the scientific community, providing potential areas for further research.

The quantitative research in the first design cycle also shows that some influencing factors are more important than others from the perspective of professionals in the HE sector, but all influencing factors are very important for at least some of them. Future research could investigate which circumstances determine the importance of the influencing factors. Finally, based on this, a framework could be developed to support the implementation of new TEL approaches. The framework would first need to assist in identifying the relevant circumstances and then provide methods to assist in considering the influencing factors that are relevant under the given circumstances.

9.2.2. Contribution and Outlook: Higher Educational Sector

Regarding contributions to the HE sector, the first design cycle of this thesis provided an overview of which influencing factors can be considered when implementing TEL approaches. This overview can facilitate professionals in the HE sector to take important influencing factors into account when implementing TEL approaches and thus to use technologies more meaningfully in teaching. Furthermore, the first design cycle suggests a classification of these influencing factors by description types (see Table 4.11). This classification can be helpful when creating training materials for teachers because it indicates which influencing factors to focus on.

The most important contribution of the thesis for the HE sector, especially for the Styrian HE sector, is certainly the designed e-service eCampus, which is available online since May 2021 and supports teachers in the Styrian and now Austrian HE sector in building up competencies for the meaningful use of technologies in teaching. The design of this e-service was the main purpose of this work, which according to evaluation can be considered at least partially successfully achieved. The medium-term outcome should be that the teachers in the Styrian HE sector have these competencies and in the long term this should have the impact that more teachers in the Styrian HE sector use technologies meaningfully in teaching. Within the scope of the thesis the mid-term outcome and the long-term impact could not be evaluated. Such an evaluation should be carried out in a few years and should also check what influence the e-service eCampus had on the measured development.

The designed e-service or the proposed NDT could also be used in other HE sectors to design similar e-services. It can be assumed that these e-services would show a similar result in terms of acceptance. Teachers who already have experience with TEL and therefore an interest in using TEL are likely to accept the e-services, i.e. use them. Teachers who have little interest in using TEL are also unlikely to use those e-services. In the design, however, one could try to increase the probability of acceptance and consciously pay additional attention to the design of the constructs "job relevance" and "social image". According to the results of this thesis, these have an influence on acceptance, but the design has not been successful or only partially successful with the e-service eCampus.

On a meta-level, the thesis also shows that several studies proved that while TEL is now widely used at HEIs (Bratengeyer et al., 2016; Pausits et al., 2021), this mainly refers to the use of tools such as PowerPoint and learning management systems such as Moodle with basic functions (Bratengeyer et al., 2016; Hoffmann, 2016; Bond et al., 2018; Schweighofer and Zullus, 2019). Other, more specialized and usually more modern TEL approaches are mostly used only occasionally at HEIs. This is also reflected in the acceptance of eCampus. According to the results of the thesis, eCampus is mainly used by teachers who are interested in using more than just typical TEL approaches. However, according to the results of the studies, this group of teachers seems to be the much smaller group of teachers, which would explain the lower number of users than hoped for.

The author of this thesis concludes that measures to build up competencies in the use of TEL probably cannot ensure that more TEL is used at HEIs. Such measures can contribute to the fact that a few teachers, who are interested in TEL anyway, use new approaches or improve and extend existing ones. To increase the use of TEL at HEIs across the board, as suggested by Schweighofer, Grünwald, and Ebner (2015), the laws and drivers of the digital economy should be considered in the development and use of TEL approaches at HEIs, since in the digital economy these laws and drivers determine which technologies will eventually be adopted by the masses (Katz and Shapiro, 1985; Arthur, 1996; Zerdick et al., 2013). Thereby, the past also shows that these laws and drivers can allow inferior technologies to prevail over better technologies, e.g. VHS vs. Betamax (Cuellar, 2002). In the field of TEL, PowerPoint and learning management systems such as Moodle are widely used because they are standards and also have positive network effects (cf. Katz and Shapiro, 1985; Arthur, 1996; Zerdick et al., 2013). Even if there are better TEL approaches, e.g. with a higher educational value, these TEL approaches can hold their own through the laws and drivers of the digital economy.

So, if the goal of a HEI is that new TEL approaches are deployed across the board, the HEI should focus on a few approaches that deliver value, make them standards, e.g., through mandatory use or by using approaches that are already standards in the digital economy, and ensure that network effects can take hold in the approach, i.e., simplified, that the value to individual users increases as more users use the approach (Katz and Shapiro, 1985; Arthur, 1996; Zerdick et al., 2013).

Lyons (2017) suggested in this context to introduce TEL approaches where network effects can be generated through learning analytics or peer-to-peer learning. Dalsgaard and Ryberg (2023) thought that TEL approaches should have open connections to the outside world so that the network is enlarged and network effects are generated. However, from the point of view of the author of this thesis, it would also be sufficient if such a network is established within a HEI. Designing a TEL approach that is a platform with its own ecosystem could also work, since according to Rothe, Taeuscher, and Basole (2018) such platforms can also grow faster if the integrated partners also continuously add value to the platform.

Rothe, Gersch, and Tolksdorf (2016) described an approach that, in the view of the author of this thesis, can also create standards and generate network effects. They suggested that the concept of mass customization is also used for TEL and that information technology based services, so-called learning services, are offered on a web-based information system to design learning scenarios in a structured way. There, teaching and learning components can also be exchanged between teachers. (Rothe, Gersch, and Tolksdorf, 2016) This enables network effects to take effect, because the more teachers create teaching and learning components, the higher the value for other teachers who can use these teaching and learning components themselves.

Of course, it is not easy to establish such approaches and it takes time until the critical mass is reached and network effects take effect. With the AD-DSR approach, research projects could play an important role here to design approaches that are ultimately accepted, i.e. used, by the mass of teachers.

9.2.3. Contribution and Outlook: Other Fields[1]

For other research fields, i.e. not the HE sector, this thesis also contributes with the proposed NDT. Although the purpose of this NDT is specifically for the HE sector, the included acceptance construct and DPs can also be used as a starting point for the design of other artifacts in other research areas.

The basic idea of the AD-DSR approach can also be applied in other research areas. The approach incorporates the complementary nature of design science and behavioral science by using theories of technology acceptance (behavioral science) to support the design of an artifact (design science). The approach provides specific steps to do this. Similar specific approaches can be designed for other behavioral science research fields, e.g., teacher and student behavior, tourist behavior, financial behavior, business behavior, and more (Kwon and Silva, 2020). In the same way as the AD-DSR approach, such new approaches could define specific steps for the DSR process that assist in incorporating these theories of behavioral science into the design of artifacts.

Finally, this chapter uses service engineering (S!E) as an example to explain how the AD-DSR approach contributes to the engineering disciplines. The AD-DSR approach is a specific concretization of the DSR methodology for the design of artifacts where user acceptance is a challenge and is thus situated in the realm of science. S!E is a practice-oriented engineering discipline, for the systematic and structured development of services. It is thus situated in the realm of engineering. Both AD-DSR and S!E pursue similar goals, use similar methods, and encounter similar problems. The specific problem of user acceptance is also of great relevance for S!E. However, both DSR and AD-DSR should not be fully equated with S!E. The first two are scientific disciplines used in academic settings, while the latter is an engineering discipline used in practical settings.

[1] Parts of this section have already been published in: Beer (2022a)

The Cambridge Academic Content Dictionary[2] provides the following definitions of science and engineering. Science is *"the systematic study of the structure and behavior of the natural and physical world, or knowledge obtained about the world by watching it carefully and experimenting"*. Engineering is *"the study of using scientific principles to design and build machines, structures, and other things, including bridges, roads, vehicles, and buildings"*.

Engineering disciplines attempt to solve practical problems using scientific principles. How and why the problem is ultimately solved is not of great importance, and companies that use S!E to develop new e-services have no interest in answering these questions for society. Science, however, always tries to explain phenomena and to obtain knowledge. Although DSR and AD-DSR, at their core, solve a practical problem like an engineering discipline, they must always explain the underlying phenomena and provide new knowledge. Hevner (2007) explained that DSR contributes to the knowledge base with any extensions to the original theories and methods made during the research. Hevner, March, et al. (2004) emphasized that the main goal should be to determine how well an artifact solves the practical problem. However, especially for AD-DSR, in order to contribute to the knowledge base in the ways described in this thesis, it is essential to also understand what role theories and methods have played (design science) and why an artifact solves a problem (behavioral science). This understanding requires a scientific rigor in the execution of DSR or AD-DSR projects that is not mandatory in S!E projects, nor is it practical due to the amount of effort required to obtain this knowledge.

However, the difference between DSR and AD-DSR on the one hand and S!E on the other is exactly why the first two can contribute greatly to S!E. Although engineering disciplines do not make a scientific contribution, they use scientific knowledge to solve practical problems more efficiently and effectively. With respect to the application of AD-DSR, the targeted contributions to the knowledge base are relevant to S!E. The accepted artifact is the solution to an unsolved practical problem because no accepted artifact previously existed in the environment. The artifact and the derived NDT can therefore be used in S!E practice as a guide to develop similar services that will eventually be accepted.

[2]https://dictionary.cambridge.org (last access: 2022-04-22)

In addition, increased application of AD-DSR should eventually provide sufficient knowledge to incorporate the approach into S!E process models. For example, the S!E process model presented by Kreuzer and Aschbacher (2011) consists of the six phases: (1) strategy audit and service assessment, (2) idea generation and assessment, (3) business case description, (4) service concept, (5) pilot testing, and (6) service controlling and improvement. Each phase includes tools that are easy to use, especially for small and medium-sized businesses. From a current perspective, the effort imposed by the scientific rigor of the AD-DSR approach is likely too high for use in this S!E process model. However, the knowledge gained from future AD-DSR projects could enable the transfer of the scientific approach to the practice-oriented world of S!E.

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Appendix A.

