Essays on
Digital Healthcare and Inclusion

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Abstract

This dissertation consists of two main parts in seven essays: Five essays revolve around digital healthcare, while two additional essays cover teachers' attitude towards inclusion. The first three essays are about the use of telehealth software in chronic disease treatment, using the case of hemophilia. Essays IV and V discuss the development of a 3D-software prototype to provide medical models to novice surgeons or other practitioners. The last two essays present a study on what impacts a teacher's attitude towards inclusion in vocational education.

Essay I develops the model and hypotheses which are used in essay II. It combines and adopts several existing models to cover factors that could influence a physician's decision to recommend a telehealth app to a patient. Essay II builds on this work and tests the model with survey data. The results show that physicians are more likely to recommend a software if they use the software themselves and if they perceive the software to improve their workplace processes.

Essay III turns the perspective of the first two essays and investigates which factors influence a patient to use a telehealth app. This was researched by creating a model based on a combination of existing models that describe the behavior of software users and models of patient behavior. Its results indicate that hedonic motivation has an influence, meaning that healthcare apps still need to provide some level of engagement. The other significant influence was cues to action from the social environment, which includes physicians. This additionally validates the necessity of the study undertaken in the first two essays, where the reasoning for a physician to give such an advice was analyzed.

Essay IV and V show the development of a hardware/software prototype to solve current shortcomings in the field of surgical-adjacent medicine, like soft-tissue fillers. Facial treatments, even for aesthetic purposes, often involve unnecessary patient risk due to treatment by unexperienced practitioners and/or a lack of standardized procedures. The developed prototype focuses on affordability and helps in treatment planning and professional self-development. Essay IV focuses on the architecture of the prototype itself, while essay V adds an exemplary embedding into a treatment process and a test in a live treatment.

Essays VI and VII investigate factors influencing vocational teachers' attitude towards inclusion. Essay VI is the pilot study. The inclusion-related attitudes of teachers are considered to be essential predictors for their pedagogical and inclusion-related perception and action in inclusive lessons as well as for the teaching success. The results show that previous experiences with inclusion, self-efficacy and the understanding of teaching and learning are the main predictors for a teacher's personal willingness to act in an inclusive environment.

Inhalt (German Abstract)

Diese Dissertation besteht aus zwei Teilen in sieben Essays: Fünf Essays behandeln das digitale Gesundheitswesen, während zwei weitere Essays die Einstellung von Lehrern zu Inklusion umfassen. Die ersten drei Essays untersuchen die Benutzung von Telehealth-Software in der Behandlung chronischer Krankheiten am Beispiel der Hämophilie. Essay IV und V erörtern die Entwicklung eines 3D-Software-Prototypen, um medizinische Behandlungsmodelle für Chirurgen und andere Anwender zur Verfügung zu stellen. Die letzten beiden Essays präsentieren eine Studie über die Einflussfaktoren auf die Einstellung von Lehrern zu Inklusion im Berufsbildungssektor.

Essay I entwickelt ein Modell und Hypothese, welche in Essay II genutzt werden. Es kombiniert und adaptiert verschiedene existierende Modelle, um Faktoren zu erfassen, die die Empfehlungsentscheidung eines Arztes gegenüber einem Patienten bezüglich einer Telehealth-App beeinflussen könnten. Essay II baut darauf auf und testet das Modell mittels einer Umfrage. Die Ergebnisse zeigen, dass Ärzte eine entsprechende Software eher empfehlen, wenn sie die Software selbst benutzen und falls sie den Eindruck haben, dass die Software die Abläufe in der Praxis verbessert.

Essay III nimmt die entgegengesetzte Perspektive zu den ersten beiden Essays ein und untersucht, welche Faktoren einen Patienten zur Nutzung einer Telehealth-App bewegen. Um dies abzubilden, wurden existierende Modelle zu Software-Nutzer-Verhalten und Patientenverhalten zu einem neuen Modell kombiniert. Die Ergebnisse zeigen, dass trotz des ernsten Kontexts ein Vergnügen an der App-Nutzung positiv wirkt. Weiterhin sind Hinweise aus dem sozialen Umfeld ein signifikanter Einflussfaktor. Ärzte wurden als Teil dieses sozialen Umfeldes abgebildet, was nochmals die Relevanz der ersten beiden Studien bestätigt.

Essays IV und V zeigen die Entwicklung eines Hardware/Software Prototypen, um aktuelle Probleme in der plastischen Behandlung zu lösen. Behandlungen im Gesicht, selbst für rein ästhetische Zwecke, beinhalten oft ein unnötiges Patientenrisiko aufgrund von unerfahrenen Anwendern und kaum standardisierten Behandlungsprozeduren. Der entwickelte Prototyp soll eine kostengünstige Option für Behandlungsplanung und -dokumentation sowie eigene professionelle Entwicklung der Anwender sein. Essay IV erörtert die Architektur des Prototypen, während Essay V die Einbindung in den Behandlungsprozess und einen Test in einer tatsächlichen Behandlung beinhaltet.

Die Essays VI und VII untersuchen Faktoren, welche die Einstellung von Lehrern gegenüber Inklusion beeinflussen. Essay VI stellt dabei die Pilotstudie dar. Die untersuchten Einflussfaktoren sind Prädiktoren für die pädagogische Wahrnehmungsweise und den Unterrichtserfolg von Lehrern. Die Ergebnisse zeigen, dass vorangegangene Erfahrung mit Inklusion, Selbstwirksamkeit und das Lehr-Lernverständnis die persönliche Bereitschaft eines Lehrers im inklusiven Umfeld vorhersagen.

Synopsis: Essays on Digital Healthcare and Inclusion

1 Introduction and Contents

This dissertation consists of five essays in the area of digital healthcare, and two additional essays covering issues in vocational education (see Table 1). Essays I, II and III examine the usage of telehealth apps in hemophilia (chronic blood disease) care. Essays IV and V explore the development of a software/hardware prototype to make surgical treatment models available via 3D-technology. Essays VI and VII investigate the attitude of teachers in vocational education towards inclusion. In this chapter, these three fields of research and their essays are introduced.

	Essay		**Title**
Part	***No.***	***Short title***	
Digital Healthcare	I	Physicians 1	Motivation of Physicians to recommend an App for a serious Disease to Patients (Research in Progress)
	II	Physicians 2	Motivation of Physicians to Use and Recommend Apps for the Treatment of Haemophilia
	III	Patients	Patients' Attitudes toward Apps for Management of a Chronic Disease
	IV	3D Treatment 1	Making treatment knowledge available via 3D-models
	V	3D Treatment 2	Using 3D-technology to support facial treatment
Vocational Education	VI	Inclusion 1	Teachers attitude towards inclusion in vocational education
	VII	Inclusion 2	Factors influencing inclusion-related attitudes of teachers at vocational schools. Results of an empirical study in German federal states

Table 1: Contents of this dissertation

This cumulative dissertation spans several research fields, the essays were peer reviewed, and they are being published in the sectors of Information Systems, Computer Science, Medicine, General Education, and Vocational Education. As an overarching umbrella, all essays contribute to an improved social participation, albeit in different ways. Essays I, II and III identify how to increase the use of telehealth systems for hemophiliacs, which, when correctly utilized, increase the patients' possibilities to participate in sporting activities worry-free. Essays IV and V discuss the provision of reliable surgical medical models with affordable

equipment, which addresses the global lack of skilled surgical care (Bath et al. 2019). In union with the first three essays, healthcare can be seen as a necessity for social participation. Essays VI and VII are more directly linked to social participation, since they address some of the key actors (i. e., teachers) in implementing it in the education system.

1.1 Telehealth use in hemophilia care

Essays I, II and III focus on the development and testing of models to better understand the use of telehealth apps in hemophilia care both from a patient's and physician's point of view. Telehealth improves therapy adherence (Agnihothri et al. 2020; Bauer et al. 2014; Paré et al. 2007) and other factors like patient-physician communication and cost for the health care system (Steventon et al. 2012; Achelrod et al. 2017). Still, digital hemophilia care is widely underused (Lane et al. 2006; Hay et al. 2017). The three studies focus on Germany, where only a third of hemophiliacs and half of the care centers utilize supporting telehealth apps (Hesse et al. 2013; Mondorf et al. 2019). To get an exhaustive insight into the factors influencing telehealth use, two studies focusing on the two main actors -patients and physicians- were carried out. These studies are presented in the first three essays. The project was first presented as a Research in Progress (RiP) paper with essay I, where we introduced a model to describe why a physician would recommend a telehealth app, with an additional focus on the physicians own use of the software. To achieve this, the model was built based on the Self-Determination Theory (SDT) (Deci und Ryan 2000), which made it possible to use scales focused on the different motivations for a recommendation to a patient. Since telehealth ideally also requires the interaction of the physicians, the Value-based Adoption Model (VAM) (Kim et al. 2007) was added to the framework. It describes the physicians' intention to use the software. The integration of SDT and VAM tests for the influence of this use on recommendation behavior. Essay II contains the results of a study using the combined model. Essay III analyzes the intention to use telehealth software from a patient's perspective. Therefore, a different model must be utilized. The model framework for essay III is an integration of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh et al. 2012) and the Healthcare Belief Model (HBM) (Janz und Becker 1984). The model reflects the typical reasons to use a software using UTAUT2 as well as special healthcare motivations using HBM. The results of essay III validate the necessity of a study of the physicians' perspective, since social cues, also by physicians, are shown to be a main positive influence towards telehealth software use. Essays II and III was supported by two German hemophiliac associations, IGH and DHG.

1.2 Using 3D-models to convey surgical treatment knowledge

Essays IV and V focus on the development of a prototype (software/hardware solution) to support, guide, and document surgical-adjacent facial treatments with the use of affordable 3D-technology. Like the first three essays, digital support tools could improve the healthcare process, but are under-utilized or otherwise not available due to complexity or cost. The developed prototype shows a way to counteract this. The essays tackle two issues: First, the surgical sector still relies on the outdated apprenticeship model (Pellegrini et al. 2015a), which is not precise and possibly harmful to patients. Second, while there is equipment available for purchase, it is usually too costly to be utilized in most practices. Essay IV discusses the design of a prototype that resolves these issues by aiding practitioners with 3D-equipment and software. It is focused on using affordable 3D-scanners and open-source software as well as integrating a reliable medical model. Soft tissue filler treatments serve as a use case in both essays. Essay V describes how the prototype can be incorporated in treatment procedures and provides a proof of concept as well as some usability tests.

1.3 Teachers attitude towards inclusion in vocational education

Essays VI and VII examine the attitude of teachers at German vocational schools towards inclusion. Throughout the last two decades, the education sector has undergone a shift towards inclusion. Inclusion is defined as

All students, irrespective of their gender, social and economic conditions as well as disabilities and special educational needs should be educated in joint learning settings to secure societal and vocational participation

by the UN (UN 2014) and part of the UNESCO-charter since 2015 (Sayed and Ahmed 2015). It is explicitly aimed at the sector of general education as well as the sector of vocational education and training. As a consequence, respective laws implementing inclusion were introduced on national levels, but the success of these political actions was often not monitored. Following the first set of essays, a problem is best studied by examining their key actors. In this case, teachers at the general and vocational schools are the key persons for implementing inclusive education (Miesera und Gebhardt 2018). Besides professional knowledge, attitude is a core aspect of professional competence (Kunter 2011). Attitude was shown to havea high impact on pedagogical and inclusive acting as well as on inclusive teaching and learning results of students (Sharma und Sokal 2016; Miesera und Gebhardt 2018). Hence, international research has focused on teachers' attitudes towards inclusion, but studies in the Vocational Education and Training (VET) sector are rare. Essay VI can be considered a pilot study to essay

VII. Attitude is defined as an individual's viewpoint or disposition towards a particular 'object' (a person, a thing, an idea, etc.) (Borg und Gall 1996) and viewed as a three-component model, consisting of an affective, behavioral, and cognitive dimension (Newcomb et al. 1961). To properly capture this construct, the essays are set up as mixed-method studies. The affective dimension is measured with qualitative items, while the behavioral and cognitive dimensions are measured via scales.

2 Methods

Different types of studies and methods are used in this dissertation (see Table 2). In the following, we will briefly present and describe the different types of studies and which methods were used to examine the posed questions.

Essay		Content	Method(s)
I	Physicians 1	Literature review	Literature synthesis
II	Physicians 2	Physician survey	PLS-SEM, MLR
III	Patients	Patient survey	PLS-SEM; MLR
IV	3D Treatment 1	Prototype plan	
V	3D Treatment 2	Prototype test	
VI	Inclusion 1	Teacher survey	SEM, MLR, COQ
VII	Inclusion 2	Teacher survey	MLR, COQ

MLR = Multiple linear regression, PLS-SEM = Partial least squares - structural equation modeling, SEM = structural equation modeling, COQ = Categorized open questions

Table 2: Data and methods used in this dissertation

Essay I discusses the model used in essay II. Therefore, it is limited to literature review. The model integrates SDT and VAM adapted to the context of digital healthcare. Hence, literature was drawn from both information systems as well as medicine. Essay II adds data and empirical analysis to the model presented in essay I. Essay III changed the perspective but considered the same disease. To model the patient view, an integration of UTAUT2 and HBM was utilized. The data in essays II and III was collected via survey with Likert scales and open questions related to sociodemographic issues. Both essays use PLS-SEM to test the proposed models, supplemented by Multiple Linear Regression (MLR) to verify the result of the Structural Equation Modeling (SEM) and gain some insights to individual respondent groups. Partial Least Squares Structural Equation Modeling (PLS-SEM) was utilized to account for the comparably small sample sizes.

Essays IV and V identify a health care problem and explore the development of a possible solution to it. Therefore, essay IV focuses on some literature review, but mainly presents the architecture utilized in the prototype. Essay V provides a proof of concept for the prototype.

Essays VI and VII are again survey-based studies analyzed via SEM and MLR, but the nature of the subject required an additional qualitative approach. Therefore, both can be considered mixed-method studies. The chosen methods reflect the current state of research regarding attitude itself. It is usually treated as a three-dimensional construct consisting of cognition, affection, and behavior. Existing scales in the context of a teacher's attitude only cover the cognitive and behavioral dimension. Thus, for these dimensions the adequate scales were adapted and tested in a SEM model, while the affective dimension was measured by explorative open questions, which were later categorized.

3 Main Contributions and Implications

In this chapter, the research results, contributions, and implications of each essay are briefly discussed.

Essay I presents the model and hypotheses development used in essay II. The model uses a framework of SDT and VAM to examine a physicians' use and recommendation of hemophilia treatment apps. Key findings are that physicians tend to recommend hemophilia apps to their patients if they use functions provided by the software themselves. This may seem self-evident for telehealth apps, but the current software also allows the patients to use it as a pure documentation tool without physician interaction. The physicians' willingness to recommend it is also supported by perceived process improvements due to the app. The two essays contribute to the knowledge about physicians as key actors in implementing digital healthcare. Essay II offers implications for the development of telehealth apps, as it highlights that more than patient benefit needs to be considered. Physicians need to be involved in the development as well, which will increase their willingness to recommend the software in the future.

Essay III complements the results of the first two essays with the patients' perspective. It utilizes UTAUT2 supplemented by HBM to examine which factors positively contribute to a patients' intention to use telehealth apps in hemophilia care. When looking at the group of current non-users, social influence and hedonic motivation both show a positive influence on usage intention. The study demonstrates that despite hemophilia being a serious chronic disease, the motivation for a more digital care stems either from more engaging apps or cues from their social environment, the latter including their physicians. Other studies have also confirmed the relevance of app engagement (Gimpel et al. 2021).

Essay IV describes the development of a hardware/software prototype, which is expanded upon and tested in essay V. We introduced a web-based software prototype to plan and document soft-tissue filler treatments with 3D-models. The prototype implements a medical model to standardize the treatment and reduce patient risk. The implication for practise is that unexperienced practitioners using guidance by these treatment codes, implemented in our software, and relatively cheap 3D-cameras can perform good and safe face treatments. Another implication is that there is less need for an experienced practitioner to execute the apprenticeship learning model. It is possible to transfer the necessary knowledge via coded recommendations by an expert and with digital systems. This is also of theoretical interest, because it changes the transfer of knowledge. Besides codification, which is typically used in diagnostic medicine, photos (scans) and 3D-treatment documentation present another transfer option.

Essay VI is the pilot study to essay VII, with both essays providing insight into the current attitudes towards inclusion and which factors influence it. The studies show that most teachers currently hold a neutral attitude. Positive influences are previous experiences with persons with disabilities (private or professional), targeted qualification, and self-efficacy. The teachers own understanding of the subject matters shows an influence as well – a broader defined view of inclusion increases the personal willingness, and a more instructional understanding of learning and teaching leads to a more negative attitude. Practical implications are to offer more targeted trainings for teachers and improve the available resources and conditions for teachers in order to successfully implement inclusion.

4 Bibliographic Information

Table 3 gives details and the current publication status for each essay in this dissertation. Since the publications are spread across several fields of research with different customs and assessments regarding publications, this chapter will provide additional information in this regard. All essays contained in this work are peer-reviewed and accepted for publication or already published, with the exception of essay VII, which has already been presented at a peer-reviewed conference and is currently under review for publication.

Essay		Outlet	Year	JQ3	HB2014	Status
No.	*Short title*					
I	Physicians 1	Proceedings of the European Conference on Information Systems (ECIS)	2019	B	0.2	Published
II	Physicians 2	INQUIRY: The Journal of Health Care Organization, Provision, and Financing	2021	-	0.2	Published
III	Patients	Proceedings of the 16. Internationale Tagung Wirtschaftsinformatik	2021	C	0.1	Published
IV	3D Treatment 1	Proceedings of the Int'l Conf. on Health Informatics & Medical Systems (HIMS)	2021	-	-	Publication in Progress
V	3D Treatment 2	18th European Mediterranean & Middle Eastern Conference on Information Systems (EMCIS 2021) (LNBIP Proceedings)	2021	C	0.1	Publication in Progress
VI	Inclusion 1	Zeitschrift für Berufs- und Wirtschaftspädagogik	2018	-	-	Published
VII	Inclusion 2	Zeitschrift für Erziehungswissenschaft	(2022)	-	-	Under Review

The ranking is based on JQ3 (VHB 2019) and the Handelsblatt ranking[1].

Table 3: Information on the publication status and ranking (if available) of each essay

Essay I was published in the proceedings to the European Conference on Information Systems (ECIS) (Alpar and Driebe 2019). The Conference has a B ranking in JourQual3 (JQ3) (VHB 2019) and is considered the second most relevant conference in Information Systems. Essay II is a significantly extended version of Essay I, as it contains an application of the model developed in Essay I. Essay II was published in INQUIRY: The Journal of Health Care Organization, Provision, and Financing (Alpar and Driebe 2021a). While the journal is not ranked in JQ3, it received 0.2 points in the Handelsblatt (HB) ranking[1], where it is therefore ranked equally to ECIS. INQUIRY is an Open Access Journal, and the publication was supported by the Open Access Publication Fund of the University of Marburg. Essay III was published in the proceedings to the 16. Internationale Tagung Wirtschaftsinformatik (WI) (Alpar and Driebe 2021b), which is ranked C in JQ3 (VHB 2019). Essay IV will be published

[1] https://www.handelsblatt.com/downloads/9665428/1/journal-ranking.pdf, the Handelsblatt journal ranking was continuously used as a performance measure at the School of Business and Economics of the Philipps-University of Marburg.

in the proceedings to the Int'l Conf on Health Informatics and Medical Systems (HIMS), which is part of the World Congress in Computer Science, Computer Engineering, & Applied Computing (CSCE). CSCE is considered the fifth-largest computer science conference worldwide, but as such not ranked via HB or JQ3. Essay V will be published in the Lecture Notes in Business Information Processing as proceedings to the European Mediterranean & Middle Eastern Conference on Information Systems (EMCIS), which is ranked C in JQ3 (VHB 2019). Essays VI and VII were positioned in the VET sector, where it is common to present a study at several conferences, but not every conference generates proceedings. Therefore, the finally published parts of the essays still differ significantly in their content. A short version of Essay VI was presented at the International VET-Conference 2017 in Rostock and published in the proceedings (Driebe et al. 2017). The Essay was also presented at the Jahrestagung der Sektion Berufs- und Wirtschaftspädagogik der Deutschen Gesellschaft für Erziehungswissenschaft (DGfE), which is the main conference of the German VET sector. The main journal of the German VET sector is the Zeitschrift für Berufs- und Wirtschaftspädagogik, where Essay VI was finally published (Driebe et al. 2018). A significantly less academic version of it was also published in Berufsbildung, which is a journal intended for science-practice transfer. Essay VII was presented at two conferences: The 84. Tagung der Arbeitsgruppe für Empirische Pädagogische Forschung (AEPF), where a potential expanded SEM analysis was discussed, and the European Conference on Educational Research (ECER), which is the biggest European conference regarding education research and allowed to discuss the results in an international context. The Essay is currently submitted and under review at the Zeitschrift für Erziehungswissenschaft, which is an established German journal in educational research. Table 4 shows the estimated work share of co-authored papers.

Essay		Author	Comments	Contribution (%)
No.	*Short title*			
I	Physicians 1	Thomas Driebe	Significant contributions to all sections. Higher contributions to theoretical background.	50%
		Paul Alpar	Significant contributions to all sections. Higher contributions to model development.	50%
II	Physicians 2	Thomas Driebe	Significant contributions to all sections. Higher contributions to data collection and analysis.	50%
		Paul Alpar	Significant contributions to all sections. Higher contributions to hypotheses development.	50%
III	Patients	Thomas Driebe	Significant contributions to all sections. Higher contributions to data collection and analysis.	50%
		Paul Alpar	Significant contributions to all sections. Higher contributions to hypotheses development.	50%
IV	3D Treatment 1	Thomas Driebe	No co-authors.	100%
V	3D Treatment 2	Thomas Driebe	Significant contributions to all sections.	50%
		Paul Alpar	Several contributions to all sections.	30%
		Peter Schleussner	Contribution to prototype development and data collection.	20%
VI	Inclusion 1	Thomas Driebe	Significant contributions to all sections.	60%
		Matthias Götzl	Several contributions to all sections.	10%
		Robert w. Jahn	Several contributions to all sections. Significant contribution to data collection.	15%
		Andrea Burda-Zoyke	Significant contributions to theoretical foundation and qualitative analysis.	15%
VII	Inclusion 2	Thomas Driebe	Significant contributions to empirical analysis.	20%
		Andrea Burda-Zoyke	Significant contributions to all sections. Significant contribution to data collection.	30%
		Robert W. Jahn	Significant contributions to all sections. Significant contribution to data collection.	30%
		Matthias Götzl	Small contributions to all sections. Significant contribution to data collection.	20%

Table 4: Contributions of (co-)authors

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Essay I: Motivation of Physicians to Recommend an App for a Serious Disease to Patients

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Abstract: The possibilities to use telehealth in the treatment of patients have dramatically increased due to digitalization of health care and the availability of suitable end devices. Most telehealth re-search focuses on patients or on organizations (like hospitals), while the behaviour of physicians is often neglected. In life-style issues and in cases of mild, temporary diseases, patients often consult just the Internet or friends. In case of serious and chronic diseases, this is not possible and physicians continue to play an important role in the treatment process. Specialised physicians diagnose, monitor, and treat such diseases. They can play two roles in such cases. First, they may influence the patient's decision whether to use telehealth. Second, if the patients adopt the software, the physicians can further analyse the electronically available data with support of other parts of the software. In other words, they can reap further benefits from tele-health. This situation has barely been empirically analysed in information systems or healthcare research. Therefore, we develop a model to better understand the physicians' motivations to recommend the use of telehealth software to patients given his different roles.

Keywords: Telehealth, Physicians, Healthcare technology adoption, Chronic diseases, Apps.

1 Introduction

Telehealth is part of the broader e-health domain, which serves as an umbrella term for describing the use of modern information systems (IS) in the health care sector (Oh et al. 2005). Telehealth involves the use of communication technology to deliver health care outside of traditional health-care facilities (WHO 2018). Today, telehealth often encompasses the use of m-health technologies. M-health is defined as the subset of e-health delivering health information and services over a mobile platform (Akter 2012). The use of a smartphone app for medical purposes is a form of m-health. Telehealth is meant to support health care professionals as well as patients (Motamarri et al. 2014). It improves patient autonomy (Koch 2006), quality of life (Polisena et al. 2010) and may decrease mortality rates in chronic diseases (Darkins et al. 2008; Steventon et al. 2012). Moreover, telehealth seems to enable more effective prophylactic therapies, resulting in less emergency attendances and hospital admissions (Martín-Lesende et al. 2017; Polisena et al. 2010). Another notable effect is therapy adherence (Velardo et al. 2017). It is believed that telehealth technology needs to go beyond pure monitoring and should involve physician-patients interaction (Velardo et al. 2017).

In physician-patient interaction, health research is usually focused on the patient (Koch 2006). The increased availability of connected mobile devices facilitates the delivery of telehealth services (Rathbone and Prescott 2017). Today, most of these services are managed either by the patients themselves or by automated software. In a low-risk treatment this might be sufficient, but in cases of high-risk chronic diseases the participation of a physician is advantageous or needed. A physician's recommendation of an app is central for patients' potential adoption of the app. The involvement of a physician increases the confidence of patients because they feel professionally monitored allowing them to act more independently in the end (Velardo et al. 2017; Cox et al. 2017). A participating physician may, with the help of software, react quicker and prevent negative health incidents.

The physician's involvement may be a decisive factor for the success of telehealth interventions (Greenhalgh and Shaw 2017). Telehealth use varies between diseases (Ringbæk et al. 2015), resulting in a fragmented set of studies. However, Wade et al. (2014) point out, that physicians' acceptance is central to the adoption of telehealth and that physicians need to perceive the technology as effective to adopt it. Yet, with traditional health research being either patient-focused or describing the physician-patient relationship (e. g. Charles et al. (1999)), the motivation of physicians to recommend telehealth and get involved remains unclear (Hatz et al. 2017).

Since physicians are important for the diffusion of telehealth, we focus on the physicians' motivation to recommend and use telehealth technology. In other words, we observe the adoption of telehealth that can go beyond telemonitoring. We develop, therefore, a model for the recommendation behaviour of physicians that includes their potential willingness to get involved with the product beyond patient functionalities. Bearing this in mind, our main research question can be simply stated as:

RQ: What motivates physicians to recommend telehealth software for treatment of a chronic disease and how strong is the influence of these motivations?

Next, we discuss previous research to further outline the relevance of our physician-focused study. Then, we describe the context of our study. This is followed by modelling and hypotheses development. Lastly, we discuss the design of the survey and provide a short summary.

2 Previous Research

Psychometric research describing physicians' motivation to recommend telehealth is sparse, but there are useful findings in related areas. The first related area is research on how physicians decide between prescribing similar drugs. This is similar to choosing between two treatment approaches, i.e., telehealth or traditional treatment. Early research includes work about the role of physicians in prescribing generic versus original drugs (Hellerstein 1998). The prescription behaviour showed an unexpected independency from patient characteristics, indicating that physicians simply tend to rely on their preferred treatment methods. This research has been continuously replicated for different drugs. The studies usually concluded that physicians' preference for a treatment is the determining factor in their choice of a treatment, but they do not describe the formation of the preference. This holds true for early replication studies (Solomon et al. 2003) as well as for very recent ones (Anderson 2018).

The second related area is the adoption of m-health technology, especially amongst physicians. As previously stated, the physicians' involvement may present a crucial part in successful telehealth applications. Telehealth adoption and health behaviour research are usually patient focused, while the physicians' interaction with healthcare technologies has been usually viewed from an organizational point of view (Lluch 2011). This is confirmed by a recent review by Hatz et al. (2017), who point out that technology adoption within the healthcare sector is a complex issue influenced by the factors of innovation, environment, organization, and individual. They further stress the central role of the physician in healthcare technology adoption since he serves in multiple roles as initiator, supporter, and decision maker. Therefore, the physicians' motivation to adopt telehealth is a crucial factor, but empirical analysis of what

constitutes this motivation is lacking (Hatz et al. 2017; Wisdom et al. 2014). In consequence, reliable motivation measures are also missing (Wisdom et al. 2014). Note, that in telehealth scenarios, the physician may also take the additional role of a user.

Lastly, the research of clinical best practice implementation offers some insight into physicians' behaviour. While the telehealth software itself represents a medical product, recommending it to a patient is similar to applying a new treatment. In this respect, the physician behaves like implementing a finding from medical research into clinical practice. In healthcare, the gap between evidence-based best practice and actual patient care presents an ongoing problem (McGlynn et al. 2003; Madon et al. 2007; Zardo and Collie 2014). This gap manifests itself in slow uptake or failure of new, research-based practices despite numerous, high quality evidence for its effectiveness (Appleby et al. 2016). Similar to the prescription behaviour outlined above, the physicians' personal preferences are the only significant antecedents of research implementation (Squires et al. 2011). It has also been noted that the internal factors (e. g. motivation, attitude) require more analysis (Grimshaw et al. 2004). Consequently, several studies of physicians' attitudes and beliefs related to best practices have been conducted (e. g. (Weng et al. 2013)). Appleby et al. (2016) provide a systematic review of the factors influencing physicians' behaviour: peer pressure, practice habits, perceived usefulness, and perceived relevance are the main factors. In the case of the disease we observe (see below), telehealth presents an evidence- and research-based best practice that has already produced positive results (Mondorf et al. 2012).

To summarize, the importance of physicians in the implementation of telehealth has been identified. It has been established that external factors related to the physician (e.g., peer pressure) seem to be more important than factors related to the patient. The impact of internal factors like the physician's altruism on his recommendation behaviour has not been analysed thoroughly yet.

3 Bleeding Disorders

We focus our study on a chronic disease that requires patient self-management as well as patient-physician cooperation. These are bleeding disorders, which involve elaborate patient self-care in cooperation with individualized extensive support by the physician. According to the World Federation of Hemophilia (WFH), 295,866 people suffer from bleeding disorders globally. The most common bleeding disorder is haemophilia (62%). We focus on haemophilia since it is on the one hand a rare disease requiring individual care and therapy, but on the other

hand prevalent enough to have sparked the development of several telehealth platforms. The disease and treatment situation are outlined next.

Blanchette et al. (2014) describe the disease as follows: Haemophilia means the missing of blood clotting factors VIII or IX (WFH, 2016). Clotting factors are needed to form blood clots and, in the case of external bleedings, scarf in order to stop bleedings and seal wounds. The danger of this disease seems obvious with external bleedings, but haemophiliacs are also prone to internal bleedings. Internal bleedings may occur in joints due to too much stress (e. g., rough landing after a jump) or, in extreme cases, even inside the brain. While bleedings inside the brain are rare, joint bleedings present a permanent threat to haemophiliacs, since multiple incidents result in joint-disabling arthropathy. The treatment of haemophiliacs is a replacement therapy, where the missing clotting factor is synthesized and provided in patient-individual timeframes as a transfusion (Blanchette et al. 2014). The right timeframes are crucial to the quality of the treatment and, therefore, the patients' quality of life. They are also the factor that is most positively influenced by telehealth (Mondorf et al. 2012). The dosage regimen of the replacement factors is a topic of conflicting interest between insurances, physicians, and patients. This is due to two main reasons: On the one hand, replacement factors are very costly to synthesize. On the other hand, the factor cannot be over-dosed, but easily under-dosed. Therefore, physicians tend to prescribe more than needed to be on the safe side (Knobe and Berntorp 2012), but this can lead to high cost to insurances who cannot spend this money to fight other diseases.

The patients' susceptibility to bleedings influences the timeframes, within which the replacement factor is provided and which determine the type of therapy. "On-demand" therapy only includes episodic provision of a replacement factor after a bleeding incident. This reduces replacement factor consumption and does not require much therapy adherence from the patient, but it allows an internal bleeding to take place before the patient recognizes it and reacts. Therefore, on-demand therapy, while cheaper and easier, at the first glance, presents a long-term health risk (Blanchette et al., 2014). "Prophylactic" therapy means the regular intake of replacement factors independently from bleeding incidents. Prescription of prophylactic therapy depends on the severity and the number of bleeding incidents, which already occurred (Blanchette et al., 2014). Prophylactic therapy performs better in preventing bleeding incidents, but it is initially more costly and more demanding in terms of therapy adherence (Hoots and Nugent 2006). M-health software is particularly useful in supporting prophylactic therapy, since the therapy needs to be constantly adjusted to individual patient characteristics (Blanchette et al., 2014). After injection of replacement factor, patients differ in their factor degradation rate

(pharmacokinetic) properties. The retention of the protection depends on the patient's weight and other factors (Collins et al. 2010). Knowledge about the current factor level is decisive to haemophiliacs, since a higher level allows for joint-stressing activities like sports, whereas a low level demands less stressful activities. M-health applications allow the patient to track his level and adjust his daily activities. The applications also allow to report time and location of bleeding incidents, allowing for telemonitoring and subsequent therapy adjustments by the physicians (Mondorf et al. 2012).

In most western countries, a treatment centre system paired with a central register has been established to distribute and monitor transfusions. Blood transfusions are handled separately from regular medicine due to the increased risk tied to them. Patients are, therefore, not using pharmacies but treatment centres, where they receive their tested medication and meet their responsible physician. Haemophilia apps supporting the treatment and providing telehealth options are treated as a medical product in most developed countries and, therefore, need to adhere to standards and tests (Schmoldt 2016). German physicians are required by law to report the factor consumption of their patients. Therefore, haemophilia apps in Germany are integrated into the IS of treatment centres, but their use is not mandated.

In a basic treatment setting, the patient uses the app to document his factor usage and bleeding incidents. The app transmits the data to the patient's treatment centre (if the app is supported by the treatment centre). If the physician only uses the data during the patient's next personal visit, it still qualifies as telehealth, since the data is still continuously transferred to the treatment centre. The physician may also opt to set certain thresholds and be alarmed in the case of incidents. Greenhalgh et al. (2017) call it "warm" telehealth, when the physician may intervene based on monitoring data. In a more advanced setting, the data submitted by patients can be automatically sent to the central registry. Another advanced use is a multi-patient analysis supported by the software through additional functions. Both haemophilia apps used in Germany, *smart medication* and *Hameoassist*, provide these features. Patients may use other software to record their consumption of factor concentrates or bleeding incidents but they are not supported by treatment centres. So, they need to submit a paper copy on their visit.

4 Research Model and Hypotheses Development

We have outlined above that there is only sparse research on the healthcare technology adoption behaviour by physicians and even less on which factors influence their recommendations, despite the critical role of the physician in patients' choices as evidenced by research (e. g. Anderson 2018).

In IS and marketing literature, recommendations have been often explained through the lense of word of mouth (WOM) (East et al., 2005). In numerous studies, WOM has been shown to be a crucial factor in consumer choice, being perceived as more persuasive and trustworthy than traditional marketing, e. g. print or TV ads (Cheung & Thadani, 2012). With the rise of online shopping, WOM was extended to online platforms and further referred to as electronic word of mouth (eWOM). According to Cheung & Thadani (2012), it presents several unique features. First, the recommendations diffuse very fast and are easily scalable. Second, eWOM recommendations are more persistent and accessible, since ratings and posts stay available online. Third, it is easily measurable and provides a basis for analysis due to the volume of recommendations taking place in online sales. However, the credibility of the recommendation is unclear, since the receiver does not know the sender personally, like in traditional WOM. To summarize, existing literature uses (e)WOM to describe recommendation behavior among consumers and it explains it by several motivators.

However, the relationship between a patient and his physician is different. It is more hierarchical, due to knowledge disparity, and more personal, due to individual appointments. In our case, patients and physicians use partly two different systems (documentation/monitoring), which depend on each other, but do not have the "same product" characteristic, which is typical in the consumer area. Finally, physicians usually do not have the time for extensive use of social media but meet peers a few times a year at special conferences. Therefore, eWOM models seem to be less promising for our situation than a thorough analysis of physicians' motivations to recommend a treatment or an app, in our case. A good candidate towards this goal is general Self-Determination-Theory (SDT), which provides a tested frame of motivations and allows to include context-specific factors (Deci & Ryan 2000).

SDT positions any motivation within three fundamental psychological needs: autonomy, competence and relatedness (Deci and Ryan 2000). Autonomy encompasses the need to perceive oneself as an independent being not relying on external benevolence. Competence describes the desire to perceive one's own actions as effective and to feel skilful in carrying out these actions. Relatedness involves the need for belonging and affiliation to a social group. Satisfaction of those needs translates to different levels of motivational engagement. Motivation is distinguished into three types: Intrinsic, extrinsic and amotivation (Ryan and Deci 2000). Intrinsic motivation is present when an activity provides satisfaction by itself, while external motivation means an activity is pursued to achieve certain results. Amotivation occurs when an individual's needs are dissatisfied and he is therefore less likely to pursue a given activity, e.

g., when actions are not perceived as effective, self-controlled, or recognized within the social group.

As mentioned above, intrinsic motivation means satisfaction from performing the activity itself. In the context of our study, it reflects the satisfaction a physician receives when recommending an app, which he beliefs will improve the treatment and the patient's quality of life. In a healthcare context, the satisfaction in helping others is complemented by the importance of the physician-patient relationship, as determined by McMurray et al. (1997). Pre-existing studies on physicians' intrinsic motivation are rare (Franco et al. 2002). Malik et al. (2010) showed in a study researching physicians' job satisfaction, that serving people is a frequent positive intrinsic influence of satisfaction. We therefore hypothesize:

H1: Perceived satisfaction from helping patients positively influences recommendation intention.

