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Fostering Innovative Learning and Satisfaction in Virtual Teamwork: Shedding Light on Apprentices

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Abstract

Purpose: The digital transformation and the increased use of technologies have changed the world of work severely. With it, collaboration and cooperation methods among employees. Therefore, new ways of working together must be applied to work in an international and digital working environment. For Vocational Education and Training (VET), developing new (transversal) competencies to engage in virtual teamwork is necessary to adequately prepare young professionals for the present and future labor market. However, there is little research on the current situation in VET regarding virtual teamwork.

Approach: We deployed a cross-sectional design and collected data from $N = 181$ commercial apprentices in Germany regarding virtual teamwork. We analyze our data using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the interrelationships between input, process, and outcome variables to foster satisfaction and innovative learning in virtual teams as desired targets of VET. To assess these results regarding virtuality, the complexity of tasks, gender of the apprentices, and the size of the training firms, we derived a multigroup analysis (MGA) of our model.

Findings: The results indicate that organizational factors have the most significant influence concerning the relationship between input and process factors. Surprisingly, the technical affinity of individuals has only a minor effect. Regarding the relationship between process

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and outcome factors, motivation and responsibility have the highest impact on innovative learning, whilst communication culture severely affects the perceived satisfaction in virtual teamwork.

Conclusion: The findings lead to valuable insights on factors influencing virtual teamwork in VET and can help to design learning programs to prepare young professionals to smoothly transition to and successfully master their future working environments by using new ways of collaboration and cooperation. This is particularly relevant for VET, as prior research has focused primarily on primary and secondary education. Lastly, we identify potential scales and items that help capture some of the inherent constructs of virtual teamwork.

Keywords: Team Work, Workplace Learning, Collaboration, New Work, Outcomes of Education and Training, Vocational Education and Training, VET

1 Introduction

The digital transformation and the increased use of information and communication technologies have changed our daily life in many spheres. Major changes become apparent particularly in the world of work. The rapid transformation of the economy and work processes severely affect how work is performed in organizations (Dobricki et al., 2020; Paeßens et al., 2023). One important change regards the ways of working together: Collaboration in (global) teams in a technology-enhanced working environment is becoming increasingly important (Noble & Billet, 2017; Schlicht, 2019). In addition, the megatrend of globalization growingly requires international, cross-border coordinated behavior. With that, a new mindset to master these challenges is required (Schilirò, 2021) and a new set of (transversal) competencies to collaborate in virtual teams (VT) must be developed. However, virtually working together in teams is a demanding task for both employees and young professionals (Darban, 2022). This puts pressure on Vocational Education and Training (VET):

The overarching goal of VET is to prepare young professionals to both smoothly transition in and successfully master their future profession (European Commission, 2013). An increased engagement in virtual teams and the development of corresponding VT-competencies during the apprenticeship has therefore become necessary (Harteis, 2018; Schwendimann et al., 2018). VET acts as a crucial factor to foster this by vocational training either in a school-based way or by training in the firm (Busemeyer & Trampusch, 2012).

While substantial research has been undertaken to look at how digital technologies are used in the context of learning and how respective learning outcomes can be fostered, this has predominantly been done in the context of primary and secondary education or higher education. However, the immanent factors that shape VET need to be taken into account to allow for a meaningful and contextual interpretation. Yet, only a very limited number of

research analysing the use of digital technologies in VET in a collaborative way can be found (Schwendimann et al., 2018).

Therefore, we shed light on how apprentices currently work together in VTs and on the factors which help or hinder cognitive, affective, motivational, and behavioral processes to foster meaningful outcomes for both apprentices and training firms: Satisfaction (SAT) and innovative learning (IL). We focus on these two individual outcomes as these can be best depicted and evaluated by apprentices in a sensitive and meaningful way. We derive three research questions (RQs) to shed light on this phenomenon:

RQ1: To what extent has virtual teamwork (VTW) been integrated into VET?

RQ2: Which relationships can be identified within the input, process, and outcome factors of VTW in VET?

RQ3: How does the model differ in the multigroup analysis regarding gender, virtuality, task complexity (TC), and firm size in VTW?

2 Theoretical Foundation

In order to establish the theoretical basis, the following chapter defines relevant concepts regarding virtuality and virtual teamwork and presents the underlying model to examine the interrelationships of input, process, and outcome factors of VTW to foster satisfaction and innovative learning in virtual teams.

2.1 Virtuality and Virtual Teamwork

Defining the concept of a VT is not an easy task, as no uniform definition of the term exists. In the literature, terms such as distributed, computer-mediated, transnational or remote teams are also used to describe VTs (Jacques et al., 2020; Jarrett et al., 2016; Lagerström & Andersson, 2003; Silva & Merino, 2017). When it comes to VTs, scholars often refer to aspects of dispersion and the use of digital media (Dulebohn & Hoch, 2017; Gibson & Gibbs, 2006; O'Leary & Cummings, 2007). The phrase dispersion refers to a geographical, temporal, and structural spreading (O'Leary & Cummings, 2007). Concerning the use of digital media in a VT, Kirkman and Mathieu (2005) identified three dimensions: The extent of the use of virtual tools, the informational value, and the synchronicity. The extent of the use of virtual tools pertains to how much team members depend on digital tools to interact with each other. The informational value specifies the extent to which virtual tools transfer data that are useful for VT effectiveness. Synchronicity encompasses the exchange in a team, which can occur in real time (synchronous), or with a time difference between the interactions

(asynchronous) (Goel et al., 2003). Additionally, the dimensions of diversity, transnationality, and heterogeneity indicate a VT (Earley & Mosakowski, 2000; Zander et al., 2012). However, none of these factors is a prerequisite for a VT status. The transition from a face-to-face team to a VT occurs without a clear boundary. Most teams are located somewhere on the spectrum between the two extremes of a face-to-face team or a solely VT (Griffith et al., 2003; Kirkman & Mathieu, 2004). For this paper, we follow the definition of Hertel et al. (2005, p. 71), who describe a VT as following:

> *"VT consist of (a) two or more persons who (b) collaborate interactively to achieve common goals, while (c) at least one of the team members works at a different location, organization, or at a different time so that (d) communication and coordination is predominantly based on electronic communication media (…)".*

2.2 The Input-Process-Outcome Model of Virtual Teams

The input-process-outcome (IPO) model provides a theoretically based framework for decomposing VTW into its essential components (Dulebohn & Hoch, 2017). The basic framework of the model is derived from the empirically tested model of McGrath (1964). Following this, some modifications exist, such as the approaches taken by Martins et al. (2004), Cohen and Gibson (2003), or Maznevski and Chudoba (2000), who explicitly focus on the collaboration of a VT. Ilgen et al. (2005) adapted the model with regard to the allocation of the process level by assigning concrete subcategories (Ilgen et al., 2005; Marks et al., 2001). Furthermore, feedback loops, which can counteract the static character through their cyclical viewpoint, have been integrated (Hackman & Morris, 1975; Ilgen et al., 2005; Salas et al., 2009). In 2017, Dulebohn and Hoch modified the original model by integrating eight independent, empirical study results that adopt different perspectives regarding the effectiveness of VT. In addition, they incorporated a feedback loop into the model based on Ilgen et al. (2005), as a complex system like a VT can have more than a single cycle (Dulebohn & Hoch, 2017). The intention of the IPO model is to provide a theoretical framework that can be used to identify and categorize selected success factors of VTW and to systematically represent their interconnections and relations (Dulebohn & Hoch, 2017). The model has been employed in the international research context multiple times. References can be found, i.e., for investigating leadership in virtual teams (Bartsch et al., 2020; Wong & Berntzen, 2019), to analyze virtual collaboration during the COVID-19 pandemic (Shockley et al., 2021), or to identify factors affecting team performance (Berber et al., 2020; Kim et al., 2020).