Structured Literature Review Influencing Factors[1]

This appendix shows the detailed process that took place during the structured literature review to identify potential influencing factors that should be considered when using technology-enhanced learning (TEL). As an example, the appendix shows how the category "mind-set & feelings before TEL" was formed. The category includes all factors related to beliefs, perceptions, or expectations before TEL approaches are introduced or used:

1. Collecting: The analyzed publications study the following factors: beliefs, students' beliefs, teachers' beliefs, estimated potential for learning contribution, students' conceptions of TEL, students' conceptions, students' expectations, teachers' expectations, and technological expectancy. In doing so, for instance, these factors were collected due to following phrases out of the publications (note: some of the listed phrases contain other factors as well and were therefore not only counted in the category "mind-set & feelings before TEL"):
   a) beliefs: *"The aim of this study is to investigate the complexity of past experiences with ICT, pedagogical beliefs, and attitude toward ICT in education that the Net Generation student teachers have about their intention to teach and learn with technology."* (So, Choi, et al., 2012)

[1]This appendix has already been published in: Schweighofer and Ebner (2015)

b) students' beliefs: *"The purpose of the study was to explore possible links between student socioeconomic status (SES), beliefs about information and communication technologies (ICTs), and out-of-school learning resources."* (Vekiri, 2010)
c) teachers' beliefs: *"This study was conducted to explore the relationships between teachers' motivation toward web-based professional development, Internet self-efficacy, and beliefs about web-based learning."* (Kao, Y.-T. Wu, and C.-C. Tsai, 2011)
d) estimated potential for learning contribution: *"This study aims at critically reviewing recently published scientific literature on the use of computer and video games in Health Education (HE) and Physical Education (PE) with a view: (a) to identifying the potential contribution of the incorporation of electronic games as educational tools into HE and PE programs, [. . .]"* (Papastergiou, 2009)
e) conceptions of TEL of students: *"The present study investigated junior college students' conceptions of and approaches to learning via online peer assessment (PA) using a phenomenographic approach."* (Y.-F. Yang and C.-C. Tsai, 2010)
f) students' conceptions: *"By interviewing 83 Taiwanese college students with some web-based learning experiences, this study attempted to investigate the students' conceptions of learning, conceptions of web-based learning, and the differences between these conceptions."* (C.-C. Tsai, 2009)
g) students' expectations: *"Multiple regression analyses using Mplus 4.21 were carried out to investigate how different facets of students' expectations and experiences are related to perceived learning achievements and course satisfaction."* (Paechter, Maier, and Macher, 2010)
h) teachers' expectations: *"This exploratory case study examined preservice teachers' expectations of and attitudes toward the learning and integrating of ICT into their teaching, and their perceptions of the availability and use of ICT in the Teacher Education Program (TEP) and their placement schools."* (Martinovic and Z. Zhang, 2012)
i) technological expectancy: *"Thus, researchers should take into consideration both technological and learning expectancies of students while investigating e-learning acceptance."* (J.-L. Chen, 2011)

2. Ordering: The identified terms were sorted according to their similarity

as follows:

a) beliefs, students' beliefs, teachers' beliefs, estimated potential for learning contribution
b) conceptions of TEL of students, students' conceptions
c) students' expectations, teachers' expectations, technological expectancy

3. Defining: The following hypernyms for the ordered terms were defined:

   a) beliefs: beliefs, students' beliefs, teachers' beliefs, estimated potential for learning contribution
   b) conceptions: conceptions of TEL of students, students' conceptions
   c) expectations: students' expectations, teachers' expectations, technological expectancy

4. Defining: The following hypernym for the category was defined:

   a) Mind-set & feelings before TEL: beliefs, conceptions, expectations

5. Assigning: The analyzed publications were assigned to the new defined hypernym(s).

Appendix B.

Survey Influencing Factors[1]

This appendix shows the structure of the questionnaire (excerpt) used to determine the relevance of the influencing factors from the proposed model (see Figure 4.1) from the perspective of professionals at higher educational institutions. The questionnaire was translated from German into English for this thesis.

$Q_{IF}1$. How old are you?

__________ years

$Q_{IF}2$. In which country do you work?

O Germany
O Switzerland
O Austria (Styria)
O Austria (not Styria)
O none of the above: _________________

$Q_{IF}3$. In which kind of organization are you employed?

O School
O University of applied sciences
O University
O College of education
O Company

[1] This appendix has already been published in: Schweighofer, Weitlaner, et al. (2019)

$Q_{IF}4a$. Which function do you possess in this organization? (School)

O Teacher
O Headmaster
O none of the above: ________________

$Q_{IF}4b$. Which function do you possess in this organization?
(University of applied science)

O Head of degree program
O Full-time lecturer/teacher
O Part-time lecturer/teacher
O Responsible for online learning and/or didactics
O none of the above: ________________

$Q_{IF}4c$. Which function do you possess in this organization?
(University/ College of education)

O Rector, faculty director, head of institute
O Professor, assistant professor, lecturer
O Responsible for online learning and/or didactics
O none of the above: ________________

$Q_{IF}4d$. Which function do you possess in this organization? (Company)

O Management
O Instructor, teacher
O none of the above: ________________

$Q_{IF}5$. How long have you been in this position?

__________ years

$Q_{IF}6$. In which field are you working?

O Natural sciences
O Engineering and technology
O Medical and health sciences
O Agricultural sciences
O Social sciences
O Humanities

$Q_{IF}7$. Have you ever developed or used technology enhanced learning approaches?

O Yes
O No

$Q_{IF}7a$. Have you ever considered the following aspects during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching?
(Only if answer to question $Q_{IF}7$ was "Yes")

	Yes	No
Acceptance aspects	O	O
Business aspects	O	O
Cognitive aspects	O	O
Course-related aspects	O	O
Demographic differences	O	O
Influence from prior knowledge and experience	O	O
Instruction aspects	O	O
Learners' learning aspects	O	O
Learners' requirements	O	O
Learning success	O	O
Mind-set & feelings before TEL	O	O
Mind-set & feelings during TEL	O	O
Motivational aspects	O	O
Requirements on teachers	O	O
Self-regulation aspects	O	O
Social aspects	O	O
Support processes	O	O
Teachers' teaching aspects	O	O
Technical infrastructure aspects	O	O
Technology-related aspects	O	O

$Q_{IF}8$. How important (unrelated to your position) is the consideration of the following aspects during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching for you?

	Very unimportant	Unimportant	Important	Very important
Acceptance aspects	O	O	O	O
Business aspects	O	O	O	O
Cognitive aspects	O	O	O	O
Course-related aspects	O	O	O	O
Demographic differences	O	O	O	O
Influence from prior knowledge and experience	O	O	O	O
Instruction aspects	O	O	O	O
Learners' learning aspects	O	O	O	O
Learners' requirements	O	O	O	O
Learning success	O	O	O	O
Mind-set & feelings before TEL	O	O	O	O
Mind-set & feelings during TEL	O	O	O	O
Motivational aspects	O	O	O	O
Requirements on teachers	O	O	O	O
Self-regulation aspects	O	O	O	O
Social aspects	O	O	O	O
Support processes	O	O	O	O
Teachers' teaching aspects	O	O	O	O
Technical infrastructure aspects	O	O	O	O
Technology-related aspects	O	O	O	O

$Q_{IF}9$. How much time would you spend (in your position) when considering the following aspects during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching?

	Very little	Little	Much	Very much
Acceptance aspects	O	O	O	O
Business aspects	O	O	O	O
Cognitive aspects	O	O	O	O
Course-related aspects	O	O	O	O
Demographic differences	O	O	O	O
Influence from prior knowledge and experience	O	O	O	O
Instruction aspects	O	O	O	O
Learners' learning aspects	O	O	O	O
Learners' requirements	O	O	O	O
Learning success	O	O	O	O
Mind-set & feelings before TEL	O	O	O	O
Mind-set & feelings during TEL	O	O	O	O
Motivational aspects	O	O	O	O
Requirements on teachers	O	O	O	O
Self-regulation aspects	O	O	O	O
Social aspects	O	O	O	O
Support processes	O	O	O	O
Teachers' teaching aspects	O	O	O	O
Technical infrastructure aspects	O	O	O	O
Technology-related aspects	O	O	O	O

Q_{IF}*10.* Please choose those five aspects from the following list which are most important for you (unrelated to your position) during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching.

O Acceptance aspects
O Business aspects
O Cognitive aspects
O Course-related aspects
O Demographic differences
O Influence from prior knowledge and experience
O Instruction aspects
O Learners' learning aspects
O Learners' requirements
O Learning success
O Mind-set & feelings before TEL
O Mind-set & feelings during TEL
O Motivational aspects
O Requirements on teachers
O Self-regulation aspects
O Social aspects
O Support processes
O Teachers' teaching aspects
O Technical infrastructure aspects
O Technology-related aspects

Q_{IF}*11.* Now arrange these aspects in descending order based on their priority.

Previously selected items

$Q_{IF}12$. Please choose those five aspects from the following list on which you (in your position) would spend the most time during the development of technology-enhanced learning (TEL) approaches or when using technology to support learning and teaching.

O Acceptance aspects
O Business aspects
O Cognitive aspects
O Course-related aspects
O Demographic differences
O Influence from prior knowledge and experience
O Instruction aspects
O Learners' learning aspects
O Learners' requirements
O Learning success
O Mind-set & feelings before TEL
O Mind-set & feelings during TEL
O Motivational aspects
O Requirements on teachers
O Self-regulation aspects
O Social aspects
O Support processes
O Teachers' teaching aspects
O Technical infrastructure aspects
O Technology-related aspects

$Q_{IF}13$. Now arrange these aspects in descending order based on the expenditure of time.

Previously selected items

Appendix C.

Interview Guide for Expert Interviews on Requirements[1]

This appendix contains the interview guide that was used for the expert interviews to gather requirements for the e-service eCampus. The interview guide was translated from German to English for this thesis.