The prescriptions, interventions, and technologies a physician applies are largely dependent on external, extrinsic factors, such as their professional community (Appleby et al. 2016). This is mostly reflected by the SDT dimension of relatedness, which has been proven a crucial factor in any work environment (Deci et al. 2017). Gagnon et al (2003) used the theory of interpersonal behaviour to describe telemedicine adoption by physicians, and concluded that social norms and responsibility within the physician community positively influence the intention to adopt a telemedicine technology. The impact of the physician's peer group on his perceived relatedness and job satisfaction was also shown by McMurray et al. (1997), further establishing the importance of the physician's peer group. This was also proven by an early network analysis by Burt (1973), showing that physicians with more and better connections were more educated, held a higher status, and were early adopters of new technologies. Moreover, a systematic review by Godin et al. (2008) analysed the factors influencing healthcare professionals' behaviour and found social influences to be one of the most consistent predictors. Similar results were given by Malik et al. (2010), who found respect by peers to be a frequent socio-cultural determinant of physicians' job satisfaction. In the context of our study, peer pressure is reflected by other physicians already recommending the app to their patients and reporting resulting treatment improvements to the community of physicians. Therefore,

H2: Perceived peer pressure positively influences recommendation intention.

A physician may also recommend telehealth software because he expects to improve his treatment effectiveness through its usage. This is different from inherent satisfaction in helping others because the emphasis is here on the positive outcome of his work (e.g., like the

percentage of successful surgeries). Therefore, a technology might be recommended because the physician views it as his professional responsibility to apply a more effective intervention (Gagnon 2003). Physicians state a desire for a good professional experience as relevant for job satisfaction (Malik et al., 2010). In this part of our model, we assume that the physician views the advantages of telehealth as useful for himself (and the patient). For example, the physician expects a better adherence from the patient using an app for documentation which makes his job easier and makes him perform better. Another example may be the desire of the physician to monitor a high-risk patient more closely, which may be achieved by using an app. If any of these advantages are seen achievable with the new technology, the physician will more likely recommend an app to the patient.

H3: Expectations of improved work outcomes positively influence his recommendation intention.

Amotivation occurs when any of the three dimensions relatedness, autonomy, or competence is thwarted. Perceived decreasing autonomy, in this instance, is a factor the physician may fear for the patient. Usually, when analysing motivation, the three dimensions of SDT are applied to the individual in question, but autonomy in healthcare settings demands a different approach. Patient autonomy and self-determination are constantly promoted in healthcare literature and also desirable for the physicians. Especially in chronic disease management, patient autonomy in treating the disease increases their quality of life and reduces the physicians' workload. A physician may suspect that patients who feel they are constantly monitored will act less autonomous. For haemophiliacs, this could mean being less cautious, finally resulting in the need for more interventions by the physician.

H4: Perceived decreased patient autonomy negatively influences recommendation intention.

In SDT, amotivation also occurs if an action is deemed as not worth the effort (Ryan& Deci, 2000). In the context of our study, if a physician perceives telehealth use as ineffective, his need for effectiveness will be thwarted. This may be the case if a physician does not consider the app to provide any improvements to an ongoing treatment. Berliner (2014) pointed out, that a physician's evaluation of a technology is also made in absence of actual medical evidence, which leads to a purely perception-based decision. A physician who considers an app to have no relevant effect on the treatment will not recommend it. Therefore:

H5: Perceived non-effectiveness negatively influences recommendation intention.

The use of the app for haemophilia documentation affords further functions and benefits beyond the treatment of an individual. Two important benefits are the possibility of reliable and easy

multi-patient analyses and the automatic transmission of factor usage and incident figures to the central registry as mandated by the Transfusion Law. A physician may recommend to his patents the use of the app but he does not need to use these additional functions. The use by patients is a necessary but not a sufficient condition for use by physicians. In other words, he cannot use them if his patients are not using the app but he may not use them even if they do. There can be different reasons for such a behaviour, e.g., lack of time or knowledge about the app. We can consider the decision of the physician to use additional features as an adoption decision embedded in the above SDT model. His decision to recommend the app to a patient may be influenced by his intent to use the additional features. This can be considered another extrinsic motivation but we model it separately because of its complex structure.

We use the Value-based Adoption Model (VAM), developed by Kim et al. (2007) to model the intent of the physician to recommend app use based on his use of advanced functions. While originally developed to measure the adoption of the mobile internet, it was later also used in different contexts, e.g., the adoption of the Internet of Things (Hsu and Lin 2018). VAM is fundamentally based in the cost-benefit paradigm defined in the context of decision theory (Johnson and Payne 1985), where a product's utility is determined by what it provides in contrast to what it demands. VAM defines this as benefits and sacrifices, where each consists of two sub-dimensions (Kim et al. 2007). Benefits are split into *enjoyment* and *usefulness* based on Cognitive Evaluation Theory (CET) (Deci and Ryan 1985). Sacrifices include *technicality* and *fees*. Technicality refers to the non-monetary costs of technology use like time and effort. Fees include monetary cost. Physicians incur both either through direct use of the app or the use by their personnel. Physicians are not reimbursed for that in the German system.

Following VAM, we consider recommendation intention to be based on benefit and sacrifice components. The first component of benefit is usefulness. Usefulness has proven to be a reliable antecedent in technology adoption models and is present in frequently used models like TAM and UTAUT. Usefulness is considered the utilitarian component of benefit and, following CET, also the extrinsic part. It is defined as the value a user perceives from using a new technology. In the context of VAM, usefulness also reflects the quality of a product. Here, usefulness solely relates to the value of the systems's components as used and perceived by the physician. . The advantages to the physician are as mentioned: He is able to monitor multiple patients, react in emergencies and has the patient data visualized instantly, and automatically report the concentrate usage as required by law. Perceived usefulness has also shown to be a valuable predictor in health care contexts (Holden and Karsh 2010).

H6: Perceived usefulness positively influences the adoption intention.

Perceived enjoyment reflects the hedonic and intrinsic component of the benefit aspect. In our study it relates to physicians who use telehealth software because they enjoy using it. Similar to usefulness, enjoyment is a reliable factor in predicting the value and adoption behaviour. It has proven to be a significant predictor where general adoption theories were applied to healthcare contexts, but also in healthcare-specific models (Hatz 2017).

H7: Perceived enjoyment positively influences the adoption intention.

The sacrifice component contains monetary and non-monetary cost. Technicality represents the non-monetary costs. In the context of telehealth technology, several factors add to the non-monetary cost: First, the physician has to learn how to use the software, imposing a time cost on less intuitive software. Second, the physician needs time to use the software. If it is a monitoring software, he needs to check the provided data in regular intervals or, if the monitoring is automated, to reserve some time for reacting to possible alarms. Although the application of the software creates benefits switching to it (and perhaps using it) is often perceived as additional workload. This may be even more of an issue, since there is no reimbursement for supporting the telehealth software.

H8: Perceived technicality negatively influences the adoption intention.

In Germany, usage of the software usually also involves handling by care centres' nurses. Their engagement constitutes opportunity cost for the physicians who are their employers or for a hospital. Out of pocket cost may be incurred for training (or other expenses for training outside of the office). Telecommunication, equipment, storage, and supply costs are negligible as physicians do not need any special equipment. Again, the lack of reimbursement may have a negative impact (Schmoldt 2016). Thus, the perceived "fees" will lessen the intention to adopt a telehealth technology.

H9: Perceived fees negatively influence the adoption intention.

Figure 1 shows our complete research model.

5 Survey Design and Summary

We will conduct a survey based on the given model in order to answer the research question. The relevant population consists of physicians who treat haemophilia in Germany. We have received the commitment of the council of physicians in the German Haemophilia Society (DHG) to distribute the survey among appr. 180 physicians who are members of the society (majority of German specialists for haemophilia). DHG is the biggest German association of

haemophilia patients and open to physicians too. Given the relatively small population and the complex model, we will probably need to decrease the number of paths going into the *recommendation intention* for model evaluation. This simplification can be easily achieved by creating meaningful „summarizing“ constructs that are already indicated by dotted lines in Figure 1 (e.g., by creating the construct *benefits* that directly influences *recommendation intention* and that is formed by *perceived usefulness* and *perceived enjoyment*).

Control variables include age and care intensity. While age is rarely a determining factor for physician behaviour change (Godin et al. 2008), this might differ in the case of new technologies. We also introduce care intensity as a control variable, measured by the frequency of physician-patient interactions. Since telehealth allows to streamline interaction sessions, physicians with more frequent interactions may tend to prefer telehealth implementation to lessen their workload.

The motivation constructs will be operationalised with items chosen and adapted from Hatz et al. (2017) and Gagné et al. (2014). For VAM constructs, we will use items adapted from Hsu and Lin (2016). If validity, reliability, and model fit are acceptable, we will conduct the analysis with partial least squares structural equation modelling.

The evaluation of the model will help to better understand what motivates physicians (not) to recommend to patients the use of an app that helps to document and monitor a chronic disease. The theoretical understanding of their motivations has practical implications for physician and patient associations, health politicians, insurances, and other interested parties. If these parties consider the apps to be useful, they can better influence the physician’s recommendation behaviour (e.g., insurances could decrease the cost of the physician for additional work by offering a reimbursement since they profit from more economic use of replacement factors).

To conclude, we study motivations of physicians to recommend telehealth to patients. Previous research identified the necessity to investigate this. We study the issue observing the treatment of the chronic disease haemophilia. In this context, the use of the software by patients is a necessary but not a sufficient condition for use by physicians. We will apply the developed model to data gathered from haematologists.

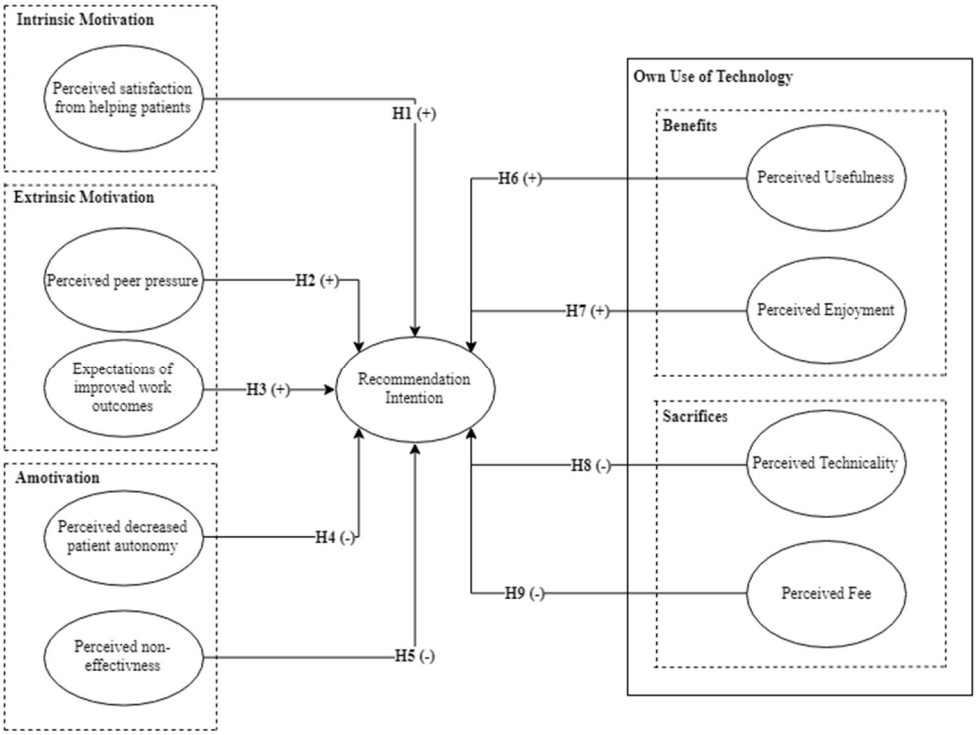

Figure 1: Research model for the intention to recommend a telehealth app

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Essay II: Motivation of Physicians to Use and Recommend Apps for the Treatment of Haemophilia

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Abstract: Digitalization of health care and the availability of suitable end devices lead to an increase in the use of telehealth applications. Most research on telehealth focuses on patients or organizations (like hospitals), while the role of physicians in this context is often neglected. In case of serious and chronic diseases, they play two major roles in the use of telehealth. Firstly, they may influence the patient's decision whether to use it at all (if more than one option is available, they may also influence the patient's choice of software). Secondly, if there is a need for a physicians' participation (eg, in telecare), an adoption decision by the physician to use the system is necessary. We develop a model to understand a physician's motivations to recommend the use of telehealth software to patients and to adopt it himself. The results demonstrate that physicians recommend telehealth based on their own use intention and the perceived performance improvements in patient treatment. Further, their own use intention is dependent on the usefulness of the system for their work. Potential disadvantages like decreased patient autonomy or cost of the system use do not influence the physician's decisions

Keywords: telehealth, chronic disease management, physicians, treatment recommendation, haemophilia

1 Introduction

The effectiveness of telehealth apps has been shown in the treatment of numerous chronic diseases[1-4], including haemophilia[5-7]. Compared to paper-based alternatives, apps improve therapy adherence, they are more comfortable to use, they improve the communication between physicians and patients, and they reduce costs in the health care system [7-12]. Despite these advantages, telehealth is still not as widely used when comparing the reported user numbers with the number of haemophiliacs. In Germany, for example, only around a third of haemophiliacs use telehealth and only about half of the care centres offer it [13,14] (most of the physicians treating haemophilia are associated with a care centre), although available solutions exist since 2009 [15]. This study is carried out to investigate this discrepancy. The use of telehealth in chronic disease management (CDM) usually includes two parties, the physician and his patients. While several studies already investigated what prompts patients to use telehealth [16], the physician-side is under-researched [17].

The lack of research regarding physicians is problematic, since they play a key role in telehealth propagation: Not only are they users themselves, but their recommendations also impact patient behaviour[18]. Furthermore, their acceptance of telehealth explains much of its uptake and outweighs other factors like technology problems or lack of resources [17]. Use of telehealth by patients does not necessarily mean that physicians will use and work with the collected data electronically. Sometimes, physicians just let their staff prepare the collected data, but they continue to work based on papers themselves. Hence, physicians play a dual role as potential recommenders and adopters of telehealth. Understanding and influencing physicians' behaviour is vital for its effective use. However, telehealth research so far has mainly focused on patient behaviour, physician-patient interaction, and the general impact of telehealth [16]. Studies in healthcare information technology (HIT) research have analysed physician motivation to adopt HIT or the impact of their recommendation behaviour, but not both. On one hand, recommendation behaviour was only observed as a predictor. For example, the effect of physician recommendations on patients' privacy decisions when using electronic health record (EHR) systems was examined and identified as a positive influence [18]. On the other hand, studies analysing physician HIT adoption behaviour [19,20] do not relate their findings to the resulting recommendation behaviour. Other studies researched the effect of recommendations, but not what triggers recommendations [21].

To summarize, physicians are central to the adoption and recommendation process of HIT, but the variables driving the recommendation as well as the connection between recommendation and adoption in this context are insufficiently researched. Knowledge of these variables would

allow to explain why telehealth apps, although beneficial in chronic disease treatment, are sometimes not used. This study focuses on the physicians' motivation to recommend and adopt telehealth technology and is carried out to identify the driving factors behind recommendations and close this gap.

Next, we discuss previous research. Then, we describe the exact context of our study. This is followed by modelling and hypotheses development. After that, we discuss the design and present results of our survey. Finally, we discuss the results and give some conclusions.

First, we consider research regarding physician recommendations independently of HIT.

There are studies, for example, that show physician recommendations as a positive predictor of vaccination [22] or participation in cancer screening [23]. O'Malley et al. [24] analyse the circumstances and occurrence of physician recommendations for cancer screening. They show that certain patient groups are more likely to receive recommendation than others, which was not based (only) on their medical condition. In their study, patients with easier access to the healthcare system and better socioeconomic status are more likely to receive mammography recommendations. In other words, physician recommendations are influenced by predictors different from a pure healthcare context. The referenced studies show the importance of physician recommendations and that physicians seem to be influenced by non-health variables, but they do not explain the physicians' motivation to recommend a behaviour.

Telehealth can be viewed as a treatment intervention like medication. Therefore, a recommendation for telehealth use can also be compared with a regular drug prescription. In prescription research, it has been analysed which factors determine the prescription of drugs [25]. The somewhat surprising result of the study is that physicians purely rely on their preference for a drug instead of considering a patient's characteristics. This finding has been replicated in various treatment scenarios. The studies usually conclude that a physicians' preference for a treatment is the determining factor in the choice of a treatment. This was shown in early studies [26] and confirmed again in recent replication research [27]. These studies only use a few variables relating to prescribing physicians (like the size of the practice where the prescribing physician works or his association with a medical society). The studies show the impact of the physician's preferences, but they lack the ability to provide insight into how these preferences are formed.

In summary, there is evidence for the importance and value of physicians' recommendation, but the internal drivers of physician recommendation remain unclear. The findings from drug prescription behaviour show that physicians prescribe based on their preferences, but the internal drivers of these preferences remain unclear. To better understand these drivers, we

develop below a model for the recommendation behaviour of physicians that also includes their potential willingness to get involved with telehealth apps beyond simply recommending them to patients. Bearing this in mind, our main research question can be stated as:

What motivates physicians to recommend and adopt a telehealth software for treatment of a chronic disease?

We will now lay out the setting of our study, in which we intend to measure these drivers: Central concerns of patients with chronic diseases are self-management and easy access to physicians, if needed. Both can be facilitated by telehealth technology [28]. The implementations of telehealth vary among treatment contexts: Telehealth seems to be most useful in monitoring chronic diseases or other long-duration health threats, for example, high-risk pregnancies [29]. Defining factors are: (Relatively) long distances between physician and patient, permanent possibility of critical incidents, and individualised treatment [28,30]. In order to conduct a study in such a treatment scenario, we need to concentrate on a chronic disease, which includes patient self-management in addition to the patient-physician interaction. These requirements are met by the treatment of haemophilia, a bleeding disorder. It is characterized by the life-long need for medication (frequency depends on the severity) and the permanent possibility of bleeding incidents, which may create additional negative effects like joint arthropathy. The patients are cared for by a system of treatment centres, by which the physicians are organized. In Germany, the centres also distribute the medicine (replacement factors). The physicians need to report replacement factor consumption to a central registry. The context is adequate for our research question, since physicians can either just recommend the telehealth software to the patient or use additional functions themselves, as further explained below.

2 Hypotheses and Research Model

As shown above, research on physicians' recommendation of telehealth technology and their adoption behaviour has several gaps, specifically when describing what variables influence these behaviours. Currently, no standardized model exists to measure recommendation behaviour. Therefore, we develop a new model, where we use Self-Determination-Theory (SDT) [31]and Value-based Adoption Model (VAM) [32] as frameworks. We identify relevant variables based on the literature.

SDT is used to model the different motivational factors because we want to describe the physicians' motivation to recommend telehealth technology. SDT views any motivation as part of three fundamental psychological needs: Autonomy, competence and relatedness [31]. These needs are satisfied by relating self-perceptions: Autonomy by perceiving oneself as

independent, competence by perceiving one's own actions as effective, relatedness by feeling affiliated to a social group. The satisfaction of those needs results into a level of motivational engagement. Three motivational types are distinguished: Intrinsic motivation, extrinsic motivation and amotivation [33]. Motivation is intrinsic when an activity provides satisfaction by itself. If an activity can lead to measurable benefits (here, for example, less documentation errors) then it is extrinsically motivated. If an activity does not lead to satisfaction, the motivation can turn into an amotivation, leading to a rejection of the activity. Our model is organized according to these three motivation types (see Figure 1).

A possible intrinsic motivation for physicians is the satisfaction a physician receives when helping patients who would use the app. Helping patients by recommending a useful app is likely to improve the relationship with the patient which is an important component of a physician's job satisfaction[34]. Early studies on physicians' intrinsic motivation are rare [35], but research of physicians' job satisfaction determined that serving people is a frequent positive intrinsic influence on satisfaction [36]. We therefore hypothesize:

H1: Perceived satisfaction from helping patients positively influences the recommendation intention.

A physician's decision about the best treatment can also be influenced by external, extrinsic factors. These external factors differ from an intrinsic satisfaction, as a physician indifferent to his patients still wants to provide an effective treatment. A physician might even feel responsible to use new technology as part of his professional self-perception [37]. Good professional experience is a component of a physician's job satisfaction [36], which reflects the need to experience oneself as competent [33]. Therefore, we assume here that physicians perceive new telehealth technology as beneficial to the treatment process. The available apps improve patient behaviour in key concerns like therapy adherence, since documenting is easier and the documentation is readily available to the physician. Apps also enable close monitoring in case of high-risk treatments and improve the physician's reaction time. Better monitoring also leads to less emergency admissions overall, thus reducing the physicians' workload and increasing the patients' quality of life [38]. More reliable data and their better further processing help the physician to improve the treatment of patients. The physician may perceive the new technology as helpful to improve his professional results.

H2: Perceived process improvements positively influence the physician's recommendation intention.

Another extrinsic factor is peer pressure from the physician's professional community. Physician behaviour, when implementing new research results, is influenced by whether these results are already part of established peer practice [39]. Gagnon et al [37] used the theory of interpersonal behaviour to describe telemedicine adoption by physicians and concluded that social norms and responsibility within the physician community positively influence the intention to adopt a telemedicine technology. The impact of the physician's peer group on his perceived relatedness and job satisfaction was also shown by McMurray et al. [34], further establishing the importance of the physician's peer group. A systematic review by Godin et al. [40] compared models describing healthcare professionals' behaviour and found that a component of social influence is beneficial to accurate predictions. Similar results were given by Malik et al. [36], who found respect by peers to be a frequent socio-cultural determinant of physicians' job satisfaction. In the context of our study, peer pressure arises when other physicians recommend the app to their patients or report on resulting treatment improvements. Therefore, we assume

H3: Perceived peer pressure positively influences recommendation intention.

If any of the three SDT dimensions, relatedness, autonomy, or competence, are negatively perceived, motivation turns into amotivation. Amotivation factors decrease the likelihood of performing a behaviour, in our case recommending an app. In case of telehealth technology, physicians may fear the perceived loss of patient autonomy. In chronic disease management, patient autonomy is a necessity, since patients often need to take their medication by themselves and, if possible, keep track of their own health status. This is beneficial to physicians since it reduces their workload. However, a new telehealth technology (like documentation apps) that introduces better monitoring may have also adverse effects. The patients could feel to be in a state of permanent surveillance. This could have a negative impact on the patient-physician relationship, since the patient might feel that the physician does not trust him and his self-management abilities anymore. Low levels of trust between patient and physician are associated with further negative effects, like lower perceived physician empathy and reduced treatment compliance [41]. Hence, physicians may refrain from recommending such apps, since they worry about negative effects from a decrease in perceived patient autonomy.

H4: Perceived decrease in patient autonomy negatively influences recommendation intention.

As outlined above, besides simply recommending the app, the physician also has the option to use the telehealth system himself. If patients use the app and transfer the data to the treatment centre where their physician is treating them, the physician can use the telehealth system for following functions:

1. He can have the data automatically reformatted as required by the central register and transmit them as required by law.
2. He can create charts that show the patient's "experience" with haemophilia over time as documented since the use of the app.
3. He can make comparisons of the patient with other patients with respect to haemophilia and other patient characteristics (e.g., a comparison of patients with same severity of the disease and similar age but different consumption of clotting factors).

The option to use additional features of the telehealth system constitutes an adoption decision by the physician. We use the VAM[32] to model the physicians' adoption decision. Among multiple models available for adoption behaviour, VAM has been used, e.g., in studies of adoption of mobile and IoT devices [42]. The model is an implementation of the cost-benefit paradigm from decision theory [43], measuring a product's utility by matching what it provides (benefits) and what it demands (sacrifices). Benefits are separated into *enjoyment* and *usefulness* based on Cognitive Evaluation Theory (CET) [44], while sacrifices include the sub-dimensions *technicality* (cost in time and effort) and *fees* (monetary cost). *Usefulness* and *enjoyment* to the physician have been shown to influence adoption decisions in healthcare-specific contexts [20,45,46]. Considering *technicality* and *cost*, especially the lack of reimbursement[47] can be considered a sacrifice. In contrast to SDT, where context-dependent variables have to be derived from literature for each motivational type, the VAM variables are already set and summarized in the following four hypotheses:

H5: Perceived usefulness positively influences the adoption intention.

While perceived usefulness is the extrinsic component of the benefit construct, perceived enjoyment reflects the intrinsic component.

H6: Perceived enjoyment positively influences the adoption intention.

Technicality reflects the non-monetary cost component of sacrifice. To use telehealth software efficiently, the physician needs to invest his own time. The time investments are not reimbursed so far.

H7: Perceived technicality negatively influences the adoption intention.

Besides the physicians, the staff of treatment centres also requires training in the use of telehealth software and time to maintain it, creating financial burden that they receive as salary or overtime costs. These costs are usually directly or indirectly borne by the physicians.

H8: Perceived costs negatively influence the adoption intention.

Hypotheses 5-8 consider different factors influencing the physicians' own adoption decision. Once a physician intends to adopt a telehealth system, each additional patient using the system will increase the overall usefulness of the telehealth system. Therefore, the physician will recommend the app to additional patients, making his adoption intention a positive influence on recommendation behaviour:

H9: Adoption intention positively influences recommendation intention.

Figure 1 shows the combined hypotheses. It further shows that the model consists of two parts, the SDT-part to the left and the VAM-part to the right.

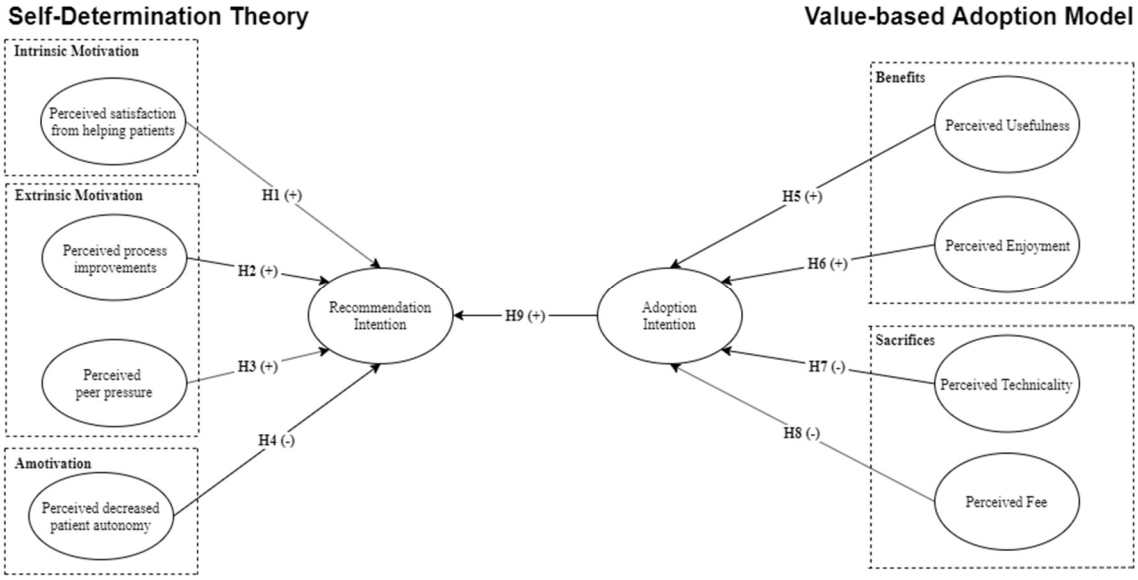

Figure 1: Main research model

3 Methods

3.1 Selection and Description of Participants

To test the proposed hypotheses, a survey is conducted among all physicians who specialise in haemophilia treatment in Germany. These physicians work in or with designated haemophilia treatment centres. Therefore, their number can be relatively reliably estimated at around 150 which represents the whole population (no prior sampling). Almost all of them are also members of DHG, the largest German association of haemophilia patients. We sent the survey to them via DHG (i.e., we did not receive their addresses) by regular mail accompanied by a supporting letter from the scientific advisory board of DHG. A response could be given via mail or via a website that contained the online version of the survey (where physicians did not have to reveal their identity). Reminders to fill out the survey were also sent to treatment centres and expressed personally at a haemostasis conference.

Physicians tend to have the lowest response rate in studies across healthcare personnel [19]. We received 47 responses in total. On one hand, this is a small number of responses. On the other hand, the respondents represent almost one third (31.3%) of the whole population. We received 1677 data points from the 47 surveys and 138 missings; this corresponds to a missing rate of 8.2 %. We utilized multiple imputation to replace missing values to prevent row-wise observation dropout due to missings. All missings were replaced using the Stata 14.1 mi imputation functionality. This helps to reduce potential bias from a small sample size.

3.2 Data Analysis

Our data and model were analysed using Stata 14.1. Additionally, SmartPLS 3 was used to test the SEM. Several methods were used to evaluate the results of the questionnaire. Cronbach α to test internal consistency, average variance extracted (AVE) and construct reliability (CR) to determine convergent validity and a Varimax-rotated EFA result to assess factor loadings and structure. Then, three multiple regressions were performed to test the different parts of the model. To test the complete model, we utilized SmartPLS 3 to perform a PLS-SEM. To estimate model fit, we use Standardized Root Mean Square Residual (SRMR) (<0.08) [48] and Normed Fit Index (NFI) (>0.9) [49]. We further check for common method bias (CMB) by testing if factor-level VIFs are lower than 3.3 [50].

3.3 Variables and Questionnaire Development

We adopted the variables from Ryan and Deci [33] as a starting point for the STD part since no specific scale for physician recommendation behaviour was available. They were adapted to our context as follows. The intrinsic motivation is measured as the *satisfaction from helping patients, which is adopted from Ryan and Deci's "satisfaction from helping others"* [33]. Extrinsic motivation is based on Hatz et al. [20], who developed the PMA scale to measure factors influencing physicians to adopt medical innovations. We adopted two of their constructs, "functional" as *perceived process improvements* and "conformity" as *perceived peer pressure*. However, we specify the medical innovation as apps for chronic disease treatment. Amotivation is operationalized, as discussed above, as a concern that patients may feel that they lose their *autonomy* and feel permanently observed when using an app. We created a self-designed construct to measure this potential argument against recommending an app. All items of the SDT part of the model were covered by 15 questions. All Items were translated to German. All scales are 5-Point-Likert scales. A physician's agreement with each item was indicated from "Does apply" to "Does not apply". As shown in Table 2, all constructs are measured by three

items. This was done to shorten the answering time and reduce the response burden [51] as much as possible, while retaining acceptable construct measures.

The constructs for the VAM part of the model are based on Kim et al. [32]. They provide scales to measure *perceived usefulness*, *expected enjoyment, perceived technicality*, and *perceived cost* as well as *adoption intention* in the context of mobile internet in general. We adapted the scales to the more specific case of telehealth. As above, all items were translated to German. All scales are 5-Point-Likert scales. All items of the VAM part of the model were covered by 15 questions. Only the recommendation intention was measured by one item since it acts as dependent variable in this study.

The study was presented to the advisory board of DHG, which approved it and provided an additional cover letter. The cover letter informed about the purpose and anonymity of the study. All procedures performed were in accordance with the ethical standards of conducting a questionnaire study. Two members of the advisory board also assessed the translation and wording of the items.

We added five variables to measure sociodemographic properties and control for the physicians' working conditions. The added variables include the physician's age and gender, his treatment frequency of haemophiliacs (in terms of number of patients per month), distribution of documentation method, and his centre's app support (i.e., if a telehealth system is available in the treatment centre). The responding physician must estimate the variables *treatment frequency* and *distribution of documentation method* because they are usually not exactly documented anywhere. If a treatment centre does not support an app use, the patient cannot transmit the data electronically to the centre and the treating physician. While age and gender are rarely a determining factor for change in physician behaviour [40], this might differ in the case of new technologies. Asking about treatment frequency is necessary, since physicians treat a strongly varying number of haemophilia patients. Physicians with a high treatment frequency might be more likely to use telehealth as a tool to reduce their work load. The physicians' age was measured in age brackets to maintain anonymity in the small sample.

4 Results

4.1 Respondent Data

More than three quarters of the participants work in centres supporting the use of telehealth apps. Note that about half of the treatment centres in Germany offer telehealth for haemophilia [52]. This means that centres that offer telehealth are overrepresented in our sample (via physicians who work there). However, not all patients treated in a centre use telehealth.

According to the surveyed physicians about 63% of patients use paper-based documentation and only 33% an app. The resulting 4% use some electronic support that they or someone built for them (e.g., a spreadsheet). Most physicians in the sample are between 40-59 years old with a nearly equal gender distribution. No physician is younger than 30. The treatment frequency ranged from 3 to 55 patients per month. On average, a physician treats 17.12 patients per month, but as assumed, the differences in treatment frequency are big (SD = 12.76).

Variable	Characteristic	N	%
Physicians interviewed		47	
Age Group	Below 30	0	0
	30-39	2	4
	40-49	13	27
	50-59	28	59
	Above 60	4	8
Gender	Male	25	54
	Female	22	46
Physician works in a centre offering telehealth	Yes	36	77
	No	11	23
Performed treatments per month		Ø 17.12	SD: 12.76

Table 1: Characteristics of surveyed physicians

4.2 Reliability and Validity

As Table 2 shows, all constructs meet the criterion of a minimal Cronbach α of 0.7 for the overall reliability [48]. Since we use several adopted or self-designed measures, a confirmatory factor analysis was conducted to ensure the quality of the measures. The global criteria are below the usual thresholds (RMSEA: 0.204; CFI: 0.708; TLI: 0.64), which is likely due to the small sample size. Construct-wise, the results satisfy the statistical requirements: as Table 2 shows, the AVE is above 0.5 (Fornell-Larcker-Criterion) for each construct. The CR is also above the recommended threshold of 0.7 [53] for each construct. Factor loadings are also above the required threshold of 0.6 [53]. Therefore, all of our constructs can be used in the upcoming analyses.

Variable	Item	Factor	Cronbach's	Mean	AVE	CR
Perceived satisfaction from helping others	INT1	0.6675				
	INT2	0.7268				
	INT3	0.6292				
			0.96	3.93	0.84	0.94
Perceived process improvements	IMP1	0.6802				
	IMP2	0.6308				
	IMP3	0.7296				
			0.88	3.75	0.69	0.87

Perceived social pressure	SOC1 SOC2 SOC3	0.6912 0.7365 0.7921	0.87	3.13	0.71	0.88
Perceived decreased patient autonomy	AUT1 AUT2 AUT3	0.8467 0.8805 0.6499	0.84	2.11	0.69	0.87
Perceived usefulness	USE1 USE2 USE3	0.7658 0.7758 0.8004	0.86	3.82	0.85	0.94
Perceived enjoyment	ENJOY1 ENJOY2 ENJOY3	0.8356 0.9217 0.8083	0.96	3.30	0.85	0.94
Perceived technicality	TECH1 TECH2 TECH3	0.7833 0.8287 0.9245	0.91	3.90	0.74	0.89
Perceived fee	COST1 COST2 COST3	0.7684 0.7614 0.8112	0.79	2.04	0.63	0.83
Adoption intention	INTENT1 INTENT2 INTENT3	0.8935 0.7749 0.8880	0.96	3.82	0.86	0.95

Table 2: Reliability and Validity

4.3 Regression Analysis

The regression analysis is split into three parts: First, we analyse the variables influencing recommendation intention considering the full sample (SDT Model 1, n=47) but without the formative parts of VAM. We only consider intrinsic and extrinsic motivation, amotivation, and the physicians' adoption intention as antecedents of recommendation intention (see Figure 1). The regression shows acceptable overall results (Adj. R^2 and VIF) but only two factors are significant (see Table 3, column 2). A closer look at the data reveals that nine physicians work in centres that do not support telehealth. Obviously, they cannot use the functions of the software that are provided for physicians and have the data transferred automatically to the central registry. Therefore, they cannot adopt telehealth and the (lack of) adoption intention has no influence on recommendation intention in the whole sample (see Table 3, column 2). In the next calculation, we reduce the sample to include only physicians in centres that already offer telehealth (n=38), i.e., we exclude the relating variable *centre supports telehealth*. Now the

variable adoption intention is also significant in the expected way (see Table 3, column 3). In the last regression, we analyse the VAM Model (see Figure 1), i.e., the variables influencing adoption intention (see Table 3, column 4). Note that for ease of reading, we define constructs as "perceived" by the physicians, yet in the case of physicians in centres not supporting telehealth, "expected" would be probably the correct term (in principle they could have gathered some experience in the past if they previously worked in a centre that supported telehealth).

Table 3 presents the results of the regression analyses.

Variables	SDT Model 1	SDT Model 2	VAM Model
Sample size (n)	47	38	38
Age	-0.05	-0.03	-0.19
Gender	-0.26	-0.22	-0.21
Frequency	0.00	0.00	-0.01
Centre supports telehealth	0.44		
Adoption Intention	0.45	0.45**	
Perceived satisfaction from helping others	0.41***	0.25	
Perceived process improvements	0.40***	0.24***	
Perceived peer pressure	0.12	0.08	
Perceived decreased patient autonomy	-0.04	-0.05	
Perceived usefulness			0.52***
Perceived enjoyment			0.21
Perceived technicality			0.22
Perceived fee			-0.19
Constant	0.26	0.52	2.10
Dependent variable	Recommendation Intention	Recommendation Intention	Adoption Intention
Mean VIF	2.64	2.29	2.20
Max VIF	4.54	4.31	3.48
Adj. R^2	0.865	0.841	0.643

*** = p<0.01, ** = p<0.05, * = p<0.1

Table 3: Results of the multiple regression models

The maximum variance inflation factor (VIF) is far below the critical threshold of 10 in all models, indicating no confounding from multicollinearity [54]. The adjusted R^2 shows that the models explain a relevant part of the change in the dependent variable. Due to the high significance and adj. R^2, all three regressions achieve a statistical power level of 90 % [55]. The

intrinsic motivation *perceived satisfaction from helping others* and the extrinsic motivation *perceived process improvements* show a significant influence on *recommendation intention*, while *perceived usefulness* exerts a significant influence on *adoption intention*. The three control variables *age*, *gender,* and *frequency* show no change or influence in any model. *Adoption intention* is only significant if *centre using telehealth* is not included in the regression, i.e., if we only observe physicians whose centre is supporting telehealth.