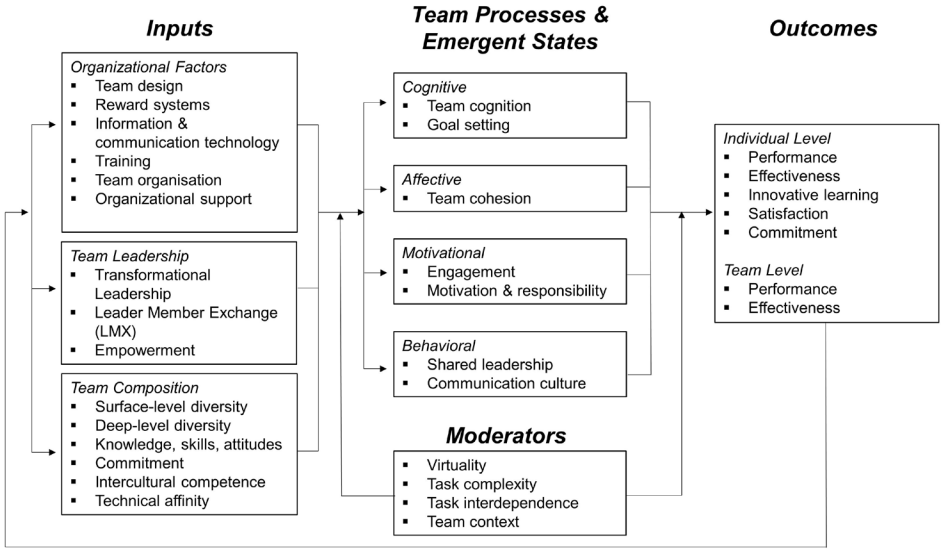

Figure 1: Input-Process-Outcome Model of Virtual Teams (own illustration based on virtual teams in organizations from Dulebohn & Hoch, 2017)

As visualized in Figure 1, the model is composed of four parts: I*nput factors, team processes or emergent states, moderators*, and *outcome factors*.

The *input* factors are divided into three categories: The organizational factors (OF), team leadership, and team composition. The OF refer to the organizational design and the objectives of the VT, the working environment, and the structural support (Bell & Kozlowski, 2002; Dulebohn & Hoch, 2017). The team leadership subsumes skills and behavior to compensate for the absence of face-to-face contact to lead a VT successfully. A team leader can apply different leadership concepts, such as transformational leadership or leader member exchange (Hoch & Kozlowski, 2014). The team composition refers to surface-level diversity, such as culture, ethnicity, or language, and to the deep-level diversity, such as the personality traits of VT member and their values. Moreover, the knowledge, skills, and attitudes of a team member constitute the team composition factors (Dulebohn & Hoch, 2017).

The *team* processes and *emergent states* are dynamic processes that occur when interacting in a VT, whereas the states are team properties, affected by the inputs, processes, moderators, and outcomes (Dulebohn & Hoch, 2017; Marks et al., 2001). Individuals of a team come together, interact with each other, and form a social system – a team that is more than the sum of its parts (Steiner, 1972). The process within the team determines the performance or effectiveness of the team and its individuals (Hackman, 1987; Steiner, 1972). In the model,

team processes and emergent states are divided into cognitive, affective, motivational, and behavioral processes.

The *moderators* influence the strength and direction between the input and the team processes/emergent states as well as between the team processes/emergent states and the outcomes. According to Dulebohn and Hoch (2017, p. 572), the key moderator in the model is virtuality as a "multi-dimensional concept and phenomenon". Furthermore, task independence, TC, and the team context – as the external environment in which a VT performs – are included as moderators in the model.

Two levels of *outcomes* are distinguished in the model: The team level and the individual level. Each refers to performance and effectiveness as a team and as an individual VT member, respectively. Furthermore, individual SAT and IL, which constitute the main focus of our paper, are integrated into the model (Dulebohn & Hoch, 2017).

2.3 Derivation of Hypotheses

The hypotheses to be tested are derived based on the links between the input and process (*H1–H4*), as well as between the process and outcome factors (*H5–H8*). The hypotheses are visualized in Figure 2.

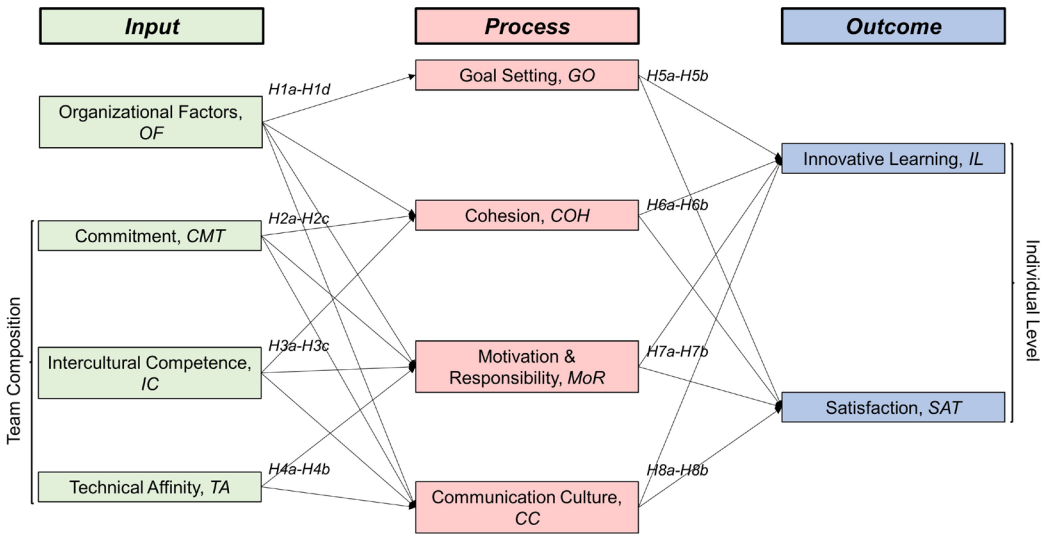

Figure 2: Input-Process-Outcome Factors of Virtual Teamwork – Latent Variables and Hypotheses (own illustration based on virtual teams in organizations from Dulebohn & Hoch, 2017)

The construct of OF in our study includes the team organization as well as organizational support. Team organization represents the organizing of a teamwork, task planning, and the distribution of tasks, as well as how decision-making is supported (Wiedemann et al., 2013). The organizational support focuses on reasonable communication among the team as well as on building trust through fostering equity and understanding (Gibson & Manuel, 2003). Promoting a supportive climate in a team encourages, amongst other aspects, effective conflict management, a shared understanding concerning the goals of the VTW, and the freedom of expression in a VT (Gibson & Manuel, 2003; Hinds & Weisband, 2003). It is important that the organizational goals are congruent with the motivation of individual team members and the team as a whole (Kozlowski & Bell, 2003). In the context of VET, the influence of the organization on team-level processes is expected to be higher than in regular work contexts, as training and supervising by instructors or teachers plays a significant role in apprenticeships (Organisation for Economic Co-operation and Development [OECD], 2021). We therefore derive the following hypotheses:

H1a/b/c/d: The dimensions of OF are positively related to goal setting (GO) / cohesion (COH) / motivation and responsibility (MoR) and communication culture (CC).

Members of a VT have inherent characteristic personality traits like thoughts or behaviors (Dulebohn & Hoch, 2017). One of these traits is the commitment (CMT) to act as a member of a VT. Being proud of and committed to the team, and contributing to the tasks of the team, are key drivers for building trust and for the COH of a (virtual) team (Derven, 2016; Gonzalez & Melo, 2021). Behaviors in a (virtual) team to foster a commonly shared CMT raise, among others, the level of trust and go along with higher degrees of COH as well as of CC (Derven, 2016; Hackman, 1987). The feeling of belonging to a (virtual) team is also described for apprentices (Price & Luszat, 2018). We therefore derive the following hypotheses:

H2a/b/c: The CMT of a VT member is positively related to COH / MoR / CC.

In general, heterogeneous teams struggle with a lower degree of COH, emphasizing the importance of intercultural competence (IC) (Staples & Zhao, 2006). Au and Marks (2012) found that culture and nationality have an impact on the identification with the VT, whereas missing identification with the VT can lead to stereotypical thinking or a lack of CMT and COH. Gibson and Manuel (2003) discovered evidence that trust among team members, is negatively impacted by cultural differences. In addition, communication among culturally different team members is expected to be more difficult (Gibson & Manuel, 2003). Therefore, a sufficient degree of IC is especially relevant to overcome cultural, temporal, or organizational hurdles (O'Hara-Devereaux & Johansen, 1994), especially as apprentices have different cultural backgrounds and cooperation in an international context becomes more relevant during and after VET (Stamm, 2013). On these grounds, we derive the following hypotheses:

H3a/b/c: The IC of a VT member is positively related to COH / MoR / CC.