1. Greeting and Explanation
   a) Thank for the time. Duration approx. 120min.
   b) Goal: Identify requirements for the eCampus e-service, the implementation of which will contribute to the acceptance of eCampus.
   c) Eight thematic blocks.
   d) Please provide answers as an expert and from the perspective of the target group teachers of the Styrian higher education area.
   e) eCampus is intended to be an e-service for teachers at all Styrian universities via which they can acquire targeted information about the use of technologies in teaching and learning processes.
   f) Guiding principle: The focus should not be on the technologies, but on the use cases in which technologies are used and can provide support.
2. Job Relevance

[1]This appendix is based on the following already published work: Beer and Hatzl (2022)

a) What tasks do teachers have to perform that eCampus could support them with? How should eCampus support them in this? (In general and specifically for own university)
b) What TEL technologies/approaches can instructors use for these tasks? (In general and specifically for own university)
c) What should use cases on eCampus describe so that they are relevant to teachers? (Task? TEL technology/approaches? Which for the university?)
d) What other content is relevant for teachers with regard to their teaching activities and should therefore be taken into account on eCampus or in the development of use cases?

3. System Quality
    a) What functionalities should eCampus offer as a system? How exactly should these functionalities look/be structured/function?
    b) What quality characteristics should the eCampus as a system fulfill? Which are most important here? What can this look like?
    c) What should the visual design of eCampus look like?
    d) How should the navigation on eCampus be structured?
    e) How should the use cases be structured? Is such a structure necessary? What should it look like?
    f) Do we need filter options to find use cases? What filter options should there be to find use cases?
    g) Do we need a recommendation system to recommend use cases or to find them on the basis of recommendations? What should this recommendation system look like? Process and what kind of recommendations?

4. Service Quality
    a) What additional services/processes should eCampus offer so that it is used and accepted? (generally which services)
    b) What kind of organizational services?
    c) What kind of technical services?
    d) What kind of training?
    e) How should these services be offered? How should it be ensured that:
        - individual attention is paid to users?

- the eCampus remains at a high level?
- the eCampus has an appealing contemporary design?
- the eCampus inspires security and trust?
- the eCampus responds to user needs?

f) One goal of eCampus is for teachers to participate through their own contributions (use cases): How should the editorial system or the process be structured so that teachers can contribute use cases themselves?
  - What roles and responsibilities should there be, i.e. what could a meaningful authorization concept look like?
  - What should the workflow for content creation look like?
  - Presentation of the content: which meta information is important?
  - Who should be allowed to edit and to what extent?

5. Information Quality
  a) In which way should use cases be prepared? What could that look like? (Videos? PDFs? anything else!)
  b) What should be included in the preparation of a use case? What is relevant and should be described/explained? What could that look like?
  c) Which terms should be used at eCampus? (Use Case? Technology? Tool?)

6. Personal Innovativeness
  a) What should eCampus offer so that teachers are interested in trying it out? What could that look like?
  b) How should interest in eCampus be built up in advance? What could that look like?
  c) How should eCampus become a standard for self-study in TEL? What could that look like?
  d) How should trust in eCampus be increased in advance? What could that look like?
  e) What should eCampus offer and/or what should be done up front to reduce switching costs from existing training/information sources in this area (technological: integration of new technology/new system; knowledge-related: Learning to use new sys-

tem)? What might this look like?

7. Subjective Norm
    a) What should eCampus offer so that teachers talk positively about eCampus and encourage others to use eCampus as well? What could that look like?
    b) What should the eCampus offer so that the value of the eCampus increases the more users use the eCampus? What could that look like?
    c) Which services should be offered by third-party providers (not from Styrian universities) on eCampus that increase the value of eCampus? What could that look like?
8. Social Image
    a) What should eCampus offer so that teachers feel their social image increases when they use eCampus? What could that look like?
9. Policy Quality
    a) Which legal requirements should be considered?
    b) What framework conditions must be defined so that teachers can use eCampus without hesitation (organizational and other framework conditions)?

Appendix D.

Requirements for the E-Service[1]

This appendix contains the defined requirements for the e-service eCampus. The following three tables show the requirements and their expected influence on acceptance constructs. Table D.1 shows the content-relevant requirements, Table D.2 the system-relevant requirements, and Table D.3 the service- and process-relevant requirements. Requirements that were discarded during the project or not yet implemented before the final evaluation in this thesis are crossed out in the tables. Requirements that have only been partially implemented are shown in italics. Each requirement has also been assigned a unique id, which uses the following scheme:
Req_consecutive-number-within-category_category_subcategory_
construct(_other-constructs)_short-name.

[1]This appendix is based on the following already published work: Beer and Hatzl (2022)

Table D.1.

Content-Relevant Requirements

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_1_C_SUC_INFQ_JR_Key-data: Each use case must contain certain basic information/core data depending on the type of use case.		X				X		
Req_2_C_SUC_JR_Core-content: *The use cases should be short and concise and contain step-by-step instructions. They should provide a quick introduction to the application. Technical tools should not only be referred to, but should also be briefly explained/treated (type of tool, most important key data, advantages/disadvantages).*						X		
Req_3_C_SUC_INFQ_JR_Media: *Depending on the use case, the content should be described with videos or PDFs (or other media). The creators must decide which medium is best suited for the use case.*		X				X		
Req_4_C_SUC_SYSQ_Initial-testimonials: If possible, the use cases should initially also include a testimonial.	X							
Req_5_C_SUC_SYSQ_Filter-criteria: The defined filter and recommendation criteria must be filled initially for each use case.	X							
Req_6_C_SUC_INFQ_Visual-design: The visual design of a use case should be appealing, but above all clear.		X						
~~Req_7_C_SUC_INFQ_Videos:~~ ~~The videos should be rather short. Instead, there should be several videos for different areas of the use case. The videos should also have subtitles so that they can be viewed without sound.~~		X						
~~Req_8_C_SUC_INFQ_Self-tests:~~ ~~Where appropriate, self-tests can be included in the use cases so that the teachers can check themselves. This makes sense especially for legal topics.~~		X						
Req_9_C_SUC_INFQ_SN_Links-to-external-content: The use cases should contain links to further topics. Third-party content may not be used for advertising purposes, but must be relevant to eCampus.		X		X				
Req_10_C_SUC_PQ_License: Content must be published under CC-by licensing (videos: creation on Youtube, integration eCampus).								X
Req_1_C_F_JR_Topics-focus: The use cases should mainly focus on the topics of knowledge transfer and knowledge verification. Administration (e.g. participant management) should also be covered.						X		
Req_2_C_F_JR_Topics-focus-2: *The use cases should deal with basic functionalities of TEL that are specific to the university and intended for beginners (mainly functions of the LMS). At the same time, more sophisticated, innovative and modern use cases should also be part of eCampus. This means that the selection of the initial 50 use cases must be based on the needs and wishes of the individual universities.*						X		
Req_3_C_F_JR_Content-alignment: *The use cases should always have a high practical relevance. Ideally, the reference to the university is also strong. Experience reports should be included and it should be explained for which settings the use cases are relevant (group size, type of course, etc.).*						X		

(continued)

Table D.1.

Content-Relevant Requirements (continued)

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_4_C_F_JR_Content-alignment-2: Didactic considerations should also be present. Focus should be placed on the settings in which use cases work and scientific evidence for use cases should be provided.						X		
Req_5_C_F_JR_Overall-concepts: Supports for creating overall concepts for courses should be available on eCampus.						X		
Req_6_C_F_JR_Free-and-available-tools: The focus of the use cases should be on tools that are free or available at the university.						X		
Req_7_C_F_JR_Other-topics: The eCampus should include use cases on “finding OER”, “using OER”, and “data protection and copyright”.						X		
Req_8_C_F_SN_General-content-requirements: The content should be of high quality and relevant.				X				
Req_1_C_St_JR_Didactical-considerations: Didactic considerations should be described superordinately (because tool-independent) and the individual use cases should refer to them or the didactic considerations should refer to the use cases.						X		
Req_2_C_St_JR_Overall-concepts: Overall concepts for courses should be available on eCampus with references to individual didactic considerations and use cases.						X		
Req_3_C_St_JR_Other-topics: The eCampus is also intended to address general overarching TEL-relevant topics as use cases that cannot be specifically assigned to a tool.						X		
Req_4_C_St_SYSQ_Integration: Each use case must be incorporated into the structure accordingly.	X							
~~Req_1_C_Misc_SERVQ_Online-documentation:~~ ~~A short online documentation (concerning the use of eCampus) should be offered.~~							X	
Req_2_C_Misc_PI_SERVQ_Team: *Information about the eCampus team/network should be shown. This includes the communication that the SHK and the universities are strongly involved (specification of logos) or from the user's point of view that content comes from their own university or lecturers (e.g. naming of use case creators).*			X				X	
Req_3_C_Misc_SERVQ_Links-to-publications-events: Information on relevant publications or events is to be provided. Both per use case and superordinate.							X	
Req_4_C_Misc_SERVQ_Contact-details: Information about the support service (technical and content) should be provided.							X	
Req_5_C_Misc_SERVQ_Maintenance-window: Information on the availability of the system (e.g. for maintenance) should be displayed.							X	
Req_6_C_Misc_SERVQ_PQ_GDPR: Information about data protection aspects (GDPR) of eCampus itself should be provided briefly and concisely.							X	X
~~Req_7_C_Misc_INFQ_Contact-details-2:~~ ~~Contact possibilities per university concerning questions about eCampus in general should be listed.~~		X						

(continued)

Table D.1.

Content-Relevant Requirements (continued)

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_8_C_Misc_INFQ_Glossary: A glossary for terms used at eCampus should be available. This should also be linked to a mouse over effect at eCampus.		X						
Req_9_C_Misc_INFQ_PI_Core-terms: The core terms use case or use case/teaching method, tool, etc., which constantly occur on eCampus, should already be clearly explained at the start. In addition, the advantages of eCampus should also be presented here.		X	X					
~~Req_10_C_Misc_PI_Team-2:~~ ~~The eCampus team or the use case creators should not only be mentioned by name, but should also appear on eCampus with a short profile.~~			X					

Table D.2.