4.4 SEM Analysis

In a second step, partial least squares regression (PLS) with SmartPLS 3 was used to analyse the whole research model at once. In contrast to the multiple regression analysis, this allows us to consider the effect of the complete VAM part on recommendation intention. Figure 2 shows the main results. Three connections are identified as significant influence: perceived process improvements ($\beta = 0.236$, $p = 0.048$), perceived usefulness ($\beta = 0.514$, $p = 0.006$), and adoption intention ($\beta = 0.454$, $p = 0.016$), both the SDT and VAM part of the model are relevant to explaining recommendation. These results are consistent with the previous regression analyses, indicating the robustness of the results. The results also show that the constructs, including the ones that are not significant, have the expected signs.

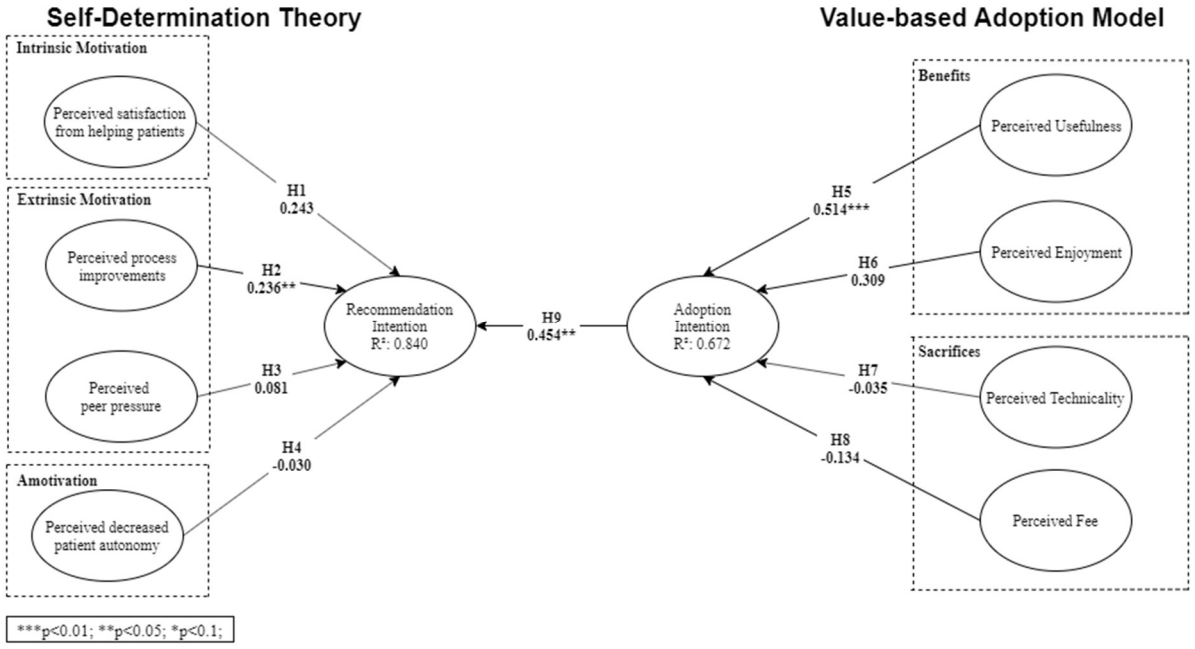

Figure 2: Result of the partial least squares SEM model

With the adjusted R^2 of 0.840 for recommendation intention and 0.672 for adoption intention (see Figure 2), the chosen antecedents are well-suited for predicting both constructs. The statistical power for both constructs is above 0.99, therefore the possibility of type-II-errors is

very low [56]. The model fit requirements are satisfied with a SRMR of 0.035 and a NFI of 0.937 [48,49]. Factor-level VIFs also stay below 3.3, indicating no CMB [50].

5 Discussion

The key findings are that physicians would recommend a haemophilia app to their patients especially if the physicians themselves use the functions afforded by the software, i. e., they perceive the software as useful and adopt it. In addition, perceived process improvements positively influence the physician's recommendation willingness. These relationships are shown in the PLS-SEM and supported by the regression analyses, which we will discuss in more detail in the following sections.

The PLS-SEM showed three significant relationships regarding recommendation intention. As expected, the physician's adoption intention influences whether he will recommend the app to a patient. It offers the strongest explanatory value for recommendation in the model. Physicians recommend telehealth software if they use its features themselves. The physician's decision to use the software is influenced by his perceptions of the usefulness of its functions, which confirms previous findings on the importance of perceived usefulness in physician HIT adoption[21,45,46,57]. As described above in the section on hypotheses development, the functions include here automated reporting to the national central registry, easy visualization of patients' haemophilia-relevant blood values, and comparison of patients by different criteria. Perceived process improvements influence the recommendation intention as well. These improvements are also provided by the functions of the app and include patient monitoring, easier reporting processes and making patient data more easily available for further processing. The relevance of improved efficiency concurs with a longitudinal telehealth study, where physician requirements for adoption were researched [58]. The other extrinsic motivation, peer pressure, does not influence the recommendation intention. This may be explained by an earlier study by Zheng et al. [59]: they found that the adoption decision by physicians is influenced by healthcare professionals only if they are also part of the physician's friend network. The items in our study did not focus on befriended physicians only. Venkatesh et al. [45] offer another explanation. They found a significant, but adverse effect of social influence: physicians who were better connected in their professional networks were less likely to introduce new EHR technology, if the new technology was perceived as reducing their autonomy and power. While the peer pressure shows no negative influence in our case, the effects may cancel each other out. The remaining STD part showed no other influence on recommendation intention. Physicians do not recommend telehealth software out of an intrinsic desire to help patients, but rather due to the

influences listed above. Physicians fear that patients feel a decrease in autonomy when they are monitored by their physician through the app. However, this amotivation variable is not influential. This may be explained by the positive effects of telehealth software on patient autonomy identified in several recent studies showing that self-governing of treatments increases patient autonomy[60-62]. The positive effect may offset the expected decrease in autonomy.

Apart from perceived usefulness, the VAM variables were non-significant. Concerning perceived enjoyment, the topic of chronic disease management may simply be too serious to allow for much joy when using the system. Perceived technicality may be more system- than physician dependent and the two existing systems could be easy enough to use. A recent study researched for example the physician satisfaction in places where telehealth was rapidly established due to Covid. They found that technical difficulties and tedious handling impeded physician satisfaction [63]. Perceived fee is also likely not significant since the two systems are supported either by a pharmaceutical company or an independent association supporting research in haemostaseology (VFTH e. V.). In this context, both act as third parties that supply/finance the server infrastructure as well as technical support and free training courses [14,64].

The findings of the three multiple regression models support the results of the PLS-SEM and offer additional insight: As the first regression analysis showed, satisfaction from helping others can be a significant influence under specific conditions. If recommendation intention does not consider the physicians' own system use, they seem to be influenced by the (perceived) satisfaction from helping patients. However, under daily work pressure their altruism is overshadowed by the usefulness of technology for their daily work. It can be expected that if they can work with the technology in a useful way, they will become more effective which will benefit their patients too. The regression analysis therefore validates the main findings of the PLS-SEM model, with perceived usefulness and process improvements as the most influential variables. The treatment frequency had no influence on either recommendation or adoption intention, perhaps due to a relatively small absolute number of haemophiliacs a physician is treating. Neither did age, but more than half of the physicians in this sample were in the group between 50 and 59 (which is also true for the whole population).

Our study contributes knowledge to the research about physicians as central decision-makers in health environments. This follows the remark of Sykes et al. [19] that the increasing deployment of EHRs makes understanding the drivers of its use an issue of practical and scientific

significance. While previous research suggested that physicians' treatment decisions were usually determined by personal preferences, our study finds usefulness for work to be the determining factor as the most important lesson.

The practical implication for the development of telehealth apps for illnesses like haemophilia is that it is not enough to develop software that benefits patients. Physicians treating the illness must be involved to include processes they deal with, partly in the background. The benefits for physicians will then lead to their recommendation to patients, esp. if both sides are made aware of the possibilities afforded by the software. Insurance companies and other supporters of telehealth software (e. g., patient associations) may also learn from our findings since apps reduce treatment costs.

5.1 Limitations

Limitations of our study mainly concern the sample size as well as the specific setting and the indirect measurement. The sample size was addressed by using a mix of methods well-suited to handle small sample sizes. Regression analysis as well as PLS-SEM have been utilized to ensure our results are not biased by a single methodological confounding factor. While haemophilia treatment as the setting of the study only relates to a small number of patients and physicians (compared to diabetes, for example), there is no reason to expect that the results do not hold on a bigger scale, i.e., in the treatment of more prevalent chronic diseases, since the impact of a physician's recommendation is likely similar. Lastly, we only measured the intention to use and recommend the telehealth system. Since our main results only include physicians of centres where the telehealth systems are already available, the barriers from intention to actual use are low. Nonetheless, a future follow-up study would ideally have a longitudinal design and track the relation between intention and use.

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Essay III: Patients' Attitudes toward Apps for Management of a Chronic Disease

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Abstract: We model the intention of patients to use a telehealth app for the management of a chronic disease. Our model integrates the health belief model with a model of information technology acceptance to reflect the technology- and health-related parts of the intention. The intention of non-using patients to use the app is influenced by their hedonic motivation and social influence. An analysis of sub-groups reveals deeper insights: Patients without access to the app would use it based on the expected performance and their self-efficacy. Patients who do not use the app despite having access to it would use it if influenced by their social environment and if they perceive their disease to be severe. A third group does not even know whether they can use the app. The results show that proper education of patients and people influencing them is necessary even in the case of chronic diseases.

Keywords: Chronic Disease Management, M-Health, Telehealth, Technology Adoption, Patient Behavior

1 Introduction

Treatment of chronic diseases has been continuously improved over the last decades, with an increasing focus on patient self-care [1]. Chronic diseases differ from acute diseases (that last only a short time) in their impact on patients as well as on the healthcare system and are the most common cause of death worldwide [2]. M-health is well suited to support chronic disease patients [3] and it is expected to improve their treatment adherence [2]. It has also been shown analytically that m-health can be superior to the office-visit model with respect to patient's average life expectancy and expected total lifetime utility [4]. The benefits come mostly from additional opportunities for intervention by the health care provider. We concentrate on hemophilia, as an exemplary chronic disease. It is often "neglected" by research on m-health [5] because the number of patients is comparably low at 400,000 hemophiliacs [6] vs. 400,000,000 diabetics [7] worldwide. The hemophilia treatment is named replacement therapy because it replaces the blood clotting factors missing in hemophiliacs. Clotting factors help to close wounds and stop internal bleedings. The required substance for hemophilia treatment, a synthetic blood clotting factor, is costly and prone to overconsumption, since the precisely needed dose is difficult to determine, but overdosing has no negative health consequences [8]. In a study regarding the outpatient expenditures for 34,000 children with chronic diseases in California, only 145 children from this group had hemophilia but they accounted for 41% (195$ million) of the state spending for this group [9]. M-health supported documentation offers advantages to patients and the health care system, as they provide data about the success of different therapy approaches and allow for a more precise dosage and thus less overconsumption. This study uses combined models from health psychology and information systems to analyze which conditions facilitate the application of m-health for support of chronic diseases, esp. hemophilia.

2 Background

2.1 Hemophilia

Hemophiliacs are prone to longer bleedings after injuries and possible internal bleedings, e. g., inside joints or the brain. This may result in disabling arthropathy and, in severe cases, death [8]. Regular treatment (replacement therapies) produces better results concerning the prevention of arthropathy (compared to on-demand), but patients may not comply with the therapy and health care providers are hesitant to finance it [8]. This study researches hemophiliacs in Germany.

Chronic disease management (CDM) apps, here specifically for hemophilia treatment, are an example of m-health support. Since September 2020, hemophiliacs in Germany receive their prescription from hematologists and their factor supply in pharmacies. Hematologists are organized in hemophilia treatment centers (HTC), which range from big comprehensive care centers with approx. 40 patients and with specialized personal to individual physicians with some hemostaseological experience. They are required by the German blood transfusion law to report their patients' factor usage to the German Hemophilia Registry (DHR). For this purpose, HTCs depend on an accurate documentation by the patients or their legal guardian. Patients also report relevant occurrences like joint bleedings.

Now, most patients document their factor usage in a paper notebook, which the nurses in the HTC use to update the patient data on each visit. This paper-based documentation is prone to several errors. Adherence to documentation and treatment is difficult to verify, since the only time patients must show their records is when visiting their physician, which can be just once a year. Patients often make updates just before the visit, which can result in wrong dates, for example. The notebooks do not provide a standardized way of recording joint bleedings. Therefore, patients improvise and often do not enter information that is precise enough.

Alternatively, two apps have been separately developed to facilitate the documentation via easier input (scan of the factor charge number) and digital data transfer to the centers. These apps offer additional features and advantages. For example, physicians can utilize them to monitor patients' adherence to regular prophylactic therapy. Disabling arthropathy as the most common consequence of hemophilia is also easier prevented by CDM apps, since they allow to precisely record the bleedings: the patient simply taps the location of the bleeding on a body drawing, which provides the physician with an overview of all occurrences. In addition, the data can be immediately forwarded to a hematologist. The collected data can also help to better monitor the cost effectiveness of different treatment regimens [10]. HTCs need to have the corresponding infrastructure, and therefore, support only one of the apps or none at all. Both apps are certified medical products.

To summarize, hemophilia is different from chronic diseases like diabetes, because on one hand an exact tracing of the medication taken is needed (in the past blood transfusions were sometimes contaminated with diseases of the blood donors). On the other hand, overdosage "only" burdens insurances and society but not patients.

2.2 Research Problem

There is no law in Germany that mandates the use of an app. Even if an HTC supports an app, it is not allowed to demand its use from a patient or to put a non-user into any disadvantage compared to patients who use the app. Also, no physician can deny treatment if a patient does not want to use the app. Each patient can decide absolutely freely whether to use the app. Models of technology acceptance are well-suited to describe this voluntary use of an app. One of the most advanced and comprehensive of such models is UTAUT2 (Unified Theory of Acceptance and Use of Technology 2). It is based on several previous behavior models like the technology acceptance model (TAM), TAM2, and the theory of reasoned action (TRA) [11]. Its constructs cover IT aspects as well as some psychological aspects. However, it does not contain health-related constructs which can be very important in the context of chronic diseases.

Psychology of medicine has developed models that take health believes into account, specifically related to an illness or behavior which can lead to an illness. These models can be used to measure intentions of people to change their behavior or to measure the effectiveness of activities that try to make people adhere to medical advice. The measures need not demand any use of technology by patients. For example, warnings about consequences of smoking on cigarette packages do not expect any technology use. For such purposes models like the health belief model (HBM) have been developed [12]. The HBM was originally developed to explain and predict the acceptance of medical recommendations [13]. It assumes that, health-related actions depend on an individual's perception of his own health status and assessment of these actions. This perception is formed by how threatened individuals feel and how beneficial the possible action may be. The threat is determined by the perceived seriousness and susceptibility of the disease, and the decision is further weighted against costs and benefits of the action. Additionally, the decision is influenced by cues to action, represented by health events or physician advice [13].

Our research goal is to systematically develop an adoption model for the use of an app in the context of a chronic disease. The app helps to manage a life-threatening disease. The resulting model can be applied to gain knowledge in this specific context. Modeling the use of treatment-supporting apps for (chronic) diseases, requires consideration of IT and health-related issues [14].

In some cases, older acceptance models are used despite the existence of newer models with better conceptual coverage. Leanness of the combined model was often achieved by simply omitting some constructs. This is problematic because important concepts may be missing, and explanations of the problem can be biased. TAM and HBM show conceptual similarity between

their constructs (e. g., perceived usefulness) [15]. We create a combined model systematically by combining constructs which are conceptually similar but retain the conceptual coverage of HBM and newer acceptance models. This way, we achieve an adequate conceptual coverage and a relatively lean model.

3 Model Building

We start with health-related constructs provided by the HBM, then continue with shared constructs and discuss the technology-related constructs from UTAUT2 at the end.

The HBM-exclusive part of the model contains the health-specific constructs perceived susceptibility and perceived seriousness. They may be viewed as an individual's threat appraisal, which is part of several HBMs [12]. It is an essential part of health behavior, since every coping behavior (e. g., using an m-health app) needs to be induced by a perceived threat [16]. The versions of HBM are not consistent in the operationalization of the links between susceptibility, seriousness, threat, and behavior [17]. Following previous studies, we measure susceptibility and seriousness as separate dimensions to achieve a more differentiated prediction [16]. High values of susceptibility and seriousness, positively influenced the behavioral intention in other cases [18]. The construct of perceived threat originates in psychological research about fear, where the influence of fear on behavior change is described in various contexts, including health [16]. The perceived seriousness is viewed as the most common variable [16] and has consistently been found to facilitate behavior change [19]. Accordingly, we hypothesize that a hemophiliac perceiving his illness as more severe will more likely use the digital documentation:

H1: Perceived seriousness has a positive effect on usage intention.

Perceived susceptibility constitutes the second component of fear [16, 20]. E. g., it is used in the research of preventive breast cancer mammography [20]. The construct has consistently shown to facilitate behavior change, the more a subject was aware of and felt susceptible to a disease [12]. It does not make sense to consider the fear of getting hemophilia, because it is hereditary. In our study, threat is specified as the threat of disabling arthropathy caused by joint bleeding since this is a common and dangerous consequence of hemophilia. If a patient perceives himself as more susceptible to suffer from joint bleeding, he is more likely to switch to m-health documentation in order to better monitor and prevent the bleedings Therefore, we propose:

H2: Perceived susceptibility has a positive effect on usage intention.

Self-efficacy describes the degree of a person's ability to perform an intended behavior [21]. It is an effective predictor of behavioral intention and has been later added to the HBM [12], while it was included in the Protection Motivation Theory (PMT), an alternative to HBM, from the beginning [16]. Users confident in their ability to effectively use technology will be more likely to use that technology. This positive influence has been validated in general models of technology acceptance [22] as well as in studies focusing on m-health [12]. It has also been found to be the most decisive predictor in studies researching long-term health behavior, e. g., dietary behavior [23]. Here, self-efficacy describes a patient's ability to intuitively use smartphone apps. It is assumed that a patient, who perceives himself as efficient in the use of apps and smartphones in general, is more likely to also use the smartphone-based documentation.

H3: Self-efficacy has a positive effect on usage intention.

Next, we discuss constructs that are found both in HBM and UTAUT2. The integration of these models allows for a reduction of latent constructs where they conceptually overlap. The similarity of the constructs can be derived from their definition and operationalization. The HBM constructs are viewed as easy to adapt for specific use [17] and they have been shown to be valuable predictors using alternative operationalizations [13].

Performance expectancy is defined as the degree to which an individual believes that using a system will help him to increase performance [22]. It proved to be a strong predictor of behavioral intention in studies with a healthcare context [24]. Perceived benefits in the HBM were defined as the likelihood of an action to be taken depending on an individual's perception of the effectiveness of the action [13]. Therefore, both are perceptions about effectiveness, differentiating only between an action and (IT) system. In our study, the action is defined as using a system (the app), therefore the constructs are similar. This notion of benefit has been used by various researchers to predict health behavior [13, 18]. Here, benefits provided by the app are, for example, improved bleeding monitoring and facilitated exchange with hematologists. An extensive literature review in the domain of telehealth treatment of chronic diseases identified perceptions of effectiveness as a possible facilitator to tele-homecare programs [25]. We assume, therefore, that an increase in the perceived benefits of an app-based documentation will increase a patient's intention to use it.

H4: Performance expectancy has a positive effect on usage intention.

Effort expectancy describes the ease of using a technology [11]. Perceived barriers are defined as potential impeding aspects of a health action [13]. These can be described as "difficulty of

use" which is the opposite of ease of use. However, both descriptions are guided by the same idea and can be operationalized in the same way. Documentation apps face two types of barriers: the software must match the technical abilities of users and their health knowledge. Technical barriers can be slow loading and responses while a medical barrier may be the use of terms the patient is not familiar with. The apps need to present easy interactions that give medically and technically clear instructions. We assume that if the user expects such problems, his intention to use the app will decline.

H5: Effort expectancy has a negative effect on usage intention.

Social Influence (e. g., advice from family, friends, or physicians) has been found to be another strong predictor of behavior intention [11]. In a recent study on patient adoption decisions of a diabetes management app, it had the strongest positive influence [26]. Concerning social influence, it is described as the degree to which an individual perceives that important others believe he or she should use a new system [22], while the cues to action encompass influence exerted by significant others [17]. Thus, the constructs may be considered to be similar. Social influence is also found in general behavioral theories like TRA and TPB, where subjective norm is included as perceived social pressure to perform a certain behavior [27]. Advice is usually a positive, awareness-raising factor and will, therefore, exert a positive influence [12]. In previous studies, social influence has sometimes not been an important factor for determining behavior regarding health technology [28], but those studies mainly applied UTAUT to health care professionals. As this study focuses on patients, who normally heed their physician's advice, social influence is expected to take a more significant role. Another study showed physicians to be viewed as reliable sources concerning health app suggestions [29]. In sum, this study assumes advice from physicians and/or friends to increase the intention of patients to use smartphone documentation, since they want to satisfy their social group's expectations.

H6: Social influence has a positive effect on usage intention.

The technology-exclusive part of our model consists of the UTAUT2 constructs facilitating conditions and hedonic motivation. Facilitating conditions describe the availability of physical resources aiding in the use of m-health (e. g., smartphone) as well as support by friends or an introduction course given by the care center [11]. They have been found to reliably predict behavior intention in a health-care context [12]. Here, facilitating resources specifically include an easy to use smartphone and the possibility to ask for help when using the app. We assume that better resources and support will increase the likelihood of using an app-based documentation.

H7: Facilitating conditions have a positive effect on usage intention.

Hedonic motivation describes the fun or pleasure derived from using a technology [11], m-health in this case. It represents an intrinsic motivation within UTAUT [11]. Although our study is conducted in the context of CDM, hedonic motivation may be present because apps represent a much newer technology than paper-based documentation. Patients may find satisfaction in using new technology for managing their disease. Therefore, a patient experiencing more pleasure in using apps is expected to be more likely to use an app-based documentation:

H8: Hedonic motivation has a positive effect on usage intention.

UTAUT2 further proposes price value and habit as constructs. Price value is excluded, since the sample only used m-health apps distributed by the HTCs free of charge. Habit was dropped from the model, since there is no possibility for patients to use a similar app before adoption and develop correlated habits. While fitness or health tracking apps also serve tracking purposes, their use is not in a life-threatening context. The consequences of not using them for days are usually not severe. All moderators proposed by UTAUT2 were included except gender, because hemophilia only affects males.

Figure 1 presents the complete research model while making the origins of concepts explicit. It also shows where previous models are overlapping and can be made leaner in our case.

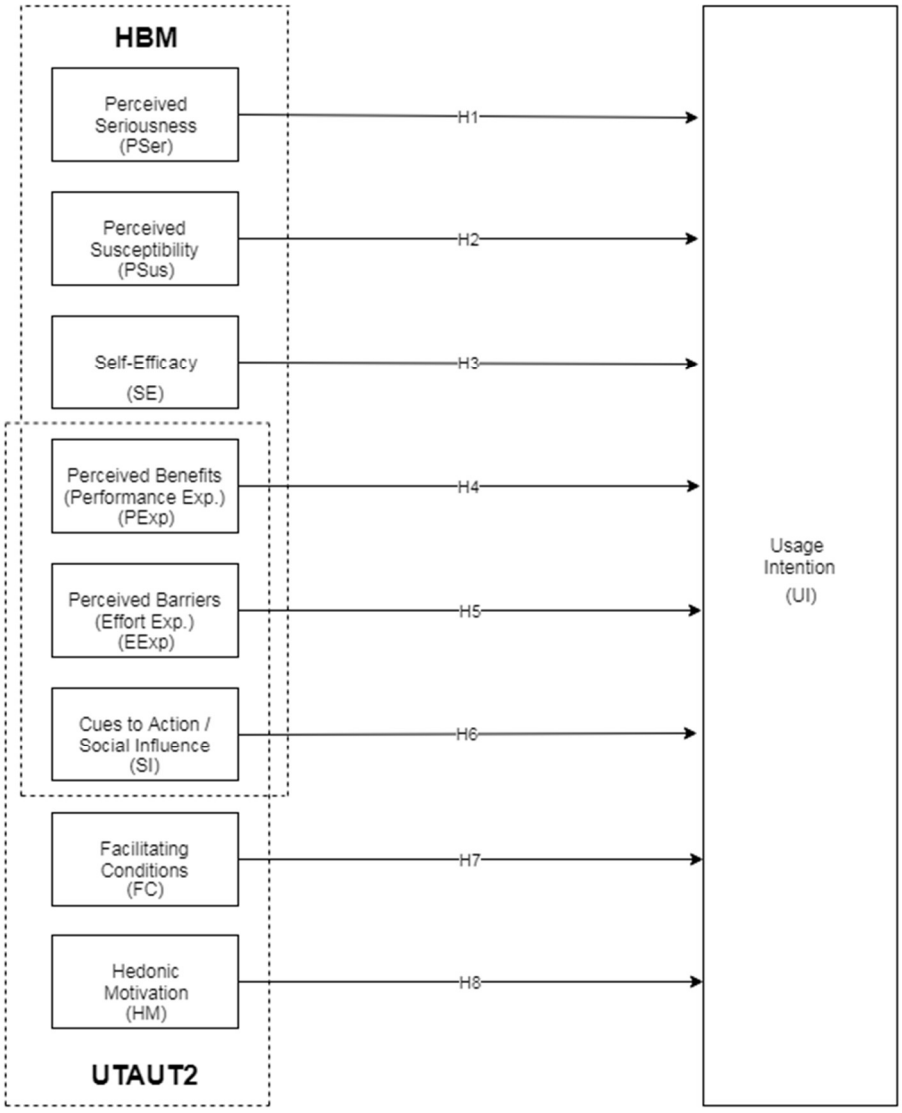


Figure 1: Research model with UTAUT2/HBM overlap

4 Sample & Data Collection

To test the proposed model and hypotheses, a survey was conducted with support of the two major German hemophilia associations of patients. They have more than 3250 members in sum [30, 31] which includes patients, their relatives, and physicians. The unique number of patients is not exactly known; we estimate it, based on talks with experts, at about 3000. The associations aided in distributing the survey to their members via mail, e-mail, or as a link on their home page but no follow-up was possible because respondents were absolutely anonymous. The e-mail contained a link to the online version of the survey, while the mail contained a printed version with a return envelope. We received 144 responses in total. This amounts to less than 5% of the population of unique patients in both associations. There are three possible reasons for the relatively low return. First, most current users of the app did not care to participate since they are aware of m-health in this case. Second, patients with the mild or moderate form of

hemophilia rarely use hemophilia medication and barely document anything. Third, due to the rare occurrence of hemophilia relative to other chronic diseases, the patients are frequently asked to participate in surveys for medical research. The survey was designed to differentiate between users and non-users and contained accordingly different questionnaire sections for them. From the total, 71 respondents were using an app. These patients perceive to have a significantly better knowledge about hemophilia than non-users. In this research, we were interested in the 73 respondents who do not use any app to document their illness, yet. Eleven responses were excluded because of suspicious answer patterns (always the same answer) and contradictory answers to reverse questions, leaving n = 62.

5 Measures & Instruments

In addition to the questions related to the above research model, several socio-cultural and health-specific items were asked. The additional questions include whether the survey was answered by the hemophiliac himself or his legal guardian, the age, and the way they document their disease now (app or paper). Furthermore, information on an individual's knowledge about hemophilia was collected since it was determined as a possible variable in health behavior [32]. The participants were also asked to state their objectively measured severity of hemophilia. Table 1 provides insight into the sample.

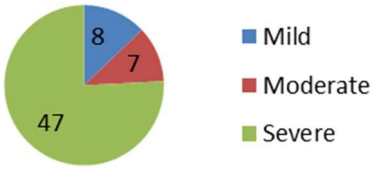
Variable	Mean (SD) / distribution	Measurement
Age	39.6 (19.84)	
Knowledge by severity	Mild: 2.33 (0.71) Moderate: 2.71 (0.76) Severe: 2.94 (0.73)	Not existing (1) – Perfect (5)
Degree of hemophilia		Mild (1), moderate (2) and severe (3)
Health status	73.45 (24.13)	Bad (0) – Perfect (100)

Table 1: Sample statistics

The (perceived) knowledge about hemophilia rises with the severity of the disease. When adding non-users (62) and users (71), the percentage of severe cases in our survey is 80%. This is higher than in the general population where the share of severe cases of all hemophilia cases

is estimated to be at 60%. First, the number of severe cases among association members is probably bigger than in the general population because these patients are more concerned with their disease and its treatment than patients with mild or moderate hemophilia. Second, the interest of patients with severe hemophilia in new CDM approaches is probably bigger than of other patients so they are more likely to answer a related questionnaire.

Most model constructs were tested using scales derived from previous research. We used the HBM's main constructs perceived susceptibility, seriousness, benefits, and barriers [33]. The measurement of perceived barriers and benefits is also used to represent effort and performance expectancy, these constructs overlap with UTAUT2. We follow previous studies in the e-health domain [34] and view self-efficacy as the ability to use e-health applications. The scale was taken from a previous study [35] and altered to specifically apply to CDM apps. The scales for measuring the factors facilitating conditions and hedonic motivation are based on a previous UTAUT2 study [11]. The scale for the integrated social influence/cues to action construct is adopted from a study that also combines UTAUT and HBM [36].

It was necessary to decrease observation dropout due to missing values given the small size of the sample. Therefore, Markov-Chain-Monte-Carlo imputation was used to provide viable substitutes for missing values. The missing values were tested to be missing at random. Ten values from eight respondents were imputed. Table 2 sums up the used constructs and Cronbach's α within the present study. The recommended threshold for Cronbach's α is 0.7, with values lower than that acceptable in exploratory studies [37]. Only Social Influence does not provide a satisfying α but it is considered close with a value of α=0.69. Facilitating Conditions and Self-Efficacy score the highest means (Table 2), suggesting that the confidence and support to use digital documentation is present.

Variable	Abbreviation	Cronbach's α	Mean (SD)
Usage intention	UI	0.96	3.67 (1.66)
Perceived Susceptibility	PSus	0.95	3.51 (1.64)
Perceived Seriousness	PSer	0.88	3.05 (1.23)
Performance Expectancy	PExp	0.88	2.76 (1.14)
Effort Expectancy	EExp	0.88	2.05 (0.88)
Social Influence	SI	0.69	2.47 (1.10)
Facilitating Conditions	FC	0.77	4.25 (1.14)
Hedonic Motivation	HM	0.90	3.59 (1.37)
Self-Efficacy	SE	0.89	4.99 (0.90)

Table 2: Variables

6 Analyses

Further analyses are conducted with PLS-SEM in SmartPLS3 and with Stata 14.1. First, a correlation analysis is conducted to detect possible antecedents to behavioral intention. While not providing predictive ability, the correlation analysis allows to determine possible relationships. Second, a PLS-SEM is calculated to test the research model. Third, several multiple regression analyses are carried out to extract more information concerning relevant subgroups of the sample because their size is too small for a PLS analysis. The correlation matrix between the variables given in the previous chapter and behavioral intention is presented in Table 3.

	UI	**PSus**	**PSer**	**PExp**	**EExp**	**SI**	**FC**	**HM**	**SE**
UI	1								
PSus	0.16	1							
PSer	0.26*	0.50***	1						
PExp	0.47***	-0.09	0.00	1					
EExp	-0.29**	-0.21	-0.21	0.02	1				
SI	0.39***	0.08	0.10	0.29*	-0.01	1			
FC	0.06	0.07	0.07	0.04	-0.32**	0.22*	1		
HM	0.67***	-0.07	0.14	0.60***	-0.44***	0.28**	0.17	1	
SE	0.26**	0.09	0.11	-0.00	-0.67***	0.09	0.56***	0.34**	1
***p<0.01; **p<0.05; *p<0.10									

Table 3: Correlation Matrix

Concerning the correlations, it is evident that the antecedents behave as intended towards the outcome variable, with Effort Expectancy as the only antecedent with negatively phrased items presenting the only negative correlation. Apart from Perceived Susceptibility and Facilitating

Conditions, all predictors show a significant correlation. Hedonic Motivation and Performance Expectancy correlate best with Usage Intention and show the highest level of significance together with Social Influence. It is, therefore, likely that these factors are significant predictors of Usage Intention.

Several antecedents show a high and significant correlation with each other, therefore the VIF is calculated to test for multicollinearity. As Table 4 shows, no VIF in the regression analysis is greater than ten, indicating no relevant multicollinearity within the regression analysis [38]. In the PLS-SEM, no VIF exceeds 3.3, which indicates that multicollinearity and common method bias have no relevant influence there [39]. We further used Shapiro-Wilk to assess normality of the data, and several non-normal distributions were found. While this will not impact the nonparametric PLS, robust estimators were used in the regression analyses to address it. The assumptions of linearity and homoscedasticity were tested for via plotting and the Breusch-Pagan test. Both assumptions are fulfilled.

A PLS-SEM analysis is conducted to determine the relationship between antecedents and Usage Intention. It is based on N = 62 with results shown in Figure 2. The antecedents account for a variability of 68% of the Usage Intention ($R^2 = 0.679$). This R^2 makes the sample size of 62 sufficient for a statistical power of 80% and with 5% probability of error [40]. The significant positive predictors include Social Influence and Hedonic Motivation. Therefore, H5 and H8 are supported. The antecedents Perceived Susceptibility, Perceived Seriousness, Performance Expectancy, Effort Expectancy, Facilitating Conditions and Self-Efficacy showed no predictive power for Usage Intention. Therefore, hypotheses H1, H2, H3, H4, H7 and H6 are not supported when analyzing the full sample.

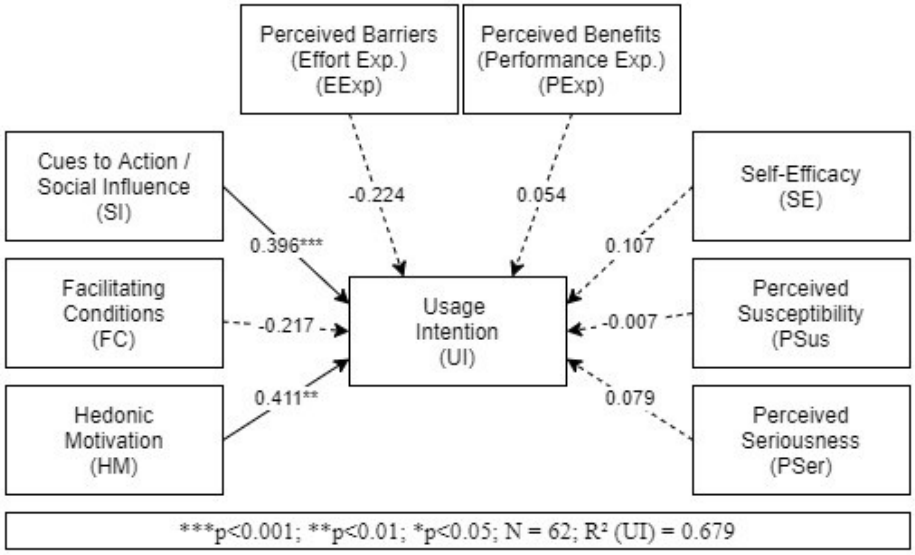


Figure 2: Path coefficients and significances in the PLS-SEM analysis

However, the full sample is not homogenous with respect to the availability of an app for documentation. On one hand, there are non-users who may want to use digital documentation, but their HTC is not supporting it. On the other hand, there are non-users who do not use an app although their HTC supports it. The situation of the two groups of patients is objectively different so that a separate analysis is needed. A third group is formed by patients who do not know whether their HTC offers an app. We expected that hemophilia patients would be well informed about the disease and the possibilities for its management (see also Table 1) but almost 30% of respondents crossed the "do not know" option. Accordingly, the participants could be split in a sub-sample that does not use digital documentation despite its availability (Group DU), another sub-sample with no access to it (Group NA) and a third group not knowing whether it is available (Group DK). Due to the smaller sample size of the subgroups (given in Table 4), we can only search for a large effect size and accept a higher probability for Type II errors. Also, since smaller sample size can decrease the significance level, we set the significance threshold to 0.1 in the regression analyses [41]. Table 4 presents the different multiple regression analyses.

Hedonic Motivation is the only significant antecedent for the non-informed group. It means that they do not understand what value the digital documentation may have and, therefore, would only use it as a more entertaining way to document. Participants with no current access to digital documentation expect it to be useful (Performance Expectancy) and consider themselves to be well-prepared (Self-Efficacy) for it. Lastly, participants who do not use digital documentation despite having access to it are significantly influenced by Social Influence and Perceived

Seriousness. The influence by Facilitating Conditions has an unexpected negative sign which we suspect to be a Simpson paradox, which was validated by additional single variable linear regression [42]. Hence, we will exclude Facilitating Conditions from further discussion. The non-adoption by this group is surprising at first. A look at the illness severity in this group explains this behavior to some extent. because 44% of participants do not have the severe form (in other groups the share is only 21% and 12%) and do not really need much documentation. If we add to this group app users, the share of severely ill patients rises to 78%.

Variable	Group DK	Group DU	Group NA
Perceived Susceptibility	0.14	-0.28	0.10
Perceived Seriousness	-0.07	0.73*	0.05
Performance Expectancy	-0.05	-0.52	0.64*
Effort Expectancy	0.44	-0.01	-0.08
Social Influence	0.18	0.80**	0.07
Facilitating Conditions	0.08	-0.70*	-0.42
Hedonic Motivation	0.79**	0.97	0.05
Self-Efficacy	0.49	0.62	0.88*
R^2	0.77	0.74	0.59
Adj. R^2	0.58	0.51	0.39
MaxVIF	3.52	6.42	4.76
N	19	18	25
% Severe	78	56	88
***p<0.01; **p<0.05; *p<0.10			

Table 4: Multiple Regression Analysis

7 Discussion and Conclusions

The present study examined the factors determining the intention of patients to use m-health for a chronic disease. Suitable factors from UTAUT2 and HBM were analyzed in a PLS-SEM and in several multiple regressions. The analysis of the full sample of non-users reveals that Social Influence and Hedonic Motivation are significant predictors. The significant positive relationship of Social Influence confirms the relevance of the social environment in deciding whether to use digital documentation. The more suggestions patients receive from their friends,

family members, or physicians, the more inclined they are to use digital documentation. It shows a significant difference between the role of Social Influence for professionals and patients: while professionals seem to be little concerned about others' opinions [28], patients seem to rely more on advice, which makes sense given their lack of professional knowledge. These results are in line with other studies researching m-health usage from the patients' perspective [12, 24], confirming that Social Influence should be considered when researching m-health usage intention.