Franke et al. (2019, p. 456) defined the affinity for technology interaction as a "key personal resource for technology interaction". In VTs, team members with a higher technical affinity (TA) are expected to be more able to cope with complex (technical) requirements (Franke et al., 2019). They are more engaged in the team, face complex situations with a higher motivation, take responsibility, and facilitate easier (virtual) communication. Apprentices, many of them belonging to "Generation Z" and, thus, used to socializing online, are expected to have a certain TA (Schwieger & Ladwig, 2018; Serinikli, 2019). Thus, we derive the following hypotheses:

H4a/b: The TA of a VT member is positively related to MoR / CC.

Clear and explicit formulated (learning) goals (Edmondson & Roloff, 2009) are an important factor for learning. Researchers have found a significant relationship between GO and the outcome level, on SAT and learning orientation, amongst others (Lloyd & Härtel, 2010; Sarin & McDermott, 2003). As apprentices lack extensive experience concerning VTW and goal setting in VTs, the specification of an explicit goal and assistance concerning ways to achieve this goal are important. Based on this derivation, we derive the following hypotheses between GO and the outcome level:

H5a/b: The GO is positively related to IL / SAT.

The feeling of belonging to a team and identifying with a common goal positively influences the performance of the team as well as team learning (Edmondson & Roloff, 2009). The climate of safety in a team also affects the outcome level (Hofmann & Stetzer, 1996). Studies (Brahm & Kunze, 2012; DeOrtentiis et al., 2013) have shown that for adolescents and young adults, COH in a (virtual) team is relevant for effective teamwork, resulting in the desired team performance. We therefore derive the following hypotheses concerning the relationship between COH and the outcome level:

H6a/b: The COH is positively related to IL / SAT.

Research has shown that MoR – at an individual as well as at a team level – are critical factors for team performance (Hackman, 1987; Yang & Ok Choi, 2009). Motivation and engagement to reach the goals of the team can lead to better change management, commitment to the organization and its goals, as well as motivated employees with low levels of turnover (McBain, 2007). Individual and team-level motivation should go hand in hand as far as possible (Kozlowski & Bell, 2003). In VET, taking on MoR must be promoted as they are needed in both VTW and later in working life. Following this, we derive the hypotheses concerning the relationship between MoR and the outcome level:

H7a/b: The MoR are positively related to IL / SAT.

H8a and *H8b* focus on the relationship between CC and the outcome factors IL and SAT. Weimann et al. (2010) reported a positive effect of CC on the SAT of team members as well as on the success of a team. Furthermore, conflict management is related to the outcome level of teamwork (Lloyd & Härtel, 2010). Malik (2013) studied the effect of team communication on SAT and pointed out the importance of a positive approach to conflicts and conflict resolution, as well as the appreciation of the individual opinions of team members. In sum, a positive relation between the CC of apprentices and the outcome level can be assumed. We therefore hypothesize:

H8a/b: The CC is positively related to IL / SAT.

3 Methods

The following section describes the research design, data, instruments, and analysis deployed in this study.

3.1 Design

To answer the RQs, we employ a cross-sectional design (Bourque, 2004; De Vaus, 2004). The data were collected at one point in time to capture ex post the perspective of the participants regarding VTW. To answer RQ1, we analyzed our data by providing descriptive statistics on the current state of VTW in VET. For RQ2, we used partial least squares structural equation modeling (PLS-SEM) to illustrate the impact of several input and process variables on SAT and IL among commercial apprentices. We based this on the theoretical model of VTW by Dulebohn and Hoch (2017). To achieve this goal, a suitable (partially adapted) psychological construct for every part of the IPO model was identified. Several checks regarding normal distribution and one-dimensionality were carried out before testing indicators and constructs via a confirmatory factor analysis (CFA). To examine our results regarding the moderator variables virtuality and TC as well as the gender of the apprentices and the size of their training firms, we derived an MGA of our model (RQ3).

3.2 Sample and Data

To collect our data, we applied criterion sampling procedure (Patton, 2001) to reach as many commercial apprentices (selection criterion) as possible. To reach our targeted communities and networks, we actively and passively promoted our survey on several websites that are relevant for apprentices (e.g., Facebook groups for apprentices, Xing and LinkedIn as leading networking and career platforms) (King et al., 2014) and reached out to firms and relevant

apprenticeship stakeholders (overall 329 firms all over Germany that engage in commercial apprenticeship training). The online survey was set up using Qualtrics XM (2022) during April 16 and May 16, 2022. The median response time was 19.32 minutes. Our initial sample consisted of $N = 387$ participants.

We engaged in a rigorous data cleaning process as we excluded individuals that did not provide sufficient information on their current occupational situation or did not meet the intended criterion (e.g., individuals who are not enrolled in a commercial apprenticeship, whose apprenticeship ended more than 12 months ago, or individuals that completed a dual study with academic parts rather than an apprenticeship[1]) or stated that they had never engaged in VTW. Furthermore, an outlier analysis was performed via Mahalanobis distances (Collier, 2020).

Our final sample comprises $N = 181$ apprentices engaged in a commercial apprenticeship in Germany. The mean age is $m = 19.8$ years ($SD = 2.319$), with 130 female and 47 male (four not specified) individuals. Regarding their respective occupation, 75 participants are completing an apprenticeship as industrial management assistant (41.4%), 28 as office managers (15.5%), and 31 individuals work in finance as either banking professionals ($n = 15$; 8.3%) or management assistants for insurance and finance ($n = 16$; 8.8%). Regarding the respective industry, most apprentices are in the food industry ($n = 32$; 17.7%), the banking and finance industry ($n = 27$; 14.9%), and in the automotive industry ($n = 25$; 13.8%). Most of the apprentices work in large (>250 employees; $n = 142$; 78.5%) or medium-sized firms (50-249 employees; $n = 24$; 13.3%). In most training firms, a works council was in place ($n = 157$; 86.7%). 58 apprentices are in their first year of training (32.0%), 90 in their second year (49.7%), 20 in their third year (11.0%), and 13 stated they had finished their apprenticeship less than 12 months ago (13.0%). The majority of apprentices are rather ($n = 79$; 43.6%) or very satisfied ($n = 79$; 43.6%) with their current potential to engage in firm-based training and development.

Table 1: Sample Characteristics

Variable	*Specification*	*N*	*%*	*Cum. %*
Gender	Male	47	26.0	26.0
	Female	130	71.8	97.8
	n.s.[1]	4	2.2	100.0
Age	< 18 Years	31	17.1	17.1
	18 To 21 Years	111	61.3	78.5
	22 To 24 Years	31	17.1	95.6
	> 25 Years	8	4.4	100.0

1 In Germany, a "dual study" has become increasingly popular for both firms and young professionals to enter the workforce. It combines the idea of the classic apprenticeship (with firm-based and potentially school-based training) with a part of study in higher education institutions. For a scoping review, turn to Haasler (2020).

Highest Graduation	Lower Track Sec. School [Mittelschule]	2	1.1	1.1
	Middle Track Sec. School [Realschule]	86	47.5	48.6
	Higher Track Sec. School [Fachabitur[2]]	30	16.6	65.2
	Higher Track Sec. School [Abitur/FgHR[3]]	63	34.8	100.0
Firm Size	Smallest [1–9 employees]	7	3.9	3.9
	Small [10–49 employees]	4	2.2	6.1
	Medium [50–249 employees]	24	13.3	19.3
	Large [> 250 employees]	142	78.5	97.8
	n.s. [1]	4	2.2	100.0
Works Council	In Place	157	86.7	86.7
	Not In Place	15	8.3	95.0
	n.s. [1]	9	5.0	100.0

Note: [1] n.s. = not specified, [2] = higher track that prepares students to attend a university of applied sciences or 3 a university

3.3 Instruments

To measure our instruments, we used pre-existing scales stemming from several elaborated questionnaires. Some modifications needed to be made to adapt them to our intended target group (translation into German, language simplification; additional information on latent variables, indicators, and distribution can be requested from the corresponding author). As we intentionally focused on VTW, all our scales specifically incorporate a virtual content dimension. As the degree of virtuality is non-trivial to measure in a direct manner (Chudoba et al., 2005), we utilized the frequency of the usage of digital tools in a VTW as a proxy for virtuality. One of the goals of this paper is to identify appropriate scales and items for each section of the IPO model to then adapt them meaningfully to our research setting. In Table 2, an overview of all scales to measure their respective latent factor, origin, and their allocation within the IPO model is provided, as well as some first statistical details [*M/SD/Min/Max*] are displayed.