System-Relevant Requirements

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_1_S_SaN_SYSQ_JR_Structure: The content structuring must be mapped on eCampus. It may be necessary that a use case = Moodle course must exist in several categories of the structure and that there are several levels of categorization. Categories and subcategories do not occur more than once.	X					X		
Req_2_S_SaN_SYSQ_PI_Search: A search functionality as free-text search is necessary. This must include headings and content and should include experience reports, feedbacks and forum posts. In addition, selected filter criteria must enable the search. These filter criteria are thereby divided into fixed filters, which are set by the use case creator, and variable filters, which result from ratings/recommendations by users. The search functionality shall be separated from the navigation, but visually provide the same options as the navigation. The result should also show the supercategories of the use case.	X		X					
Req_3_S_SaN_SYSQ_Navigation: Navigation along the structuring is to be implemented in two ways. On the one hand, navigation along a textual tree structure must be implemented, and on the other hand, navigation along visually more appealing image tiles should be implemented. The user should be able to switch between these two navigation options.	X							
Req_4_S_SaN_SYSQ_Top5: The top five most viewed use cases should also be displayed on the navigation and search page. Most viewed is defined by opening a use case.	X							
Req_5_S_SaN_SYSQ_Already-seen: It should be displayed which use cases have already been viewed. For this it should be necessary that a teacher himself indicates that this use case was viewed (mere opening should not be enough).	X							
Req_6_S_SaN_SYSQ_Reminders: It should be possible to set reminders for (sub-)categories of the structure and to be informed by email when new use cases are added to this (sub-)category of the structure. For this purpose, the general notifications of Moodle should be used and when setting the reminder, the corresponding settings in the user profile should be linked, so that the email notification can be activated there.	X							
Req_1_S_UC_PI_Freely-accessible-use-cases: Selected use cases should also be visible without login, i.e. on the homepage before login. Personal contributions (discussion forums, experience reports, etc.) should also be visible. However, it is not possible to post in the public area.			X					
Req_2_S_UC_SYSQ_INFQ_SN_JR_SERVQ_Create-use-cases: The system must enable the creation of use cases by users. Templates should be available for creating use cases that ensure that all use cases look the same for each type of use case and contain defined mandatory fields. Each use case should include a discussion forum by default. The creation should be guided by the system, also with regard to the consideration that end users can create such use cases, and at the beginning, for example, the selection of the type of use case should be required. Use cases created by end users can be released by users with the role of administrator (or similar). A feasible way of doing this is to be developed in the project.	X	X		X		X	X	
Req_3_S_UC_SYSQ_Experience-reports-feedback: It should be possible to create experience reports or feedback on use cases. Possibly this should be checked by administrators before release. Alternatively, at least a reporting function by users should be included so that inappropriate experience reports or feedbacks can be deleted by administrators if necessary.	X							

(continued)

Table D.2.

System-Relevant Requirements (continued)

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_4_S_UC_JR_Reference-to-other-use-cases: It must be possible to refer from individual use cases to others.						X		
Req_5_S_UC_INFQ_JR_Embedding-other-formats: *eCampus must enable PDFs or text modules and videos for the use case descriptions. A YouTube channel can be set up for the videos, the videos of which are integrated into the use case accordingly. End-users, i.e., instructors who wish to submit their own use cases, will not have direct access to the YouTube channel. These videos are to be uploaded by the team of administrators.*		X				X		
Req_1_S_GD_JR_Blog: The eCampus should also specifically refer to / draw attention to relevant publications and events in the field of TEL. These references should be “constantly” visible without being intrusive.						X		
Req_2_S_GD_SYSQ_Others-also-saw: Recommendations should be displayed as to which use cases other users have viewed when looking at a particular use case. Again, “view” refers to just opening a use case.	X							
Req_3_S_GD_SYSQ_PI_Optical-design: The optical design of eCampus should provide a high usability, be consistent and be oriented to a current style. The look should be rather plain and simple but also include visual support, while not losing clarity. Slight changes to the standard Moodle design would be desirable. The color design should be based on the eCampus logo.	X		X					
Req_1_S_GSR_SYSQ_Barrier-free-access: The eCampus should be barrier-free. Whenever possible, this should be strived for.	X							
Req_2_S_GSR_SYSQ_Responsive-design: The eCampus must have a Responsive Design.	X							
Req_3_S_GSR_SYSQ_Availability/Performance: The availability of eCampus must be high and eCampus must also be available at evening times. The system must be crash-proof and provide good performance (not too long response times).	X							
Req_4_S_GSR_INFQ_Glossary: A mouse-over effect with link to terms defined in the glossary is to be implemented. This implies that a glossary must be available for eCampus. In terms of accessibility, an alternative could be necessary for the mouse-over effect.		X						
Req_5_S_GSR_INFQ_Bilingualism: The possibility to convert the contents of eCampus to an English version can be considered, if possible without much effort.		X						
Req_6_S_GSR_PI_Extensibility: The system should be easily expandable if updates, technical extensions and further content are to be added in the future.			X					
Req_7_S_GSR_PQ_GDPR: The system must be GDPR compliant.								X
Req_8_S_GSR_SYSQ_Login: The login must be designed as simple as possible.	X							
Req_9_S_GSR_INFQ_Entry-information: When logging in for the very first time, an information page is to be launched that explains, among other things, basic terms and objectives of eCampus. In the event of significant changes in the system, this functionality should also be able to be used.		X						

(continued)

Table D.2.

System-Relevant Requirements (continued)

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_10_S_GSR_PI_Technical-integration: The system could be fully integrated into existing university structures (i.e. automatic login when logged into university).			X					
Req_1_S_IU_SN_Feedback-to-eCampus: The system should provide users with a feedback option on eCampus.				X				
Req_2_S_IU_SYSQ_PI_SN_SERVQ_Networking-contact: *The eCampus should offer the possibility to communicate with other users, use case creators and technical/content support persons (via email). Support and use case creators should be able to be contacted directly via the use cases. Users directly via testimonials/feedback/discussion forums. In both cases the profile should be linked to the email address. A search for persons should not be implemented.*	X		X	X			X	
Req_3_S_IU_SYSQ_Feedback: Upon re-entry, instructors should be asked every three months whether they have already used regarded use cases (formulate in general terms and do not refer to explicitly regarded use cases) and whether they would be willing to provide feedback/experience reports on them. This request must be designed in such a way that it is not seen as disruptive or intrusive.	X							
~~Req_4_S_IU_SYSQ_SN_Usage-statistics:~~ ~~So that teachers who write many field reports etc. also have the opportunity for a possible reward (naming as teacher of the month up to integration in events), there should be an overview for administrators of which teachers have written how many contributions. The cumulative results of this should be visible to all users or even publicly and update automatically (number of users, number of use cases, number of viewed use cases, number of field reports, etc.).~~	X			X				
~~Req_5_S_IU_SN_Explicit-recommendations:~~ ~~The system should enable recommendations from users for users of certain use cases via email. A default recommendation text with a link to the use case should be included here. Email address must be entered by the user.~~				X				
~~Req_6_S_IU_SN_SI_SERVQ_User-profile:~~ ~~The system should offer users the possibility to create a profile (name, university, courses, etc.), which should be visible to other users after consent. (Serves as preparation for possible later profiling functionalities).~~				X	X		X	
~~Req_7_S_IU_PI_Reminder-for-eCampus:~~ ~~The system should remind the user by email after a long period of inactivity. If the user does not react to this, he/she should not be reminded again. In any case, this functionality requires the consent of the user and could be implemented via the newsletter functionality.~~			X					
Req_8_S_IU_PI_SN_Public-experience-reports: *Positive experience reports from users should be able to be presented publicly after the user's consent. This does not have to be done directly, but will be entered by a team of administrators. I.e. after a vote with the creator / the said text is copied and entered on the homepage.*			X	X				

Table D.3.

Service- and Process-Relevant Requirements

Requirement	System quality	Information quality	Personal innovativeness	Subjective norm	Social image	Job relevance	Service quality	Policy quality
Req_1_P_Su_SYSQ_PI_JR_SERVQ_Support-central-and-per-university: There should be a central and university integrated support, i.e. personal contact persons who are available via a service line for technical, content and eCampus-related questions within 48h.	X		X			X	X	
Req_2_P_Su_SYSQ_JR_Information-creators: *For each use case, persons, typically the use case creators, should be available as contact persons in order to be able to provide specific information about content-related questions and further information about the use case.*	X					X		
Req_1_P_M_SYSQ_Content-maintenance: Certain filters and information in use cases should be checked regularly (once or twice a year) and updated if necessary.	X							
Req_2_P_M_Technical-maintenance: Security-relevant updates must be installed regularly.								
Req_1_P_Mar_PI_SERVQ_PQ_Marketing: Regular and long-term information should be provided about eCampus and it should be advertised (internal and external marketing). Complementary mass media and interpersonal communication channels should be used for this purpose, such as: (1) print media (e.g., folders, flyers, newspapers, news), (2) social media (with videos), (3) events (e.g., general application and workshops with introduction), (4) website and other systems of the university, (5) internal e-mail distribution list (university-specific), (6) support service/contact person of the university, and (7) personal contact (e.g., TELS-AG, Module 8 eDidactics, eDidactics in general).			X				X	X
~~Req_2_P_Mar_PI_Certificate:~~ ~~A certification system can be developed in the long term, which confirms that people have acquired use cases.~~			X					
~~Req_1_P_Us_SYSQ_SI_SERVQ_Voluntary-participation:~~ ~~Incentives should be created for active, optional participation of teachers in eCampus. These incentives should be designed as an ongoing, regular reward process (e.g. competitions) with an official, media-effective award (e.g., at an event, with a photo) in the sense of (1) an honor (e.g., teacher of the month, confirmation/certification, official thank-you letter), or (2) a benefit in kind (e.g. invitation to lunch) for the creation of use cases or other participatory activities (e.g. honor reports), whereby the process is not communicated in advance.~~	X				X		X	
~~Req_2_P_Us_SERVQ_PQ_Mandatory-participation:~~ ~~Rules for mandatory participation should be created. These can include the following possibilities: (1) cooperation agreements, (2) the involvement of eDidactics participants (module 8: obligatory review/creation of use cases), (3) monetary compensation for participation services, and (4) officially (by the rectorate or university-internally) certified continuing education measures.~~							X	X
~~Req_3_P_Us_SERVQ_Use-case-creation-by-user:~~ ~~Standardized and supervised processes for the creation of use cases by users are to be defined.~~							X	
~~Req_4_P_Us_PI_Key-user-integration:~~ ~~Test/key users (multipliers) are to be involved in the further development of eCampus.~~			X					
~~Req_1_P_Misc_SN_Third-party-services-offers:~~ ~~Various third-party services are to be integrated into eCampus in a well-considered manner.~~				X				
~~Req_2_P_Misc_SERVQ_Discounts:~~ ~~Discounts for technologies can be offered as a service, but preferably this should go through the universities.~~							X	

Appendix E.