Hedonic Motivation shows to be the strongest and most significant predictor, which matches the results of other adoption studies [5, 11]. It suggests that m-health apps need to exceed their utilitarian value and provide additional features to gain the patients' interest. This may seem surprising given the serious nature of chronic diseases, but also fits the observed scenario: Patients will document their factor usage either way. Digitalization cannot be achieved by only simply digitalizing the process, but it must keep the patient engaged. M-health users value supportive functions like integrated reminders and tracking [29].

The analysis of the full sample does not disclose perceptions of patients in a specific situation. The sub-samples are small but still lead to some interesting and statistically significant findings. The group with no access to digital documentation shows a significant influence of Performance Expectancy on Usage Intention. This implies that positive expectations about m-health are likely to lead to an increasing demand for such possibilities. Given the close and often long relationship between physicians and their patients, we do not believe that patients will switch to another physician (and HTC) for that reason but we think when patients look for a new physician (e.g., because of relocation) the opportunity to use an app for documentation will play a role. For the group of patients with access to digital documentation but who do not use it, the concern about hemophilia consequences (Perceived Seriousness) raises UI. For patients with severe hemophilia in this group, it is probably just a question of smartphone skills, cost, or time till they switch. Since they are open to Social Influence, some relating advice may help to persuade them to switch to an app. The third group which is not informed about the support of their HTC with respect to apps is puzzling. Whatever the real situation in their HTC may be, they did not care to find out. This is understandable for mild and moderate forms but not for the severe form of hemophilia (79% in this group!). These people should know about the existence of apps for documentation from their association (or other sources).

The present study offers several theoretical contributions and practical implications. By combining UTAUT2 and HBM, the specific behavior in the health context is represented in

more detail than previously [43]. It follows the appeal to explore theory-based additions to health-IT use [14]. In comparison to studies on healthcare professionals [12], our study shows that patients are different from professionals with respect to m-health. This should be recognized when trying to persuade both groups to use m-health or when conducting studies in this domain.

Compared to previous studies [44], our study shows the necessity of utilizing the full UTAUT2 model instead of TAM or only parts of TAM2, since significant predictors like hedonic motivation may be overlooked otherwise. Our study also shows a direct impact of social influence on adoption intention instead of just an indirect one via perceived usefulness. In other words, even if a patient does not perceive an app as useful, he may still use it if the treating physician recommends it. We can also add that the perceived usefulness, which was a central predictor to adoption attention in previous studies [44], is only a significant predictor for patients who currently have no possibility to use the respective CDM app (due to their treatment center). The study also provides some insights useful to m-health providers and healthcare professionals on how to get patients to adopt m-health. The significance of Social Influence demonstrates that app providers need to reach out to treating physicians and the patients' social environment, which in the case of rare chronic diseases could be done via patient associations. App providers should implement engaging and interesting additions to their apps. There are already abundant implementations of such functions in the context of general health applications. Similar features can be applied in the context of chronic diseases, where the serious nature of the disease needs to be respected, but nonetheless information should be presented in an interesting manner.

The limitations of the study are based on the measurement of intention rather than use, the small sample, and the specific context. Participants with the intention to use an app still must install and actually use the app. Therefore, a longitudinal design to track actual usage after the intention has been formed is more reliable. Unfortunately, this is especially difficult when respondents' privacy must be assured without any compromise. The number of respondents is a methodological restriction. Hence, the findings of this study can only be considered as exploratory. A higher number of participants would also allow for structural relationship modelling in subgroups, since multiple regressions cannot fully map the factors' relationships with each other.

Disease specifics do not allow a simple extension of the findings to other diseases. Hemophilia patients already have the disease. Perceived susceptibility may play a bigger role with a disease

that can be contracted (e.g., various forms of cancer). The download of the app cannot be done via an app store, but it must be provided by the HTC due to the sensitivity of the data handled and the needed cooperation with the HTC/physician. If an app can be offered via an app store, the rank of the app, its public rating by other users, and similar factors may influence the adoption of such apps.

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Essay IV: Making Treatment Knowledge available via 3D-models

Co-author(s): None

Abstract: This paper describes the development of an application to support surgical procedures and workforce development by utilizing WebGL and 3D-equipment. Improvement is obtained by codifying the knowledge of experienced clinicians through the use of 3D-models. Soft tissue filler treatments of the face serve as an example for applying this knowledge through the use of 3D-templates. The application aims to help novices to plan a treatment, validate a treatment model and improve the training and professional development of future clinicians.

Keywords: novice clinicians, 3D, documentation, treatment support, plastic procedures

1 Introduction

This paper describes the ongoing development of a solution to remedy the disparity in professional training between experienced and novice clinicians. Soft filler tissue treatment is used to showcase the prototype. Soft-filler tissue treatments of the face are interventions to achieve reconstructive and aesthetic changes in the face. The solution prototype is a cost-effective software/hardware combination that utilizes 3D-scanning, planning and documentation tools. We aim to provide a prototype that facilitates knowledge transfer and professional development. When finished, the prototype should also help in making the documented procedures available as new knowledge for future clinicians. Since the current training of clinicians is similar to other surgical disciplines, we will first elaborate on the ongoing problems in surgical knowledge transfer and treatment support.

2 Problem

When comparing surgical and diagnostic medicine, the increase in available digital support systems clearly favours diagnostics (Wall und Krummel 2020). This is evident in the available industry equipment as well as in the scientific literature. For example when utilizing AI, all recent scientific studies as well as commercial systems awaiting FDA approval were of diagnostic nature (Topol 2019). This disparity is problematic: The focus of research and development is shifting away from surgery, while advancement in this sector would be beneficial as well, and data increasingly indicates that a vast majority of the world's population has no access to skilled surgical care (Bath et al. 2019). Therefore, not only does the lack of digital support systems in surgery need to be addressed, but also the accessibility of these systems needs to be ensured. For example, in cancer diagnostics, the IBM Watson AI is able to provide the knowledge of an immense body of literature to a small clinic in a remote location.

The disparity described above can be attributed to the fact that diagnostic systems receive a limited number of structured digital inputs such as an EKG signal or radiographic images. There is also usually no need to process this data in real-time. A physician can take time to evaluate a diagnosis and search a vast body of literature for a structured and therefore referenceable problem. The AI support also allows the physician to utilize the whole body of scientific literature, which is beyond a single person's capacity (Druss und Marcus 2005). Surgery, on the other hand, works with inputs that include the position of organs and instruments, the haptic of these organs, sometime live video feeds as well as live data like heartrate. Furthermore, live assessment of the data is often needed. This difference also results in contrasting professional training between diagnostic and surgical medicine. Since it is difficult to relay the training

needed for successful surgeries in a book, surgeons use Halsted's apprenticeship model (Pellegrini et al. 2015b). This approach relies on the future surgeons to replicate good clinical practice under the supervision of experts. This method is long criticized for two reasons: It is known to be a risk to patient safety and it does not allow the surgeon to receive further feedback after his training (Velazquez-Pimentel et al. 2021). Reliable and objective feedback is needed to continue professional development. Healthcare software for professional development often also lacks the capability to seamlessly integrate into daily routine, and is then neglected to avoid the extra effort (Hult, Helena Vallo, Anders Hansson, and Martin Gellerstedt 2020). Adding to that, surgical culture shifts towards more complex and demanding techniques as well as shorter trainer-trainee relationships (Velazquez-Pimentel et al. 2021). The problem is exacerbated in the field of aesthetic and reconstructive plastic surgery. Procedures like face-lifting are often performed by non-surgeons, since they only require needle injection as opposed to a surgical procedure. For example, in Germany, a dermatologist who is not practising as a surgeon may conduct a soft-filler therapy with hyaluron and in some countries clinicians are not required to be trained physicians at all. The clinicians mainly receive their knowledge via Halsted's apprenticeship model. This process is likely to increase the patient risk: While face lifting does not seem as intrusive as most surgical treatments, the consequences of mistakes may still be severe: At best, the patient's face receives an unwanted deformation, but at worst, the clinician injects the compound into a bloodstream, which may lead to paralysis or worse (Price et al. 2007).

3 Clinician Training in Plastic Surgery

While knowledge management in health care has been long discussed (Denise Kitchiner et al. 1996), the health care sector is one of the later adopters of digital knowledge management systems (Mohajan 2016). The healthcare sector in general suffers from missing transfer of the rich scientific knowledge to clinical practice (Syed Sibte Raza Abidi 2007). Knowledge management increased the differences between diagnostical and surgical healthcare: While the diagnostic decision processes were easy to digitalize, the apprenticeship model proved more difficult to transfer. A popular way to alleviate this is training based on virtual reality (VR), but the consequences of surgical interventions are challenging to simulate. While the technology is very useful to train operating room procedures or convey the structure of organs via 3D-models, it still does not reliably compete with surgery training using cadavers (Bairamian et al. 2019). Still, 3D-data makes it possible to capture the inputs during surgeries mentioned in chapter II. It allows to capture the position and shape of every object involved and, if measured over time, may also collect data on haptic and density due to the speed of deformations. The application

of the 3D-data is dependent on the equipment: Consumer-level 3D-scanners may only be suited to capture pre- and post-surgery models, while higher-end scanners are able to compile 3D-models at a high frame rate and possibly support live operations. An important part of knowledge management is also to provide the ability to improve the knowledge of the clinicians.

The apprenticeship model further results in a small body of explicit, codified knowledge for clinicians. When teaching by observing, a model for the intervention is not strictly needed. Nonetheless, novice clinicians need to respect knowledge from various sources, e. g., anatomy for bloodstream pathways and bone structures, in order to perform a low-risk injection. The MD-Codes are a recent model developed by Mauricio de Maio that tries to include the necessary knowledge and offer a reliable template to new clinicians of soft-tissue-filler therapy (Maio 2021). The MD-Codes can serve as an example of a transfer from tacit to explicit knowledge, which still needs to be expanded upon in a knowledge management system.

We develop a prototype that allows clinicians to effectively incorporate the MD-Codes into their work, improve their abilities and contribute to the surgical knowledge base in the long term. The resulting prototype should serve as an example on how digital knowledge management systems can be utilized in a surgical field with novice clinicians and offer an alternative to the old apprenticeship model. In terms of knowledge management, it shows a possible transition of tacit knowledge (the experience of seasoned clinicians) into explicit knowledge (the applied MD-Codes). Here, knowledge management is not applied within an organization, but across a medical discipline. Inter-organizational knowledge sharing is beneficial to the patient, especially in the case of individual practitioners who are usually too small to develop own knowledge management systems (Al-Busaidi).

4 Context

Surgical interventions in face lifting are a procedure often solely determined by the clinician's experience rather than systematic foundation. They use a multitude of different substances and methods, even when performing the same operations. Knowledge about the procedures is often implicit, with clinicians mostly achieving good results due to their intuition and experience. Newly trained clinicians rely on apprenticeship learning: They observe an experienced clinician during his intervention, then try to imitate the observed techniques during their own procedures. Therefore, the interventions show varied success.

As an example of plastic surgical procedures, we use soft tissue filler based volumization. Volumization is used to remove aging effects, i. e. the shrinking of the skin, for example, in the

face. It is intended to restore a more juvenile look. Soft tissue fillers include hyaluron, collagen or autologous fat. They are applied via sharp or dull needle. The treatments vary in their injection points and point-specific injection depth, filling volume, firmness of the used filler and the injection technique. Techniques vary in the way the needle is moved during the injection. The treatment variables mentioned above together with a pre- and post-intervention 3D-scan constitute the data used in our project.

A more standardized system called the MD-Codes (Maio 2021) was introduced for approaching and planning treatments, but the codes are not sufficiently detailed to be a reliable knowledge base for new clinicians. The codes provide several groups of injection points, with the intention that one group alters a specific facial feature. These points are currently the most advanced standard in soft tissue filler therapy and specify some of the variables needed for a hyaluron treatment. As shown in figure 2, the points have different geometries and colours. The geometry indicates the necessary injection technique, and the colour suggests an injection depth, which depends on the bone structure in the area. The codes still lack specifications on where to precisely inject and which volume to use.

Several 3D-applications to support face lifting treatments already exist, but they lack the necessary features to support and improve the treatments, perhaps apart from patient satisfaction which is also important. An example is the Quantificare LifeViz System. The accompanying camera and software allow for high-resolution images and 3D-model manipulation. These systems suffer from several drawbacks: 3D-model manipulation of the face is unrestricted and not guided by medical properties and no standardized intervention system is offered. Therefore, the influence of bones on the procedure or the risk of the needle hitting a blood stream are not considered (see Figure 3). In addition, the price is relatively high, which may prevent the diffusion of the system.

5 Prototype Utilization

Using the example of treatments with soft tissue fillers, we will showcase our current prototype using WebGL and affordable 3D-scanning equipment. In the following we will cover the needed software and hardware framework, and how the prototype is used during a treatment.

5.1 Hardware and Software

The advancement of WebGL allows for a platform-independent 3D software system, since most modern browsers offer WebGL. For our prototype, we use the WebGL-based Three.js JavaScript package. With the additional use of HTML5, the prototype provides a responsive design and can be used on whatever device the clinician has available, though big screens are recommended. Three.js also provides the necessary interfaces to use most available 3D-scanners. Applicable 3D-scanners range from phones to handheld devices and the price range starts at 200€ for consumer devices and goes up to around 4000€ for professional models. A consumer device is enough for our prototype. The file format is standardized. Three.js is able to import this standardized file range, be it the classic .obj-Format or the more recent .gltf. Since many soft tissue filler treatments are executed in smaller practices, the equipment and software need to be easy to use and affordable. The handheld scanner we use to demonstrate the prototype is a XYZ-3D-scanner 2.0 that cost 235€.

Figure 1: Handheld 3D-scanning device [15]

It works with the Intel Realsense camera utilizing IR-based stereo-photogrammetry. Such a scanner can process 1920x1080 pixels at 40 fps and a depth resolution between 0.2 and 1.5 mm. The resolution is adequate for intervention planning and documentation purposes. The 3D-model only takes a few minutes to be captured, therefore this provides a cost-effective solution. Such a stereo-camera based system, supported by IR-sensors, offers the best price-performance ratio (Wong et al. 2008).

5.2 Treatment planning & documentation

Since clinicians are usually paid on a per-procedure basis, the prototype needs to be seamlessly incorporated in the existing workflow, as being too time-intensive would not incentivize its use. Clinicians are obliged to document the intervention in order to be prepared for any legal consequences, therefore, doing a pre- and post-procedure 3D-scan can be viewed as part of a routine treatment.

The facelift treatment planning has two parts, which vary in how well they may be standardized. The results of a soft tissue filler treatment are subjective because they depend, for example, on culture and personal preference. While several attempts have been made to develop an objective measure (e. g., the golden ratio), the measures were not reproducible in experimental studies (Laurentini und Bottino 2014). The other objective part is to make the treatment results predictable and prevent harm from unexperienced applications. Hence, this is the focus of our

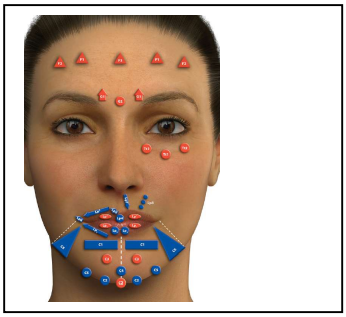

Figure 2: MD-codes for facial aesthetic treatment [13]

prototype. In the case of soft tissue fillers, a standardized treatment method first needs to make sure that the injections are correctly placed, i. e., have no possibility of piercing any bloodstream in the face. This is done by providing an initial intervention model, that is placed as an overlay ono the 3D-model of the face. In the case of our prototype, this initial model is based on the MD-codes (Maio 2021).

As described above, the MD-codes provide several groups of injection points. Our prototype offers the clinician to choose one of these groups as an overlay to plan the intervention. The chosen group depends on which feature the clinician wants to change. For example, in Figure 2, the five upper red triangles form a group to alter the forehead. The clinician may adjust the overlay to place the precise injection point on the 3D-model of the face. For each point, injection depth, volume and technique are documented. Ideally, the prototype would simulate the change in every vertex of the face model caused by a specified set of injections. The position change of a single vertex depends on several factors: The volume and injection vectors of each injection point, the interaction between each injection point and below-surface resistance like fat tissue and bones, individual attributes like skin tightness and time since injection due to the evaporation of the water part of the soft tissue filler. Therefore, the prototype focuses on precisely documenting the treatment data describing these factors, so that the accumulated data may be used to approximately simulate injection results in the future. Hence, a precise before and after documentation is needed. When using our prototype, the clinician performs an additional 3D-scan after the filler application. A post-treatment photo is usual practice to be prepared for possible legal consequences, hence it does not require extra time. In the case of bio-degradable fillers like hyaluronic acid, the treatment result will change over time, since the water content of the filling evaporates to a degree depending on the chosen compound's degree of hardness. To capture this change, a third scan after around seven days is necessary. This characteristic in particular renders soft-filler tissue treatments more challenging than they seem, since clinicians need to overshoot the initial injection just enough to counteract this degradation. Afterwards, the clinician can access a precise documentation of the performed treatment. The three 3D-scans can be compared with each other, the MD-codes overlay, and the treatment specifications. The provided information can be used to draw conclusion for future treatments,

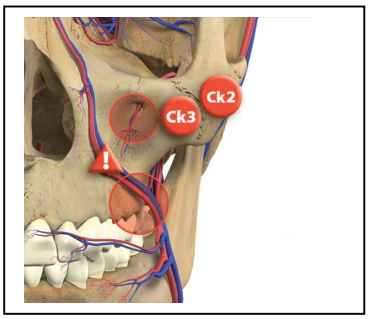

Figure 3: Example of facial bloodstream and bone features [13]

enabling professional development of novice clinicians. The documented treatments can also be exported and shared with other clinicians, for example, in order to further develop the MD-codes.

6 Prototype Design

In this chapter, we will briefly introduce the prototype architecture, 3D data format and how the MD-codes together with additional information are represented in the 3D-model.

The architecture represents the priorities in the prototype design. The prototype is usable without further setup as a purely browser-based application. It uses Three.js interfaces to import and export 3D-face models along with standard HTML5 interfaces to allow input of necessary additional data like patient name and age. The HTML5 Web Storage API allows for persistent data storage in a quick setup. This framework requires no further installation apart from a WebGL-enabled browser, which is usually present on most self-updating modern devices and includes all common browsers like Chrome or Firefox. If long-term usage of a specific device is planned, the prototype supports local storage of exported 3D-models administrated by an equally setup-free SQLite database. This browser-based architecture enables the use of the prototype by clinicians without further IT knowledge, which contributes to easier software use and, therefore, making the expert knowledge more accessible.

WebGL in Three.js allows to import 3D-models from multiple scanner types, then use them in the buffer geometry format. Buffer geometry treats the face model vertices as a single list of coordinate values (x_1, y_1, z_1, x_2, y_2, z_2, …), which allows for better performance when performing, for example, Iterative Closest Point (ICP) algorithms, as described below. Scanned models are also still small enough to utilize the Web Storage API. The prototype allows to export the file in the Standard Tesselation Language (STL) format. STL is the IEEE-recommended format to use for medical 3D surface imaging due to its usability (IEEE Recommended Practice for Three-Dimensional (3D) Medical Modeling null), which facilitates the comparison to other scanned models.

Each set of injection points based on MD-codes is a set of lines in the 3D-model. The lines are aligned towards the centre of the face model. The alignment (y-axis) is locked, but the other two axes are free to be adjusted by the clinician, who can use this to set his precise injection point. The lines are linked to the attributes of each injection. Initial values for those attributes are set according to the MD-codes, therefore, every point provides a suggestion for the applied technique, injection device, volume and injection depth. Additionally, several injection points produce alerts if they are close to an artery or other sensitive parts of the face (e. g., the eyelids).

The suggestions are based on de Maio's own clinical experience. An additional attribute is the degree of hardness of the used product, which influences how much the facial structure changes during the week after the injection, while the water part is evaporating. Since the treatments are highly individual, prototype users may change the suggested values of these attributes. However, it requires experience and professional knowledge to understand the implications of changing the injection depth from a subcutaneous to the supraperiosteal layer, for example. The values a clinician is expected to adjust are the precise position and the injected volume, since those are dependent on and derivable from the individual patient's face. Therefore, these two attributes also offer the best opportunities for the clinician's self-improvement and professional development. Hence, our prototype provides additional data to support these decisions, make the relationship between face fold depth and needed volume more transparent, and allowing comparison to previous cases. De Maio intended the MD-codes to be applicable with visual cues informing about the necessary steps at each injection point, in order to reduce the amount of preparation and irritation due to language barriers. To make the 3D-model accessible in the same way, the prototype overlay uses a visual representation to display the main values chosen for each injection point: The thickness of the line implies the injected volume of hyaluronic acid, the colour represents injection depth, and a hazard triangle indicates an injection point close to an artery. This allows the clinician to quickly grasp the planned treatment and enables a better visual comparison between different treatments. Apart from the injection position, each injection point has clearly categorized data.

In order to generate supporting data like depth measurements, several system restrictions need to be considered. The prototype is designed to be used with any 3D-scanner the clinician has available, therefore the model cannot be calibrated to a set value based on the scanner. Additionally, the scanned model may have a low mesh resolution due to less effective scanning equipment. As mentioned above, in order for clinicians to learn from performed treatments, the relationship between fold depth and injection volume needs to be traceable. This is achieved as follows: Each point of a MD-code point set is a line aligned towards the scanned face, creating an adjustable overlay. Each line is defined by two points in the coordinate system, one point inside the face model to anchor the alignment and one outside point to define the injection point. In order to standardize imported models from different scanners, imports are first scaled and rotated to fit an uncalibrated baseline face, upon which the overlays are projected. Then, the distance from each outer line point towards the scanned face model is measured. To account for low-mesh scans, the measurement is done as a raycast towards the closest point on the face model. The closest point is identified by using the ICP (Rusinkiewicz und Levoy 2000)

algorithm to match each point on the line to each point of the face model. As a result, the clinician receives an information about the fold depth at the injection point. He further receives information about facial symmetry, since the distances are calculated on both sides. The injection volume can then be adjusted accordingly. If the clinician did the same point set treatment in the past, the distance and volume values of past treatments may be looked up as well. The same distance calculation is then performed for both post-treatment scans. Therefore, the clinician gets the initial fold depth, applied volume of hyaluronic acid and the post-treatment and post-evaporation change per injection point. In total, each treatment is documented as a series of up to three 3D face models, each with the point set overlay according to the applied treatment and connected relational data regarding the different attributes of the injection points as well as general data like the patient's age.

7 Summary

Until now, knowledge of face lifting procedures is transferred in an outdated way that increases patient risk. The proposed software/intervention model follows the call for a more objective and standardized planning and evaluation of the procedures, which is enabled by 3D-technology (Toriumi und Dixon 2011).

The prototype allows for a standardized and traceable approach to treatments. This is an improvement compared to the previously used before-after photo method. The traceability allows the clinician to analyse and learn from his performed treatments. The effect of certain injection points, types, depths, and volumes is now captured in data, which allows to iterate over previous interventions, find patterns and improve the results.

This also allows for a more patient-centred treatment, as the accumulated data allows to simulate results of an intervention. This allows for a better discussion of intended intervention results and may sway indecisive patients in favour of a treatment.

Lastly, the main advantage is that the documented data can be used to train new clinicians. While the current way of learning is that of an apprentice taught by observing an experienced surgeon, the accumulated documentation allows to derive proper technique from being able to access the details of all previous treatments. The tacit knowledge of the experienced clinicians is thus available as explicit knowledge to new apprentices.

Further plans are to systematically evaluate the treatment data to develop a more mature model for future interventions and improve upon the existing MD-codes. The current architecture of the prototype focuses on making the expert knowledge in form of the MD-codes as easily accessible as possible. This restricts the software to be a browser-based application. Future

iterations can offer an interface to a web service to accumulate anonymous treatment documentations at a central web server. The treatment data can then be used to validate the MD-Codes. The prototype should demonstrate how healthcare information technology can support novice clinicians to reduce patient risk while at the same time enabling professional development of the clinicians. It should also help to validate a medical treatment model.

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Essay V: Using 3D-Technology to Support Facial Treatment

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Abstract: Facial treatments, even for aesthetic purposes, often involve unnecessary patient risk due to treatment by unexperienced practitioners and/or a lack of standardized procedures. We develop a software to support and standardize facial treatments based on knowledge of experts. The prototype utilizes WebGL and 3D-equipment, but it also focuses affordability to make its wide-spread use more likely. It aims to help in treatment planning along with professional self-development. In this paper, we describe the underlying problem, a possible medical model as a solution, the prototype architecture, and how the prototype is utilized in the treatment process. Finally, we conduct a test of the prototype.

Keywords: 3D-documentation, treatment support, non-surgical aesthetical procedures.

1 Introduction

In this paper, we present a prototype for making facial treatment knowledge available to novice practitioners consisting of a web-based software and low-cost hardware. It showcases the prototype itself as well as additional validation. We use soft filler tissue treatment to demonstrate the prototype, since this is often performed by novice clinicians. Soft-filler tissue treatments are non-surgical aesthetic interventions in the face, but nonetheless can involve critical patient risk if done wrong. The prototype focuses on providing cost-effective 3D-intervention planning and documentation, since other available, but more expensive hardware likely will not be used by novice practitioners. The aim is to provide a prototype that enables both knowledge transfer and professional development. Additionally, in order to address the problems stated in the next section, the prototype needs to be as accessible as possible in terms of hardware requirements. The prototype should also be able to validate different treatment models.

The training of practitioners is similar across surgical disciplines; therefore, we will first address the problems in current training to demonstrate the necessity of our prototype. In recent years, the number of digital support systems in the medicine sector increased, but the development is clearly biased towards diagnostic medicine compared to surgical medicine [1]. Diagnostics provide a better fit for most digital technologies: A main example is the development of medical AI, where diagnostic AI systems like IBM Watson are well-known for condensing information. The AI support allows the physician to utilize a body of scientific literature beyond a single person's capacity [2]. Also, all systems lined up for FDA approval are from the diagnostic sector [3]. This is broadening the gap between surgical and diagnostic medicine. While diagnostics are continuously improved, the basic access to skilled surgical care is lacking globally [4]. Our prototype should, therefore, contribute to the digital innovations geared towards surgical treatment with a focus on affordability.

2 Practitioner Training

The gap between diagnostic and surgical practice is not only reflected in the availability of digital support systems, but also in the professional training of diagnostic and surgical clinicians. Professional training for surgeons and adjacent disciplines like plastic treatments relies on Halsted's apprenticeship model [5]. This approach means that apprentice surgeons learn to replicate good clinical practice by observing and imitating experts. There are two shortcomings to this method: The process does not establish a good framework for further self-improvement without the help of additional experts. This missing framework opens risks for

patient safety [6]. Continuous professional development requires a framework within which to improve. Another requirement for healthcare software is to seamlessly integrate into daily routine. If software use adds to the time needed for a procedure, it will only be used if necessary or mandated [7]. Surgical medicine in general also sees a trend of more complex techniques, while apprenticeship periods get shorter [6]. This change has an increased impact on fields like aesthetic and reconstructive plastic procedures, where procedures are often performed by novices and/or non-surgeon clinicians. This is sometimes permitted in lifting treatments, where only needle injections are needed. In Germany, for example, only physicians may conduct soft-filler therapies with substances like Hyaluron. In other countries, being a trained physician is not a requirement to perform such procedures. Practitioners are often trained in workshops by companies who sell beauty-treatment products.

The training is related to Halsted's model [5], since the treatment is usually demonstrated by an expert and then replicated by the participants. This short training period has implications for patient health. While an incorrect surgical treatment may have more dire consequences, faulty needle injections can result in deformation or release of the filler compound into a vein, which may lead to paralysis or worse [8]. While knowledge management in health care has been long discussed [9], the health care sector is one of the later adopters of digital knowledge management systems [10]. The healthcare sector in general suffers from missing transfer of the rich scientific knowledge to clinical practice [11]. Knowledge management increased the differences between diagnostical and surgical healthcare: While the diagnostic decision processes were easy to digitalize, the apprenticeship model [5] proved more difficult to transfer. Still, 3D-data makes it possible to capture the inputs during surgeries mentioned in the introduction. It allows to capture the position and shape of every object involved and, if measured over time, may also collect data on haptic and density due to the speed of deformations. An important part of knowledge management is also to provide the ability to improve the knowledge of the clinicians. When teaching by observing, a model for the intervention is not strictly needed. Nonetheless, novice clinicians need to respect knowledge from various sources, e. g., anatomy of bloodstream pathways and bone structures, to perform a low-risk injection.

3 Medical Model: The MD Codes

As elaborated above, the results of face-lifting interventions depend heavily on the practitioner's experience and mentor, rather than being similar due to standardized procedures. This also leads to the development of own treatment techniques by many practitioners,

depending on what seems to produce the most volume in their patients' faces in the shortest amount of time. Besides different techniques, the preferred filler substances may vary, creating another variable. Substances differ in different categories like thickness or evaporation time, which affect treatment results. Furthermore, to be economic, practitioners try to curtail the injection volume in a way that leaves no residue in a substance bottle, i. e., they try not to waste any product.

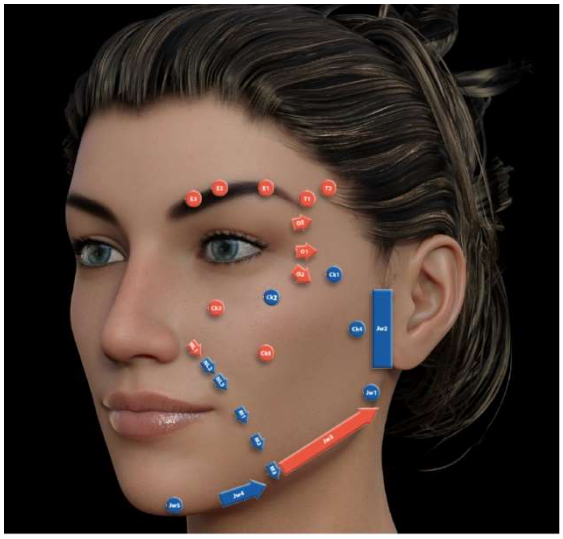

Figure 1: MD-codes for facial aesthetic treatment in the cheek area [12]

To approach these challenges, de Maio developed a treatment framework called the MD (MeDical)-codes [12]. The codes condense his own professional experience into a template for novice clinicians and are an example of transferring tacit to explicit knowledge. The MD-codes were first introduced for approaching and planning treatments in 2015 [13], but they were not sufficiently detailed to be a reliable knowledge base for new clinicians. They were focussing on providing safe locations for injections when treating different parts of the face. The codes provide several groups of injection points, with the intention that one group alters a specific facial feature (see figure 1 for examples). These points are currently the most advanced standard in soft tissue filler therapy and specify some of the variables needed for a Hyaluron treatment. As shown in figure 1, the points have different geometries and colours. The geometry indicates the necessary injection technique while the colour suggests an injection depth, which depends on the bone structure in the area. An improved system was released in 2021 [14]. The new version of the codes offers additional specifications and is now comprehensive enough to guide the complete treatment process. The MD-model [14] consists of two parts, that cover the complete treatment process. The codes themselves are a set of injection points with each point being assigned information regarding the treatment, such as needle type, injection volume,

warnings, needle movement during injection and more. Figure 2 shows an example of the specifications for the tear trough area, which is a vulnerable area between an eye and a cheek.

Anatomical unit MD code	Injection area	Target depth of injection	Injection device	Injection delivery	Alerts	Active number per side (mL)[a]
Tear trough (*Tr*)[i]						
Tr1	Central infraorbital	Supraperiosteal[b]	Cannula		⚠ Be wary of the infraorbital artery branches[i]	0.2
Tr2	Lateral infraorbital	Supraperiosteal[b]	Cannula			0.2
Tr3	Medial infraorbital	Supraperiosteal[b]	Cannula		⚠ Be wary of the angular artery and vein[i]	0.1

Figure 2: Treatment variables per point [14]

The other part of the model [14] is a number of decision rules. They suggest a set of injection points based on the current state of the patient's facial features. Figure 3 shows the decision process for the tear through area outlined in figure 2. Since it is a vulnerable area (see figure 4), most decision paths try to avoid direct needle injections. Therefore, it provides novice clinicians with instructions about both, what exactly to treat and how to perform a treatment. The rules are presented as decision trees and, when combined, always aim at a holistic treatment that conceals the effects of aging [14]. Our prototype uses the MD-model [14] as a basis to enable standardized treatment procedures. Since the MD-codes are a new model based on a single person's experience, our prototype will also be used to test and validate them. Additionally, since many practitioners have developed own techniques due to different teachers, the prototype should be able to represent individual point sets as well, or a combination of MD-codes [14] and own techniques. These documentation possibilities should enable practitioners to have a structured and traceable professional development and provide an alternative to the apprenticeship model [5]. Here, knowledge management is not applied within an organization, but across a medical discipline. Inter-organizational knowledge sharing is beneficial to the patient, especially in the case of individual practitioners who often cannot develop their own codified knowledge management systems [15].

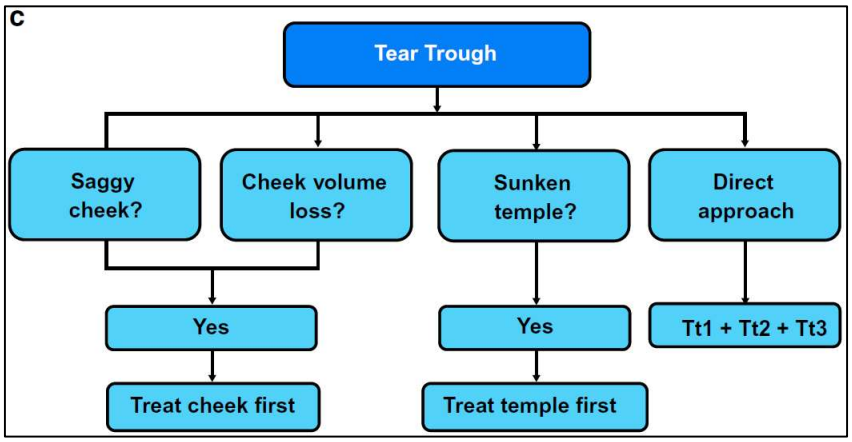

Figure 3: Decision Algorithm [14]

The MD-codes are applied in non-surgical soft tissue filler based volumization. Volumization is used to remove aging effects, for example, the shrinking of the skin in the face. It is intended to restore a more juvenile look. Soft tissue fillers include Hyaluron, collagen, or autologous fat. They are applied via sharp or dull needles. The treatments vary in their injection points and point-specific injection depth, filling volume, firmness of the used filler, and the injection technique. Techniques vary in the way the needle is moved during the injection. The treatment variables mentioned above together with a pre- and post-intervention 3D-scan constitute the data used in our project.

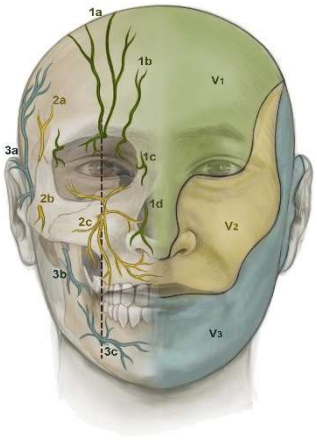

Figure 4: Example of facial bloodstream and bone features [16]

4 Prototype Architecture

The treatment by non-surgeons mentioned in the introduction leads to the additional problem that specialized equipment to support a treatment is usually missing. Better equipment would allow the practitioner for more accurate planning and ultimately reduced patient risk. While equipment is commercially available, it is usually too costly for non-specialized practitioners to purchase. Therefore, it is also necessary to provide a technology that is affordable, easy to use, and based on the medical procedure. Using the example of treatments with soft tissue fillers, we will showcase our current prototype using WebGL and affordable 3D-scanning equipment. In the following, we will cover the needed software and hardware and how the prototype is used during a treatment.

4.1 Hardware

The application of 3D-data depends on the equipment: Consumer-level 3D-scanners may only be suited to capture pre- and post-surgery models, while higher-end scanners are able to compile 3D-models at a high frame rate and possibly support live operations. Applicable 3D-scanners range from mobile phones to handheld devices and the price range is between 200€ (for

consumer devices) and around 4000€ (for professional models). As stated in the section above, a single pre-treatment scan is enough to enable treatment support guided by MD-codes. A post-treatment scan is desirable for documentation purposes. 3D-scanners usually fall within three categories [17]: very precise industry models, small-model scanners for supplementing 3D-printing and small webcam-based scanners like Kinect or Intel Realsense. The Intel Realsense camera series is prized at around 200€. It utilizes IR-based stereo-photogrammetry. Such a scanner can process 1920x1080 pixels at 40 fps and has a depth resolution between 0.2 and 1.5 mm. The 3D-model only takes a few minutes to be captured providing a quick and cost-effective solution. Such a system based on a stereo-camera, supported by IR-sensors, offers the best price-performance ratio [18]. The handheld scanner we use to demonstrate our prototype is a XYZ-3D-scanner 2.0 (see figure 5) that cost 235€. It represents an Intel Realsense SR300 camera with a handle. The specified scanning range of 0.3-0.2 meters allows an easy scan in a practitioner's office.