Table 2: Overview of Latent Factors Within the VTW Model

Model		*Latent Factor*	*Nb of Items*	*Origin*	*Mean*	*SD*	*Min/Max*
Input	*Organizational Factors (OF)*	Support (SUP)	4	West & Markiewicz, 2004	4.39	.564	2.25/5
		Team Organization (ORG)	4	Wiedemann et al., 2013	4.20	.580	2/5
	Team Composition	Commitment (CMT)	3	Kazazi et al., 2012	3.66	.490	2.33/5
		Intercultural Competence (IC)	3	Lehmann, 2003	4.52	.595	2/5
		Technical Affinity (TA)	3	Franke et al., 2019	3.80	.884	1/5
Process	*Cognitive*	Goal Setting (GO)	3	Kauffeld, 2001	4.22	.578	2.67/5
	Affective	Cohesion (COH)	3	Kauffeld, 2001	4.27	.579	2.67/5
	Motivational	Motivation/Responsibility (MoR)	3	Wiedemann et al., 2013	4.54	.488	3/5
	Behavioral	Communication Culture (CC)	3	Wiedemann et al., 2013	3.96	.783	2/5
Outcome	*Individual Level*	Innovative Learning (IL)	5	West & Markiewicz, 2004; Högl & Gemuenden, 2001	4.42	.487	2.6/5
		Satisfaction (SAT)	4	West & Markiewicz, 2004	4.24	.620	2.5/5
Moderators	*Virtuality*	Virtuality in Training Firm ($Virt_{TF}$)	8	Führungskräfte Institut [Management Institute], 2017	3.51	.627	1/5
		Virtuality in School ($Virt_{VS}$)	8	Führungskräfte Institut [Management Institute], 2017	2.59	.720	1/4.75
	Task Complexity	Task Complexity (TC)	3	Kearney, 2013	3.20	.817	1.33/5

Note: All items were measured on a 5-point Likert scale (1 = *totally disagree/totally unsatisfied*, 5 = *totally agree/totally satisfied*). The items of virtuality ($Virt_{TF}$ and $Virt_{VS}$) are measured on a 5-point Likert scale ranging from "1 = *never*" to "5 = *always*".

3.4 Analysis

To perform variance-based structural equation modeling (PLS-SEM), we turned to Smart-PLS Version 4 (Ringle et al., 2022).

When conducting structural equation modeling, it is necessary to choose an appropriate approach. Both variance-based (PLS-SEM) and covariance-based structural equation modeling (CB-SEM) are eligible options. We see the two approaches as complementary rather than opposing (see e.g., Hair et al., 2019; Richter et al., 2016; Rigdon et al., 2017), depending on the specific goal of research. We applied PLS-SEM in our research design for mainly three reasons: (1) We built on a holistic and rather complex model with many psychological constructs in our data set. Furthermore, (2) we aimed at testing a theoretical framework from a prediction perspective, i.e., what helps apprentices to foster IL and a high level of SAT (Hair et al., 2022). Lastly (3), PLS-SEM seems to be an appropriate and necessary approach, as we also want to compare groups via an MGA. PLS-SEM also has become increasingly popular in the social sciences (e.g., Lai et al., 2023; Ning & Inan, 2023).

Reliability

To test for the reliability of all latent variables, an EFA was carried out to ensure the one-dimensionality of our constructs. Regarding the appropriateness of EFA, all latent variables displayed a sufficient level of Kaiser-Meyer-Olkin (KMO) criteria > .5 and a value for the Bartlett sphericity test < .05. After principal component analysis in oblique rotation and parallel tests (Horn, 1965), one-dimensionality could be confirmed for all constructs. Furthermore, we analyzed Cronbach's α for all latent variables, showing predominantly acceptable alpha coefficients greater than .7 (Nunnally, 1978). Two constructs needed to be looked at carefully: First, the initially surveyed construct leadership (Wiedemann et al., 2013) was excluded from the model as it failed the requirements (KMO/Bartlett) for testing any reliability measures. Second, the construct CMT displayed a relatively poor Cronbach's α coefficient of .512. We nevertheless kept this factor because of acceptable indicator/construct measures in CFA.

During CFA, we tested for reliability and validity on indicator and construct level. Overall, CFA displayed acceptable measures on indicator and construct level as well as reasonable goodness-of-fit (GoF) criteria[2]. Our final PLS-SEM model likewise upheld all relevant reliability tests (Table 3).

Validity

After ensuring reliability, we turned to several validity checks. For that, we analyzed convergent and discriminant validity. We confirmed convergent validity using the average variance

2 All indicators have a significant ($p<.01$) influence on latent constructs and show a meaningful value (>.50) of squared multiple correlations with the construct (Backhaus et al., 2015). Regarding validity checks, convergent validity can be assumed with AVE values ≥.50 (Fornell & Larcker, 1981). For discriminant validity, we report acceptable HTMT-ratios over all constructs with values <.85 (Henseler et al., 2016). CFA showed acceptable GoF indices (RMSEA=.059; HI90=.065; PCLOSE=.019) (Hair et al., 2022). Details can be requested from the corresponding author.

extracted (AVE) criterion ≥ .50 (Fornell & Larcker, 1981). Furthermore, when checking for discriminant validity, the HTMT ratio was smaller than .85, indicating that all constructs were distinct from each other (Henseler et al., 2016). An overview of the respective reliability (Cronbach's α, composite reliability, AVE) and validity measures (AVE, HTMT) can be found in Table 3.

Table 3: Measures for Reliability and Validity in Our Final PLS-SEM Model

Construct	*Reliability*			*Validity*	
	α	*PC*	AVE	Convergent (AVE)	Discriminant (HTMT)
Organizational Factors [OF]	.872	.899	.526	✓	✓
Commitment [CMT]	.512	.748	.504	✓	✓
Intercultural Competence [IC]	.797	.881	.711	✓	✓
Technical Affinity [TA]	.831	.889	.728	✓	✓
Goal Setting [GO]	.780	.872	.694	✓	✓
Cohesion [COH]	.704	.835	.629	✓	✓
Motivation & Responsibility [MoR]	.730	.847	.650	✓	✓
Communication Culture [CC]	.762	.862	.676	✓	✓
Innovative Learning [IL]	.792	.856	.543	✓	✓
Satisfaction [SAT]	.835	.890	.668	✓	✓

Note: α = Cronbach's alpha, *PC* = composite reliability, AVE = average variance extracted, HTMT = heterotrait-monotrait ratio.

To conduct the MGA (RQ3), we divided our sample into two groups concerning the moderator variables TC, $Virt_{TF}$ and $Virt_{VS}$, respectively (Dulebohn & Hoch, 2017). We calculated the mean for each of the constructs and split the groups at a value of 2.99. We furthermore included a comparison concerning gender and the firm size. We applied the measurement invariance of composite models (MICOM) procedure to check for measurement invariance of our model (Henseler et al., 2016). We finally derived the permutation MGA by comparing two groups for each construct respectively with a permutation frequency of $n = 5000$.

4 Results

RQ1: To what extent has virtual teamwork (VTW) been integrated into VET?

Regarding apprentices' prior experience in VTW, $n = 103$ of the $N = 181$ individuals state that they very frequently worked in VTs. $N = 68$ indicate that they occasionally work in VT, while only $n = 10$ rarely work in VT. There also seem to be various modes in which apprentices work together in VTs: $n = 67$ individuals note that their longest VTW had a duration of one month or longer, while $n = 114$ assert that one hour or less was their shortest duration of virtually working together (Figure 3).