Use Case Prototype

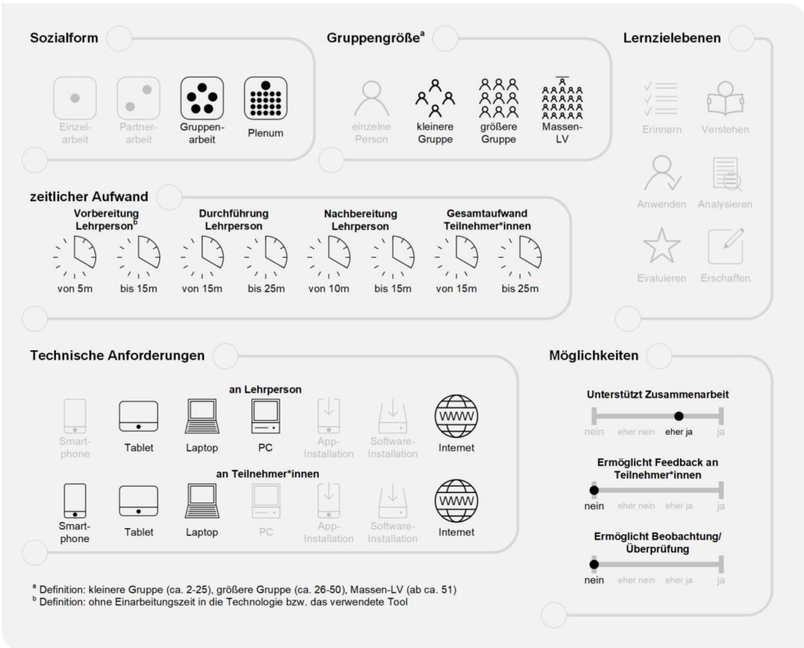
This appendix shows one of the two use case prototypes created for the evaluation in the second design cycle. The use case prototype is shown here in the original language German. The name of the use case creator and the contact details have been blacked out for data protection reasons.

Digitale Ice-Breaker-Methoden in der Präsenzlehre:
Warm-Up Aktivitäten als Einstiegsmethoden einsetzen

Ersteller*in: [redacted]
Kontaktmöglichkeit: [redacted]
Aktuelle Version: 30.10.2019

Kurzbeschreibung
Ice-Breaker-Aktivitäten können in Präsenz sowohl analog als auch mit digitalen Tools durchgeführt werden. Teilnehmer*innen (TN) können sich über Vorerfahrungen austauschen, die Gruppe (auf informelle Art) kennen lernen, oder ihre Erwartungen kommunizieren. Primäre Ziele sind ein niederschwelliger Einstieg und das „Aufwärmen" der Gruppe sowie die digitale Dokumentation der Ergebnisse. Eisbrecher-Aktivitäten können auch für Vorstellungsrunden genutzt werden. Siehe Use Case → Eine Vorstellungsrunde mit digitalen Hilfsmitteln gestalten

Allgemeine Eckdaten



Gründe für den Einsatz

- Interaktion zwischen TN
- Kennenlernen und „Warm-Up“ bzw. Auflockerung der Gruppe
- Abbau von (Kommunikations-)Barrieren
- Erfassung von Vorerfahrungen und Interessen
- Aktivität im Plenum steigern und Aktivierung der TN

Rolle der Lehrperson

Die Lehrperson (LP) leitet die Aktivität an und moderiert sie. Am Ende der Aktivität fasst die LP – wenn möglich – Gemeinsamkeiten bzw. Unterschiede in der Gruppe zusammen bzw. stellt einen Konnex oder eine Überleitung zu Lehr-/Lerninhalten her.

Einsatzmöglichkeiten / Methoden
Die nachstehend beschriebenen Methoden stellen nur eine kleine Auswahl der Möglichkeiten dar. Unter dem Suchbegriff „digital ice breaker" finden sich im Internet viele weitere kreative Beispiele und Anregungen.

„One Word Ice Breaker"**:** Als Lehrperson stellen Sie eine Frage, die die TN mit nur einem Wort beantworten sollen (z.B. ein Thema das die TN besonders interessiert; worüber sie bereits viel bzw. noch kaum Vorwissen haben oder eine spezifische Frage die zum Thema passt und mehrere mögliche Antworten hat). Die Ergebnisse werden (anonym) als Schlagwortwolken dargestellt (z.B. über Mentimeter oder AnswerGarden) und können anschließend im Plenum oder in Kleingruppen diskutiert werden. Diese Aktivität eignet sich auch für Brainstorming-Aktivitäten aller Art und die Sammlung von Begriffen bzw. die Erstellung von Assoziationsketten. Gruppengröße: 10 bis unbegrenzt.

„Wahrheit oder Lüge": Vorstellungsrunde mit Online-Kollaborationstools (wie Padlet, Google Suite, oder Office 365). TN stellen sich kurz mit 3-4 Aussagen vor (eine davon soll eine Lüge sein). Im Anschluss daran sollen andere TN versuchen, die Lüge zu erraten. Gruppengröße: bis ca. 20 TN oder Unterteilung in kleinere Gruppen (5-10).

„Mobile Show & Tell": TN werden in Kleingruppen (3-5 Personen) eingeteilt. Jede*r TN teilt 1-3 Fotos vom eigenen Smartphone mit der Kleingruppe und erzählt in 1-2 Minuten eine kurze Geschichte dazu, um sich vorzustellen. Gruppengröße: 5 bis unbegrenzt.

„Erwartungen digital abfragen": Als LP stellen Sie eine Frage zu den Erwartungen der TN an die Lehrveranstaltung / den Workshop / die Unterrichtseinheit, etc. (Beispiel: Stellen Sie sich vor, es ist das Ende des Semesters / des Workshop-Tages. Was haben Sie gelernt?) TN antworten über ein Online-Umfragetool wie z.B. Poll.ly in Form von kurzen Freitext-Antworten und können Beiträge von anderen „Liken" und somit Zustimmung bzw. Gefallen ausdrücken. Gruppengröße: bis ca. 30 TN.

„Live Umfrage“: TN bekommen Fragen mit (Multiple-Choice-)Antworten präsentiert (z.B. über Audience Response Systeme wie Mentimeter oder feedbackr). Dies können Fragen mit Bezug zum Thema sein, Fragen zur Herkunft der TN (Studienrichtung, Semesteranzahl, etc.), polarisierende Fragen mit Ja/Nein-Antworten, oder Spaßfragen, um die Stimmung innerhalb der Gruppe aufzulockern. Gruppengröße: 5 bis unbegrenzt.

Zeitlicher Aufwand

Je nach Aktivität, benützter Technologie und Gruppengröße ist der zeitliche Aufwand für Erstellung und Durchführung unterschiedlich. Grundsätzlich empfiehlt sich, 15-20 Minuten für die Aktivität im Präsenzunterricht einzuplanen und jedenfalls eine kurze Nachbereitung durchzuführen.

Tipps zur Umsetzung

- Das Ziel bestimmt die Wahl der Aktivität bzw. Methode: Überlegen Sie, was Sie mit der Eisbrecher-Aktivität erreichen möchten. Sollen TN sich nur kennen lernen? Sollen Sie besser zusammenarbeiten? Möchten Sie einen Überblick über die Gruppe bekommen? Oder ist die Eisbrecher-Methode für eine Auflockerung zwischendurch gedacht?
- Ergebnisse reflektieren / kommentieren: Gehen Sie auf die Beiträge der TN ein und stellen Sie einen Bezug zur Veranstaltung, dem Thema, Ihren Lehrmethoden oder Ihrer Person her.
- Keep it short and simple: Zu komplexe Fragen und Anleitungen können TN verwirren und demotivierend wirken. Wenn Aktivitäten zu lange dauern, sinken Motivation und Aufmerksamkeit ebenfalls.
- Teilnahme für alle: Um allen TN die Teilnahme zu ermöglichen, empfiehlt sich, die Aktivität optional paarweise durchführen zu lassen, insbesondere wenn nicht jede*r über ein mobiles Endgerät verfügt bzw. wenn Behinderungen oder Beeinträchtigungen eine individuelle Teilnahme erschweren oder unmöglich machen. Wenn Sie Leihgeräte haben, können auch diese zum Einsatz kommen.
- Bei URLs empfiehlt sich die Erstellung eines Short-Links (z.B. mittels bitly oder

TinyURL) sowie zusätzlich die Erstellung eines QR-Codes (z.B. mittels goQR.me).

Vorteile/Herausforderungen

- Das Verwenden von Online-Tools hilft bei der Dokumentation der Inhalte für Gruppe und LP, schafft mitunter einen spielerischen Zugang und holt die TN in ihrer Lebenswelt ab (Nutzung von Smartphones, etc.).
- Zugang zum Netz: TN benötigen zur Teilnahme ein funktionierendes Internet über Mobilfunk bzw. Wi-Fi sowie Hardware wie Smartphone, Tablet oder Laptop.
- Keine Technologiefallen: Achten Sie darauf, dass verwendete Technologien und Tools keine Barrieren für TN darstellen und Sie TN bei technischen Fragen unterstützen (z.B. beim Aufrufen einer URL, bei der Bedienung des Tools, etc.).