Figure 5: Handheld 3D-scanning device [19]

4.2 Software

First, the 3D-scan needs to be compiled into a 3D-model. Intel did only provide a rudimentary SDK for their Realsense scanners; therefore, a third-party software needs to be used. To keep the flexibility, we utilize the ItSeez3D-scanner suite, which is based on the Intel SDK. It is compatible to all Realsense camera models and allows to compile the model either locally or on a web server, which allows for our prototype to be also run from mobile devices with low processing power. The advancement of WebGL further supplements a platform-independent mobile device 3D-software system, since most modern browsers offer WebGL. For our prototype, we use the WebGL-based Three.js JavaScript package. With the additional use of HTML5, the prototype provides a responsive design and can be used on whatever device the clinician has available, though big screens are recommended. Three.js also provides the necessary interfaces to use most available 3D-imports. The file format is standardized. Three.js is able to import this standardized file range, be it the classic .obj-Format or the more recent

.gltf. Since many soft tissue filler treatments are executed in small offices, the equipment and software need to be easy to use and affordable.

5 Usage

In the following, we will describe how the prototype is used during an aesthetic treatment. As outlined in the introduction, the prototype needs to be seamlessly incorporated in the existing workflow. Therefore, it is advantageous that during treatment some time is usually reserved to document the interventions for legal reasons.

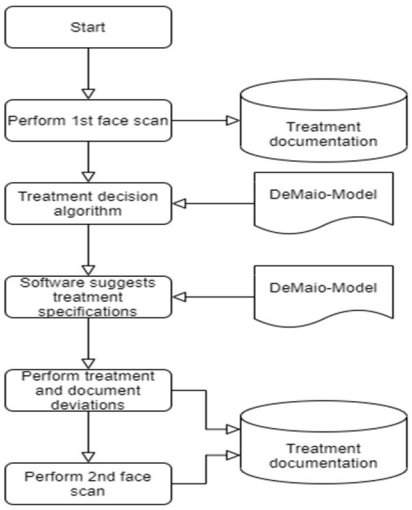

Figure 6: Treatment process

A short overview of the treatment process is shown in figure 6. The clinician first needs to perform a face scan and load it into the prototype. Then, the practitioner can choose the relevant MD-codes [14] based on the given aesthetic goal via the decision tree. Figure 3 shows the decision tree for the tear through area, where the rules can either guide to a set of points (Tt1-3) or further decision trees (Treat cheek/temple first). Based on the result, the practitioner receives a suggestion of points including treatment variables like technique or needle type. For precise documentation, each point represented in the model [14] can be dragged to its injection point on the scanned face. If the clinician deviates from suggested values for treatment variables, those changes can also be documented. Additionally, to be able to represent individual techniques, practitioners can add their own injection points along with other data. An example of this is shown in figure 7: On the top left are the data values applicable for injection points (one field per point, the size is increased for better screenshot readability). The point itself is placed as a red 3D-line on the left cheek area of the patient scan in the middle. Finally, on the top right, a menu is available to let the practitioner add individual points or point groups as well as change the camera perspective and scan orientation. The position change of a

single vertex depends on several factors: The volume and injection vectors of each injection point, the interaction between each injection point and below-surface resistance like fat tissue and bones, individual attributes like skin tightness, and time since injection (because the water part evaporates in a soft tissue filler). While the prototype currently is not able to simulate the changes, a structured documentation will enable practitioners to trace their work and better predict future results. To accomplish this, a second scan is performed after the treatment. A comparison of the documentation enables the practitioner to evaluate his work after the treatment.

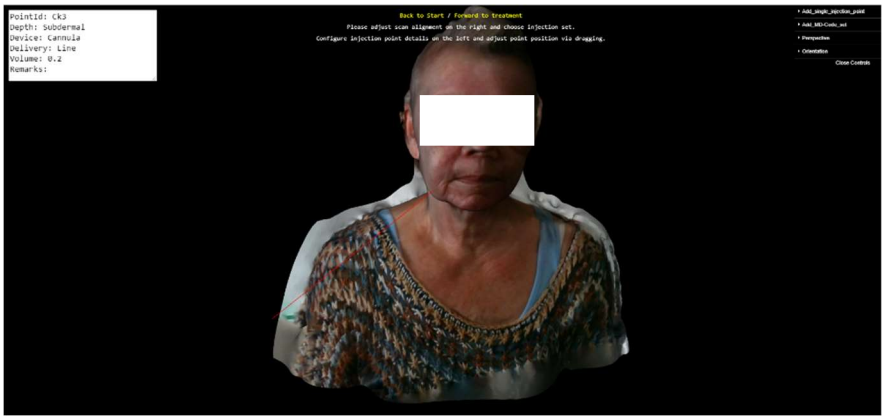

Figure 7: Example screenshot with individual injection point

6 Prototype Features

The design represents the priorities set in the sections above. The prototype is browser-based and, therefore, a setup-free application. To run, it needs a web server, which may be online or local and it is available as open-source software, like XAMPP. The Three.js API is used to import and export 3D-face models, while standard HTML5 interfaces are utilized to input additional data like patient name and age. A WebGL-enabled browser is common standard on most modern devices (e. g., Chrome, Firefox). HTML5 LocalStorage API offers the persistent short-term database. The LocalStorage key-value-pairs are used to store the necessary data as JSON-strings. Since LocalStorage is browser-based and domain-specific, it is immediately available online and local.

The browser-based architecture does not require deeper IT-knowledge from practitioners and contributes to making the software more accessible. Even low-cost desktops can offer the required browser. The suggested third-party compilation tool, ItSeez3D-Scanner, is available as an app for mobile devices or desktops. WebGL in Three.js allows multiple data types for 3D-model import, then uses them in the buffer geometry format. Buffer geometry stores vertices as a single list of coordinate values, which allows for better performance. 3D-models may also be exported in the Standard Tesselation Language (STL) format which is the IEEE-

recommended format to use for medical 3D-surface imaging due to its usability [20]. MD-code injection point sets are represented as 3D-lines in the model. They are aligned towards the centre of the face and can be adjusted in all but the y layer, enabling the practitioner to precisely set the injection point. Each line is linked to a set of injection point attributes shown in figures 2 and 7. The initial suggestions are based on MD-codes, but may be adjusted. The suggestions also produce alerts if they are too close to sensitive underlying parts of the face, like blood streams. An attribute influencing the documentation process is the degree of hardness of the used product. It determines how much the facial structure changes during the week after the injection due to the vaporizing water part. Therefore, another scan may be taken after the vaporization process finishes. While the initial suggestions are based on de Maio's clinical experience [14], individual adjustment allows practitioners to refine the model with own techniques. The results may then be compared at conferences and further develop the model. The changes by individual users are necessary, since some treatments are highly individual. Still, this option should only be utilized by more experienced practitioners.

The precise position and the injected volume on the other hand are expected to be changed by the practitioner, since those depend on each individual patient's face. Additionally, the points in MD-codes each cover a small area in which to inject, as shown in figure 1. This renders these two attributes to be the best opportunities for the clinician's self-improvement and professional development. Therefore, the prototype offers additional data to support these decisions. It allows for comparisons with results of previous cases and between pre- and post-treatment scans. To reduce the impact of language barriers and preparation time, MD-codes contain several visual cues to indicate the treatment specifics at each point. The prototype uses a similar visual representation of main point attributes on the 3D-model: line diameter correlates to the injected volume of hyaluronic acid, its colour represents injection depth, and a hazard triangle indicates an injection point close to an artery. This is useful during the treatment itself, since the practitioner can quickly access necessary information when preparing the next syringe. It also facilitates the comparison of different treatments.

To obtain the decision support data mentioned above, the prototype needs to respect several system restrictions. The supporting data includes measurements of depth and volume change in the face. The prototype cannot be effectively calibrated from the start, since it is designed to work with any scanner the practitioner has available. This may also result in a low mesh resolution of the 3D-model. Still, to enable professional self-improvement, a transparent relationship between face measurements and injection volume is needed. The implemented solution is as follows: Each injection point is a line anchored in a plane parallel towards the

scanned face. Each line is defined by two points in the coordinate system, one point on the surface of the face model to anchor the alignment and one outside point on the plane to define the injection point. To standardize imported models from different scanners, imports are first scaled and rotated to fit an uncalibrated baseline face, upon which the overlays are projected. Then, the distance from each outer line point towards the scanned face model is measured. To account for low-mesh scans, the measurement is done as a raycast towards the closest point on the face model. The closest point is identified by using the ICP [21] algorithm to match each point on the line to each point of the face model. As a result, the clinician receives an information about the fold depth at the injection point. He further receives information about facial symmetry, since the distances are calculated on both sides. The injection volume can then be adjusted accordingly. If the clinician did the same point set treatment in the past, the distance and volume values of past treatments may be looked up as well. The same distance calculation is then performed for both post-treatment scans. Therefore, the clinician gets the initial fold depth, applied volume of hyaluronic acid and the post-treatment and post-evaporation change per injection point. In total, each treatment is documented as a series of up to three 3D-face models, each with the point set overlay according to the applied treatment and connected relational data regarding the different attributes of the injection points as well as general data like the patient's age.

7 Prototype Test

To validate our prototype, we performed a test procedure with a patient in need of a full facial lift. As outlined above, the test has two objectives:

The prototype should provide the guidance necessary to perform a treatment.

The prototype should perform the task sufficiently well with low-cost equipment.

7.1 Test Conditions

The software was tested with a treatment procedure performed by an experienced dermatologist, who often performs soft-tissue filler treatments. The patient received a full facial lift. 3D-scanning was performed before and after the treatment, with a series of three different postures at each point. The three postures included a frontal image with level head, head tilted up 45 degrees and head tilted up 45 degrees while smiling. The last one is used to accentuate the treatment improvements. Below, we will show the criteria and results of the two testing procedures.

7.2 Medical Model

To test the medical model [14], the MD-codes, we assess its suggestions against the assessments of an experienced practitioner in the testing procedure. Table 1 shows the properties suggested by de Maio as well as the properties used by the practitioner. A before-and-after 3D-scan is shown in figure 8.

Injection	Depth		Volume		Needle	
	De Maio	Used	De Maio	Used	De Maio	Used
Ck1	D	D	0.3	0.2	N	N
CK2	D	D	0.2	0.2	N	N
Ck3	D	S	0.3	0.1	N	N
T1	D	D	0.5	0.1	N	C
T2	D	D	0.5	0.15	N	C
Tt1	D	S	0.2	0.05	C	C
Tt2	D	S	0.2	0.05	C	C
Tt3	D	S	0.2	0.05	C	C
NL	D	S	0.3	0.4	N	C
Jw1	D	D	0.5	0.2	N	N
Jw2	S	S	0.5	0.3	C	C
Jw3	S	S	1	0.2	C	C
Jw4	S	D	0.5	0.1	C	N
ML		S		0.2		C
W		S		0.5		C
MI		S		0.2		C
D = Deep (Supraperiosteal), S=Subcutaneous, C=Cannula, N=Needle, Volume is measured in mL						

Table 1: Testing of the MD-codes

The suggested and performed treatment show several differences. The practitioner added three own injection points not covered by the medical model. Concerning the injection point properties, the De Maio-model uses a bigger share of deep injections and much more material in several points [14]. Even considering the additional injection points, the practitioner only used 3 mL Hyaluron, while MD-codes suggested 4,9 mL for the same treatment [14]. The material is sold in bottles of 1 mL priced at around 300 € each, therefore the MD-code treatment is about 600€ more expensive in materials.

7.3 3D-Technology

The second objective tests the hardware performance. To successfully support the treatments, the scanned 3D-models need to be precise enough to represent the correct facial details.

	Vertices	Triangles	Time to compute
Pre-treatment	24876	49181	18s
Post-treatment	25109	49820	19s

Table 2: Data of the treatment scans shown in Figure 8

An important aspect, as mentioned above, is the seamless and fast integration of the software into the standardized procedures. Computing time was measured on an Intel i7-8550U CPU at 1.8 GHz. As shown in table 2, the scanner provides a consistent performance. A big advantage of commercial-grade scanners is their scanning speed. The utilized Realsense Setup requires to walk around the patient and the patient needs to remain motionless during this process. Motion will lead to distortion as visible in the shoulders area in figure 8. The scanning time was reduced by only scanning the frontal face instead of the full bust, but still around 20 seconds were needed for each scan.

Figure 8: Treatment Scans. Pre-treatment (left) and post-treatment (right), level-head posture

7.4 Discussion

The experiment was done to test two objectives. In the medical part, we tested if the software and MD-codes could provide the necessary guidance for a treatment. When utilized by an experienced practitioner, several differences were found. As mentioned above, practitioners often use their own point sets, and in our test treatment, the practitioner also diverged from the De Maio model [14]. The option of free setting of points in the prototype allows to track these individual sets. Therefore, a novice could stay within the De Maio model [14] using the

prototype, while experienced practitioners could also use our system to document their more individual treatments. The MD-codes also suggested the use of more material. As visible in figure 8, a change in cheek volume was achieved by the practitioner with three fifths of the suggested material. Since this lowers the material cost per treatment, less material use is desirable for most practitioners and patients. Novices can at first use the guiding frame of the MD-codes and then compare their results in the 3D-documentation of the prototype and gradually lower the amount of material used.

In the technical part, we tested if the low-cost equipment was able to perform the task sufficiently well. As the figures 8 and 7 show, the model textures are partially distorted in the right part of the face. This may either be due to the dim light or to patient movement during the scanning phase. Apart from that, the vertex resolution can display the change in volume, and a processing time of 18s on an average modern processor seems acceptable.

8 Conclusion

We introduced a web-based software prototype to plan and document soft-tissue filler treatments with 3D-models. The prototype implements a medical model to standardize the treatment and reduce patient risk. The implication for practise is that unexperienced practitioners using guidance by MD-codes, our software, and relatively cheap 3D-cameras can perform good and safe face treatments. Another implication is that there is less need for an experienced practitioner to execute the apprenticeship learning model. It is possible to transfer the necessary knowledge via recommendations by an expert and with digital systems. This is also of theoretical interest because it changes the transfer of knowledge. Besides codification, which is typically used in diagnostic medicine, photos (scans) and 3D-treatment documentation present another transfer option.

Our test showed that the prototype can fulfil its intended functions, but still needs some improvement, mainly on the medical side. The MD-codes can serve as a guiding framework for novices, but the differences in the test between suggested and performed treatment show the need for a more refined model, which we will discuss below.

9 Future Work

As mentioned in section 5, the prototype currently can neither simulate the precise changes that will occur due to an injection, nor can it automatically generate a complete suggestion for treatment. The position change of a single vertex depends on several factors: The volume and injection vectors of each injection point, the interaction between each injection point, and

below-surface resistance like fat tissue and bones, individual attributes like skin tightness and time since injection. Therefore, a future version of the software may collect this data and use it in a machine-learning process to predict the changes. A complete suggestion for injections is also dependent on beauty standards, which are subjective at the individual patient level. While several attempts have been made to develop an objective measure (e. g., the golden ratio), the measures were not reproducible in experimental studies [22]. However, since MD-codes provide standardized injection volumes [14], they may be viewed as another attempt to standardize beauty procedures. Hyaluron enables this by being a flexible soft-tissue filler that can adapt to different faces. Therefore, the documented results of the treatments should be tested against beauty standards in future studies. This may enable the software to produce automatic suggestions in accordance with most conceptions of beauty.

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Essay VI: Einstellungen zu Inklusion von Lehrkräften an berufsbildenden Schulen. Ergebnisse einer empirischen Studie

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Abstract: This paper presents a study regarding the attitude towards inclusion of teachers in vocational education. Attitude is a core component in the professional competence necessary to successfully implement inclusion. A survey was conducted measuring the attitude and relevant attitude-influencing variables, such as self-efficacy, of 62 teachers in two german federal states. The survey was used to validate a scale for measuring teachers' attitude in vocational schools via factor analysis as well as to analyze said attitude via multiple regression analysis.

Keywords: Inklusion, Einstellungen, Lehrkräfte, Berufsbildung, Kompetenzmessung, Fragebogenentwicklung, Inclusion, attitudes, teachers, vocational education, competence assessment, questionnaire development

1 Einleitung

Mit dem Stichwort ‚Inklusion' wird grundsätzlich das Recht bzw. die Forderung verbunden, allen Menschen Zugangsmöglichkeiten zu qualitativ hochwertiger Bildung allgemein sowie zu entsprechender Berufsbildung im Speziellen einzuräumen (vgl. DUK, 2014, S. 9; VN-BRK, 2008, Artikel 24; KMK, 2011). Ziel der inklusiven Leitidee ist, das Bildungssystem im Allgemeinen und das gemeinsame Lernen in heterogenen Lerngruppen im Speziellen so zu verändern, dass es den Bedürfnissen aller Schüler/innen bestmöglich gerecht wird und eine Teilnahme an Arbeit und Beschäftigung sowie an der Gesellschaft ermöglicht (vgl. DUK, 2014, S. 9; KMK, 2011, S. 3 f.; WERNING, 2014; BUCHMANN, 2016, S. 237; RÜTZEL, 2016). Dabei wird den Lehrkräften an allgemeinbildenden ebenso wie an berufsbildenden Schulen, welche in diesem Beitrag im Vordergrund stehen, eine besondere Bedeutung zugeschrieben (VN-BRK, 2008, Artikel 24 Abs. 4; DUK, 2014; BUCHMANN, 2016; MIESERA & GEBHARDT, 2018, S. 1).

In der aktuellen Forschung werden insbesondere Einstellungen von Lehrkräften zu Inklusion in den Blick genommen. Diese beeinflussen nicht nur deren pädagogisches und inklusionsbezogenes Handeln, sondern auch den Erfolg (inklusiven) Unterrichts sowie die Lernergebnisse der Schülerinnen und Schüler (HELMKE, 2012, S. 176; BUCHMANN & BYLINSKI, 2013; WERNING, 2014, S. 616; MELZER et al., 2015, S. 61; SEIFRIED, 2015, S. 41; PRZIBILLA et al., 2016, S. 36; MIESERA & GEBHARDT, 2018, S. 1 f.). In dem Modell professioneller Handlungskompetenz von Lehrkräften aus dem Projekt COACTIV (BAUMERT & KUNTER, 2011, S. 482), welches auch in der deutschsprachigen inklusionsbezogenen Einstellungsforschung herangezogen wird, werden diese Einstellungen vorrangig im Zusammenhang mit Überzeugungen und Werthaltungen, motivationalen Orientierungen und selbstregulativen Fähigkeiten untersucht. Dies gelten neben dem Professionswissen als zentrale Aspekte professioneller Kompetenz (PRZIBILLA et al., 2016, S. 38).

Allerdings fällt auf, dass in aktuellen Untersuchungen zu inklusionsbezogenen Einstellungen die Lehrkräfte an berufsbildenden Schulen bisher kaum berücksichtigt werden. Hierzu liegen lediglich erste, teils qualitative Studien und/oder wenig belastbare Befunde vor (ENGGRUBER et al., 2014; BYLINSKI, 2015; BURDA-ZOYKE & JOOST, 2018; MIESERA & GEBHARDT, 2018). Vor diesem Hintergrund werden in der hier vorgestellten Studie folgende Ziele verfolgt:

- Erfassung der Einstellungen zu Inklusion von Lehrkräften an berufsbildenden Schulen (mittels Fragebogen) und
- Analyse der Zusammenhänge zwischen den Einstellungen zu Inklusion und verschiedenen potenziellen Einflussfaktoren.

Dafür wird zunächst in die theoretischen Grundlagen und den Forschungsstand zum Verständnis von Inklusion und zu den entsprechenden Einstellungen von Lehrkräften eingeführt (Kap. 2). Auf dieser Basis wird das Design der Studie vorgestellt (Hypothesen und Forschungsfragen sowie Eckpunkte zur Datenerhebung) (Kap. 3). Anschließend werden die Ergebnisse präsentiert (Kap. 4) und vor dem Hintergrund bisher vorliegender Forschungsbefunde diskutiert (Kap. 5). Der Beitrag endet mit einer kurzen Zusammenfassung sowie einem Ausblick (Kap. 6).

2 Theoretische Grundlagen und Forschungsstand

2.1 Inklusion

Bei näherer Betrachtung zeigt sich schnell, dass der Begriff Inklusion nicht einheitlich definiert und verwendet wird. Zum einen werden Verhältnis und Abgrenzung von Inklusion und Integration unterschiedlich definiert. Zum anderen finden sich sogenannte ‚engere' und ‚weitere' Verständnisse von Inklusion (ENGGRUBER & RÜTZEL, 2014, S. 13). In einem engeren Verständnis wird die Gruppe der Menschen mit Behinderungen in den Mittelpunkt gerückt (engeres, behindertenbezogenes Verständnis), wie dies bspw. in der VN-BRK (2008) geschieht sowie der Tradition der Sonder- und Integrationspädagogik entspricht (ENGGRUBER & RÜTZEL, 2014, S. 13; LINDEMEIER & LÜTJE-KLOSE, 2015, S. 7). In weiten Verständnissen werden grundsätzlich alle Menschen betrachtet, teils unter Ablehnung jeglicher Kategorisierung (in Behinderte und Nicht-Behinderte) oder unter besonderer Berücksichtigung von jeglichen, vulnerablen und von Marginalisierung und Exklusion betroffenen Personengruppen, und folglich auch von Nicht-Behinderten, wie dies bspw. durch die UNESCO gefordert wird (ENGGRUBER & RÜTZEL, 2014, S. 14; LINDMEIER & LÜTJE-KLOSE, 2015, S. 8 f.). Mit Blick auf die einzelnen deutschen Bundesländer zeigt sich, dass diese in ihren Inklusionsleitbildern, soweit sie denn existieren, stark auf Teilhabe von Menschen mit Behinderung fokussieren (LANGE, 2017, S. 26 f.). Zudem werden – verstärkt durch die föderale Struktur der Bildungspolitik – in den Bundesländern sehr unterschiedliche Inklusionsansätze verfolgt (LANGE, 2017, S. 43 ff.).

In der beruflichen Bildung zeigt sich eine weitere begriffliche Differenzierung in Bezug auf das enge Inklusionsverständnis. So können in den institutionellen und gesetzlichen Grundlagen fünf Verständnisse von ‚Behinderung' ausgemacht werden, die zudem mittels unterschiedlicher Verfahren festgestellt werden: Erstens Behinderung nach VN-BRK (relationales Verständnis), zweitens sonderpädagogischer Förderbedarf gemäß der Schulgesetze der Länder mit Verweis auf KMK-Vorgaben sowie drei weitere Definitionen und Feststellungsverfahren nach dem

Sozialgesetzbuch (altersbezogene Normvorstellungen). In SGB IX wird nach dem Grad in Behinderte und Schwerbehinderte unterschieden. Während sich diese auf die Teilhabe am Leben in der Gesellschaft allgemein beziehen, bezieht sich die Definition und Feststellung der Behinderung (bzw. Rehabiltandin/Rehabilitand) nach SGB III allein auf die Teilhabe am Arbeitsmarkt (ENGGRUBER & RÜTZEL, 2014, S. 16 f.; EULER & SEVERING, 2014, S. 4 f.). In dieser Studie erfolgt zunächst keine Festlegung auf das eine oder das andere Begriffsverständnis. An den Stellen, wo eine Eingrenzung auf ein engeres Verständnis vorgenommen wird, wird lediglich aus Kürzungsgründen allein mit dem Begriff der Behinderung gearbeitet.

Unabhängig von dem Behinderungsverständnis gilt die mit der allgemeinen Forderung nach Zugang zu Bildung verbundene anthropologische Universalitätsannahme, d. h. die Annahme der Bildsamkeit aller Menschen als empirisch hinreichend belegt. Zu der ebenfalls geforderten gemeinsamen bzw. inklusiven Beschulung mit individueller Unterstützung im allgemeinen Schulsystem (Kompatibilitätsannahme) liegen hingegen bisher keine eindeutigen Befunde vor (WERNING & BAUMERT, 2013, S. 39).

2.2 Einstellungen von Lehrkräften zu Inklusion

Einstellungen (‚attitudes') zu Inklusion können als summarische Gesamtbewertung von bzw. als individueller Standpunkt und Bereitschaften zur Inklusion verstanden werden (SEIFRIED 2015, S. 32; KUNZ, LUDER & MORETTI, 2010, S. 84). Die Abgrenzung zu Konstrukten wie Überzeugungen (‚beliefs') und Haltungen erfolgt nicht einheitlich (RUBERG & PORSCH, 2017, S. 395 f.). In jüngeren Studien werden inklusionsbezogene Einstellungen zunehmend als mehrdimensionale Konstrukte definiert, auch wenn das Fehlen eines eindeutigen konsistenten theoretischen Konzepts vielfach bemängelt wird und das Zusammenspiel der Komponenten noch nicht ganz geklärt ist (SEIFRIED, 2015, S. 32 f.; RUBERG & PORSCH, 2017, S. 395 f.). So lehnen sich beispielsweise SEIFRIED (2015, S. 32 f.) und PRZIBILLA et al. (2016, S. 38) an die dreidimensionale Modellierung von ROSENBERG & HOVLAND (1960) an, die eine affektive (Emotionen), behaviorale (Verhaltensweisen) und kognitive (Überzeugungen und Meinungen) Dimension mit beeinflussenden Komponenten sowie entsprechenden Reaktionen beinhaltet.

Vorliegende Studien weisen darauf hin, dass Lehrkräfte (auch an Regelschulen) tendenziell positive Einstellungen gegenüber Inklusion äußern, auch wenn ihre Bereitschaft zur Umsetzung entsprechender Maßnahmen erkennbar negativer ausfällt (zusammenfassend KUNZ, LUDER & MORETTI, 2010, S. 93; SIEFRIED, 2015, S. 41; PRZIBILLA et al., 2016, S. 38). Allerdings variieren die Einstellungen in Abhängigkeit von unterschiedlichen Faktoren. Diesbezüglich wurden

bisher die folgenden Einflussfaktoren festgestellt (zusammenfassend AVRAMIDIS & NORWICH, 2002; HEINRICH, URBAN & WERNING, 2013, S. 86 f.; FEYERER et al., 2014, S. 181; SEIFRIED, 2015, S. 41 ff.; PRZIBILLA et al., 2016, S. 38 f.; RUBERG & PORSCH, 2017, S. 403 ff.):

- Kontakterfahrungen mit Menschen mit Behinderungen innerhalb und außerhalb des beruflichen Kontextes (häufig signifikant positiver Zusammenhang) (Kontakthypothese von ALLPORT, 1954),
- Erfahrungen mit der Tätigkeit in inklusivem Unterricht (positiver Zusammenhang),
- unterschiedliche Behinderungsformen, Förderschwerpunkte bzw. Heterogenitätsdimensionen und deren subjektive Wahrnehmung (positivere Einstellungen bei motorischen Behinderungen und Lernbehinderungen, größere Vorbehalte bei Verhaltensauffälligkeiten, geistiger Behinderung und schwerer Mehrfachbehinderung),
- inklusionsbezogene, insbesondere langfristig und auf konkrete Umsetzungssituationen angelegte Aus- und Weiterbildung bzw. Trainingsmaßnahmen (signifikant positiver Zusammenhang),
- das (bereichsspezifische) Selbstwirksamkeitserleben der Lehrer/innen bzw. Vertrauen in die eigenen Fähigkeiten (positiver Zusammenhang),
- wahrgenommene (administrative) Unterstützung (positiver Zusammenhang).

Darüber hinaus finden sich Hinweise auf einen Zusammenhang mit dem Verständnis von Inklusion (LOREMAN et al., 2013, S. 39 ff.; HELLMICH & GÖREL, 2014, S. 237).

Zum Einfluss demographischer Variablen wie Geschlecht, Alter oder Berufserfahrung liegen derzeit keine eindeutigen Befunde vor (zusammenfassend SEIFRIED, 2015, S. 41f; RUBERG & PORSCH, 2017, S. 403). Unterschiede in den Einstellungen konnten vielmehr in Abhängigkeit vom Erhebungsort (z. B. unterschiedliche Bundesländer in Österreich sowie zwischen Deutschland und Österreich) ausgemacht werden, welche auf die regional unterschiedliche Implementation von Inklusion zurückgeführt werden (RUBERG & PORSCH, 2017, S. 405 ff.).

Kaum untersucht sind die Befürchtungen und Sorgen von Lehrkräften im Rahmen der Einführung von Inklusion, obwohl sie mit besonderen Anforderungen konfrontiert werden, womit die affektive Dimension der Einstellungen zu Inklusion bisher kaum bearbeitet wird (SEIFRIED, 2015, S. 45).

Die oben ausgewiesenen Befunde resultieren aus Studien, die mit Lehrkräften allgemeinbildender, jedoch kaum oder gar nicht mit Lehrkräften berufsbildender Schulen

durchgeführt wurden. Daher sollen sie auf ihre Gültigkeit für diese Zielgruppe überprüft werden.

3 Studiendesign

3.1 Fragestellungen und Hypothesen

Unter Berücksichtigung der theoretischen Vorüberlegungen und der eingangs formulierten Frage nach den Einstellungen von Lehrkräften an berufsbildenden Schulen zu Inklusion können folgende Ziele für die vorliegende Studie formuliert werden:

- Darstellung der Einstellungen zu Inklusion von Lehrkräften an berufsbildenden Schulen und
- Analyse der Zusammenhänge zwischen Einstellungen und verschiedenen Einflussfaktoren.

Zudem geht es um die Validierung eines Fragebogens zu Einstellungen zu Inklusion für Lehrkräfte an berufsbildenden Schulen, da ein Mangel an erprobten Instrumenten, insbesondere für diese Gruppe, besteht. Seit der Einordnung der Einstellung von Lehrkräften als Facette professioneller Kompetenz (s. o.) entstand international eine Reihe von entsprechenden inklusionsbezogenen Skalen. Die unterschiedliche Qualität der Skalen wird im Hinblick auf Validierungsmethodik und Stichprobengröße deutlich (Tabelle 1).

Name	*Quelle*	*Sprache*	*Validierung*	*N**
Teachers Attitude towards Inclusion (TATI)	(Stanley, Grimbeek, Bryer & Beamish, 2003)	Englisch	EFA, CA	17
Teachers Attitude towards Inclusion Scale (TATIS)	(Cullen, Gregory & Noto, 2010)	Englisch	EFA, CA	58
Attitude Survey Towards Inclusive Education (ASIE)	(de Boer, Timmerman, Pijl & Minnaert, 2011)	Englisch	AISP	45
Einstellung zur Integration (EZI-D)	(Kunz, Luder & Moretti, 2010)	Deutsch	EFA, CA	110
My Thinking about Inclusion (MTAI)	(Stoiber, 1998)	Englisch	Eingeschränkte EFA*, CA	128
Multidimensional Attitudes towards Inclusive Education Scale (MATIES)	(Mahat, 2008)	Englisch	EFA, CA	111
Einstellungsfragebogen zur Inklusion für Lehrkräfte (EFI-L)	(Seifried, 2015)	Deutsch	EFA, CA, KFA	652
Online-Survey zur Erhebung von Einstellung	(Przibilla, Lauterbach, Boshold, Linderkamp & Krezmien, 2016)	Deutsch	EFA, CA	77

Legende: CA = Cronbachs Alpha; EFA = Explorative Faktorenanalyse; KFA = Konfirmatorische Faktorenanalyse; AISP = Automated Item Selection Procedure
*nur über einzelne Faktoren

Tabelle 1: Skalen zu Einstellungen zu Inklusion

Tabelle 1 zeigt eine Auswahl vorhandener Skalen zur Messung der Einstellungen zu Inklusion. Die Suche nach vorhandenen Skalen wurde zunächst über Google Scholar mittels Kombinationen der Begriffe ‚Einstellung', ‚Inklusion' und ‚Lehrer' (in dt. u. engl.) durchgeführt, weitere Skalen wurden anhand der Verweise der so generierten Quellen identifiziert. Die meisten dieser Skalen sind auf der Basis geringer Stichproben validiert, die sich zudem teilweise abseits von ausgebildeten Lehrkräften rekrutieren (CULLEN, GREGORY & NOTO, 2010, S. 8).

Die größte Stichprobe weist die Skala EFI-L auf, welche ebenfalls als einzige Skala mittels konfirmatorischer Faktorenanalyse validiert wurde, was eine Bestätigung ihrer Güte ermöglicht. STEFANIE SEIFRIED (2015) stellt mit der Skala EFI-L und dem zugehörigen Fragebogen ein Instrument zur Verfügung, das sowohl die Einstellung als auch theoretisch und empirisch fundierte Einflussfaktoren misst (s. o.). Sie folgt der dreidimensionalen Modellannahme, wonach sie die Dimensionen der kognitiven, der behavioralen und der affektiven Einstellungen unterscheidet. Damit hebt sich dieses Gesamtinstrument positiv von anderen ab, die häufig ohne Begründung und trotz der bereits erkannten besonderen Bedeutung die affektive Dimension vernachlässigen (ebd., S. 62 f.). Während die affektive Dimension explorativ mit einem offenen Antwortformat zu Befürchtungen, Erwartungen und Forderungen erhoben wird, ermittelt Seifried für die beiden anderen Dimensionen mit der Gesamtskala des EFI-L drei Faktoren: Die Faktoren *fachliche Förderung* und *soziale Inklusion* als kognitive fremdbezogene Komponenten sowie den Faktor *persönliche Bereitschaft* als behaviorale selbstbezogene Komponente (s. Tabelle 2).

Faktor	***Bezug***	***Einstellungs-komponente***	***Beschreibung***	***Beispielitem***
Fachliche Förderung	Fremd-bezug	Kognition	Einschätzung zur Unterrichtsqualität in inklusiven Klassen	Die Qualität des Unterrichts wird besser, wenn Kinder mit besonderen Bedürfnissen dabei sind und miteinbezogen werden.
Persönliche Bereitschaft	Selbst-bezug	Verhalten	Persönliche Bereitschaft der Lehrkräfte zum Umsetzen von Inklusion	Ich empfinde den Unterricht in einer inklusiven Klasse für mich als zu belastend.
Soziale Inklusion	Fremd-bezug	Kognition	Einschätzung zur Einbindung von Schülern mit Förderbedarf in inklusiven Klassen	Schüler mit besonderen Bedürfnissen würden in einer inklusiven Schulklasse von den anderen Kindern gut behandelt werden.

Tabelle 2: Faktoren der Skala EFI-L

Das Instrument wurde von SEIFRIED mit elaborierten statistischen Methoden und einer ausreichend großen Stichprobe (655 Lehrkräfte aus Grund-, Sonder-, Haupt- und Realschulen sowie Gymnasien) im allgemeinbildenden Sektor erprobt. Für den Einsatz im berufsbildenden Bereich sollten kleinere kontextspezifische Änderungen an den Items vorgenommen werden (z.

B. Änderung der Bezeichnung ‚Kinder' aufgrund des durchschnittlichen Alters der Klassen in ‚Schüler/innen').

Neben der Frage, welche inklusionsbezogenen Einstellungen von Lehrkräften in berufsbildenden Schulen zu identifizieren sind, ergeben sich vor dem Hintergrund der Befunde aus dem allgemeinbildenden Bereich (siehe Kap. 2.2) zunächst vier Forschungsfragen mit Bezug zu demographischen Merkmalen:

- F1: Welchen Einfluss hat das Alter auf die Einstellung zur Inklusion?
- F2: Welchen Einfluss hat das Geschlecht auf die Einstellung zur Inklusion?
- F3: Welchen Einfluss hat die Berufserfahrung auf die Einstellung zur Inklusion?
- F4: Welchen Einfluss hat das Bundesland auf die Einstellung zur Inklusion?

Unter Berücksichtigung der in zahlreichen Studien untersuchten weiteren inklusionsbezogene Einflussfaktoren lassen sich folgende Hypothesen ableiten:

- H1: Die Kontakterfahrung mit Behinderten wirkt sich positiv auf die Einstellung zur Inklusion aus.
- H2: Die Arbeit in inklusiven Klassen wirkt sich positiv auf die Einstellung zur Inklusion aus.
- H3: Das Besuchen von Fortbildungen zu Inklusion wirkt sich positiv auf die Einstellung zur Inklusion aus.
- H4: Eine erhöhte Selbstwirksamkeitswahrnehmung wirkt sich positiv auf die Einstellung zur Inklusion aus.
- H5: Subjektiv wahrgenommene Art und Schwere der Behinderung/des Förderbedarfs wirken auf die Einstellungen zu Inklusion.

Zudem gibt es Faktoren mit weniger eindeutiger Evidenz, so dass zwei weitere Forschungsfragen hinzukommen:

- F5: Welchen Einfluss hat die pädagogische Qualifikation auf die Einstellung zur Inklusion?
- F6: Welchen Einfluss hat das Verständnis von Inklusion auf die Einstellung zur Inklusion?

Ebenfalls liegen kaum Erkenntnisse zur affektiven Dimension der Einstellung zu Inklusion bei Lehrkräften an berufsbildenden Schulen vor, weshalb drei weitere explorative Fragen formuliert werden:

- F7: Welche Befürchtungen äußern Lehrkräfte an berufsbildenden Schulen bezüglich Inklusion?

- F8: Welche positiven Erwartungen äußern Lehrkräfte an berufsbildenden Schulen bezüglich Inklusion?
- F9: Welche Forderungen äußern Lehrkräfte an berufsbildenden Schulen bezüglich Inklusion?