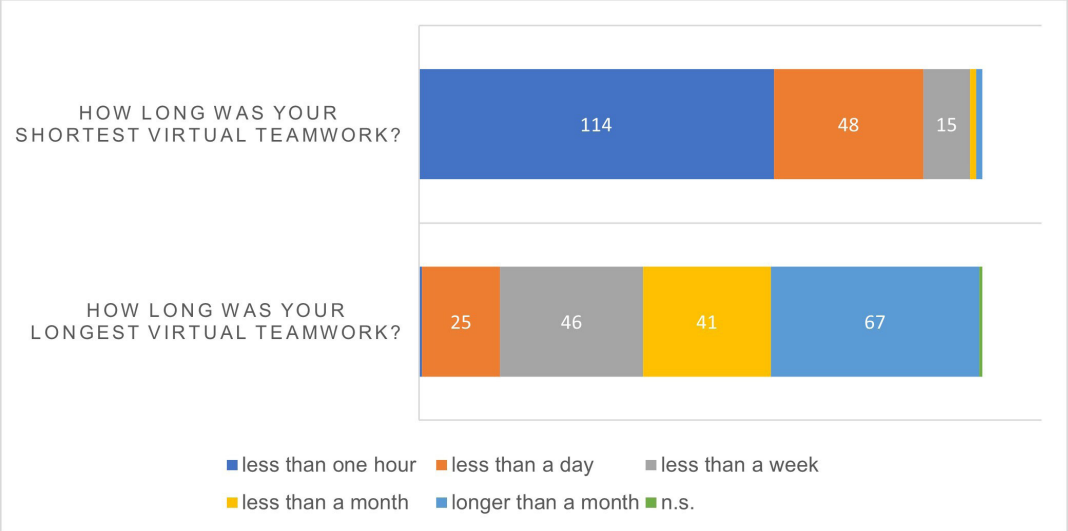

Figure 3: Duration of Virtual Teamwork in VET (N=181. Own illustration)

When assessing the frequency or average duration of a VTW, the use of digital tools becomes also important. It is of high relevance to look at specific tools that are used when virtually working together. We therefore asked about the frequency of usage regarding some of the most prominent hardware (such as PC / laptop, tablets, smartphones), ways of communication (via e-mail, videoconferencing tools, instant messaging), and collaboration tools (such as sharing or learning platforms) when virtually working together in VET. When comparing the frequency of the tools used in VTW in respective learning sites, we find meaningful differences (Figures 4 and 5).

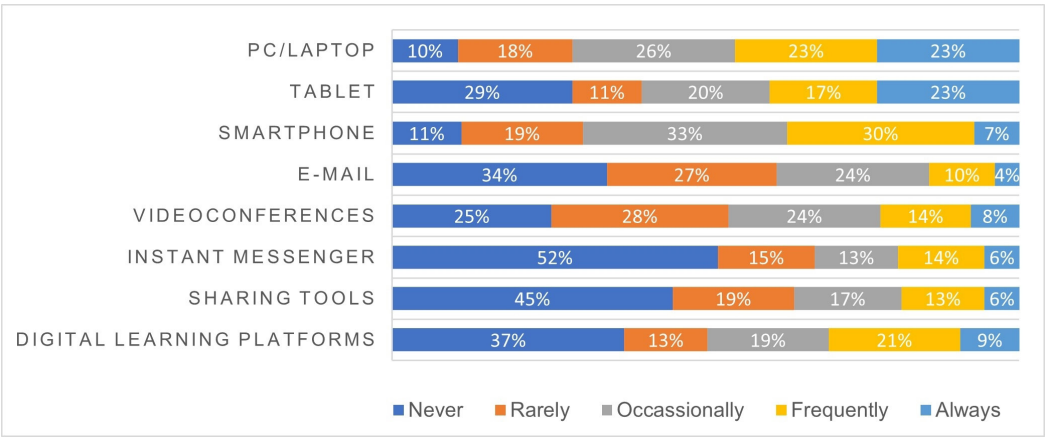

Figure 4: Frequency of Tools Used in Virtual Teamwork in Vocational Schools (N=181. Own illustration)

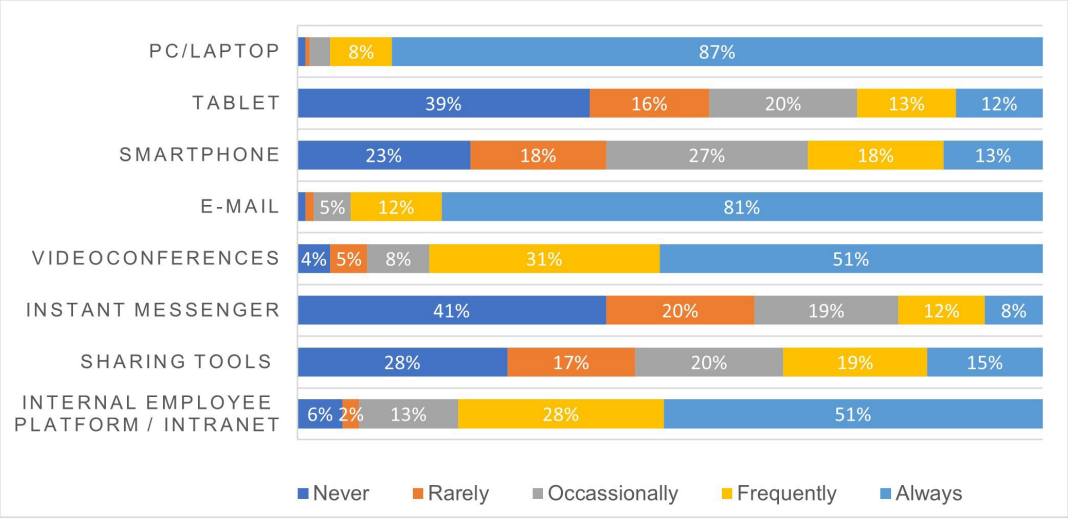

Figure 5: Frequency of Tools Used in Virtual Teamwork in Training Firms (N=181. Own illustration)

In training firms, the use of PCs/laptops seems to be much more common than in vocational schools (m_{TF} = 4.80/m_{VS} = 3.29), while tablets are more frequently used in vocational schools (m_{TF} = 2.42/$_{mVS}$ = 2.94). A meaningful difference can be seen with regard to how often videoconferencing tools are used (m_{TF} = 4.20/m_{VS} = 2.51). While in training firms, n = 149 VET-students stated they (very) frequently use such tools, only n = 40 individuals use them very frequently when working in VT in vocational schools.

RQ2: Which relationships can be identified within the input, process, and outcome factors of VTW in VET?

Concerning RQ2, a correlation matrix depicting the bivariate correlations between our constructs was examined[3]. Before interpreting our structural model, we briefly touch on the relevant assessment criteria in accordance with Hair et al. (2022). First, collinearity issues cannot be found in the data. Second, the explanatory power of our model is discussed using R^2 as well as f^2 (Cohen, 1988; Hair et al., 2022). The model explains the proportion of variance in the dependent variables according to Cohen (1988) as substantial (≥.26) with the following values: GO: R^2 = .402, COH: R^2 = .368, MoR: R^2 = .318, CC: R^2 = .348, IL: R^2 = .446 and SAT: R^2 = .444. Third, we turn to the model's predictive power to produce meaningful out-of-sample statements. For that, we assess Stone-Geisser's Q^2 as well as the mean absolute error (MAE) and the root mean square error (RMSE) (Hair et al., 2022). As most indicators

3 The detailed correlation matrix can be requested from the corresponding author.

in the two key target constructs (IL/SAT) uphold the relevant statistical comparison (PLS-SEM values < linear regression model (LM) values), we can deduce that our model has a *medium* predictive power[4].

To answer the hypotheses, the results of the path analysis between input, process, and outcome factors are illustrated in Figure 6. All the relationships suggest a positive connection between the factors, except the path from GO to IL with a (non-significant) β = -.013.

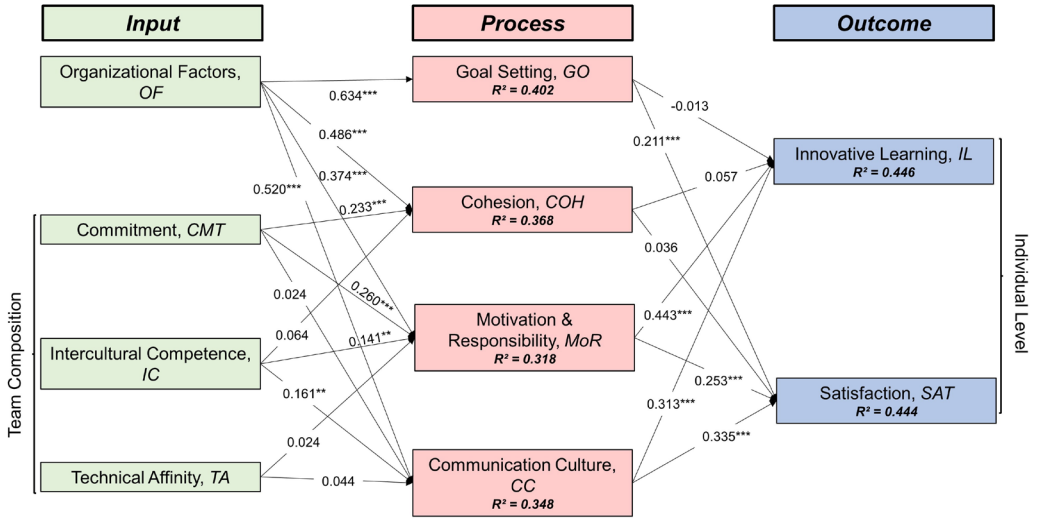

Figure 6: Final PLS-SEM Path Model With β Coefficient and P-Values
Note. Path coefficients are presented as standardized β, while p-values are indicated with asterisks: **p* < .1, ***p* < .05, ****p* < .01