Einfluss auf Lernerfolg

Icebreaker-Methoden können einen positiven Einfluss auf den Lernerfolg haben, wenn die LP z.B. über die Abfrage von Interessen und Vorerfahrungen an das Wissen der Gruppe anknüpft und Lehr-/Lerninhalte – wenn möglich – angepasst werden.

Einfluss auf Motivation

Eisbrecher-Aktivitäten können nachweislich die Motivation steigern und tragen häufig positiv zum Gruppenklima bei.[1] Sie eignen sich auch als Auflockerung und Aktivierung für zwischendurch.[2] Der Kreativität seitens der Lehrenden sind hier keine Grenzen gesetzt. TN schätzen oft weniger bekannte Aktivitäten und die Neuartigkeit von digitalen Tools.

Rechtliche Aspekte

Beim Einsatz von digitalen Tools sollte darauf geachtet werden, dass TN nach Möglichkeit keine eigenen Benutzerkonten anlegen müssen, das heißt, dass der Zugang für TN ohne Anmeldung möglich ist. LP sollten sich vorab über die Nutzungsbedingungen informieren sowie darüber, wo und wie generierte Daten gespeichert werden. Jedenfalls sind gesetzliche Bestimmungen wie z.B. die Datenschutzgrundverordnung einzuhalten.

Mögliche Tools für Umsetzung

Online-Kollaborationstools

Zur Dokumentation von Vorerfahrungen oder für digitale Vorstellungen egal welcher Art können Online-Kollaborationstools verwendet werden.

- Digitale Pinnwand Padlet (Freemium-Account für Ersteller*innen; keine Anmeldung für TN nötig)
- Produkte der Google Suite z.B. Google Slides oder Google Docs (kostenloser Account für Ersteller*innen; Anmeldung für TN möglich, aber auch anonyme Nutzung möglich)
- Office 365, z.B. PowerPoint und Word (derzeit kostenlos für 1 Jahr verfügbar bzw. oft auch direkt von Hochschulen zur Verfügung gestellt)
- Online Editoren wie Etherpads (z.B. ZUMpad oder YourPart; keine Anmeldung für Ersteller*innen und TN nötig)

Umfragetools

Kurze Umfragen können als Stimmungsbarometer verwendet werden, das Gruppengefühl stärken, oder Vorerfahrungen mittels Wortwolkengeneratoren erheben.

- Poll.ly (kostenlos, keine Anmeldung nötig)
- Mentimeter (Freemium für Ersteller*innen, kein Account für TN nötig)
- AnswerGarden (für Wortwolken, keine Anmeldung nötig).

Anwendungsbeispiel

In einem Seminar oder Workshop mit Ziel einer späteren Beteiligung der TN stellt die LP zu Beginn mithilfe des Umfragetools Poll.ly eine einfache Frage („Warum sind Sie hier?“). TN erhalten einen Kurzlink und/oder QR-Code und können mit ihrem Smartphone oder mobilen Endgerät auf die Umfrage in einem Browserfenster zugreifen und (anonym oder ggf. mit Namen oder Initialen) in einem Freitextfeld eine kurze Antwort abgeben. Die Antworten erscheinen in Echtzeit auf allen Geräten über das Browserfenster und können auch per Beamer an die Wand projiziert werden. TN können Beiträge anderer mit einem Herzsymbol – ähnlich der Verwendung in sozialen Medien – „liken“ und so ihre Zustimmung ausdrücken. Die LP bekommt in nur wenigen Minuten einen guten Überblick über Motivation zur Teilnahme, Vorerfahrungen und Interessen. Im Anschluss daran kann die LP direkt auf die Aussagen eingehen und somit TN einbeziehen und motivieren. Geeignet für alle Disziplinen und Gruppengrößen bis zu ca. 30 TN.

Weiterführende Literatur und Beispiele

- Kollaboratives Arbeiten mit Etherpads (Lehrerweb Wien)
- 21st Century Icebreakers: 10 Ways To Get To Know Your Students with Technology
- 17 bewährte Eisbrecher-Fragen für Live-Abstimmungen im Publikum

Zitierte Quellen

[1] Johnson, LouAnne (2012). *Kick-Start Your Class: Academic Icebreakers to Engage Students*. San Francisco: Jossey-Bass.
[2] Reitzer, Christine (2014). *Erfolgreich lehren: Ermutigen, motivieren, begeistern*. Berlin: Springer.

Appendix F.

Field Test and Interview Guide for E-Service Prototype

This appendix contains the 13 tasks with associated questions and the interview guide that were used to evaluate the e-service prototype in the third design cycle. The tasks, the associated questions, and the interview guide were translated from German to English for this thesis.

Tasks with Associated Questions

T1 Before you log in for the first time, please take a look at the homepage www.e-campus.st. After that, log in.

  a) Is the information on the homepage and at the first login useful for you?
  b) Is the information on the homepage and at the first login presented in a simple and understandable way?
  c) Does this information make it easier for you to use eCampus?

T2 Please read the privacy policy.

  a) Is the privacy statement useful to you?
  b) Is the privacy statement written and designed simply for you?
  c) Does the privacy statement make it easier for you to use eCampus?

T3 Please click through the glossary and have a look at the used terms of eCampus.

a) Is the glossary useful for you?
b) Is the glossary easy for you to use and simply designed?
c) Does the glossary make it easier for you to use eCampus?

T4 Please take a look at the visual design of eCampus.

a) In your view, does the visual design of eCampus contribute to the usefulness of the system?
b) Does the visual design of eCampus make it easier for you to use the eCampus?

T5 Please get an overview of the categories and use cases on eCampus.

a) Are the topics covered useful to you?

T6 Please read use cases from the category "Manage the Course".

a) Are these types of use cases useful to you?

T7 Please search for use cases that are appropriate for you by using the search, filtering, and category navigation.

a) Are the search, filters and navigation through the categories useful for you?
b) Are the search, filters and navigation through the categories of eCampus comprehensible and simple?
c) Do the search, filters and navigation through the categories make it easier for you to use eCampus?

T8 Please read through and look closely at five use cases.

a) Are the use cases and their design useful for you?
b) Are the use cases written and presented in a simple and understandable way?
c) In your opinion, do these use cases contribute to a positive discussion about eCampus?

T9 Please take a closer look at a few tools referenced in the use cases.

a) Are these tools useful to you?

T10 Ask a question about a use case in the discussion forum. If possible, answer the question of another user.

a) Is such a discussion forum useful for you?
b) Is using the discussion forum easy for you?

c) Does such a discussion forum make it easier for you to use eCampus?
d) In your view, do such discussion forums contribute to positive talk about eCampus?

T11 Please give your general feedback on eCampus in the system. In addition, please evaluate a use case and provide your feedback as a contribution to the discussion.

a) Is the possibility to give feedback or the availability of feedback from other users useful for you?
b) Are the options for giving feedback easy for you to use?
c) Does the availability of feedback on use cases make it easier for you to use eCampus?
d) In your opinion, does positive feedback on eCampus contribute to positive talk about eCampus?

T12 On eCampus there are references to other use cases in various places (most viewed, others also viewed, reminders, ...). Please view and follow these.

a) Are these references to other use cases useful to you?
b) Are these references easy for you to use?
c) Do these references make it easier for you to use eCampus?

T13 Please view and follow links to external events and resources on eCampus or within the use cases.

a) Are the references to external information and publications useful for you?
b) Is it easy for you to use these references?
c) In your view, do such references contribute to positive talk about eCampus?

Interview Guide

1. Greeting and Explanation
    a) Thank for the time. Duration approx. 30min.
    b) Focus: Your experience with eCampus in the test phase.
    c) Six thematic blocks.

2. Introductory Questions
    a) What is your experience with technology-enhanced learning so far?
    b) How do you deal with challenging new technologies?
3. Technical Implementation
    a) Were you satisfied with the technical performance of eCampus (speed, browser support, availability, ...)?
    b) Did you have any difficulties using eCampus? If yes, which elements and functionalities were unclear to you?
    c) Was it easy for you to access eCampus or would you like to see a different type of access here?
    d) What else could we display on the homepage to make it more useful and easier for you to navigate?
    e) What can be improved in the navigation and search on eCampus from your point of view?
    f) Were all terms used on eCampus sufficiently defined and explained for you? Which ones were not? Would you need any help other than a glossary?
4. Support and Maintenance
    a) What kind of support do you think should be available at eCampus?
    b) In your opinion, can maintenance also be performed during the day? Would you like to be informed about innovations on eCampus?
5. Additional Services and Processes
    a) What would motivate you to use eCampus regularly?
    b) How to efficiently promote the e-service for your needs?
    c) Would you want to use eCampus for networking with other teachers? If yes, in what way should this be done?
    d) What would motivate you to connect with other faculty on eCampus?
6. Use Cases
    a) After reading the use cases, could you imagine implementing the scenarios presented in your teaching? What kind of support

would you still need? Could you imagine providing ideas for use cases yourself?

b) How can we improve the use cases for your needs?
c) What use cases do you think would increase usefulness? (Only ask if usefulness was rated low in task 5!)
d) Can you imagine using the tools presented? Is the initial information about the tools described at eCampus sufficient for you?
e) Can you imagine using the publicly usable use case descriptions?

7. Miscellaneous

a) Does the visual design of eCampus meet your expectations? What would you change?
b) Would the use of interactive elements or multimedia components make eCampus more attractive to you? If yes, which ones?
c) How did you like the functionalities of eCampus? What other functionalities would you like to see?
d) Would public testimonials from other instructors, free to view on the homepage, make you more likely to use eCampus?
e) What other topics do you think should be covered at eCampus?
f) What can be changed to make the privacy agreement easier for you to understand? (Only ask if ease of use was rated low in task 2!)
g) Why is it not useful for you to have feedback from other users? (Only ask if usefulness was rated low in task 11!)
h) From your point of view, how could feedback functionalities be made easier? (Only ask if ease of use was rated low in task 11!)

Appendix G.

Use Case Example

This appendix shows a use case example created in the third design cycle. The use case example is shown here in the original language German.