3.2 Instrumente, Datenerhebung und Stichprobe

Die Erhebung ist als weitgehend quantitative pen-and-paper-Befragung konzipiert, welche um ausgewählte qualitative Fragen angereichert wird. Aufgrund der guten Validierung und der umfassenden Abbildung des Einstellungskonstrukts bietet sich die bereits erwähnte Skala EFI-L sowie eine Orientierung an den weiteren Teilen des Erhebungsinstruments von SEIFRIED (2015) für eine Erprobung im berufsbildenden Bereich an. Der auf dieser Basis konzipierte und für die Lehrkräfte an berufsbildenden Schulen adaptierte Fragebogen umfasste

- Angaben zur Person (Alter, Geschlecht, Qualifikation, Bundesland, berufliche Fachrichtungen der Schule, Schulform, in der hauptsächlich unterrichtet wird, Berufserfahrung),
- Angaben zur Inklusionserfahrung (Tätigkeit in Klasse mit Schülerinnen und Schülern mit und ohne besonderem Förderbedarf, Dauer dieser Tätigkeit, Kenntnis und Verständnis des Inklusionsbegriffs, Fortbildungen zum Thema Inklusion, Erfahrungen mit Menschen mit Behinderungen),
- vier Fallbeispiele, welche jeweils einen Schüler mit unterschiedlichen Behinderungen beschreiben und mittels semantischer Differentiale hinsichtlich inklusiver Beschulung beurteilt werden müssen (SEIFRIED, 2015 (s. u.)),
- Erwartungen, Befürchtungen und Forderungen zu Inklusion (offene Fragen) (SEIFRIED, 2015, S. 74),
- Einstellungen zu Inklusion (EFI-L; SEIFRIED, 2015),
- Lehrerselbstwirksamkeit (Skala WirkLehr; SCHWARZER & SCHMITZ, 1999) und
- Soziale Erwünschtheit (Kurzskala; WINKLER, KROH & SPIESS, 2006).

Es wurden Lehrkräfte an berufsbildenden Schulen in Nordrhein-Westfalen (NRW) und Sachsen-Anhalt (SA) befragt. Die Fragebögen wurden den Schulen zugesandt und über die Schulleitungen den Lehrkräften zur Verfügung gestellt. Diese konnten den Bogen in einem festen Zeitraum ausfüllen und zurückgeben. Von 290 ausgegebenen Bögen wurden 62 zurückgesandt (Rücklaufquote = 21,4 %). Die Stichprobe ist in Tabelle 3 beschrieben.

Merkmal	*Gesamt (n=62)*	*NRW (n=34)*	*SA (n=28)*
Alter (Jahre)	46,18 (9,28)	48,03 (9,30)	43,93 (8,90)
Berufserfahrung (Jahre)	15,89 (9,83)	17,87 (9,66)	13,44 (9,68)
Geschlecht (weiblich)	62,90 %	55,58 %	71,43 %
Pädagogischer Studienabschluss	90,32 %	91,18 %	89,29 %
Begriffskenntnis Inklusion	96,77 %	97,06 %	96,43 %
Erfahrung mit inklusiven Klassen	51,61 %	32,35 %	75,00 %
Jahre in inklusiven Klassen	4,71 (7,40)	1,59 (5,22)	9,76 (7,71)
Erfahrung mit MmB (keine/beruflich/ privat/beides)	27,42% /11,29% /29,03% /32,26%	35,29% /2,94% /38,24% /23,53%	17,86% /21,43% /17,86% /42,86%
Besuch von Fortbildungen zu Inklusion	22,58 %	8,82 %	39,29 %

Tabelle 3: Eigenschaften der Stichprobe

Neben den üblichen demographischen Items lässt sich die Stichprobe weiterhin über berufsschul- und inklusionsspezifische Indikatoren beschreiben. „Pädagogischer Studienabschluss“ berücksichtigt, ob die Lehrkraft ein pädagogisches Studium (z. B. Wirtschaftspädagogik) absolviert hat oder als Quereinsteiger an die Schule gekommen ist. „Erfahrung mit inklusiven Klassen/Menschen mit Behinderung (MmB)“ berücksichtigt, ob die Lehrkraft bereits in inklusiven Settings gearbeitet oder anderweitig diesbezüglich Erfahrung gesammelt hat. „Begriffskenntnis Inklusion“ prüft, ob der Begriff grundsätzlich bekannt ist, an dieser Stelle wurde weiterhin eine vertiefende Frage zum Begriffsverständnis gestellt (siehe 4.1).

Der Datensatz umfasst insgesamt 6.138 Datenpunkte mit 220 fehlenden Werten (Missingquote = 3,6 %). Der Fall mit den meisten fehlenden Werten hat 42 Missings, so dass kein Ausschluss von Fällen wegen eines zu großen Anteils fehlender Werte vorgenommen werden muss (GRAHAM, 2012, S. 43). In Anbetracht der geringen Stichprobengröße soll vermieden werden, dass komplette Observationen aufgrund einzelner fehlender Werte entfallen. Um dies ohne eine Verzerrung der Daten zu erreichen, wurde der Datensatz mittels des MCMC (Monte Carlo Markov Chain)-Verfahrens in 20 Iterationen imputiert. Eine Einschränkung besteht hier bei strukturentdeckenden und -prüfenden Verfahren, welche nicht in Zusammenhang mit multipler Imputation eingesetzt werden können und über eigene Methoden zum Umgang mit Missings verfügen (GRAHAM, 2012, S. 53).

4 Ergebnisse

4.1 Inklusionsverständnis

Wie oben bereits beschrieben, lässt sich grundsätzlich ein enges oder weites Inklusionsverständnis differenzieren. In den insgesamt 58 Antworten zu der offenen Frage „Beschreiben Sie bitte, was Sie unter Inklusion verstehen“, finden sich diese engen und weiten Kategorien teilweise wieder. Deutlich wird durch die induktive Kategorisierung der Antworten, dass erstens nur wenige Lehrkräfte an berufsbildenden Schulen Inklusion ausschließlich auf

Behinderte beziehen (enges, behindertenbezogenes Verständnis) und zweitens der Großteil der Lehrkräfte den Inklusionsprozess ausschließlich in der Schule verortet. Dies führt in Kontrast zu oben zu einer leicht abweichenden Kategorisierung der Inklusionsverständnisse: Die beiden unteren Kategorien in Abbildung 1 sind explizit schulbezogen, beginnend mit dem engen Inklusionsverständnis der reinen Behindertenförderung. Die zweite, häufigste Kategorie bildet ein weites schulbezogenes Inklusionsverständnis ab, welches allgemein den Umgang mit Heterogenität in der Schule beschreibt, und die dritte Kategorie erfasst ein Inklusionsverständnis mit Bezug auf die gesamte Gesellschaft, also den Umgang mit Vielfalt auch außerhalb der Schule.

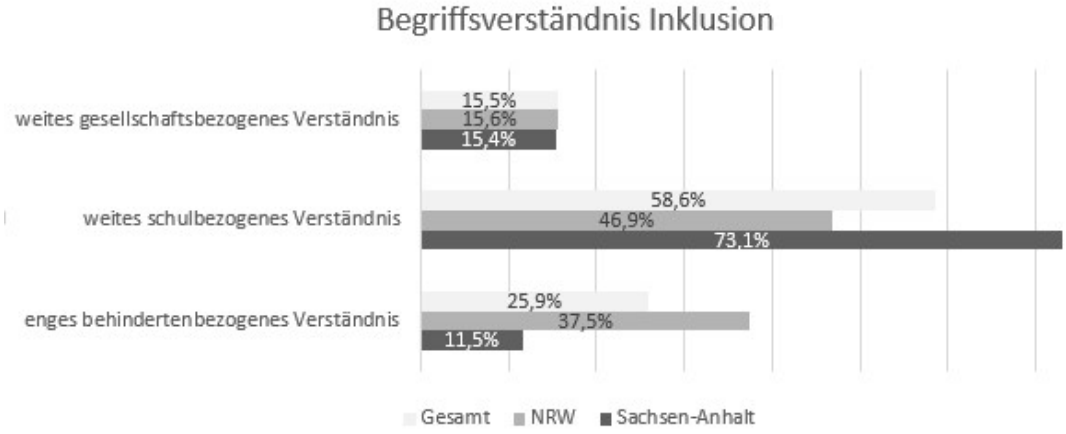

Abbildung 1: Verteilung des Inklusionsverständnisses

Wie Abbildung 1 zu entnehmen ist, überwiegt ein schulbezogenes Verständnis von Inklusion, wobei zwei Drittel der befragten Lehrkräfte ein weites Inklusionsverständnis haben. Die Kategorisierung wurde von drei geschulten Ratern durchgeführt und weist ein $\alpha_{Krippendorff}$ von 0,70 auf, kann also als reliabel betrachtet werden.

4.2 Einstellung zu Inklusion (EFI-L)

Im Weiteren wird die Skala EFI-L untersucht, die zunächst die kognitiven und behavioralen Dimensionen fokussiert. Hier wird mittels explorativer Faktorenanalyse geprüft, ob sich die Skala EFI-L auch bei Lehrkräften an berufsbildenden Schulen rekonstruieren lässt. Im Anschluss daran wird die von SEIFRIED (2015) festgestellte dreifaktorielle Struktur durch eine konfirmatorische Faktorenanalyse überprüft.

Die Ergebnisse dieser Analysen ergeben eine dreifaktorielle Struktur (Abbildung 2). Die dort enthaltenen Faktoren und Items weisen akzeptable Gütekriterien und Faktorladungen auf und

erklären 64 % der Gesamtvarianz. Die Ergebnisse replizieren weitgehend die von Seifried festgestellte Struktur.

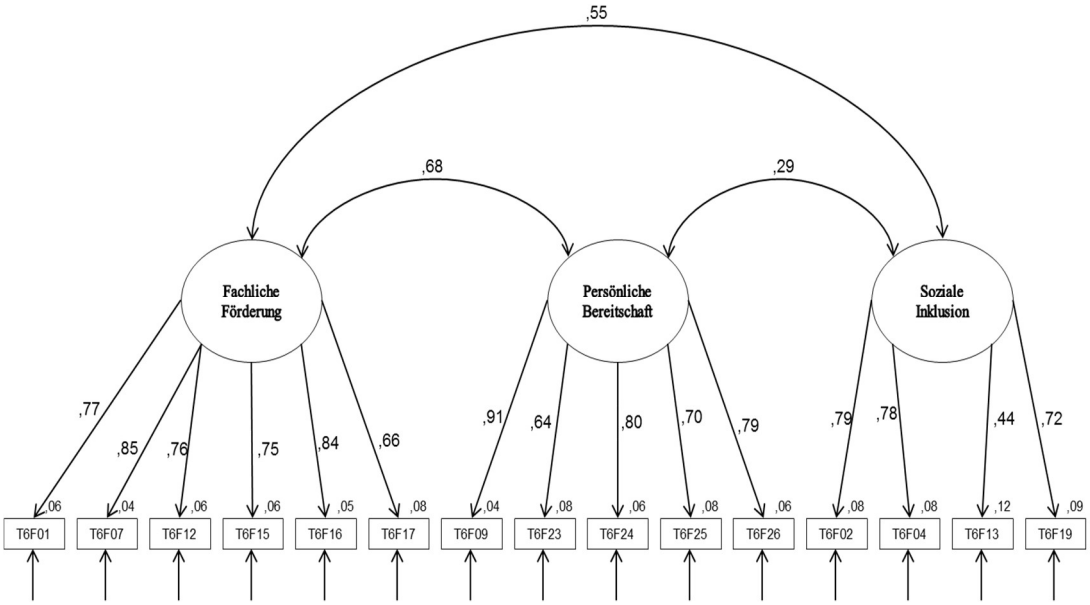

Abbildung 2: Konfirmatorische Faktorenanalyse der Skala EFI-L

Die Überprüfung der Skala EFI-L bringt auf Item- und Konstruktebene zufriedenstellende Ergebnisse hervor. Die faktorbezogenen Gütemaße Cronbachs Alpha, Konstruktreliabilität und durchschnittlich erfasste Varianz liefern durchweg hervorragende Werte (Tabelle 4). Kritischer zu betrachten sind jedoch die Werte der globalen Gütemaße. Während diese sich zwar in der Nähe der jeweils geforderten Bereiche befinden, kann hier kein Wert als statistisch ausreichend bezeichnet werden (RMSEA=0,184; CFI=0,722; TLI=0,653; SRMR=0,101). Das Problem ist eventuell auf die verhältnismäßig kleine Stichprobe zurückzuführen.

Skala	*Items*	*Mean (SD)*	*Min/Max*	*Schiefe*	*Cronbachs Alpha*	*KR*	*DEV*
Fachliche Förderung	6	2,77 (0,92)	1 / 4,7	0,269	0,85	0,98	0,91
Persönliche Bereitschaft	5	3,12 (1,07)	1 / 5	-0,104	0,84	0,98	0,90
Soziale Inklusion	4	4,09 (0,8)	2 / 5,75	-0,370	0,75	0,95	0,84
EFI-L	15	3,24 (0,74)	1,4 / 5	0,035	0,88		

1= „stimme überhaupt nicht zu“ bis 6= „stimme voll zu“

Tabelle 4: Skalenstatistiken

Tabelle 4 zeigt zudem die Eigenschaften und Güte der verschiedenen (Sub-)Skalen. Nimmt man zur besseren Übersicht den Median-Split[2] bei 3,5 vor (Werte unterhalb eher negativ, Werte oberhalb eher positiv), so wird deutlich, dass mit Ausnahme der sozialen Inklusion die durchschnittlichen Skalenwerte bei allen abhängigen Variablen eher negativ sind, was vor dem Hintergrund des bisherigen Forschungsstandes etwas überrascht. Innerhalb der Stichprobe liegt so gemessen das Verhältnis von negativer zu positiver Einstellung bei 43 zu 19. Bei der am niedrigsten bewerteten fachlichen Förderung zeigt die Schiefe, dass sich neben einer größtenteils mittelmäßigen Wahrnehmung einige Lehrkräfte finden, die diese Eigenschaft sehr niedrig bewerten. Bei der persönlichen Bereitschaft ist es umgekehrt, hier deuten die Daten auf einige sehr engagierte Lehrkräfte hin, die sich von ihren Kolleginnen und Kollegen abheben. Die am positivsten wahrgenommene soziale Inklusion weist zugleich die größte (negative) Schiefe auf, das höhere Minimum weist aber darauf hin, dass sich hier keine vollständig ablehnende Haltung findet.

4.3 Affektive Einstellungsdimension

Um neben den kognitiven und behavioralen Dimensionen auch die affektive Einstellungsdimension zu berücksichtigen und ein vollständiges Bild der inklusionsbezogenen Einstellungen gewinnen zu können, enthielt der Fragebogen Items mit offenem Antwortformat, in denen Befürchtungen, Erwartungen und Forderungen genannt werden sollten. Insgesamt wurden durch Mehrfachnennungen 189 Aussagen erfasst, die induktiv kategorisiert wurden. Zu den Befürchtungen ergaben sich fünf Kategorien, zu den Erwartungen und Forderungen jeweils vier (Abbildung 3). Wie das Begriffsverständnis wurde auch diese Kategorisierung von drei

[2] Seifried spricht hier von einem Mediansplit. Allerdings handelt es sich vielmehr um einen Skalensplit, da der Split anhand der Skala und nicht anhand des empirischen Medians vorgenommen wurde.

Ratern überprüft, wobei sich für die Befürchtungen ein knappes $\alpha_{Krippendorff}$ von 0,67 ergeben hat. Die Erwartungen mit 0,74 und die Forderungen mit 0,71 liegen etwas deutlicher über der Reliabilitätsgrenze.

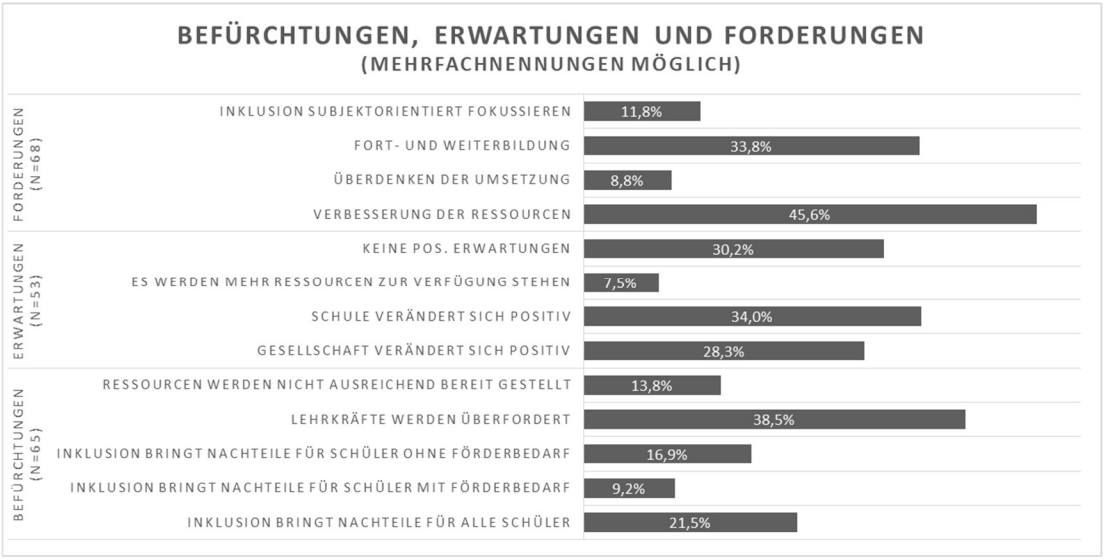

Abbildung 3: Befürchtungen, Erwartungen und Forderungen im Zusammenhang mit Inklusion

4.4 Einflussfaktoren auf inklusionsbezogene Einstellungen

Nachdem die Skala EFI-L auf ihre Validität überprüft wurde, soll im Folgenden eine Wirkungsanalyse zwischen den Skalenwerten der Gesamtskala bzw. ihren einzelnen Faktoren sowie möglichen Einflussfaktoren durchgeführt werden (siehe Kap. 2.2 und 3.1). Tabelle 5 zeigt zunächst die Korrelationen der in der Regression verwendeten Variablen.

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
(1) Alter										
(2) Geschlecht[1]	0,217									
(3) Qualifikation[2]	-0,07	-0,087								
(4) Bundesland[3]	-0,222	-0,16	-0,031							
(5) Berufserfahrung	0,84***	0,156	-0,152	-0,226						
(6) Tätigkeit in inkl. Klassen[4]	0,099	0,008	-0,098	0,43***	0,004					
(7) Begriffskenntnis Inklusion [4]	-0,016	0,14	0,249	-0,017	-0,021	0,005				
(8) Fortbildung zu Inklusion[4]	-0,027	0,064	0,046	0,363**	-0,012	0,214	0,098			
(9) Erfahrung mit Behinderung[4]	0,154	-0,062	0,044	0,149	0,169	0,131	-0,051	0,024		
(10) Selbstwirksamkeit	-0,282*	-0,204	0,165	0,164	-0,177	-0,055	0,101	0,094	-0,005	
(11) Fachliche Förderung	0,117	-0,112	0,066	0,184	0,057	0,27*	-0,296*	0,051	0,326**	0,29*
(12) Persönliche Bereitschaft	0,061	-0,134	0,169	0,309*	0,096	0,267*	-0,1	0,347**	0,41***	0,368**
(13) Soziale Inklusion	-0,077	0,119	0,004	-0,022	-0,042	0,073	-0,064	-0,071	-0,143	0,39**

***p < .001 **p < .005 *p < .01; [1] Weiblich = 1; männlich = 2; [2] Pädagogisch = 1; sonstige = 0 (siehe Tabelle 3); [3] NRW = 1; Sachsen-Anhalt = 2; [4] Nein = 0; ja = 1

Tabelle 5: Interkorrelation

Der stark signifikante Zusammenhang zwischen Alter und Berufserfahrung entspricht den Erwartungen, sonderbarer ist der negative Zusammenhang zwischen wahrgenommener Selbstwirksamkeit und Alter. Dies könnte ein Hinweis auf eine mit dem Alter kritischer werdende Selbsteinschätzung sein. Die signifikante Korrelation des Bundeslandes mit der Tätigkeit in inklusiven Klassen, Fortbildungsbesuchen und persönlicher Bereitschaft weist auf erhebliche Unterschiede zwischen SA und NRW hin. Die Ursache kann jedoch rein statistischer Natur sein, da in den Stichprobengruppen der Bundesländer die verschiedenen Schulformen der Beruflichen Bildung ungleich repräsentiert sind. Angesichts der von LANGE (2017, S. 43 ff.) beschriebenen sehr unterschiedlichen Umsetzung von Inklusion kommt die jeweilige Landespolitik als Ursache jedoch ebenso infrage. Weiterhin korrelieren inklusionsbezogene Tätigkeiten/Eigenschaften wie Lehre, Fortbildung und Erfahrung mit Behinderung positiv signifikant mit der Wahrnehmung der fachlichen Förderung und der persönlichen Bereitschaft. Lediglich die negative Korrelation zwischen Begriffskenntnis und fachlicher Förderung fällt auf. Möglich ist, dass bei besserer Begriffs- und damit auch Zielkenntnis eine kritischere Bewertung der Förderung vorgenommen wird. Abschließend korreliert die Selbstwirksamkeit wie schon in vorangegangenen Studien (s. o.) positiv mit den Einstellungsskalen. Um in Anbetracht der teilweise stark signifikanten Korrelationen die Ergebnisse auf Multikollinearität zu prüfen, wird bei den folgenden Regressionen der Varianzinflationsfaktor (VIF) genutzt.

Zur Analyse wird die multiple lineare Regression eingesetzt. Zunächst werden die Variablen der Regressionsmodelle dargestellt und eine Prüfung der notwendigen Annahmen durchgeführt. Auf dieser Basis werden die Ergebnisse der Regressionen dargestellt und die Modelle (Gesamtmodell; Fachliche Förderung; Persönliche Bereitschaft; Soziale Inklusion) auf ihre Güte geprüft. Tabelle 6 zeigt eine Zusammenfassung der Ergebnisse der Regressionen. Eine Betrachtung der Gütekriterien zeigt, dass die F-Statistik für alle vier Modelle signifikant ist. Das korrigierte R^2 liegt im für solche Untersuchungen üblichen Bereich (SEIFRIED, 2015, S. 170).

Variable	*Modell Gesamt*	*Modell Fachliche Förderung*	*Modell Persönliche Bereitschaft*	*Modell Soziale Inklusion*
Alter	0,03*	0,05*	0,02	0,01
Geschlecht	0,04	-0,04	-0,12	0,34
Pädagogische Qualifikation	0,29	0,26	0,55	-0,01
Bundesland	0,11	0,11	0,24	-0,04
Berufserfahrung	-0,01	-0,03	0,00	-0,01
Tätigkeit in inklusiven Klassen	0,28*	0,36	0,24	0,2
Begriffskenntnis Inklusion	-1,19***	-1,73***	-1,01	-0,61**
Fortbildungsbesuche zu Inklusion	0,08	-0,07	0,57*	-0,29
Erfahrung mit Behinderung	0,14**	0,19**	0,28**	-0,11
Selbstwirksamkeit	1,08***	1,04**	1,09**	1,15**
Konstante	-0,92	-1,34	-1,78	0,73
Max VIF		3,35		
Adj. R^2	0,36	0,31	0,37	0,14
F-Statistik	6,65***	22,22***	5,71***	1,96*

***p < .001 **p < .005 *p < .01

Tabelle 6: Ergebnisse der Regressionsanalyse

Die demographischen Hintergrundvariablen Alter, Geschlecht, Bundesland und Berufserfahrung haben keinen nennenswerten prädiktiven Einfluss. Signifikante Einflüsse lassen sich bei den inklusionsbezogenen Hintergrundvariablen und der Selbstwirksamkeit finden. Die Tätigkeit in inklusiven Klassen, inklusionsbezogene Fortbildungen und Kontakterfahrungen mit Menschen mit Behinderungen wirken signifikant positiv auf die Einstellungen. Die reine Kenntnis des Inklusionsbegriffs wirkt hier negativ, ist in der Stichprobe allerdings sehr unbalanciert repräsentiert (nur 2 von 62 Lehrkräften kennen den Begriff nicht). Um dieses Merkmal sinnvoller bewerten zu können, wurde die Begriffskenntnis in weiteren Analysen testweise durch das Begriffsverständnis ersetzt (kodiert gem. der Rangfolge in 4.1 mit 1= enges schulbezogenes Verständnis; 2= weites schulbezogenes Verständnis; 3= weites gesellschaftliches Verständnis), welches signifikant positiv auf die Inklusionseinstellungen wirkt (Gesamt 0,38**; Fachliche Förderung 0,49**; Persönliche Bereitschaft 0,36*). Ein signifikanter Einfluss in allen vier Modellen besteht zudem im Falle der Selbstwirksamkeit.

4.5 Einstellungen in Abhängigkeit von Art und Schwere der Behinderung

Die vier Fallbeispiele von SEIFRIED (2015) wurden leicht angepasst eingesetzt, um den Einfluss der subjektiv wahrgenommenen Art und Schwere von Behinderungen bzw. von Förderbedarfen auf die Einstellungen zu inklusiver Beschulung zu prüfen (Abbildung 4).

A ist ein Schüler, dem das Lesen und Rechnen schwer fällt. Er braucht für die Bearbeitung einzelner Aufgaben viel Zeit und benötigt zusätzliche Erklärungen der Lehrkraft und anschauliche Hilfsmittel. Seine Schulleistungen liegen deutlich unter dem Durchschnitt seiner Altersgruppe. Dieser Schüler wird ab dem kommenden Schuljahr inklusiv beschult.

Eine inklusive Beschulung von Schüler A empfinde ich als...

	1	2	3	4	5	6	7	
Positiv								Negativ
Unangenehm								Angenehm
Beängstigend								Beruhigend
Befreiend								Bedrückend
Vorübergehend								Dauerhaft
Erwünscht								Unerwünscht
Erfreulich								Ärgerlich
Natürlich								Künstlich
Geeignet								Ungeeignet
Unüblich								Üblich

Abbildung 4: Fallbeispiel 1

Jeder der Fälle beschreibt eine/n Schüler/in mit einer spezifischen Behinderungsform. Fallbeispiel 1 beschreibt eine/n Schüler/in mit Lernbehinderung, Fallbeispiel 2 eine/n Schüler/in mit einer schwer-mehrfach Behinderung, Fallbeispiel 3 eine/n verhaltensauffällige/n Schüler/in und Fallbeispiel 4 eine/n Schüler/in mit Sehbehinderung. Die Lehrkräfte sollten diese Schüler/innen hinsichtlich einer inklusiven Beschulung mithilfe verschiedener Gegensatzpaare (semantischer Differentiale) einstufen.

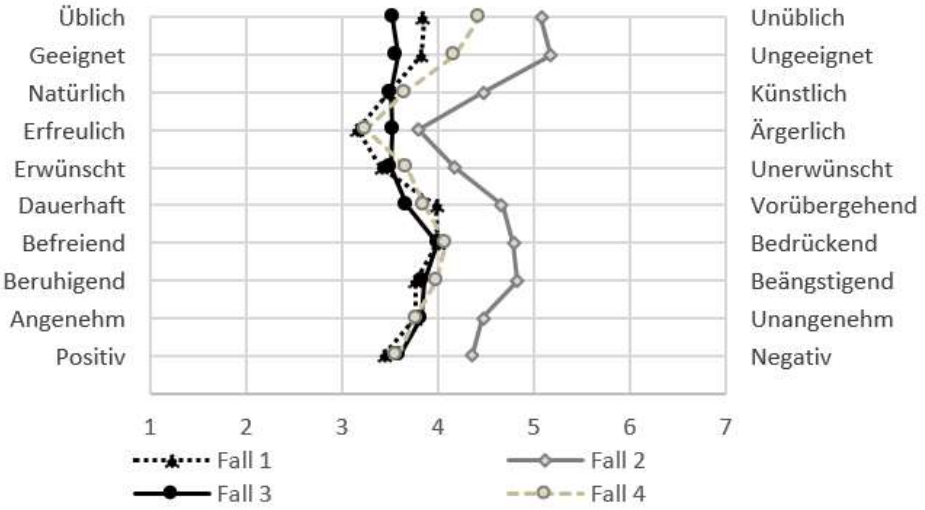

Abbildung 5: Ergebnisse der Fallbeispiele nach Differentialen

Die innere Konsistenz bringt sehr gute Ergebnisse (Cronbachs Alpha > 0,88). Um zu prüfen, ob sich die Beurteilung abhängig von Art und Schwere des Förderbedarfs unterscheidet, wurde zunächst eine multiple Varianzanalyse mit Messwiederholungen gerechnet. Hierbei ergibt sich zunächst, dass signifikante Unterschiede zwischen der Wahrnehmung der Fälle bestehen (F =

11,95; Prob > F = 0,000) (Abbildung 5). Fälle mit schweren, multiplen Behinderungen (Fall 2) werden erwartungskonform deutlich negativer beurteilt, als bspw. Verhaltensauffälligkeiten, Sehbehinderungen und Lernbehinderungen.

5 Zusammenfassende Diskussion

Nachfolgend werden die Ergebnisse anhand der aufgestellten Forschungsfragen und Hypothesen in Bezug zu bisherigen Forschungsergebnissen interpretiert, wobei vergleichende Forschungsergebnisse fast ausschließlich aus dem allgemeinbildenden Bereich stammen. Bezüglich der Fragen zum Einfluss der demographischen Variablen (F1-F5), ergeben sich folgenden Befunde:

- Für das Alter (F1) lässt sich in der Studie lediglich in Bezug zur fremdbezogenen kognitiven Komponente der fachlichen Förderung ein schwacher, signifikant positiver Zusammenhang zeigen. Ältere Lehrkräfte schätzen die Lernförderung in inklusiven Settings also positiver ein. Das Alter hat neben diesem schwachen Effekt jedoch keinen Einfluss auf die persönliche Bereitschaft der Lehrer/innen oder ihre Einschätzung zu sozialer Inklusion, was der derzeitigen uneinheitlichen Befundlage (siehe Kap. 2.2) entspricht.
- Weder für das Geschlecht (F2), noch für die Berufserfahrung (F3) oder die pädagogische Qualifikation (F5) kann ein signifikanter Einfluss gezeigt werden, was der Befundlage überwiegend entspricht (SEIFRIED, 2015, S. 42; RUBERG & PORSCH, 2017, S. 402).
- Auch das Bundesland (F4) kann in der Studie nicht als Einflussfaktor nachgewiesen werden, obwohl die unterschiedlichen Implementationsstände dies hätten erwarten lassen (RUBERG & PORSCH, 2017, S. 405 ff.).

Neben demographischen Merkmalen wurden Hypothesen zu weiteren Merkmalen und zur Selbstwirksamkeit als Einflussfaktoren auf die Einstellungen zu Inklusion (H1-H5) geprüft:

- Die Kontakterfahrung mit behinderten Menschen zeigt in der vorliegenden Studie einen signifikant positiven Einfluss (H1). Dieser Effekt steht im Einklang mit der Kontakthypothese von ALLPORT (1954), die bereits in zahlreichen Studien belegt wurde: Lehrkräfte, die bereits Kontakt zu Menschen mit Förderbedarfen hatten, entwickeln eine positivere Wahrnehmung und Einstellung gegenüber allen Menschen, die sie dieser Gruppe zuordnen, und übertragen die positive Einstellung auch auf ihre Schüler/innen (SEIFRIED, 2015; PRZIBILLA et al., 2016; RUBERG & PORSCH, 2017, S. 403).

- Der positive Einfluss der Erfahrung lässt erwarten, dass auch die Tätigkeit in einer inklusiven Klasse einen positiven Effekt hat, was jedoch nur für die Gesamtskala gilt (H2).
- Der Besuch von Fortbildungen zu Inklusion hat in der Studie erwartungskonform einen signifikant positiven Einfluss auf die selbstbezogene verhaltensnahe Komponente der Einstellung, die persönliche Bereitschaft (H3). Grund für die verbesserte Bereitschaft ist vermutlich eine empfundene bessere Vorbereitung, wodurch sich die Lehrkräfte von inklusiven Settings weniger überfordert fühlen und mehr Vertrauen in ihre Selbstwirksamkeit haben.
- Der Zusammenhang zwischen Fortbildungen und Selbstwirksamkeit konnte ebenfalls von SEIFRIED (2015, S. 178) gezeigt werden. Auch der direkt positive Einfluss der Selbstwirksamkeit auf die Einstellungen zu Inklusion, der bereits bei Seifried und vorangegangenen Studien gezeigt wurde (ebd., S. 196), bestätigt sich in der vorliegenden Studie (H4).
- In der Studie hat sich auch gezeigt, dass die subjektiv wahrgenommene Art und Stärke des Förderbedarfs (H5) einen signifikanten Einfluss auf die Einstellung der Lehrkräfte hat, was außerhalb der Regressionsmodellierung mittels Varianzanalyse festgestellt wurde. Die befragten Lehrkräfte sind weniger gewillt, Schüler/innen mit schweren Mehrfachbehinderungen zu unterrichten, als Schüler/innen mit bspw. Verhaltensauffälligkeiten, Sehbehinderungen und Lernbehinderungen. Möglicherweise fürchten die Lehrer/innen einen großen Betreuungsaufwand, ohne dass die bereitgestellten Ressourcen in Form von zusätzlichen Fachkräften oder spezieller Technologie (z. B. Braille-Tastaturen) ausreichen und andere Schüler/innen vernachlässigt werden, was mit den Ergebnissen zu den affektiven Einstellungsdimensionen korrespondiert.

Einen signifikant positiven Einfluss hat in dieser Studie zudem das Verständnis des Inklusionsbegriffs auf die fremdbezogene fachliche Förderung und die persönliche Bereitschaft (F6). Dabei war die Einstellung positiver, wenn das Verständnis eine weiter gefasste, allgemein heterogene Personengruppe umfasste, als wenn es sich nur als herausfordernde Arbeit auf Schüler/innen mit Behinderung bezog. Dies mag damit zusammenhängen, dass Lehrkräfte an berufsbildenden Schulen ihre Schülerschaft grundsätzlich als heterogen wahrnehmen und der Umgang mit einem gewissen Maß an Heterogenität eine als alltäglich wahrgenommene und in irgendeiner Form auch gewältigte Herausforderung darstellt (BURDA-ZOYKE & JOOST, 2018). Einen ähnlichen Zusammenhang zwischen Inklusionsauffassung und Einstellung erkannten

auch HELLMICH & GÖREL (2014, S. 238 f.), die ein umfassendes Inklusionsverständnis als Bedingung für die Entwicklung einer klaren Vorstellung von Inklusion sehen.

Die Untersuchung der affektiven Dimension (F7-F9) zeigt, dass die Lehrkräfte besonders eine Überlastung bzw. eine persönliche Überforderung durch Inklusion befürchten. Damit einhergehend fordern sie zusätzliche Ressourcen und ausreichende Fort- und Weiterbildungen. Diese Einschätzungen und Forderungen finden sich auch in anderen Studien (PRZIBILLA et al., 2016; BURDA-ZOYKE & JOOST, 2018; SEIFRIED, 2015). Dass die Mehrheit der Lehrkräfte – wie auch bei SEIFRIED (2015, S. 121), aber abweichend von bisherigen Studien mit Lehrkräften (PRZIBILLA et al. 2016, S. 38; KUNZ et al. 2010, S. 93; BURDA-ZOYKE & JOOST, 2018) – eine vom Skalensplit her betrachtet tendenziell negative Einstellung zu Inklusion hat, könnte darauf zurückzuführen sein, dass die Befragten ihre Forderungen nach Unterstützung und zusätzlicher Aus- bzw. Fortbildung nicht als im erforderlichen Maße erfüllt ansehen. Wenig zuträglich erscheint dabei, dass die Bundesländer zwar hohe Ansprüche an inklusive Bildung formulieren, jedoch gleichzeitig den Versuch unternehmen, Inklusion kostenneutral umzusetzen (DOMISCH & KLEIN, 2012, S. 162). So existieren in Sachsen-Anhalt neben der Teilnahme an bundesweiten Inklusionsprojekten bspw. keine weiteren Maßnahmen oder verbindliche Zeitrahmen für die Implementation von Inklusion (LANGE, 2017, S. 46). Hinzu kommt, dass die Bundesländer selbst 2017 die Kosten für Inklusion in der beruflichen Bildung teilweise nicht einmal prognostizieren können (z. B. NRW, LANGE & HENDRICKS, 2017, S. 18).

6 Schlussbetrachtung

Die vorliegende Studie hatte zum Ziel, inklusionsbezogene Einstellungen von Lehrkräften an berufsbildenden Schulen unter Berücksichtigung möglicher Einflussfaktoren anhand eines geeigneten Instruments zu erfassen. Einstellungen berühren neben dem Wissen und Können die Kernkompetenzen von Lehrkräften zur Etablierung inklusiver Bildungssysteme (UNESCO, 2003, S. 22 ff.), wobei die aktuelle Forschung insbesondere die Einstellungen fokussiert (HILLENBRAND, MELZER & HAGEN, 2013, S. 51). Zunächst erfolgte eine theoretische Grundlegung des Begriffs ‚Inklusion' und der inklusionsbezogenen Einstellungen als. Darauf aufbauend wurden vorhandene Studien zu inklusionsbezogenen Einstellungen skizziert. Auf dieser Basis wurden Fragen und Hypothesen entwickelt, welche im Verlauf der Studie geprüft bzw. beantwortet werden sollten. Die Ergebnisse der Erhebung wurden dazu genutzt, die leicht kontextspezifisch adaptierte Skala EFI-L von SEIFRIED (2015) hinsichtlich ihrer Eignung für Lehrkräfte an berufsbildenden Schulen zu überprüfen und in Verbindung mit weiteren Einflussfaktoren auszuwerten. Dabei konnte ein signifikanter Einfluss des

Inklusionsverständnisses, der Fortbildungen, der Erfahrung mit behinderten Menschen, der Selbstwirksamkeit und der Art und Schwere des schülerbezogenen Förderbedarfs gezeigt werden. Das eingesetzte Instrument konnte inhaltlich bestätigt werden, erfordert jedoch weiterhin die Erprobung in einer größeren Stichprobe von Lehrkräften an berufsbildenden Schulen. Zudem erscheinen eine Weiterentwicklung in Richtung eines weiten Inklusionsverständnisses sowie eine weitere Adaption vielversprechend, um die Einstellungen unter Berücksichtigung der Spezifika der beruflichen Bildung differenzierter untersuchen zu können (z. B. Einstellungen in Abhängigkeit von Schulformen und beruflichen Fachrichtungen, aber auch unter Berücksichtigung der Chancen auf dem ersten Ausbildungs- und Arbeitsmarkt sowie etwaiger Lernortkooperationen und Praxispartner etc.).