For the relationships between the input and the process factors, OF are positively associated with all process factors, with each relationship being highly significant ($p < .01$). When assessing the effect sizes according to Cohen (1988) (≥.02 small effect, ≥.15 medium effect, ≥.35 large effect) a large effect is indicated from OF to GO (*H1a*: β = .634, $p = .000$) and from OF to CC (*H1d*: β = .520. $p = .000$), and a medium effect from OF to COH (*H1b*: β = .486, $p = .000$), and from OF to MoR (*H1c*: β = .374, p = .000). Concerning CMT, a highly significant, small positive effect is found from CMT to COH (*H2a*: β = .233, p = .003) as well as from CMT to MoR (*H2b*: β = .260, $p = .000$). The influence of IC on MoR (*H3b*: β = .141, $p = .039$) and CC

4 Other than in CB-SEM, no GoF measures like RMSEA or CFI are reported. This is due to striving for another goal in PLS-SEM: Making an in-and-out-of-model prediction. To assess the predictive power of a PLS-SEM model, several statistical analyses need to be carried out (Hair et al., 2022; details can be requested from the corresponding author).

(*H3c*: β = .161, p = .012) is significant at $p < .05$ with a small effect. Surprisingly, TA shows no significant influence and no noteworthy effect on MoR or CC.

The relationships between the process factors and IL, MoR (*H7a*: β = .443, p = .000) and CC (*H8a*: β = .313, p = .001) show a highly significant association with a medium effect for MoR to IL and a small effect for CC to IL. The association with SAT is highly significant for GO (*H5b*: β = .211, p = .004), MoR (*H7b*: β = .253, p = .000) and CC (*H8b*: β = .335, p = .000) with a small effect, respectively.

RQ3: How does the model differ in the MGA regarding gender, virtuality, task complexity, and firm size in VTW?

By analyzing the results of the MICOM procedure (Henseler et al., 2016; details can be requested from the corresponding author), we can confirm configural invariance (Step 1) as the setup of our model is equal across all groups. Compositional invariance (Step 2) is approved for TC, $Virt_{VS}$, and firm size. We therefore refrain from conducting MGA for $Virt_{TF}$ and gender. As the means and variances of TC, $Virt_{VS}$, and firm size are not equal (Step 3), we can assume partial measurement invariance and can compare the path coefficients for the respective two groups.

After MGA for TC, $Virt_{VS}$, and firm size, we find no significant difference regarding $Virt_{VS}$, which cannot be adduced as moderator for explaining the differences in path coefficients between group 0 (low virtuality) and 1 (high virtuality). Regarding TC, comparing group 0 (high TC) and group 1 (low TC) indicates a significant difference of path coefficients only for the relationship between MoR and IL (p = .023). A comparison of the path coefficient for group 0 = .684 and for group 1 = .303 reveals a difference in path coefficients of .380. Concerning firm size, group 0 (smallest, small, medium sized firms) and group 1 (large firms) differ regarding the relationship between GO and IL (p = .025). The path coefficients for the relationship between GO and IL are -.374 for group 0 and .061 for group 1, resulting in a difference of -.434.

5 Discussion and Implications

The numbers displayed in RQ1 present the manifold challenges that a VT holds: Employees and apprentices in particular need to be prepared to have the ability to work together in VT in a short-, medium-, and long-term fashion. Moreover, the frequency of VTW indicates the relevance of virtually working together.

Regarding RQ2, hypotheses *H1a–H1d* can be supported and reveal the importance of the organizational influence on processes in VT. Support and guidance, including apprentices receiving all relevant information and having clear goals set, seem to be crucial factors in introducing and encouraging apprentices in VTW in VET. This requires support during the

preparation and scheduling (e.g., task planning and the definition of goals), implementation (e.g., supporting communication) and evaluation (e.g., feedback, reflection, and the identification of room for improvement). Following van Merriënboer and Kirschner (2018), support and guidance should be gradually diminished and reduced over time, until the task can be performed without assistance. We encourage organizations to keep this principle in mind when supervising VTW to foster learning in and about VTs. In the case of VET, this could be incorporated by decreasing support for learners during the progress of their apprenticeship and by encouraging apprentices to take more responsibility from the planning to the evaluation of VTW (Ryan & Deci, 2018). Motivation is important for apprentices during VET as well as for their future working lives. The importance of CMT, i.e., feeling committed toward a VT to fulfil a certain task, is especially relevant for COH and MoR. CMT and IC are factors referring to intrinsic motivation as well as being open-minded and help apprentices to carry out VTW following their own free will and with interest and enthusiasm, in accordance with the cognitive evaluation theory of Ryan and Deci (2018). Following our assumptions, CMT also positively influences COH in a VT. A higher degree of IC leads to a better CC, which makes sense, especially for working virtually in culturally diverse teams. Surprisingly, being open to learning new technical systems or enjoying working with them (TA) has no significant influence on MoR or CC. Therefore, our hypotheses H4a and H4b cannot be confirmed. The idea that a basic TA helps apprentices during VTW is therefore questionable. This can be viewed as a chance for apprentices who do not have a high degree of TA to catch up and not be disadvantaged when it comes to VTW in VET. It also suggests that the technical requirements can be learned without prior knowledge and without a penchant for technical ability. The perception of Franke et al. (2019, p. 456) to view TA "as a key personal resource for technology interaction" cannot be confirmed for VTW in VET. Alternatively, the tools frequently used in VTW (see figures 4 and 5) may also be user friendly and commonly employed (i.e., PC / laptop, videoconferencing tools, e-mail), making it easy for individuals to engage in VTW without a higher degree of TA.

The individual outcome factor IL involves the perceived feelings of individuals in regard to learning from VTW personally and professionally, as well as bringing in new ideas on how to improve tasks. IL is most strongly influenced by MoR. This is consistent with Ryan and Deci (2018), who identify intrinsic motivation as pivotal for successful learning. As we incorporate the innovative character of learning in VT, our findings underline the importance of motivational aspects. The importance of effectively communicating in a supportive climate to foster IL is also shown. Therefore, we can confirm the relevance of MoR and CC for apprentices to profit privately and professionally from VTW. Furthermore, innovative work methods are discovered during VTW in VET, exploring possibilities and requirements for the "new normal" in current and future work life. The SAT of apprentices depends on a clear and commonly shared goal for VTW. A realistic agreement on objectives ensures the reachability

of ideally commonly set goals and ensures that apprentices become satisfied through achieving them. The motivation of apprentices is in line with these findings due to their willingness to contribute to the VT outcome and by taking responsibility for the VT, resulting in the SAT of apprentices in VTW. The relationship between CC and SAT supports our hypotheses (*H8a–H8b*), identifying, among other aspects, conflict management and communication as important drivers for SAT in VTW (Lloyd & Härtel, 2010; Malik, 2013).

The comparison of groups suggests that there is no significant difference concerning the perceived virtuality in vocational schools, indicating no difference between a low and a high virtuality for input, process, and outcome relationships. VTW in this learning location seems to be independent from the degree of virtuality perceived by the apprentices in a VT. The comparison of groups regarding the perceived complexity of tasks demonstrates no differences between low or high values of TC apart from the relationship between MoR and IL. For more difficult tasks in a VTW, MoR seems to have a stronger influence on IL than for less complex or routine tasks. This indicates that a higher motivation is needed for difficult tasks, as well as the importance of taking responsibility for a team to promote its progress and development. Regarding firm size, in smallest, small or medium sized firms, a higher GO leads to a lower degree of IL. Too narrowly defined goals could cause a limited scope for innovation and learning. In large companies, however, GO has a slightly positive effect on IL. This, in turn, could suggest that despite narrowly defined goals, a stimulating environment of learning and innovation exists in large companies. In addition, it is conceivable that the structures in large companies are already so complex that clear targets within VTW seem to be useful.