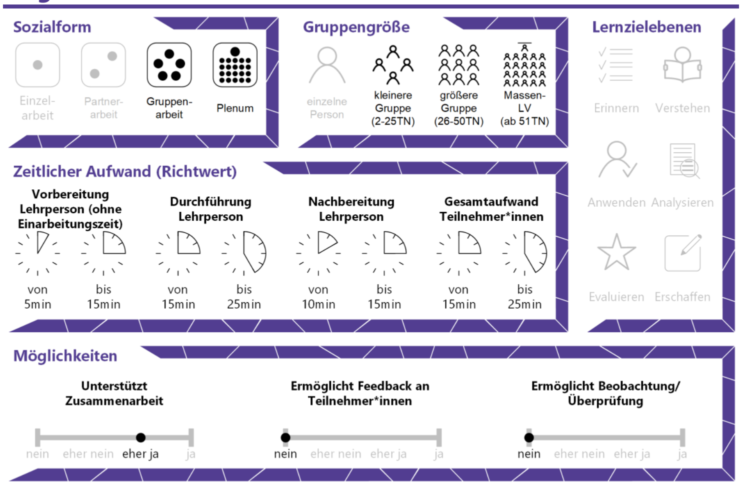
Digitale Ice-Breaker-Methoden in der Präsenzlehre

Warm-Up Aktivitäten als Einstiegsmethoden einsetzen

Kurzbeschreibung

Ice-Breaker-Aktivitäten können in Präsenz sowohl analog als auch mit digitalen Tools durchgeführt werden. Teilnehmer*innen (TN) können sich über Vorerfahrungen austauschen, die Gruppe (auf informelle Art) kennen lernen, oder ihre Erwartungen kommunizieren. Primäre Ziele sind ein niederschwelliger Einstieg und das „Aufwärmen" der Gruppe sowie die digitale Dokumentation der Ergebnisse. Eisbrecher-Aktivitäten können auch für Vorstellungsrunden genutzt werden. Siehe Use Case: „Eine Vorstellungsrunde mit digitalen Hilfsmitteln gestalten."

Allgemeine Eckdaten



 Aktuelle Version: 30.10.2019

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eCampus

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- Interaktion zwischen TN
- Kennenlernen und „Warm-Up" bzw. Auflockerung der Gruppe
- Abbau von (Kommunikations-)Barrieren
- Erfassung von Vorerfahrungen und Interessen
- Aktivität im Plenum steigern und Aktivierung der TN

Technische Infrastruktur / Empfehlungen

LP benötigen in der Regel einen Computer bzw. Laptop oder Tablet, Internet und eventuell einen Beamer zur Projektion im Unterrichtsraum.

TN benötigen Zugang zu einem Computer oder ein mobiles Endgerät (Smartphone, Tablet, Laptop) und Internet (bzw. W-Lan).

Rolle der Lehrperson

Die Lehrperson (LP) leitet die Aktivität an und moderiert sie. Am Ende der Aktivität fasst die LP – wenn möglich – Gemeinsamkeiten bzw. Unterschiede in der Gruppe zusammen bzw. stellt einen Konnex oder eine Überleitung zu Lehr-/Lerninhalten her.

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Assoziationsketten. Gruppengröße: 10 bis unbegrenzt.

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Vorstellungsrunde mit Online-Kollaborationstools (wie Padlet, Google Suite, oder Office 365). TN stellen sich kurz mit 3-4 Aussagen vor (eine davon soll eine Lüge sein). Im Anschluss daran sollen andere TN versuchen, die Lüge zu erraten. Gruppengröße: bis ca. 20 TN oder Unterteilung in kleinere Gruppen (5-10).

„Mobile Show & Tell"

TN werden in Kleingruppen (3-5 Personen) eingeteilt. Jede*r TN teilt 1-3 Fotos vom eigenen Smartphone mit der Kleingruppe und erzählt in 1-2 Minuten eine kurze Geschichte dazu, um sich vorzustellen. Gruppengröße: 5 bis unbegrenzt.

„Erwartungen digital abfragen"

Als LP stellen Sie eine Frage zu den Erwartungen der TN an die Lehrveranstaltung / den Workshop / die Unterrichtseinheit, etc. (Beispiel: Stellen Sie sich vor, es ist das Ende des Semesters / des Workshop-Tages. Was haben Sie gelernt?) TN antworten über ein Online-Umfragetool wie z.B. Poll.ly in Form von kurzen Freitext-Antworten und können Beiträge von anderen „Liken" und somit Zustimmung bzw. Gefallen ausdrücken. Gruppengröße: bis ca. 30 TN.

„Live Umfrage"

TN bekommen Fragen mit (Multiple-Choice-)Antworten präsentiert (z.B. über Audience-Response-Systeme wie Mentimeter oder feedbackr). Dies können Fragen mit Bezug zum Thema sein, Fragen zur Herkunft der TN (Studienrichtung, Semesteranzahl, etc.), polarisierende Fragen mit Ja/Nein-Antworten, oder Spaßfragen, um die Stimmung innerhalb der Gruppe aufzulockern. Gruppengröße: 5 bis unbegrenzt.

Zeitlicher Aufwand

Je nach Aktivität, benützter Technologie und Gruppengröße ist der zeitliche Aufwand für Erstellung und Durchführung unterschiedlich. Grundsätzlich empfiehlt sich, 15-20 Minuten für die Aktivität im Präsenzunterricht einzuplanen und jedenfalls eine kurze Nachbereitung durchzuführen.

Tipps zur Umsetzung

- Das Ziel bestimmt die Wahl der Aktivität bzw. Methode: Überlegen Sie, was Sie mit der Eisbrecher-Aktivität erreichen möchten. Sollen TN sich nur kennen lernen? Sollen Sie besser zusammenarbeiten? Möchten Sie einen Überblick über die Gruppe bekommen? Oder ist die Eisbrecher-Methode für eine Auflockerung zwischendurch gedacht?
- Ergebnisse reflektieren / kommentieren: Gehen Sie auf die Beiträge der TN ein und stellen Sie einen Bezug zur Veranstaltung, dem Thema, Ihren Lehrmethoden oder Ihrer Person her.
- Keep it short and simple: Zu komplexe Fragen und Anleitungen können TN verwirren und demotivierend wirken. Wenn Aktivitäten zu lange dauern, sinken Motivation und Aufmerksamkeit ebenfalls.
- Teilnahme für alle: Um allen TN die Teilnahme zu ermöglichen, empfiehlt sich, die Aktivität optional paarweise durchführen zu lassen, insbesondere wenn nicht jede*r über ein mobiles Endgerät verfügt bzw. wenn Behinderungen oder Beeinträchtigungen eine individuelle Teilnahme erschweren oder unmöglich machen. Wenn Sie Leihgeräte haben, können auch diese zum Einsatz kommen.
- Bei URLs empfiehlt sich die Erstellung eines Short-Links (z.B. mittels bitly oder TinyURL) sowie zusätzlich die Erstellung eines QR-Codes (z.B. mittels goQR.me), damit TN schneller darauf zugreifen können.

Vorteile / Herausforderungen

- Das Verwenden von Online-Tools hilft bei der Dokumentation der Inhalte für Gruppe und LP, schafft mitunter einen spielerischen Zugang und holt die TN in ihrer Lebenswelt ab (Nutzung von Smartphones, etc.).
- Zugang zum Netz: TN benötigen für die Teilnahme ein funktionierendes Internet über Mobilfunk bzw. Wi-Fi sowie Hardware wie Smartphone, Tablet oder Laptop.
- Keine Technologiefallen: Achten Sie darauf, dass verwendete Technologien und Tools keine Barrieren für TN darstellen und Sie TN bei technischen Fragen unterstützen (z.B. beim Aufrufen einer URL, bei der Bedienung des Tools, etc.).

Einfluss auf Lernerfolg

Icebreaker-Methoden können einen positiven Einfluss auf den Lernerfolg haben, wenn die LP z.B. über die Abfrage von Interessen und Vorerfahrungen an das Wissen der Gruppe anknüpft und Lehr-/Lerninhalte – wenn möglich – angepasst werden.

Einfluss auf Motivation

Eisbrecher-Aktivitäten können nachweislich die Motivation steigern und tragen häufig positiv zum Gruppenklima bei.[1] Sie eignen sich auch als Auflockerung und Aktivierung für zwischendurch.[2] Der Kreativität seitens der Lehrenden sind hier keine Grenzen gesetzt. TN schätzen oft weniger bekannte Aktivitäten und die Neuartigkeit von digitalen Tools.

Rechtliche Aspekte

Mit diesem Absatz möchten wir Sie für rechtliche Aspekte beim Einsatz von digitalen Technologien in Unterricht und Lehre sensibilisieren. Gesetzliche Bestimmungen sind jedenfalls einzuhalten. Für diesen Use Case sind insbesondere folgende Rechtsthematiken relevant:

- Urheberrecht (bei der Verwendung von Bildern und Fotos)
- Nutzungsbedingungen der verwendeten Tools
- Datenschutzgrundverordnung (inkl. Datensicherheit)

Bitte wenden Sie sich bei weiteren Fragen an die zuständige Abteilung(en) Ihrer Institution.

Mögliche Tools für Umsetzung

Online-Kollaborationstools

Zur Dokumentation von Vorerfahrungen oder für digitale Vorstellungen egal welcher Art können Online-Kollaborationstools verwendet werden.

- Padlet – webbasiertes Tool, Verwendung im Browser bzw. App (iOS, Android), Freemium (kostenlose Version mit eingeschränktem Funktionsumfang verfügbar), LP benötigt ein Benutzer*innenkonto, TN anonym, Firmensitz

USA, Pinnwand kann auch direkt im LMS eingebettet werden

- Produkte der Google Suite z.B. Google Slides oder Google Docs (kostenloser Account für Ersteller*innen; Anmeldung für TN möglich, aber auch anonyme Nutzung möglich)
- Office 365, z.B. PowerPoint und Word (derzeit kostenlos für 1 Jahr verfügbar bzw. oft auch direkt von Hochschulen zur Verfügung gestellt)
- Online Editoren wie Etherpads (z.B. ZUMpad oder YourPart; keine Anmeldung für Ersteller*innen und TN nötig)

Umfragetools

Kurze Umfragen können als Stimmungsbarometer verwendet werden, das Gruppengefühl stärken, oder Vorerfahrungen mittels Wortwolkengeneratoren erheben.