Anhand der durchgeführten Studie lassen sich Zusammenhänge zwischen verschiedenen Kovariaten und der Einstellungen zu Inklusion herstellen. Für ein Gelingen von inklusiven Bildungssettings ist insbesondere die persönliche Bereitschaft von Bedeutung. Die Studie unterstreicht die Bedeutung von inklusionsbezogenen Fortbildungen für die persönliche Bereitschaft der Lehrkräfte und gibt einige konkrete Anhaltspunkte zu deren Ausgestaltung. Da zudem der Zusammenhang zwischen Einstellungen und Erfahrungen mit Menschen mit Behinderungen bestätigt wurde, wäre zu prüfen, inwiefern entsprechende Erfahrungsmöglichkeiten im Rahmen der Aus- und Fortbildung der Lehrkräfte aufgenommen werden können (z. B. durch Unterricht in inklusiven Klassen oder durch anderweitigen Kontakt mit Menschen mit Behinderungen). Das frühzeitige Einrichten von Erfahrungsräumen in inklusiven Settings wird zudem durch die in der Studie bestätigte Relevanz von Selbstwirksamkeit für alle in der Skala erfassten Einstellungsfaktoren bekräftigt. Schließlich kann Selbstwirksamkeit u. a. durch Handlungserlebnisse oder stellvertretende Erfahrungen durch Beobachtung gesteigert werden (SCHWARZER & JERUSALEM, 2002, S. 42).

Die Ergebnisse sind abschließend kritisch zu diskutieren. Zunächst ist die vergleichsweise kleine Stichprobe zu nennen. Insbesondere die – in der qualitativen Studie von BURDA-ZOYKE & JOOST (2018) für den berufsbildenden Bereich als bedeutsam herausgearbeiteten – Merkmale der Schulform und der beruflichen Fachrichtung können aufgrund der kleinen und diesbezüglich unbalancierten Stichprobe nicht zielführend analysiert werden. Insofern wäre eine vertiefende Analyse der beruflichen Fachrichtungen sowie der Schulformen/Bildungsgänge an berufsbildenden Schulen als Einflussfaktor auf die Einstellungen zu Inklusion erkenntnisreich, wofür jedoch eine weitere Adaption des eingesetzten Erhebungsinstrumentariums erforderlich wäre.

Weiterhin wurden die Daten explizit erhoben und behandeln ein teils sehr emotional behaftetes Thema, was zu einer Selbstselektion von Probanden/innen mit einer eher (sowohl positiv als auch negativ) starken Meinung geführt haben kann. Ebenso ist zu beachten, dass die Skala EFI-L eine dreifaktorielle Skala ist, so dass die Ergebnisse der Subskalen im Besonderen zu berücksichtigen sind.

Zugunsten eines weiteren Inklusionsverständnisses und zur Berücksichtigung der Bedarfslagen in berufsbildenden Schulen könnten die in der Erhebung eingesetzten Fallbeispiele weiterentwickelt werden. So hat sich die differenzierte Erfassung von Einstellungen bereits in mehreren Studien als sinnvoll gezeigt (PRZIBILLA et al., 2016, S. 39), so dass an dieser Erhebungsmethode – zumindest in der Ergänzung zu der standardisierten Erhebung – festgehalten werden sollte. Die von SEIFRIED (2015) entwickelten Fälle stellen einzelne Schüler/innen mit unterschiedlichen Behinderungsformen dar, die hinsichtlich inklusiver Beschulung bewertet werden sollen. Damit liegt ein engeres, behinderungsbezogenes Inklusionsverständnis zugrunde in Verbindung mit der traditionellen Sicht der Sonderpädagogik, Schüler/innen mit besonderem Förderbedarf in den Regelunterricht zu integrieren. Für ein weiteres Verständnis könnte die Beschreibung einer breiter gefassten und von Klassifizierung absehenden Heterogenität einer Klasse als Ausgangspunkt der Einschätzungen dienen.

Abschließend ist noch auf die Bedeutung von Wissen und Fertigkeiten hinzuweisen (ZINN & DÖBLER, 2018; BURDA-ZOYKE & JOOST, 2018). Da Wissen und Fertigkeiten einen Einfluss auf die Einstellungen ausüben und sich umgekehrt Lehrkräfte mit positiven Einstellungen eventuell mehr resp. anderes Wissen und Können aneignen, sollten diese Merkmale in weiteren Studien im Verbund erhoben werden. Daneben ist die Ressourcensituation für die Einstellungen relevant. Die Ergebnisse der Studie legen den Schluss nahe, dass die Bereitschaft von Lehrkräften steigt, wenn entsprechende Unterstützungsmaßnahmen bereitgestellt werden. Da Inklusion in den verschiedenen Bundesländern sehr unterschiedlich umgesetzt wird (LANGE, 2017), bietet es sich an, die oben genannten Merkmale in einer Folgestudie in diesen und weiteren Bundesländern zu prüfen. Dies könnte unter anderem Hinweise darauf liefern, welche Inklusionsstrategien die Lehrkräfte an berufsbildenden Schulen geeignet einbeziehen, und somit ein besseres Bild davon liefern, wie Inklusion erfolgreich umgesetzt werden kann.

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Essay VII: Einflussfaktoren inklusionsbezogener Einstellungen von Lehrkräften an berufsbildenden Schulen. Ergebnisse einer empirischen Studie in deutschen Bundesländern

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Abstract: The inclusion-related attitudes of teachers are considered to be essential predictors for their pedagogical and inclusion-related perception and action in inclusive lessons as well as for the success of (inclusive) teaching. Numerous studies have examined the attitudes of teachers and potential factors influencing them. So far, however, the full qualified teachers at vocational schools have largely not been taken into account. Therefore, the present study investigates the level of inclusion-related attitudes among teachers at vocational schools in Germany. In addition, the study asks for the effect of potential influencing factors on the teachers‘ attitudes towards inclusion. Using a standardized questionnaire, which was supplemented with open questions, 662 teachers at vocational schools in four federal states of Germany (Hamburg, Saxony-Anhalt, Schleswig-Holstein, Thuringia), were interviewed. Attitudes towards inclusion are overall neutral. Using linear regression analysis, it can be shown that professional and private experiences with people with disabilities, experiences in inclusive classes and inclusion-related qualifications have a significant influence on personal willingness as one dimension of attitudes. In addition, general and especially inclusion-related self-efficacy show a positive effect on attitudes. It also shows that the understanding of teaching and learning has an influence on attitudes towards inclusion in general (an instruction-oriented understanding is related to more negative attitudes) and that the teachers' understanding of inclusion is related to their personal willingness. Against the background of this study, inclusion-related training courses to increase inclusion-related attitudes and the improvement of resources and framework conditions seem particularly promising for the implementation of inclusion.

Keywords: Attitudes, inclusion, teachers at vocational schools, questionnaire

1 Einleitung

Die Umsetzung von Inklusion erstreckt sich nicht nur auf die allgemeinbildenden, sondern auch auf die berufsbildenden Schulen und verfolgt das Ziel, allen Lernenden eine Teilhabe an der Gesellschaft allgemein sowie die Teilnahme an Ausbildung, Arbeit und Beschäftigung im Speziellen zu ermöglichen (vgl. DUK 2014, S. 9; VN-BRK 2008, Art. 24, KMK 2011, S. 3 f.; Werning 2014; Buchmann 2016, S. 237; Rützel 2016). In der aktuellen nationalen wie internationalen Forschung werden insbesondere die Einstellungen der Lehrkräfte zu Inklusion in den Blick genommen, da diese nicht nur deren pädagogisches und inklusionsbezogenes Wahrnehmen und Handeln beeinflussen, sondern auch den Erfolg (inklusiven) Unterrichts sowie die Lernergebnisse der Lernenden. In der Lehrkräftebelastungsforschung gelten sie zudem als interne Ressource zur Bewältigung von Anforderungen und Belastungen (vgl. Cassady 2011; Helmke 2012, S. 176; Heinrich et al. 2013, S. 86; Werning 2014, S. 616; Melzer et al. 2015, S. 61; Seifried 2015, S. 41; Przibilla et al. 2016, S. 36; Sharma & Sokal, 2016; Syring et al. 2018, S. 207f.). Neben dem Professionswissen werden Einstellungen in der deutschsprachigen inklusionsbezogenen Einstellungsforschung als zentraler Aspekt professioneller (Handlungs-)Kompetenz von Lehrkräften verstanden (vgl. Przibilla et al. 2016, S. 38; Baumert und Kunter 2011, S. 482).

Jedoch fällt auf, dass die inklusionsbezogenen Einstellungen von Lehrkräften an berufsbildenden Schulen bisher kaum berücksichtigt werden, obgleich die Einstellungen abhängig von der Schulform bzw. der Schulstufe, in der Lehrkräfte unterrichten, variieren (vgl. Avramidis und Norwich 2002; de Boer et al. 2010; Seifried 2015; Ruberg und Porsch 2017). Zu den Lehrkräften an berufsbildenden Schulen liegen lediglich erste, teils qualitative Studien und/oder wenig belastbare Befunde bzw. Befunde zu angehenden, aber nicht schon ausgebildeten Lehrkräften vor (vgl. Enggruber et al. 2014; Bylinski 2015; Burda-Zoyke und Joost 2018; Miesera und Gebhardt 2018; Miesera und Moser 2020). Zudem haben die Autor*innen dieses Beitrags in einer quantitativen Untersuchung – allerdings mit einer kleinen Stichprobe – eine erste Adaption von Instrumenten aus dem allgemeinbildenden Bereich (vgl. insb. Seifried 2015) für Lehrkräfte an berufsbildenden Schulen erprobt (vgl. Driebe et al. 2018). Daran anknüpfend werden in der vorliegenden, wesentlich umfassenderen Studie folgende Fragestellungen verfolgt:

1) Welche Einstellungen zu Inklusion liegen bei Lehrkräften an berufsbildenden Schulen vor?
2) Welche Zusammenhänge zwischen den Einstellungen zu Inklusion und potenziellen Einflussfaktoren zeigen sich?

Dafür wird zunächst in die theoretischen Grundlagen und den Forschungsstand zum Verständnis von Inklusion und zu den entsprechenden Einstellungen von Lehrkräften eingeführt (Kap. 2). Auf dieser Basis wird das Design der Studie vorgestellt (Hypothesen und Forschungsfragen sowie Eckpunkte zur Datenerhebung) (Kap. 3). Anschließend werden die Ergebnisse präsentiert (Kap. 4) und vor dem Hintergrund bisher vorliegender Forschungsbefunde diskutiert (Kap. 5). Der Beitrag endet mit einer Zusammenfassung sowie einem Ausblick (Kap. 6).

2 Theoretische Grundlagen, Forschungsstand und Forschungsfragen

2.1 Inklusion

Der Begriff Inklusion ist nicht einheitlich definiert und wird unterschiedlich verwendet. Zum einen werden Verhältnis und Abgrenzung von Inklusion und Integration unterschiedlich definiert. Zum anderen finden sich ‚engere' und ‚weitere' Verständnisse von Inklusion (vgl. Enggruber und Rützel 2014, S. 13). In einem *engeren Verständnis* werden Menschen mit Behinderungen in den Mittelpunkt gerückt (engeres, behindertenbezogenes Verständnis), wie dies bspw. in der VN-BRK (2008) geschieht sowie der Tradition der Sonder- und Integrationspädagogik entspricht (vgl. Enggruber und Rützel 2014, S. 13; Lindemeier und Lütje-Klose 2015, S. 7). In den institutionellen und gesetzlichen Grundlagen der beruflichen Bildung findet sich zum engen Inklusionsverständnis eine weitere Differenzierung in a) Behinderung in Anlehnung an die VN-BRK, b) sonderpädagogischen Förderbedarf gemäß den Schulgesetzen der Länder mit Verweis auf KMK-Vorgaben und nach dem Sozialgesetzbuch in c) Schwerbehinderte sowie in d) Rehabilitand*innen u. ä., die auch unter dem Begriff Benachteiligte zusammengefasst werden können (vgl. Enggruber und Rützel 2014, S. 16 f.; Euler und Severing 2014, S. 4 f.).

In *weiten Verständnissen* von Inklusion hingegen werden grundsätzlich alle Menschen betrachtet, teils unter Ablehnung jeglicher Kategorisierung (z. B. in Behinderte und Nicht-Behinderte) oder unter besonderer Berücksichtigung von jeglichen, vulnerablen und von Marginalisierung und Exklusion bzw. von Benachteiligung betroffenen oder bedrohten Personengruppen (z. B. aufgrund von Religion, Ethnie, sozialer Herkunft o. ä.). Folglich werden auch Nicht-Behinderte thematisiert, wie dies bspw. durch die UNESCO gefordert wird (vgl. Enggruber und Rützel 2014, S. 14; Lindmeier und Lütje-Klose 2015, S. 8 f.). Der Blick in die einzelnen Bundesländer zeigt jedoch, dass diese in ihren Inklusionsleitbildern, soweit sie denn existieren, stark auf Teilhabe von Menschen mit Behinderung fokussieren (vgl. Lange

2017, S. 26 f.). Zudem werden – verstärkt durch die föderale Struktur der Bildungspolitik – in den Bundesländern sehr unterschiedliche Inklusionsansätze verfolgt (vgl. ebd., S. 43 ff.).

In dieser Studie erfolgt keine Festlegung auf das eine oder andere Begriffsverständnis. Vielmehr geht es u. a. darum, überhaupt zu erfassen, welches Verständnis bei Lehrkräften an beruflichen Schulen vorliegt und Aussagen über den Zusammenhang von inklusionsbezogenen Einstellungen und Verständnissen zu gewinnen (s. Kap. 2.2.). An Stellen, wo eine Eingrenzung auf ein enges Verständnis vorgenommen wird, wird aus Kürzungsgründen mit dem Begriff der Behinderung gearbeitet.

2.2 Einstellungen von Lehrkräften zu Inklusion

Einstellungen (‚attitudes') zu Inklusion können als summarische Gesamtbewertung von bzw. als individueller Standpunkt und Bereitschaft zur Inklusion verstanden werden (vgl. Gall et al. 1996; Kunz et al. 2010, S. 84; Seifried 2015, S. 32). Eine Abgrenzung zu Konstrukten wie Überzeugungen (‚beliefs') und Haltungen wird nicht einheitlich vorgenommen (vgl. Ruberg und Porsch 2017, S. 395 f.). In der Sozialpsychologie werden Einstellungen allgemein in Anlehnung an Rosenberg und Hovland (1960) sowie Eagly und Chaiken (1993) über drei Dimensionen modelliert, die die Einstellungen beeinflussende Komponenten sowie daraus resultierende Reaktionen enthalten: eine kognitive Dimension (Überzeugungen und Meinungen), eine (motivational-)affektive (Emotionen) und eine behaviorale (Verhaltensweisen) (vgl. Werth et al. 2020, S. 244). Auch in jüngeren Studien zu inklusionsbezogenen Einstellungen werden diese als mehrdimensionale Konstrukte definiert, gleichwohl wird das Fehlen eines eindeutigen konsistenten theoretischen Konzepts vielfach bemängelt und das Zusammenspiel der Komponenten scheint noch nicht ganz geklärt (vgl. Seifried 2015, S. 32 f.; Ruberg und Porsch 2017, S. 395 f.). So lehnen sich z. B. Gebauer et al. (2013), Seifried (2015, S. 32 f.), Przibilla et al. (2016, S. 38) sowie Syring et al. (2018, S. 210) an die oben eingeführte dreidimensionale Modellierung an.

Vorliegende Studien weisen darauf hin, dass (angehende) Lehrkräfte (auch an Regelschulen) der Primar- und Sekundarstufe tendenziell neutrale bis positive Einstellungen gegenüber Inklusion äußern, auch wenn ihre Bereitschaft zur Umsetzung entsprechender Maßnahmen erkennbar negativer ausfällt (vgl. Avramidis und Norwich 2002; de Boer et al. 2010; Kunz et al. 2010, S. 93; Seifried 2015, S. 41; Przibilla et al. 2016, S. 38; Miesera und Gebhardt 2018; Miesera und Moser 2020). Allerdings variieren die Einstellungen in Abhängigkeit von insbesondere folgenden Einflussfaktorenfaktoren:

- Kontakterfahrungen mit Menschen mit Behinderungen innerhalb und außerhalb des beruflichen Kontextes (häufig signifikant positiver Zusammenhang) (vgl. Avramidis und Norwich 2002, S. 138 f.; Heinrich et al. 2013, S. 87; Feyerer et al. 2014, S. 180; Seifried 2015, S. 42 f.; Ruberg und Porsch 2017, S. 403; Driebe et al. 2018, S. 412),
- Qualitativ hochwertige Erfahrungen mit inklusivem Unterricht, insbesondere in Verbindung mit Reflexionen und Evaluationen (positiver Zusammenhang) (vgl. Avramidis und Norwich 2002, S. 137; de Boer et al. 2010; Seifried 2015, S. 44; Ruberg und Porsch 2017, S. 403; Driebe et al. 2018, S. 412),
- unterschiedliche Behinderungsformen, Förderschwerpunkte bzw. Heterogenitätsdimensionen und deren subjektive Wahrnehmung (positivere Einstellungen bei motorischen Behinderungen und Lernbehinderungen, größere Vorbehalte bei Verhaltensauffälligkeiten, geistiger Behinderung und schwerer Mehrfachbehinderung) (vgl. Avramidis und Norwich 2002, S. 135 f.; Ruberg und Porsch 2017, S. 404 f.; Driebe et al. 2018, S. 413),
- inklusionsbezogene, insbesondere langfristig und auf konkrete Umsetzungssituationen angelegte Aus- und Weiterbildung bzw. Trainingsmaßnahmen und regelmäßige Information (positiver Zusammenhang) (vgl. Avramidis und Norwich 2002, S. 139; de Boer et al. 2010; Heinrich et al. 2013, S. 86; Feyerer et al. 2014, S. 177; Seifried 2015, S. 43 f.; Miesera und Gebhardt 2018; Driebe et al. 2018, S. 412),
- das (bereichsspezifische) Selbstwirksamkeitserleben der Lehrkräfte bzw. Vertrauen in die eigenen Fähigkeiten (positiver Zusammenhang) (vgl. Seifried 2015, S. 44f.; Ruberg und Porsch 2017, S. 405; Miesera und Gebhardt 2018; Driebe et al. 2018, S. 413),
- wahrgenommene (administrative) Unterstützung und Qualität des Schulumfeldes (positiver Zusammenhang) (vgl. Avramidis und Norwich 2002, S. 140 ff.; Heinrich et al. 2013, S. 89 ff.; Ruberg und Porsch 2017, S. 405).

Darüber hinaus finden sich Hinweise auf einen Zusammenhang zwischen Einstellungen und dem Verständnis von Inklusion (vgl. Loreman et al. 2013, S. 39 ff.; Hellmich und Görel 2014, S. 237; Driebe et al. 2018, S. 413).

Zum Einfluss demographischer Variablen wie Geschlecht, Alter oder Berufserfahrung liegen derzeit keine eindeutigen Befunde vor (vgl. zusammenfassend Avramidis und Norwich 2002; de Boer et al. 2010; Seifried 2015, S. 41f; Ruberg und Porsch 2017, S. 403). Unterschiede in den Einstellungen konnten jedoch in Abhängigkeit vom Erhebungsort (z. B. unterschiedliche Bundesländer in Österreich sowie zwischen Deutschland, Österreich und Kanada) ausgemacht werden, welche auf die regional unterschiedliche Implementation von Inklusion zurückgeführt

werden (vgl. Ruberg und Porsch 2017, S. 405 ff.; Miesera und Gebhardt 2018; Miesera und Moser 2020).

Kaum untersucht sind die Befürchtungen und Sorgen von Lehrkräften im Rahmen der Einführung von Inklusion, obwohl sie mit besonderen Anforderungen konfrontiert werden, womit die affektive Dimension der Einstellungen zu Inklusion bisher kaum bearbeitet wird (vgl. Seifried 2015, S. 45; Syring et al. 2018).

Die oben ausgewiesenen Befunde stammen – mit Ausnahme von der kleinen Vorstudie von Driebe et al. (2018) – aus Studien, die mit Lehrkräften allgemeinbildender Regel- und Sonderschulen oder mit angehenden, aber noch nicht voll ausgebildeten Lehrkräften an beruflichen Schulen durchgeführt wurden. Jedoch zeigt sich, dass die Einstellungen in Abhängigkeit vom Lehramtstyp bzw. der Schulform variieren (vgl. Ruberg und Porsch 2017, S. 404; Seifried 2015, S. 42; Miesera et al. 2018), wobei die Befundlage hierzu durchaus uneinheitlich erscheint (vgl. Syring et al. 2018, S. 209). Da die ausgebildeten Lehrkräfte berufsbildender Schulen bisher jedoch kaum betrachtet wurden, sollen mit dieser Studie auch die oben skizzierten Erkenntnisse hinsichtlich Ausprägung der Einstellungen und wesentlicher Einflussfaktoren auf ihre Gültigkeit für diese Zielgruppe überprüft werden.

2.3 Fragestellungen und Hypothesen

Neben der grundsätzlichen Frage, welche inklusionsbezogenen Einstellungen bei Lehrkräften in berufsbildenden Schulen vorliegen, stellen sich für die vorliegende Studie vor dem Hintergrund der referierten Befunde folgende Forschungsfragen und Hypothesen zu Zusammenhängen zwischen den Einstellungen und potenziellen Einflussfaktoren sowie zur affektiven Dimension der Einstellungen. Mit Bezug auf demographische, berufsbiografische und bildungssystembezogene Merkmale ist vor dem Hintergrund des leicht uneinheitlichen Forschungsstandes zu fragen: Welchen Einfluss hat das Alter (F1), das Geschlecht (F2), die Berufserfahrung (F3), die pädagogische Qualifikation (F4), das Bundesland (F5) und der primäre Einsatzbereich im berufsbildenden Schulwesen[3] (F6) sowie das Verständnis von Inklusion (F7) auf die Einstellung zur Inklusion?

Unter Berücksichtigung der in zahlreichen Studien untersuchten weiteren inklusionsbezogenen Einflussfaktoren lassen sich folgende Hypothesen ableiten: Die Kontakterfahrung mit beeinträchtigten Menschen (H1), die Arbeit in inklusiven Klassen (H2), der Besuch von

[3] Aufgrund der Hinweise, dass der Erhebungsort und damit der bildungssystemische Kontext eine Rolle auf die inklusionsbezogenen Einstellungen hat, ist anzunehmen, dass es innerhalb des stark differenzierten Berufsbildungssystems (Übergangssystem, Duales System, berufliche Vollzeitschulen, berufl. Sonderschulbereich) Unterschiede gibt.

inklusionsbezogenen Qualifikationen (H3), eine erhöhte allgemeine Selbstwirksamkeitswahrnehmung (H4) und eine erhöhte inklusionsbezogene Selbstwirksamkeitswahrnehmung (H5) wirkt sich positiv auf die Einstellung zur Inklusion aus.

Über den bisherigen Forschungsstand hinausgehend besteht die Vermutung, dass die inklusionsbezogenen Einstellungen mit dem Lehr-Lern-Verständnis zusammenhängen. Lehrer*innen, die gegenüber inklusivem Unterricht positiv eingestellt und Schüler*innen mit ihren spezifischen Besonderheiten wahrnehmen, haben möglicherweise auch eine konstruktivistischere, subjektorientierte Überzeugung. Lehrkräfte mit einem instruktionalen, lehrendenzentrierten Lehrverständnis haben demgegenüber eher Vorbehalte gegen inklusive Settings. Daher wird untersucht (F8), welchen Einfluss das Lehr-Lern-Verständnis auf die Einstellung zur Inklusion hat?

Vor dem Hintergrund der sehr dünnen Befundlage zur affektiven Dimension werden drei weitere explorative Fragen formuliert, welche Befürchtungen (F9), positiven Erwartungen (F10) und Forderungen (F11) Lehrkräfte an berufsbildenden Schulen bezüglich Inklusion äußern.

3 Methoden

3.1 Instrumente

Zur Erhebung inklusionsbezogener Einstellungen existiert eine Reihe von Instrumenten und Skalen, deren Qualität jedoch im Hinblick auf Validierungsmethodik und Stichprobengröße variiert (siehe jeweils mit einem Überblick z. B. de Boer et al. 2010; Bosse und Spörer 2014; Miesera et al. 2018; Driebe et al. 2018, S. 399). Die meisten Skalen sind auf der Basis eher geringer Stichproben validiert, die sich zudem teilweise nicht aus ausgebildeten Lehrkräften rekrutieren. In der erwähnten Vorstudie der Autor*innen dieses Beitrags wurde das Instrumentarium von Seifried (2015) u. a. mit der Skala EFI-L aufgegriffen, da diese Skala mit relativ großer Stichprobe (N=652) mit Lehrkräften aus allgemeinbildenden Regel- und Sonderschulen und zudem mittels konfirmatorischer Faktorenanalyse validiert wurde. Das Gesamtinstrument folgt der dreidimensionalen Modellannahme mit kognitiver, behavioraler und affektiver Dimension. Damit hebt es sich positiv von anderen ab, die häufig ohne Begründung und trotz der bereits erkannten besonderen Bedeutung die affektive und teils auch die behaviorale Dimension vernachlässigen (vgl. ebd. S. 62 f.; Syring et al. 2018, S. 207). Während die affektive Dimension explorativ mit offenen Fragen zu Befürchtungen, Erwartungen und Forderungen erhoben wird, ermittelt Seifried für die beiden anderen Dimensionen mit der Gesamtskala des EFI-L drei Faktoren: Die Faktoren *fachliche Förderung*

und *soziale Inklusion* als kognitive fremdbezogene Komponenten sowie den Faktor *persönliche Bereitschaft* als behaviorale selbstbezogene Komponente (Tabelle 1).

Faktor	**Bezug**	**Einstellungs-komponente**	**Beschreibung**	**Beispielitem**
Fachliche Förderung	Fremd-bezug	Kognition	Einschätzung zur Unterrichtsqualität in inklusiven Klassen	Die Qualität des Unterrichts wird besser, wenn Kinder mit besonderen Bedürfnissen dabei sind und miteinbezogen werden.
Soziale Inklusion	Fremd-bezug	Kognition	Einschätzung zur Einbindung von Schülern mit Förderbedarf in inklusiven Klassen	Schüler mit besonderen Bedürf-nissen würden in einer inklusiven Schulklasse von den anderen Kindern gut behandelt werden.
Persönliche Bereitschaft	Selbst-bezug	Verhalten	Persönliche Bereitschaft der Lehrkräfte zum Umsetzen von Inklusion	Ich empfinde den Unterricht in einer inklusiven Klasse für mich als zu belastend (invers).

Tabelle 1: Faktoren der Skala EFI-L

Diese Skala wurde für Lehrkräfte an berufsbildenden Schulen adaptiert und in einer kleinen Stichprobe von Lehrer*innen aus berufsbildenden Schulen aus NRW und Sachsen-Anhalt eingesetzt (N=62). Ihre Überprüfung bringt auf Item- und Konstruktebene zufriedenstellende Ergebnisse hervor. Somit steht mit der adaptierten Skala EFI-L ein Instrument zur Verfügung, das die inklusionsbezogenen Einstellungen auch bei Lehrkräften an berufsbildenden Schulen zuverlässig misst (vgl. Driebe et al. 2018, S. 405).

Der Fragebogen der hier dokumentierten Hauptstudie umfasste – neben der EFI-L-Skala zur kognitiven und behavioralen Komponente sowie den offenen Fragen zur affektiven Komponente – vor dem Hintergrund der formulierten Fragen und Hypothesen

- Angaben zu Person und Lehrtätigkeit (Alter, Geschlecht, pädagogische Qualifikation und Berufserfahrung, Bundesland, Schulform, in der hauptsächlich unterrichtet wird, eigene Behinderung/sonderpädagogischer Förderbedarf, Benachteiligung o. ä.),
- Kenntnis des Inklusionsbegriffs (geschlossene Frage), Verständnis von Inklusion in der beruflichen Bildung und von inklusiven Klassen in berufsbildenden Schulen (offene Fragen)
- Angaben zu inklusionsbezogenen Erfahrungen (Erfahrungen mit Menschen mit besonderen Bedürfnissen, Tätigkeit in inklusiven Klassen, inklusionsbezogene Qualifizierungsveranstaltungen),
- Lehrerkräfteselbstwirksamkeit (Skala WirkLehr; Schwarzer und Schmitz 1999) und inklusionsbezogene Lehrerselbstwirksamkeit (Bosse und Spörer 2014),

- Lehr-Lern-Verständnis (erprobt an Berufsschullehrkräften für den wirtschaftsberuflichen Unterricht; Seifried 2009).

3.2 Stichprobe

Es wurden Lehrkräfte an berufsbildenden Schulen in den vier Bundesländern Hamburg (HH), Sachsen-Anhalt (SA), Schleswig-Holstein (SH) und Thüringen (TH) befragt, welche (u. a.) in Klassen der beruflichen Fachrichtung Wirtschaft und Verwaltung unterrichten. Die Fragebögen wurden – je nach Zugangsmöglichkeit – in Präsenz von Lehrkräftegruppen in den Schulen ausgefüllt oder über die Schulleitungen an die Lehrkräfte verteilt. Diese konnten den Bogen in einem jeweils festen Zeitraum in 2019 ausfüllen und gesammelt (anonym) zurückgeben. Aufgrund von missing data wurden 17 Bögen vollständig ausgeschlossen. Insgesamt wurden 662 Fragebögen ausgefüllt (s. zur Stichprobe Tabelle 2).

Bundesland	Hamburg (N=140)	Sachsen-Anhalt (N=57)	Schleswig-Holstein (N=315)	Thüringen (N=147)	Summe (N=662)*
Alter (M(SD))	48.5 (10.1)	48.2 (10.4)	44.9 (10.1)	49.9 (10.2)	47.1 (10.3)
Geschlecht (m/w/d)	44%/56%/ 0%	19%/77%/ 0%	43%/54%/ 0%	27%/73%/ 0%	37%/62%/ 0%
Pädagogische Qualifikation					
Lehramt Berufsbild. Schulen	84%	63%	80%	50%	72%
Lehramt Allgemein. Schulen	6%	18%	7%	33%	14%
Sonder-/Sozialpädagogik	2%	0%	1%	1%	1%
Sonstiges pädagog. Studium	4%	14%	5%	6%	6%
kein pädagogisches Studium	5%	5%	7%	10%	8%
Referendariat	91%	68%	88%	82%	85%
Berufserfahrung in Jahren (M(SD))	16.7 (11.0)	20.6 (12.3)	13.2 (10.2)	21.8 (12.2)	16.5 (11.6)
Primärer Einsatzbereich in der berufsbildenden Schule					
Berufsausbildung	56%	88%	48%	62%	56%
Übergangsbereich	20%	2%	13%	7%	12%
SEK II mit Ziel Hochschul-zugangsberechtigung	19%	9%	31%	24%	25%
Förderberufsschul-/beruf-licher Sonderschulbereich	0%	0%	0%	1%	0%
k.A.	5%	2%	8%	6%	6%
Inklusionserfahrungen					
Eigene Beeinträchtigung	5%	6%	7%	8%	7%

Inklusionserfahrung (keine/ privat/berufl./beides)	18%/6%/ 36%/39%	12%/9%/ 47%/32%	13%/7%/ 42%/37%	14%/5%/ 37%/41%	15%/6%/ 40%/38%
Erfahrung in inklusiven Klassen	76%	74%	74%	71%	73%
Inklusionsbezogene Qualifizierung	29%	14%	28%	29%	27%

*3 Fälle ohne Angabe des Bundeslandes

Tabelle 2: Stichprobe

In Anbetracht der Stichprobengröße soll vermieden werden, dass komplette Observationen aufgrund einzelner fehlender Werte entfallen. Um dies ohne eine Verzerrung der Daten zu erreichen, wurde der Datensatz für die Skalen EFI-L, WirkLehr, InklSW und LLV mittels des MCMC (Monte Carlo Markov Chain) - Verfahren in 20 Iterationen imputiert (vgl. Graham 2012, S. 53).

3.3 Analysemethoden

Die Analyse der Einstellungen zur Inklusion (für die Gesamtskale zur kognitiven und behavioralen Dimension sowie für die drei Faktoren), der allgemeinen und inklusionsbezogenen Selbstwirksamkeit sowie des Lehr-Lernverständnisses erfolgte mittels deskriptiver Statistik. Zudem erfolgt eine Wirkungsanalyse zwischen den Skalenwerten der Gesamtskala zur kognitiven und behavioralen Dimension bzw. ihren drei einzelnen Faktoren sowie möglichen Einflussfaktoren mittels linearer Regression.

Die Antworten auf die offenen Fragen zum Verständnis von Inklusion sowie zur affektiven Dimension der Einstellungen wurden mittels inhaltlich strukturierender qualitativer Inhaltsanalyse ausgewertet (vgl. Mayring 2015). Das Inklusionsverständnis wurde binär in Anlehnung an die grundsätzliche Unterscheidung zwischen engem und weitem Verständnis codiert und für das enge Verständnis wurden im Rahmen des Probedurchlaufs induktiv weitere Sub-Codes gebildet. Zur Analyse der affektiven Dimension wurde das aus der Vorstudie gewonnene Kategoriensystem (vgl. Driebe et al. 2018, S. 407) genutzt und im Rahmen des Probedurchlaufs überarbeitet bzw. induktiv neue (Sub-)Kategorien entwickelt.

4 Ergebnisse

Den leitenden Fragestellungen der Studie folgend werden zunächst die Ergebnisse zu den inklusionsbezogenen Einstellungen von Lehrkräften an beruflichen Schulen referiert (Kap. 4.1). Anschließend werden die Ausprägungen der Skalen zur Selbstwirksamkeit und zum Lehr-Lernverständnisses sowie des Inklusionsverständnisses als zentrale potenzielle Einflussfaktoren untersucht (Kap. 4.2-4.4). Abschließend werden die Ergebnisse zu den

Zusammenhängen zwischen potenziellen Einflussfaktoren und inklusionsbezogenen Einstellungen vorgestellt (Kap. 4.5).

4.1 Einstellungen zu Inklusion

4.1.1 Kognitive und behaviorale Dimension (EFI-L)

Die Struktur des für die Lehrkräfte an berufsbildenden Schulen adaptierten Instruments zur Erhebung der kognitiven und behavioralen Dimension der inklusionsbezogenen Einstellungen (EFI-L1 bis EFI-L15) wurde mittels einer konfirmatorischen Faktorenanalyse geprüft (siehe Abbildung 1). Da keine multivariate Normalverteilung (Mardia-Test auf multivariate Normalverteilung $p < .001$) vorliegt, wurde die WLSMV-Schätzmethode für die Prüfung des Modells genutzt, die sich besonders für grobstufige, ordinalskalierte Variablen eignet.

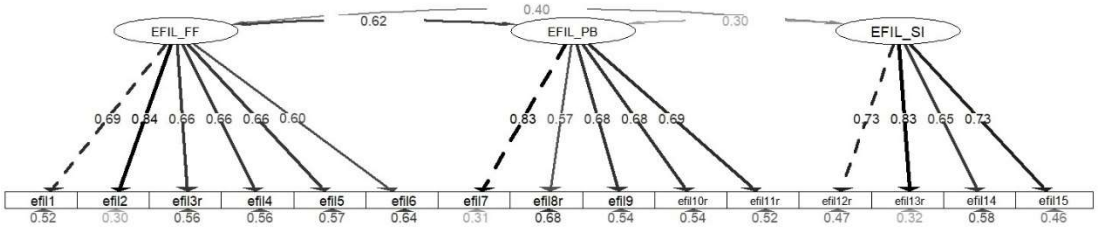

Abbildung 1: Konfirmatorische Faktorenanalyse der Skala EFI-L

Die Modellpassung ist gut. Die Fit-Werte (Chi-Quadrat (87) = 141.79, $p < .001$, RMSEA = .031 CFI = .991, TLI = .989, SRMR = .048) zeigen, dass das Modell, welches sich aus den drei Faktoren „Fachliche Förderung“ (EFIL_FF), „Soziale Inklusion“ (EFIL_SI) und „Persönliche Bereitschaft“ (EFIL_PB) zusammensetzt, akzeptiert werden kann (Seifried 2015, S. 107f.; Driebe et al. 2018, S. 400).

Skala[1]	Items	Median	Mean (SD)	Min/Max	Schiefe	Kurtosis	Cronbachs Alpha
Fachliche Förderung (FF)	6	3.0	3.05 (.89)	1 / 6	.173	-.117	.84
Soziale Inklusion (SI)	4	4.2	4.23 (.83)	1.7 / 6	-.121	-.125	.84
Persönliche Bereitschaft (PB)	5	3.5	3.53 (1.04)	1 / 6	.085	.302	.82
EFI-L[2]	15	3.6	3.60 (.70)	1.7 / 5.8	.225	.082	.87

[1] „stimme überhaupt nicht zu“ bis 6= „stimme voll zu“, [2] Skala EFI-L = (FF + PB + SI) / 3

Tabelle 3: Skalenstatistiken EFI-L

Tabelle 3 zeigt die Eigenschaften und Güte der (Sub-)Skalen. Nimmt man den Skalen-Split bei 3.5 vor (Werte unterhalb eher negativ, Werte oberhalb eher positiv), so wird deutlich, dass Fachliche Förderung negativer und Soziale Inklusion positiver bewertet wird. Insgesamt liegen die Einstellungen unter Berücksichtigung der kognitiven und behavioralen Dimension mit 3.6 im neutralen Mittelfeld.