Theoretical Implications

In the problem outline, it was made clear that specific research in the context of VET is necessary in order to be able to map collaborative learning with the aid of digital technologies in a context-specific and content-rich manner (e.g., Schwendimann et al., 2018). Reference has also been made to the fact that the VET sector is still underrepresented in this particular research area. Our research aims to address exactly these points: With our study, we want to provide (first and exploratory) insights about the diverse process flows and important influence factors of VT in the specific context of VET. To this end, we identified an internationally well-known theoretical model of VT (Dulebohn & Hoch, 2017) and potential scales / items to best represent some of the inherent constructs, which could fit into research in VET. The instruments were meaningfully adapted to the needs of the target group of apprentices and tested in EFA / CFA. Results showed that both factor analysis and within PLS-SEM, our instruments and model seem to explain a significant share of variance (with R^2 between .318 and .446). As our aim was also to make out-of-sample predictions, we were able to assess a medium predictive power for our model.

Practical Implications

VET is supposed to prepare young adults for the requirements of their current and future workplaces. However, the digital transformation has changed the way we work and how humans interact in an unprecedented way (European Commission, 2013; Paeßens et al., 2023). Particularly the area of collaboration seems to be impacted rigorously (Schwendimann et al., 2018). With our study, we want to contribute to this line of research by offering first and explorative result for context of VET that have implications for a variety of practical areas: Firstly, it might help organizations in providing them with information on certain conditions which are conducive to learning. In many countries such as Germany, firm-based training provided by in-company trainers plays a pivotal role in preparing apprentices for their working life (Baum et al., 2022). At the same time, in-company trainers perceive an increasing demand on them triggered by a changing working environment. In particular, pedagogical and didactic competencies are becoming increasingly important for in-company trainers in a progressively digital world (Nicklich et al., 2022). In offering a more detailed vision on the manifold factors that shape VTW, firms and in-company trainers could be supported to provide meaningful opportunities for training that are tailored to the needs of apprentices. What is more, for the development of young adults, it appears that the design of successful learning opportunities needs to meet the contextualized affordances of VET. By elaborating on what factors help or hinder a desirable outcome in the context of VTW, we might be able to help practitioners to reach this goal.

6 Limitations and Outlook

As in every study, some limitations must be addressed. Our purposeful sampling procedure was aimed at reaching as many apprentices as possible via the criterion sampling method. While we deem this appropriate for answering our RQs, one could nevertheless argue that a more random sampling would be a reasonable alternative to avoid an overrepresentation of certain groups. With the argument that accessing apprentices' networks is difficult, future research could control for that by applying other modes of data gathering. Moreover, our sample consists of individuals who are undergoing VET in Germany. According to Busemeyer & Trampusch (2012), VET in Germany can be depicted in the collective skill formation regime - with both school-based and in-company training components. Accordingly, some organizational and content-related differences compared to other skill formation regimes may occur. Nevertheless, all skill regimes are characterized by a large variety of (learning) situations in which VT must be applied – regardless of the learning location. Since VET in an overarching sense pursues the training of all relevant knowledge, skills, and attitudes that are needed for collaboration in modern workplaces, it can be assumed that our results are also relevant for other VET contexts than the collective ones. Another limitation involves missing

data: From an initial round of 387 apprentices, 181 matched our specified criteria, eventually. We examined this issue carefully by considering sophisticated imputation methods, such as multiple imputations (Allison, 2009). In the end, we opted for the removal of all those from the sample who did not provide sufficient data on an individual level (e.g., current occupation). Lastly, we need to consider a possible selection bias in our sample. We promoted our survey via online channels rather than "paper and pencil". This could attract those with a higher digital affinity and, therefore, bias our results[5]. Future research could account for this bias by collecting other forms of data such as qualitative interviews to triangulate the results from the quantitative study with those from a qualitative approach. In our research, we have focused on those factors for which we were able to identify the strongest hypotheses based on an extensive literature review. Yet, the concept of VT also entails other constructs as well, especially trust, affiliation, leadership, perceived feeling of team membership, and human interaction. Future research should, therefore, endeavor an even more extensive use of accompanying instruments to comprehensively paint a holistic picture of VT and to triangulate the present findings. This could also entail an experimental design study that might allow a more content-centered approach by stimulating specific work activities across a wider setting of groups, or by extending the analysis on social factors in a VT. Future research would be also beneficial regarding a differentiation between labor-related learning in explicit learning settings and labor-integrated learning as a part of the working progress (Weber, 2013).

With a "new normal" in place, VTW is becoming increasingly important. This poses manifold challenges for firms and employees alike as well as bringing new affordances. We contribute to this area of research and offer a first glance into what factors foster VTW.

Ethics Statement

The authors state that they have heeded the ethical principles in this submission by implementing the ethical principles via informed consent in line with the IJRVET ethics statement.

5 A detailed comparison of our sample with the population can be requested from the corresponding author.

References

Allison, P. D. (2009). *Missing data*. Sage Publications.

Au, Y., & Marks, A. (2012). "Virtual teams are literally and metaphorically invisible": Forging identity in culturally diverse virtual teams. *Employee Relations*, *34*(3), 271–287. https://doi.org/10.1108/01425451211217707

Backhaus, K., Erichson, B., & Weiber, R. (2015). F*ortgeschrittene multivariate Analysemethoden: Eine anwendungsorientierte Einführung* [Advanced multivariate analysis: A practical introduction] (3rd ed.). Springer Gabler.

Bartsch, S., Weber, E., Büttgen, M., & Huber, A. (2021). Leadership matters in crisis-induced digital transformation: How to lead service employees effectively during the COVID-19 pandemic. *Journal of Service Management*, *32*(1), 71–85. https://doi.org/10.1108/JOSM-05-2020-0160

Baum, M., Blank, M., Lukowski, F., & Pfeiffer, S. (2022). *Ausbildungspersonal und technischer Wandel* [Training staff and technical change]. Bundesinstitut für Berufsbildung. https://www.bibb.de/dienst/publikationen/de/download/18187

Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective leadership. *Group & Organization Management*, *27*(1), 14–49. https://doi.org/10.1177/1059601102027001003

Berber, N., Slavić, A., & Aleksić, M. (2020). Relationship between perceived teamwork effectiveness and team performance in banking sector of Serbia. *Sustainability*, *12*(20), 8753. https://doi.org/10.3390/su12208753

Bourque, L. B. (2004). Cross-sectional design. In M. S. Lewis-Beck, A. Bryman & T. F. Liao (Eds.), *A Sage reference publication. The Sage encyclopedia of social science research methods* (vol. 1, pp. 229–230). Sage.

Brahm, T., & Kunze, F. (2012). The role of trust climate in virtual teams. Journal of Managerial Psychology, *27*(6), 595–614. https://doi.org/10.1108/02683941211252446

Busemeyer, M. R., & Trampusch, C. (2012). The comparative political economy of collective skill formation. In M. R. Busemeyer & C. Trampusch (Eds.), *The political economy of collective skill formation* (pp. 3–38). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199599431.003.0001

Chudoba, K. M., Wynn, E., Lu, M., & Watson-Manheim, M. B. (2005). How virtual are we? Measuring virtuality and understanding its impact in a global organization. *Information Systems Journal*, *15*(4), 279–306. https://doi.org/10.1111/j.1365-2575.2005.00200.x

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge. https://doi.org/10.4324/9780203771587

Cohen, S. G., & Gibson, C. B. (2003). In the beginning: Introduction and framework. In C. B. Gibson & S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 1–13). Jossey Bass.

Collier, J. E. (2020). *Applied structural equation modeling using AMOS: Basic to advanced techniques*. Routledge.

Darban, M. (2022). Learning in virtual student teams: An examination of shared leadership. *Journal of Research on Technology in Education*, *54*(5), 736–753. https://doi.org/10.1080/15391523.2021.1916800

De Vaus, D. A. (2004). Research design. In M. S. Lewis-Beck, A. Bryman & T. F. Liao (Eds.), *A Sage reference publication. The Sage encyclopedia of social science research methods* (vol. 3, pp. 964–965). Sage.

DeOrtentiis, P. S., Summers, J., Ammeter, A. P., Douglas, C., & Ferris, G. R. (2013). Cohesion and satisfaction as mediators of the team trust – team effectiveness relationship. *Career Development International*, *18*(5), 521–543. https://doi.org/10.1108/CDI-03-2013-0035

Derven, M. (2016). Four drivers to enhance global virtual teams. *Industrial and Commercial Training*, *48*(1), 1–8. https://doi.org/10.1108/ICT-08-2015-0056

Dobricki, M., Evi-Colombo, A., & Cattaneo, A. (2020). Situating vocational learning and teaching using digital technologies – a mapping review of current research literature. *International Journal for Research in Vocational Education and Training*, *7*(3), 344–360. https://doi.org/10.13152/IJRVET.7.3.5

Dulebohn, J. H., & Hoch, J. E. (2017). Virtual teams in organizations. *Human Resource Management Review*, *27*(4), 569–574. https://doi.org/10.1016/j.hrmr.2016.12.004

Earley, P., & Mosakowski, E. (2000). Creating hybrid team cultures: An empirical test of transnational team functioning. *Academy of Management Journal*, *43*(1), 26–49.