- Poll.ly – Freeware, Verwendung ohne Anmeldung, Firmensitz Schweiz
- Mentimeter (für kurze Umfragen oder Wortwolken) – Freemium (kostenlose Version mit eingeschränktem Funktionsumfang verfügbar), LP benötigt ein Benutzer*innenkonto, Firmensitz USA; LP steigt über mentimeter.com, TN über menti.com ein
- AnswerGarden (für Wortwolken) – Freeware, Verwendung ohne Anmeldung, Firmensitz Niederlande

Anwendungsbeispiel

In einem Seminar oder Workshop mit Ziel einer späteren Beteiligung der TN stellt die LP zu Beginn mithilfe des Umfragetools Poll.ly eine einfache Frage („Warum sind Sie hier?“). TN erhalten einen Kurzlink und/oder QR-Code und können mit ihrem Smartphone oder mobilen Endgerät auf die Umfrage in einem Browserfenster zugreifen und (anonym oder ggf. mit Namen oder Initialen) in einem Freitextfeld eine kurze Antwort abgeben. Die Antworten erscheinen in Echtzeit auf allen Geräten über das Browserfenster und können auch per Beamer an die Wand projiziert werden. TN können Beiträge anderer mit einem Herzsymbol – ähnlich der Verwendung in sozialen Medien – „liken“ und so ihre Zustimmung ausdrücken. Die LP bekommt in nur wenigen Minuten einen guten Überblick über Motivation zur Teilnahme, Vorerfahrungen und Interessen. Im Anschluss daran kann die LP direkt auf die Aussagen eingehen und somit TN einbeziehen und motivieren. Geeignet für alle Disziplinen und Gruppengrößen bis zu ca. 30 TN.

Weiterführende Literatur und Beispiele

- Kollaboratives Arbeiten mit Etherpads (Lehrerweb Wien)
- 21st Century Icebreakers: 10 Ways To Get To Know Your Students with Technology
- 17 bewährte Eisbrecher-Fragen für Live-Abstimmungen im Publikum

Quellen

[1] Johnson, LouAnne (2012). *Kick-Start Your Class: Academic Icebreakers to Engage Students*. San Francisco: Jossey-Bass.

[2] Reitzer, Christine (2014). *Erfolgreich lehren: Ermutigen, motivieren, begeistern*. Berlin: Springer.

Appendix H.

Survey Final Evaluation[1]

This appendix shows the questionnaire used for the final evaluation of the designed artifact the e-service eCampus. The questionnaire was translated from German to English for this thesis.

Questionnaire

Dear Teachers,

Thank you for taking the time to participate in this survey! Participation should take between 5 and 10 minutes maximum.

The eCampus is an e-service for teachers. In self-study, you can find and learn suitable technology-enhanced learning (TEL) approaches for your own teaching at https://e-campus.st/ at any time. To this end, a wide variety of use cases for TEL are examined from several angles and described in detail in so-called use cases. The goal is for you to find everything you need for the successful use of TEL at eCampus.

eCampus is available free of charge to all teachers at Styrian higher educational institutions and is intended to serve as the central platform for acquiring knowledge in the use of TEL in higher education teaching. With this survey we would like to collect information so that we can further improve this e-service for you and so that eCampus can support you in your everyday teaching and in the use of TEL in the best possible way.

[1]This appendix is based on the following already published work: Beer (2022b)

If you have not yet used eCampus, please take part in this survey anyway, because you too can contribute important information to the further development of eCampus, and in particular how this e-service can be improved for you!

No personal data is collected in the survey. Registration or providing your name is not required for participation, which is why it is generally not possible to draw conclusions about individuals or identify you or other participants in the survey. Furthermore, the results of this survey (e.g. final reports, etc.) are published exclusively in aggregated and anonymized form. For more information on data protection and your rights in this regard, please see https://www.campus02.at/startseite/datenschutz/ds-umfrage/. Your participation is, of course, voluntary.

Thank you for your support!

Your eCampus team.

The eCampus project is a joint digitization project of TU Graz, KF Uni Graz and FH CAMPUS 02. For information on the project, please see https://e-campus.st/. The survey is conducted and evaluated by FH CAMPUS 02, Körblergasse 126, 8010 Graz.

D1 How would you rate your experience with technology-enhanced learning?

Note:

very low: You have never used technologies in teaching before.

medium: You can use typical tools such as PowerPoint and Moodle without any problems.

very high: You are doing research in the area of TEL.

O Very low
O Low
O Below average
O Average
O High
O Very high

D2 How long have you been teaching?

O Less than a year
O 1 to 2 years
O 2 to 4 years
O 5 to 6 years
O 7 to 8 years
O 9 to 10 years
O more than 11 years

D3 At which higher educational institution do you mainly teach?

O CAMPUS 02 University of Applied Sciences
O FH JOANNEUM University of Applied Sciences
O Private University College of Teacher Education Augustinum
O Medical University of Graz
O Montanuniversität Leoben
O University College of Teacher Education Styria
O Graz University of Technology
O University of Music and Performing Arts Graz
O University of Graz

K1 I have already heard about eCampus.

O Yes
O No

Please indicate the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Rather disagree	Neutral	Rather agree	Agree	Strongly agree
BI1 I plan to log in to eCampus in the future.	O	O	O	O	O	O	O
BI2 I plan to read use cases on eCampus in the future.	O	O	O	O	O	O	O
BI3 I plan to use information from eCampus to improve my teaching.	O	O	O	O	O	O	O

AU1 How many times have you logged in to eCampus?

O Never
O Once
O Twice to 3 times
O 4 to 5 times
O 6 to 7 times
O 8 to 9 times
O More than 10 times

AU2 On average, how much time do you spend on eCampus when you are logged in?

O Never logged in before
O Less than five minutes
O 5 to 10 minutes
O 15 to 30 minutes
O 30 to 60 minutes
O One to two hours
O More than 2 hours

AU3 How intensively have you used eCampus so far?

Note:

very little: Logged in for a short time at most.

medium: Read one use case.

very much: Read several use cases and tried them out in teaching.

O Very little/Never
O A little bit
O Below average
O Average
O Above average
O Much
O Very much

Please indicate the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Rather disagree	Neutral	Rather agree	Agree	Strongly agree
SE1 I am able to operate an e-service such as eCampus with no support and assistance.	O	O	O	O	O	O	O
SE2 I am confident that I can overcome any obstacles when using an e-service such as eCampus.	O	O	O	O	O	O	O
SE3 I believe that I can use different e-services such as eCampus.	O	O	O	O	O	O	O
EX1 I have experience with e-services such as eCampus.	O	O	O	O	O	O	O
EX2 I know e-services similar to eCampus.	O	O	O	O	O	O	O
EX3 I have used e-services similar to eCampus before.	O	O	O	O	O	O	O
PI1 It is very attractive for me to try new e-services such as eCampus.	O	O	O	O	O	O	O
PI2 I prefer that others have used a new e-service before I try it.	O	O	O	O	O	O	O
PI3 I often feel a bit uncomfortable to try out new e-services, even though it may be beneficial to me.	O	O	O	O	O	O	O
SN1 People who influence my behavior think that I should use eCampus.	O	O	O	O	O	O	O
SN2 People who are important to me think that I should use eCampus.	O	O	O	O	O	O	O
SN3 People in my working environment think that I should use eCampus.	O	O	O	O	O	O	O
SI1 Colleagues like to see you use eCampus.	O	O	O	O	O	O	O
SI2 People in my organization who use eCampus have more prestige than those who do not.	O	O	O	O	O	O	O
SI3 People in my organization who use eCampus have a high profile.	O	O	O	O	O	O	O

Please indicate the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Rather disagree	Neutral	Rather agree	Agree	Strongly agree
JR1 In my job, usage of eCampus is important.	O	O	O	O	O	O	O
JR2 In my job, usage of eCampus is relevant.	O	O	O	O	O	O	O
JR3 The use of eCampus is pertinent to my job-related tasks.	O	O	O	O	O	O	O
PQ1 My organization motivates me to use eCampus.	O	O	O	O	O	O	O
PQ2 My organization has integrated the eCampus into its own.	O	O	O	O	O	O	O
PQ3 My organization gives me time to use eCampus.	O	O	O	O	O	O	O
PQ4 My organization pays me to use eCampus.	O	O	O	O	O	O	O
PU1 I find an e-service like eCampus to be useful.	O	O	O	O	O	O	O
PU2 Using eCampus improves my teaching performance.	O	O	O	O	O	O	O
PU3 Using eCampus enhances my effectiveness.	O	O	O	O	O	O	O

Please indicate the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Rather disagree	Neutral	Rather agree	Agree	Strongly agree
PEOU1 I find eCampus to be easy to use.	O	O	O	O	O	O	O
PEOU2 I find the navigation on eCampus easy.	O	O	O	O	O	O	O
PEOU3 The operation of eCampus is clear and understandable.	O	O	O	O	O	O	O
SYSQ1 The eCampus is user-friendly.	O	O	O	O	O	O	O
SYSQ2 The eCampus operates reliably.	O	O	O	O	O	O	O
SYSQ3 I like the functionalities of eCampus.	O	O	O	O	O	O	O
INFQ1 I understand most of the terms used throughout eCampus.	O	O	O	O	O	O	O
INFQ2 The use cases on eCampus are up to date.	O	O	O	O	O	O	O
INFQ3 The use cases on eCampus have a high quality.	O	O	O	O	O	O	O
INFQ4 The use cases on eCampus are comprehensive.	O	O	O	O	O	O	O
SERVQ1 There is technical support that helps me use eCampus.	O	O	O	O	O	O	O
SERVQ2 There is training that helps me use eCampus.	O	O	O	O	O	O	O
SERVQ3 There is content support that helps me implement use cases.	O	O	O	O	O	O	O