4.1.2 Affektive Dimension

Im Bereich der offenen Fragen im Fragebogen zur affektiven Dimension inklusionsbezogener Einstellungen gaben 586 (88.5%) Befragte Antworten zu Befürchtungen an, 535 (80.8%) zu positiven Erwartungen und 589 (89.0%) zu Forderungen. Zu den Befürchtungen ergab die qualitative Inhaltsanalyse vier Kategorien, die teilweise in weitere Subkategorien ausdifferenziert wurden, aber im Folgenden zusammengefasst werden, zu den positiven Erwartungen sechs und zu den Forderungen fünf Kategorien (s. Abbildung 2). Die Intercoder-Reliabilität zwischen zwei unabhängigen Codern für 30% der ausgewerteten Fragebögen ist für die Dimensionen Erwartungen mit r_{Holsti}= .91 und Forderungen mit r_{Holsti}= .89 (sehr) zufriedenstellend. Für die Befürchtungen ergab sich eine Intercoder-Reliabilität von r_{Holsti}= .76, welche sowohl auf deutlich erkennbare Codierfehler als auch auf Unschärfen im Kategoriensystem und Codierleitfaden zurückzuführen ist. Die deutlich erkennbaren Codierfehler wurden unter Berücksichtigung des Codierleitfadens im Rahmen der weiteren Auswertung korrigiert.

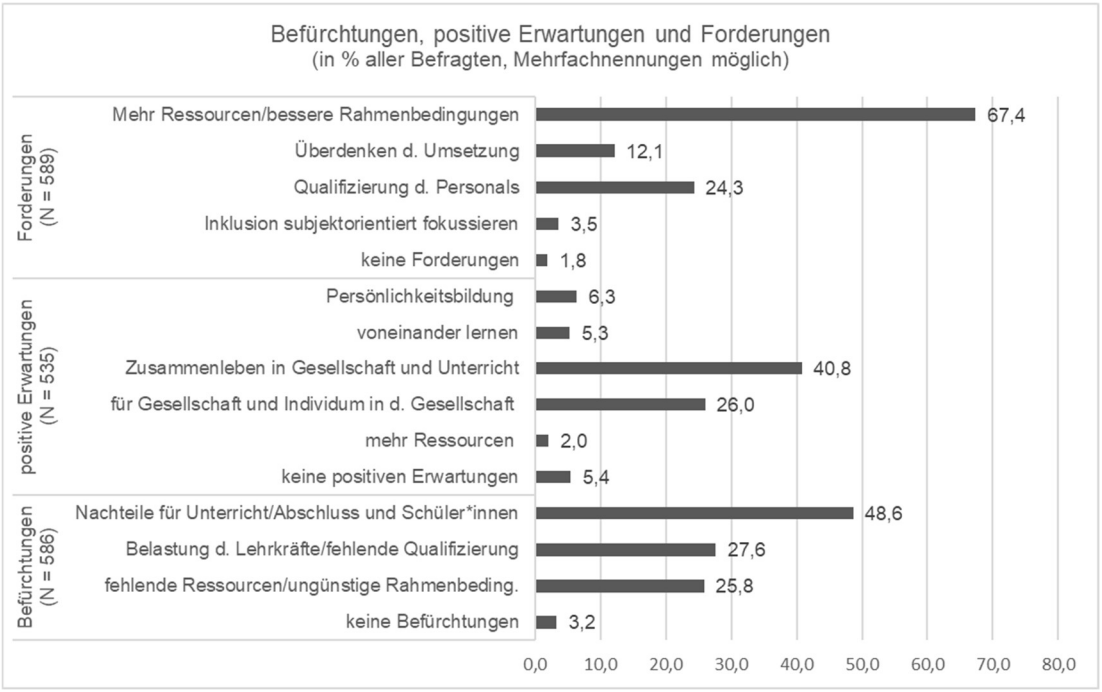

Abbildung 2: Befürchtungen, positive Erwartungen und Forderungen im Zusammenhang mit Inklusion

Die Befragten befürchten vor allem Nachteile für die Qualität des Unterrichts bzw. bezüglich der Erfüllung von Anforderungen aus Abschlussprüfungen und Zielen der Bildungsgänge sowie im Zuge dessen auch für die Lernenden. Diesbezüglich werden sowohl Nachteile explizit für Schüler*innen mit Förderbedarfen als auch für Schüler*innen ohne Förderbedarfe oder für alle Lernenden gesehen. Diese Befürchtung wird von fast der Hälfte der Lehrkräfte (48.6%) geäußert und korrespondiert mit der identifizierten tendenziell negativeren Einstellung zur „Fachlichen Förderung“ (Einschätzung zur Unterrichtsqualität in inklusiven Klassen). Zudem sieht mehr als ein Viertel der befragten Berufsschullehrkräfte (27.6%) die Gefahr einer hohen Belastung oder gar Überforderung ihrer selbst durch mit Inklusion verbundenen neuen zusätzlichen Aufgaben und Anforderungen, woraus sich einige auch die angeführten befürchteten Nachteile für Lernende begründen. Weiterhin befürchtet jeder Vierte (25.8%), dass nicht hinreichend Ressourcen zur Verfügung gestellt bzw. erforderliche Rahmenbedingungen geschaffen werden (insbes. werden fehlendes Personal und Zeit, aber auch zu große Klassengrößen, zu wenig finanzielle Mittel und nicht ausreichende Räumlichkeiten bemängelt). Während wenige Lehrkräfte (5.4%) explizit und entgegen der Fragestellung keine positiven Erwartungen artikulieren, glauben 40.8% der Befragten an positive Wirkungen für das Zusammenleben in der Gesellschaft und im Unterricht (z. B. Steigerung von Toleranz, Akzeptanz, Empathie, Sozialkompetenz) und ca. ein Viertel (26%) an positive Wirkungen bzw. Bereicherungen für die Gesellschaft und die Individuen im Gefüge

der Gesellschaft (z. B. Steigerung von Vielfalt, Chancengleichheit, Integration in den Arbeitsmarkt). Dies korrespondiert mit der identifizierten tendenziell positiven Einstellung zur „Sozialen Inklusion“ (Einschätzung zur Einbindung von Schüler*innen mit Förderbedarf in inklusiven Klassen). Sehr wenige Lehrkräfte erwarten, dass zusätzliche Ressourcen für die Umsetzung bereitgestellt werden. Andererseits fordert aber auch mehr als jede zweite befragte Lehrkraft (67.4%) die Bereitstellung zusätzlicher Ressourcen bzw. Rahmenbedingungen (z. B. mehr Personal, Sonder- und Sozialpädagog*innen, kleinere Klassen, finanzielle Mittel, Zeit, barrierefreie Räumlichkeiten). Etwa jede*r Vierte (24.3%) äußert einen Bedarf an zusätzlicher Fort- und Weiterbildung bzw. zumindest Information. 12.1% der Lehrkräfte fordern ein Überdenken der Inklusionsstrategie (z. B. Konzepte anpassen bis hin zur Begrenzung der Inklusion) und einzelne (3.5%) fordern eine subjektorientierte Fokussierung der Inklusion, d. h. stärker Bedürfnisse und Potenziale der Einzelnen zu berücksichtigen.

4.2 Selbstwirksamkeit und inklusionsbezogene Selbstwirksamkeit

Die allgemeine Lehrkräfteselbstwirksamkeitsskala (Schwarzer und Schmitz, 1999) wurde mittels konfirmatorischer Faktorenanalysen geprüft. Die einfaktorielle Struktur lässt sich bestätigen. Da keine multivariate Normalverteilung (Mardia-Test auf multivariate Normalverteilung $p < .001$) vorliegt, wurde die WLSMV-Schätzmethode für die Prüfung des Modells genutzt. Die Modellpassung ist akzeptabel. Die Fit-Werte (Chi-Quadrat (14) = 43.45, $p < .001$, RMSEA = .057, CFI = .978, TLI = .966, SRMR = .060) zeigen, dass das Modell akzeptiert werden kann.

Die inklusionsbezogene Selbstwirksamkeitsskala (Bosse und Spörer, 2014) wurde ebenfalls mittels konfirmatorischer Faktorenanalysen geprüft. Auch hier lässt sich die einfaktorielle Struktur gut bestätigen. Da keine multivariate Normalverteilung (Mardia-Test auf multivariate Normalverteilung $p < .001$) vorliegt, wurde die WLSMV-Schätzmethode für die Prüfung des Modells genutzt. Die Modellpassung ist gut. Die Fit-Werte (Chi-Quadrat (2) = 4.74, $p < .001$, RMSEA = .046, CFI = .996, TLI = .988, SRMR = .031) zeigen, dass das Modell akzeptiert werden kann.

Die internen Konsistenzen der Selbstwirksamkeitsskalen und die entsprechenden Skalenstatistiken sind der Tabelle 4 zu entnehmen.

Skala	Items	Median	Mean (SD)	Min/Max	Schiefe	Kurtosis	Cronbachs Alpha
Selbstwirksamkeit	7	2.9	2.86 (.48)	1 / 4	-.276	.702	.80
Inklusionsbezogene Selbstwirksamkeit	4	2.5	2.41 (.61)	1 / 4	-.058	-.021	.81

1= „stimme nicht zu“ bis 4= „stimme genau zu“

Tabelle 4: Skalenstatistiken Selbstwirksamkeit

4.3 Lehr-Lern-Verständnis

Die von Seifried (2009) berichteten Konsistenzen seiner dreifaktoriellen Skala zur Erfassung des Lehr-Lern-Verständnisses sind lediglich akzeptabel, sodass im Rahmen der vorliegenden Untersuchung die Struktur des Instruments (LLV1 bis LLV21) zunächst mittels einer explorativen Faktoranalyse geprüft wurde. Dabei konnte die dreifaktorielle Struktur extrahiert werden. Sowohl der Bartlett-Test (Chi-Quadrat (210) = 2200.802, $p < .001$) als auch das Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO = .819) weisen darauf hin, dass sich die Variablen für eine Faktoranalyse eignen. So wurde eine Hauptkomponentenanalyse mit Varimax-Rotation durchgeführt, welche auf das Vorliegen von drei Faktoren mit Eigenwerten größer als 1.0 hinweist. Diese Lösung wurde aufgrund des Screeplots und der theoretischen Überlegungen final gewählt und erklärt 28.9% der Varianz. Damit liegen drei Faktoren vor: „Instruktionales Lehr-Lern-Verständnis“, „Konstruktivistisches Lehr-Lern-Verständnis“ sowie „Systematik-orientiertes Lehr-Lern-Verständnis“. Aufgrund relativ geringer Faktorladungen und identifizierter Querladungen im ersten und zweiten Faktor wurde eine weitere Berechnung mit Items durchgeführt, deren Ladungen größer .40 waren.

Aufgrund inhaltlichen Vorwissens kann diese Lösung angenommen werden. Sie deckt sich weitgehend mit den Befunden von Seifried (2009). Nachfolgend wurde diese Lösung im Rahmen einer konfirmatorischen Faktorenanalyse geprüft. Da keine multivariate Normalverteilung (Mardia-Test auf multivariate Normalverteilung $p < .001$) vorliegt, wurde die WLSMV-Schätzmethode für die Prüfung des Modells genutzt, die sich besonders für grobstufige ordinalskalierte Variablen eignet. Die Modellpassung ist allenfalls akzeptabel (Chi-Quadrat (62) = 261.23, $p < .001$, RMSEA = .070, CFI = .898, TLI = .872, SRMR = .069). Wenig überraschend sind dementsprechend die internen Konsistenzen der Skalen zu bewerten.

Skala	Items	Median	Mean (SD)	Min/Max	Schiefe	Kurtosis	Cronbachs Alpha
Instruktionales LLV	4	3	2.98 (0.81)	1 / 6	.268	.222	.70
Konstruktivistisches LLV	6	4.7	4.69 (0.60)	2.5 / 6	-.400	.015	.70
Systematisches LLV	3	5	4.84 (0.71)	2 / 6	-0.419	.030	.59

Tabelle 5: Skalenstatistik Lehr-Lern-Verständnis (LLV)

Trotz dieser Probleme mit der Skalengüte wird deutlich, dass in der Stichprobe eine deutlich stärkere Zustimmung zu konstruktivistischen und Systematik-orientierten Lehransätzen vorhanden ist (Tabelle 5). Letzterer soll aufgrund der geringen Zuverlässigkeit für die weiteren Analysen ausgeschlossen werden.

4.4 Inklusionsverständnis

Die beiden grundsätzlich unterscheidbaren Inklusionsverständnisse (enges, behinderungsbezogenes vs. weites) finden sich auch in den Antworten zu der offenen Frage „Beschreiben Sie bitte, was Sie unter Inklusion verstehen“. Bei 356 der Befragten (53.8%) finden sich Hinweise auf ein enges und bei 215 Probanden (32.5%) Hinweise auf ein weites Inklusionsverständnis. 91 Befragte (13.7%) machten hierzu keine Angabe oder es war keine eindeutige Codierung zu einer der Kategorien möglich (Tabelle 6). Die diesbezügliche Intercoder-Reliabilität von zwei unabhängigen Codern für 30% der ausgewerteten Fragebögen beträgt zufriedenstellend r_{Holsti}= .837.

Verständnis von Inklusion in der beruflichen Bildung	absolut	in %
Enges Verständnis, davon *(Mehrfachkodierung der Subkategorien möglich, Gesamtzahl ohne Mehrfachzählung)*:	**n = 356**	**53.8**
– Behinderung/Beeinträchtigung	n = 220	
– Schwerbehinderung	n = 2	
– Sonderpädagogischer Förderbedarf	n = 24	
– Weitere Beschreibungen (z. B. Einschränkungen, Handicap, behinderungsfokussierte Benachteiligung, besonderer Förderbedarf)	n = 148	
Weites Verständnis (alle; Akzeptanz u. Berücksichtigung von Vielfalt u. Diversität; heterogene Lernvoraussetzungen, insbes. Schulabschluss, Migration, soziale Herkunft, diverse und nicht nur behinderungsbezogene Benachteiligungen)	**n = 215**	**32.5**
k.A., nicht kategorisierbar	**n = 91**	**13.7**

Tabelle 6: Verteilung des Inklusionsverständnisses

4.5 Einflussfaktoren inklusionsbezogener Einstellungen

Im Folgenden werden die Ergebnisse der Regressionsanalyse zum Zusammenhang zwischen den Skalenwerten der Gesamtskala (kognitive und behaviorale Dimension) bzw. ihren drei einzelnen Faktoren sowie möglichen Einflussfaktoren vorgestellt (s. Tabelle 7). Die Gütekriterien zeigen, dass die F-Statistik für alle vier Modelle signifikant ist. Das adjustierte R^2 liegt im für solche Untersuchungen üblichen Bereich (Seifried 2015, S. 170).

	Modell Gesamt	Modell Fachliche Förderung	Modell Persönliche Bereitschaft	Modell Soziale Inklusion
Alter (in Jahren)	.003	.007	.009	-.006
Geschlecht (Ref.: weiblich)				
männlich	.033	-.008	.051	.054
Berufserfahrung (in Jahren)	.003	.003	-.002	.008
Pädagogisches Studium (1=ja, 0=nein)	-.052	-.055	.035	-.135
Bundesland (Ref.: Schleswig-Holstein)				
Thüringen	-.085	-.172^{+}	.018	-.100
Hamburg	.090	.251**	.030	.010
Sachsen-Anhalt	-.141	-.060	-.127	-.236^{+}
Primärer Berufsbildungsbereich (Ref.: Berufsausbildung)				
Übergangssystem	-.010	-.070	.084	-.043
Sekundarstufe II mit Ziel Hochschulzug.berecht.	.011	.037	.061	-.066
Förderberufsschul-/berufl. Sonderschulbereich	.029	-.107	.713	-.518
Eigene Behinderung	.029	.208	-.084	-.034
Erfahrung mit Menschen mit Beeinträchtigungen (Ref.: keine)				
Berufliche Erfahrungen	-.019	-.173	.160	-.047
Private Erfahrungen	-.023	-.047	-.044	.018
Berufliche und private Erfahrungen	.136	-.003	.379**	.032
Erfahrung in inklusiven Klassen (1=ja, 0=nein)	.094	-.031	.271**	.043
Inklusionsbezogene Qualifizierung (1=ja, 0=nein)	.136*	.137^{+}	.391***	-.135
Selbstwirksamkeit				
Inklusionsbezogene Selbstwirksamkeit	.508***	.610***	.685***	.228***
Allgemeine Lehrkräfteselbstwirksamkeit	.160**	.006	.236*	.249**
Lehr-Lern-Verständnis				
Konstruktivistisches Lehr-Lern-Verständnis	.119**	.115^{+}	.014	.227***
Instruktionales Lehr-Lern-Verständnis	-.124***	-.167***	-.128**	-.075^{+}
Konstante	1.441***	1.280**	.536	2.507***
Adj.R^2	.381	.267	.355	.129
Max. VIF		5.066		
F	18.46***	11.36***	16.61***	5.21***

***p<.001, **p<.01, *p<.05, $^{+}$p<0.1

Tabelle 7: Einflussfaktoren auf die Einstellungen zu Inklusion von Berufsschullehrkräften

Die demographischen Merkmale Alter und Geschlecht haben ebenso wenig Einfluss wie die Berufserfahrung und die grundlegende pädagogische Qualifikation. Das Bundesland und mithin der bildungssystemische Kontext hat einen leichten differenzierten Einfluss auf die kognitiven Komponenten. Der Einsatzbereich im Berufsbildungssystem hat keinen prädiktiven Einfluss auf die inklusionsbezogenen Einstellungen, obwohl zu erwarten war, dass Lehrkräfte aus dem sog. Übergangssystem und der Benachteiligtenförderung positiver eingestellt sind.

Signifikante Einflüsse lassen sich bei den inklusionsbezogenen Erfahrungen und Qualifikationen, der Selbstwirksamkeit und des Lehr-Lern-Verständnisses finden, welche im Folgenden näher dargestellt werden. Konkret wirken berufliche und private Kontakterfahrungen mit Menschen mit Behinderungen, die Tätigkeit in inklusiven Klassen sowie inklusionsbezogene Qualifikationen signifikant positiv auf die inklusionsbezogenen Einstellungen. Allerdings ist präzisierend einzuschränken, dass inklusionsbezogene Erfahrungen und Qualifikationen primär die persönliche Bereitschaft als behaviorale Dimension beeinflussen. Die kognitiven Aspekte (Überzeugungen und Meinungen) werden davon kaum beeinflusst. Ein signifikanter Einfluss in allen drei Modellen besteht jedoch im Hinblick auf die Selbstwirksamkeit. Hier wird offensichtlich, dass die allgemeine Selbstwirksamkeit als Lehrkraft, vor allem aber die spezifische inklusionsbezogene Selbstwirksamkeit die Einstellungen sehr positiv beeinflusst. Zudem zeigt sich, dass das Lehr-Lern-Verständnis einen erwartungskonformen Einfluss in allen drei Modellen hat: Instruktional orientierte Lehrpersonen weisen eine tendenziell kritischere Einstellung gegenüber Inklusion auf.

Weiterhin wurde der Einfluss des Inklusionsverständnisses, das in einem offenen Antwortformat erhoben und binär (enges vs. weites Verständnis) codiert wurde (Kap. 4.4), auf die inklusionsbezogenen Einstellungen überprüft. Dies erfolgte aufgrund des erhöhten missing-value-Anteils außerhalb der Regressionsanalyse im Rahmen eines Gruppenvergleichs. Es wurde überprüft, ob sich die Einstellungen von Lehrkräften mit engem Inklusionsverständnis signifikant von Lehrkräften mit einem weiten Inklusionsverständnis unterscheiden. Dies wurde für die Gesamtskala, wie auch für die drei Subskalen (Faktoren) durchgeführt (Abbildung 3). Die Gruppe derer, die kein Verständnis offenlegen oder deren Antworten nicht kategorisierbar sind (N=91) wird hier ausgeblendet.

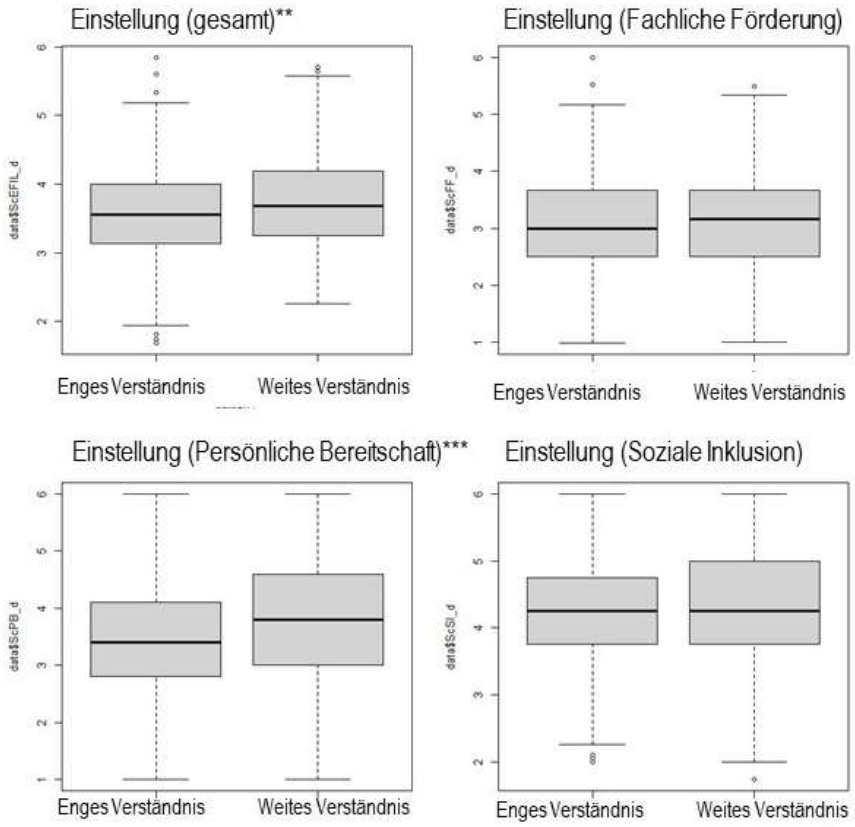

Abbildung 3: Einfluss des Inklusionsverständnisses auf die inklusionsbezogenen Einstellungen

Hinsichtlich der Gesamtskala inklusionsbezogener Einstellungen zeigt der Gruppenvergleich, dass Lehrkräfte mit weitem Inklusionsverständnis leicht positivere Einstellungen gegenüber Inklusion (M = 3.75, SD = 0.7, n = 210) aufweisen als Lehrkräfte (M = 3.57, SD = 0.68, n = 350), die ein enges Inklusionsverständnis haben (t(429.94) = -2.969, p = .003). Die Effektstärke nach Cohen (1992) liegt bei Cohen's d = .262 und r = .130) und entspricht einem eher schwachen Effekt.

Hinsichtlich der Subskalen „Fachliche Förderung" (t(433.54) = -1.471, p = .142) und „Soziale Inklusion" (t(425.03) = -.837, p = .403) zeigen sich keine Unterschiede zwischen Lehrpersonen mit engem und weitem Verständnis.

Hinsichtlich der Subskala „Persönliche Bereitschaft" zeigt der Gruppenvergleich, dass Lehrkräfte mit weitem Inklusionsverständnis eine stärkere Bereitschaft zum Umsetzen von Inklusion (M = 3.79, SD = 1.1, n = 210) aufweisen als Lehrkräfte (M = 3.43, SD = 1.0, n = 350), die ein enges Inklusionsverständnis haben (t(419.96) = -4.0116, p < .000). Die Effektstärke nach Cohen (1992) liegt bei Cohen's d = -.350 und r = .171 entspricht einem mittleren Effekt.

5 Diskussion

Nachfolgend werden die Ergebnisse anhand der aufgestellten Forschungsfragen und Hypothesen in Bezug zu bisherigen Forschungsergebnissen (s. Kap. 2) diskutiert, wobei vergleichende Forschungsergebnisse weitgehend aus dem allgemeinbildenden Bereich oder dem Kontext angehender Lehrkräfte für berufsbildende Schulen (Kap. 1) stammen. Die festgestellten Einstellungen zur Inklusion der Berufsschullehrkräfte insgesamt fallen neutral (M=3.6, Kap. 4.1) und damit im Vergleich zu den von Miesera und Gebhardt (2018, S. 9) ermittelten Einstellungen bayrischer angehender Lehrkräfte im Vorbereitungsdienst für ein Lehramt an beruflichen Schulen (M=3.34 bei einer abweichenden Fünf-Punkt-Likert-Skala) nur leicht niedriger aus (vgl. ähnlich Miesera und Moser 2020). Sie sind zudem vergleichbar mit den Befunden für Lehrer*innen in allgemeinbildenden Schulen (Kap. 2.2).

Bezüglich der Fragen nach dem Einfluss der demographischen, berufsbiografischen und bildungssystembezogenen Variablen (F1-F6), ergeben sich folgenden Befunde:

- Weder für das Alter (F1) noch für das Geschlecht (F2), die Berufserfahrung (F3) oder die pädagogische Qualifikation (F4) kann ein signifikanter Einfluss auf inklusionsbezogene Einstellungen festgestellt werden, was der Befundlage überwiegend entspricht (Kap. 2.2).
- Aufgrund der unterschiedlichen Implementationsgrade von Inklusion insb. zwischen den Bundesländern war zu erwarten, dass das Bundesland (F5) einen Einfluss auf die Einstellungen hat. Die Regressionsanalyse zeigt, dass solche Einflüsse durchaus bestehen. Es gibt zumindest Indizien, dass die Berufsschullehrkräfte in den mitteldeutschen Ländern (Thüringen und Sachsen-Anhalt) leicht negativere Einstellungen bezogen auf die kognitiven Dimensionen aufweisen als ihre Kolleg*innen in Hamburg und Schleswig-Holstein. So stellte Lange (2017) im Ländervergleich fest, dass u. a. Hamburg und Schleswig-Holstein relativ früh bildungspolitische Bemühungen zur Gestaltung eines inklusiven Bildungssystems unternommen haben (z. B. Leitbild und klare Schritte formuliert).
- Aufgrund der diversen Bildungsgänge im schulischen Berufsbildungssystem (u. a. bez. Adressat*innen, Zielstellungen, zu erwerbenden Zertifikaten) war zu erwarten, dass der primäre Einsatzbereich der Lehrkräfte innerhalb des berufsbildenden Schulsystems (F6) differenzierte Anforderungen stellt und daher Einfluss auf die Einstellungen hat. Diese Annahme wird durch die Daten nicht gestützt.

Neben diesen Merkmalen wurden Hypothesen zu inklusionsbezogenen Erfahrungen und zur Selbstwirksamkeit als Einflussfaktoren auf die Einstellungen zu Inklusion (H1-H5) geprüft:

- Kontakterfahrungen mit behinderten Menschen zeigen in der vorliegenden Studie keinen durchgehenden signifikant positiven Einfluss (H1) auf die inklusionsbezogenen Einstellungen von Berufsschullehrkräften. Lediglich auf die behaviorale Einstellungsdimension (persönliche Bereitschaft) zeigt die Kombination aus beruflichen und privaten Erfahrungen den vor dem Hintergrund der häufig bestätigten Kontakthypothese erwarteten positiven Effekt, während Seifried (2015, S. 131ff.) einen Einfluss von Erfahrungen mit behinderten Menschen auch auf die fachliche Förderung feststellen konnte. Miesera und Gebhardt (2018, S. 11) konnten in ihrer Studie mit angehenden Lehrkräften an beruflichen Schulen nur einen sehr geringen Zusammenhang zwischen Erfahrungen und Einstellungen feststellen, wobei die Erfahrungsskala dort neben den Kontakterfahrungen mit behinderten Menschen auch Kenntnisse und Erfahrungen im Zusammenhang mit inklusiven Klassen umfasst (s. u.) und die Ergebnisse insofern nur begrenzt vergleichbar sind.
- Der positive Einfluss der Erfahrung lässt erwarten, dass auch die Tätigkeit in einer inklusiven Klasse einen positiven Effekt hat, was jedoch in der vorliegenden Studie ebenfalls nur für die behaviorale Dimension gilt (H2).
- Zudem hat der Besuch von Fortbildungen zu Inklusion einen erwartungskonform signifikant positiven Einfluss auf die verhaltensnahe Dimension der Einstellung (persönliche Bereitschaft) (H3). Grund dafür ist vermutlich eine empfundene bessere Vorbereitung, wodurch sich die Lehrkräfte von inklusiven Settings weniger überfordert fühlen und mehr Vertrauen in ihre Selbstwirksamkeit haben. Ein solcher Zusammenhang zwischen Fortbildungen und Selbstwirksamkeit zeigt sich ebenfalls bei Seifried (2015, S. 178).
- Zudem bestätigt sich in der vorliegenden Studie der direkte positive Einfluss der allgemeinen Selbstwirksamkeit als Lehrkraft auf die Einstellungen zu Inklusion, der bereits in anderen Studien im allgemein- wie berufsbildenden Lehramt gezeigt wurde (H4). Dies gilt zumindest für die Dimensionen Persönliche Bereitschaft und Soziale Inklusion sowie für die Gesamtskala.
- Vor allem aber zeigt sich ein deutlicher globaler Effekt der inklusionsbezogenen Selbstwirksamkeit (H5), die erwartungskonform einen erheblichen prädiktiven Wert für die kognitive und behaviorale Dimension der Einstellungen hat und u. a. auch bei Miesera und Gebhardt (2018, S. 11) für angehende Lehrkräfte an beruflichen Schulen festgestellt wurde.

Die in allen Facetten negativeren Einstellungen gegenüber Inklusion von Lehrkräften mit einem zunehmend instruktional orientierten Lehr-Lern-Verständnisses (F8) könnte damit zusammenhängen, dass die mit dieser Orientierung verbundene Lehrkräftezentrierung des Unterrichts scheinbar weniger gut vereinbar ist mit einer im inklusiven Unterricht gebotenen individuellen Förderung von Lernenden mit spezifischen Beeinträchtigungen oder besonderen Bedürfnissen. Anders herum könnten die konstruktivistischen, subjekt- bzw. schüler*innenorientierten Überzeugungen, welche mit einer positiveren Einstellung gegenüber Inklusion einhergehen, mit individualisierter Förderung der Lernenden besser vereinbar sein.

Der signifikante kleine Effekt des Inklusionsverständnisses auf die Einstellungen (F7) und insbesondere die höhere persönliche Bereitschaft bei einem vorliegenden weiten Inklusionsverständnis könnte damit zusammenhängen, dass berufliche Schulen seit jeher eine vergleichsweise hohe allgemeine Heterogenität in der Schülerschaft aufweisen (Albrecht et al. 2014) und die Lehrkräfte den Umgang hiermit – in größerem Umfang als mit spezifischen Behinderungsformen – kennen und diesbezüglich auf ein angstreduzierendes Kompetenzerleben zurückblicken können.

Die Untersuchung der affektiven Dimension (F9-F11) zeigt, dass die Berufsschullehrkräfte zuvorderst Nachteile für die Qualität des Unterrichts sowie im Zuge dessen auch für die Lernenden (mit und/oder ohne Förderbedarf) befürchten. Diese Befürchtung, die von ca. jeder zweiten Lehrkraft geäußert wird, korrespondiert mit der identifizierten eher skeptischen Einstellung zur „Fachlichen Förderung“ (Einschätzung zur Unterrichtsqualität in inklusiven Klassen). Andererseits überrascht diese Befürchtung vor dem Hintergrund der Befundlage aus nationalen und internationalen Studien und Reviews, nach denen weder für die Schüler*innen mit noch ohne (kognitive Lern-)Beeinträchtigung leistungsbezogene Nachteile in inklusiven Settings im Vergleich zu nicht-inklusiven festgestellt werden konnten (vgl. zusammenfassend in Seifried 2015, S. 22ff.; Krämer et al. 2021). Zudem befürchtet mehr als jede vierte Lehrkraft eine Überlastung bzw. eine persönliche Überforderung durch Inklusion sowie fehlende Ressourcen. Damit einhergehend fordern ca. zwei Drittel der Lehrkräfte zusätzliche Ressourcen und jede vierte ausreichende Fort- und Weiterbildungen. Diese Einschätzungen und Forderungen finden sich auch in anderen Studien (Seifried 2015; Przibilla et al. 2016; Burda-Zoyke und Joost 2018). Vor dem Hintergrund des mehrfach festgestellten positiven Zusammenhangs zwischen bereitgestellten vielfältigen Ressourcen (z. B. finanzieller, technischer, personeller, räumlicher) und schulischen Rahmenbedingungen sowie Unterstützungen (z. B. durch die Schulleitung, Beratungsangebote) einerseits und Einstellungen zur Inklusion andererseits (Seifried 2015, S. 47) könnte in diesem Bereich ein

Handlungspotenzial liegen, um Einstellungen zur Inklusion zukünftig zu verbessern. Wenig zuträglich erscheint dabei, wenn die Bundesländer zwar hohe Ansprüche an inklusive Bildung formulieren, jedoch gleichzeitig den Versuch unternehmen, Inklusion kostenneutral umsetzen zu wollen (Domisch und Klein 2012, S. 162).

6 Schlussbetrachtung

Die vorliegende Studie hatte zum Ziel, inklusionsbezogene Einstellungen von Lehrkräften an berufsbildenden Schulen anhand eines geeigneten Instruments zu erfassen sowie Zusammenhänge zu möglichen Einflussfaktoren zu analysieren.

Die Ergebnisse zeigen, dass die schon in der Vorstudie (Driebe et al. 2018) leicht adaptierte Skala EFI-L von Seifried (2015) mit den drei Faktoren „Fachliche Förderung“, „Soziale Inklusion“ und „Persönliche Bereitschaft“ auch für Lehrkräfte an beruflichen Schulen akzeptiert werden kann.

Mit Blick auf die Einflussfaktoren auf inklusionsbezogene Einstellungen konnte in der vorliegenden Studie ein signifikanter Einfluss der beruflichen und privaten Erfahrungen mit Menschen mit Behinderungen, der Erfahrungen in inklusiven Klassen und der inklusionsbezogenen Qualifizierung auf die persönliche Bereitschaft gezeigt werden. Zudem zeigen die allgemeine und in besonderer Weise die inklusionsbezogene Selbstwirksamkeit einen positiven Effekt auf das Gesamtmodell. Des Weiteren konnte gezeigt werden, dass das Lehr-Lernverständnis einen Einfluss auf die Einstellungen zur Inklusion hat und zwar in der Form, dass ein instruktional orientiertes Verständnis mit negativeren Einstellungen im Gesamtmodell sowie in seinen drei Einzel-Modellen zusammenhängt. Mit Blick auf das Inklusionsverständnis zeigt sich, dass ein weites Verständnis insbesondere mit einer höheren persönlichen Bereitschaft zusammenhängt.

Für ein Gelingen von inklusiven Bildungssettings ist gerade die persönliche Bereitschaft von Bedeutung. Die Studie unterstreicht die Bedeutung von inklusionsbezogenen Fortbildungen für die persönliche Bereitschaft der Lehrkräfte. Da zudem der Zusammenhang zwischen Einstellungen und Erfahrungen mit Menschen mit Behinderungen bestätigt wurde, wäre zu prüfen, inwiefern entsprechende Erfahrungsmöglichkeiten im Rahmen der Aus- und Fortbildung der Lehrkräfte aufgenommen werden können (z. B. durch Hospitieren und/oder Unterricht in inklusiven Klassen bzw. durch anderweitigen Kontakt mit Menschen mit Beeinträchtigungen oder auch in Form von Fallarbeit mit Videovignetten zum inklusiven Unterricht). Das frühzeitige Einrichten von positiv konnotierten Erfahrungsräumen in inklusiven Settings wird zudem durch die in der Studie bestätigte Relevanz von

Selbstwirksamkeit für alle in der Skala erfassten Einstellungsfaktoren bekräftigt. Schließlich kann Selbstwirksamkeit u. a. durch Handlungserlebnisse oder stellvertretende Erfahrungen durch Beobachtung gesteigert werden (vgl. Schwarzer und Jerusalem 2002, S. 42).

Unter Berücksichtigung der affektiven Dimension deutet sich daneben bildungspolitischer Handlungsbedarf an. Dies betrifft die bereitzustellenden Ressourcen (z. B. finanziell, technisch, personell, räumlich) und schulischen Rahmenbedingungen sowie Unterstützungsangebote (z. B. durch die Schulleitung, Beratungsangebote).

Die Ergebnisse sind abschließend kritisch zu diskutieren. Die Skala zum Lehr-Lern-Verständnis zeigt keine hohe Zuverlässigkeit. Hier wären in kommenden Untersuchungen ggf. andere – ggf. domänenunabhängigere – Instrumente zu nutzen. So könnte das Konstrukt der Lehransätze nach Trigwell und Prosser (2004) eine gute Alternative darstellen.

Weiterhin wurden die Daten explizit erhoben und behandeln ein teils sehr emotional behaftetes Thema, was zu einer Selbstselektion von Probanden*innen mit einer eher (sowohl positiv als auch negativ) starken Meinung geführt haben kann. Ebenso ist zu beachten, dass die Skala EFI-L eine dreifaktorielle Skala ist, so dass die Ergebnisse der Subskalen im Besonderen zu berücksichtigen sind.

Abschließend ist noch auf die Bedeutung von Wissen und Fertigkeiten hinzuweisen (Zinn und Döbler 2018; Burda-Zoyke und Joost 2018). Da diese einen Einfluss auf die Einstellungen ausüben und sich umgekehrt Lehrkräfte mit positiven Einstellungen eventuell mehr resp. anderes Wissen und Können aneignen, sollten diese Merkmale in weiteren Studien im Verbund erhoben werden.

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Eidesstattliche Versicherung

Ich, Thomas Driebe, habe die vorgelegte Dissertation selbst und ohne fremde Hilfe verfasst. Beiträge von Ko-Autoren sind dokumentiert und ich habe nicht andere als die in ihr angegebenen Quellen oder Hilfsmittel benutzt. Weiterhin sind alle vollständig oder sinngemäß übernommenen Zitate als solche gekennzeichnet sowie die Dissertation in der vorliegenden oder einer ähnlichen Form noch bei keiner anderen in- oder ausländischen Hochschule anlässlich eines Promotionsgesuchs oder zu anderen Prüfungszwecken eingereicht worden.

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