Edmondson, A. C., & Roloff, K. S. (2009). Overcoming barriers to collaboration: Psychological safety and learning in diverse teams. In E. Salas, G. F. Goodwin, & C. S. Burke (Eds.), *The organizational frontiers series. Team effectiveness in complex organizations: Cross-disciplinary perspectives and approaches* (pp. 183–208). Routledge.

European Commission. (2013). Work-based learning in Europe: Practices and policy pointers. European Commission.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3150980

Franke, T., Attig, C., & Wessel, D. (2019). A personal resource for technology interaction: Development and validation of the affinity for technology interaction (ATI) scale. *International Journal of Human-Computer Interaction*, *35*(6), 456–467. https://doi.org/10.1080/10447318.2018.1456150

Führungskräfte Institut. (Management Institute) (2017). *Umfragen und Stimmungsbilder zu aktuellen Themen aus Steuerpolitik, Sozialpolitik, Arbeitspolitik, Europapolitik und Management* [Surveys and sentiments on current issues in tax policy, social policy, labor policy, european policy, and management]. Manager monitor, 2017(6), 1–3. https://www.fki-online.de/uploads/media/20171205_manager-monitor.pdf

Gibson, C. B., & Gibbs, J. L. (2006). Unpacking the concept of virtuality: The effects of geographic dispersion, electronic dependence, dynamic structure, and national diversity on team innovation. *Administrative Science Quarterly*, *51*(3), 451–495. https://doi.org/10.2189/asqu.51.3.451

Gibson, C. B., & Manuel, J. A. (2003). Building trust: Effective multicultural communication processes in virtual teams. In C. B. Gibson & S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 59–86). Jossey Bass.

Goel, S., Sharda, H., & Taniar, D. (2003). Messaging in distributed systems. *Computer Systems Science and Engineering*, *18*(6), 339–355.

Gonzalez, R. V. D., & Melo, T. M. de (2021). How do autonomy, cohesion and integration of teamwork impact the dynamic capability? *Total Quality Management & Business Excellence*, *32*(7), 794–810. https://doi.org/10.1080/14783363.2019.1636640

Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. *MIS Quarterly*, *27*(2), 265–287. https://doi.org/10.2307/30036531

Haasler, S. R. (2020). The German system of vocational education and training: challenges of gender, academisation and the integration of low-achieving youth. *Transfer: European Review of Labour and Research*, *26*(1), 57–71. https://doi.org/10.1177/1024258919898115

Hackman, J. R. (1987). The design of work teams. In J. W. Lorsch (Ed.), *Handbook of organizational behaviour* (2nd ed., pp. 315–342). Prentice-Hall.

Hackman, J. R., & Morris, C. G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. *Advances in Experimental Social Psychology*, *8*, 45–99. https://doi.org/10.1016/S0065-2601(08)60248-8

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A primer on partial least squares structural equation modeling (PLS-SEM) (3rd ed.). Sage.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Harteis, C. (Ed.) (2018). *The impact of digitalization in the workplace: An educational view*. Springer International Publishing.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *International Marketing Review*, *33*(3), 405–431. https://doi.org/10.1108/IMR-09-2014-0304

Hertel, G., Geister, S., & Konradt, U. (2005). Managing virtual teams: A review of current empirical research. *Human Resource Management Review*, *15*(1), 69–95. https://doi.org/10.1016/j.hrmr.2005.01.002

Hinds, P., & Weisband, S. (2003). Knowledge sharing and shared understanding in virtual teams. In C. B. Gibson & S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 21–36). Jossey Bass.

Hoch, J. E., & Kozlowski, S. W. J. (2014). Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership. *The Journal of Applied Psychology*, *99*(3), 390–403. https://doi.org/10.1037/a0030264

Hofmann, D., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. *Personnel Psychology*, *49*(2), 307–339. https://doi.org/10.1111/j.1744-6570.1996.tb01802.x

Högl, M., & Gemünden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization Science*, *12*(4), 435–449. https://doi.org/10.1287/orsc.12.4.435.10635

Horn, J. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, *30*, 179–185. https://doi.org/10.1007/BF02289447

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology*, *56*, 517–543. https://doi.org/10.1146/annurev.psych.56.091103.070250

Jacques, P. H., Garger, J., & Filippelli-DiManna, L. P. (2020). Antecedents to trustworthiness, satisfaction, and potency in ad hoc face-to-face and computer-mediated teams. *Journal of Behavioral and Applied Management*, *21*(1). https://doi.org/10.21818/001c.19521

Jarrett, S. M., Glaze, R. M., Schurig, I., Muñoz, G. J., Naber, A. M., McDonald, J. N., Bennett, W., & Arthur, W. (2016). The comparative effectiveness of distributed and colocated team after-action reviews. *Human Performance*, *29*(5), 408–427. https://doi.org/10.1080/08959285.2016.1208662

Kauffeld, S. (2001). *Teamdiagnose* [Team diagnosis]. Verlag für Angewandte Psychologie [Publisher for applied psychology].

Kazazi, J., Papenfuß, A., & Möhlenbrink, C. (2012). *HMI laboratory report 7: Durchführung einer Clusteranalyse unter Verwendung von Variablen der Teamarbeit* [Conducting a cluster analysis using teamwork variables]. Institut für Flugführung. https://docplayer.org/41551185-Hmi-laboratory-report-7-durchfuehrung-einer-clusteranalyse-unter-verwendung-von-variablen-der-teamarbeit.html

Kearney, N. (2013). *Die Effekte ambidextrer Führung auf die Ideengenerierung und Ideenimplementierung, die Teaminnovation und die allgemeine Teamleistung* [The effects of ambidexter leadership on idea generation and implementation, team innovation, and overall team performance] (doctoral dissertation, Technische Universität Berlin). https://d-nb.info/1067385312/34

Kim S., Lee H. & Connerton, T. P. (2020). How psychological safety affects team performance: mediating role of efficacy and learning behavior. *Frontiers in Psychology*, *11*, 1581. https://doi.org/10.3389/fpsyg.2020.01581

King, D. B., O'Rourke, N., & DeLongis, A. (2014). Social media recruitment and online data collection: A beginner's guide and best practices for accessing low-prevalence and hard-to-reach populations. *Canadian Psychology / Psychologie canadienne*, *55*(4), 240–249. https://doi.org/10.1037/a0038087

Kirkman, B. L., & Mathieu, J. E. (2004). The role of virtuality in work team effectiveness. *Academy of Management Proceedings*, *2004*(1), L1-L6. https://doi.org/10.5465/AMBPP.2004.13862418

Kirkman, B. L., & Mathieu, J. E. (2005). The dimensions and antecedents of team virtuality. *Journal of Management*, *31*(5), 700–718. https://doi.org/10.1177/0149206305279113

Kozlowski, S. W. J., & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen & R. J. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology* (pp. 333–375). Wiley.

Lagerström, K., & Andersson, M. (2003). Creating and sharing knowledge within a transnational team—the development of a global business system. *Journal of World Business*, *38*(2), 84–95. https://doi.org/10.1016/S1090-9516(03)00003-8

Lai, C., Wang, Q., & Huang, X. (2023). The evolution of the association between teacher technology integration and its influencing factors over time. *Journal of Research on Technology in Education*, 1–21. https://doi.org/10.1080/15391523.2022.2030266

Lehmann, K. (2003). *Auswahl von Mitgliedern virtueller Teams. Entwicklung und Validierung eines Online-Testverfahrens* [Selecting members of virtual teams: development and validation of an online test procedure] (doctoral dissertation, Universität Kiel). Deutscher Universitätsverlag.

Lloyd, S., & Härtel, C. (2010). Intercultural competencies for culturally diverse work teams. *Journal of Managerial Psychology*, *25*(8), 845–875. https://doi.org/10.1108/02683941011089125

Malik, T. (2013). Positive effects of opinion-count on job satisfaction of team members in business enterprises. *Journal of Communication Management*, *17*(1), 56–74. https://doi.org/10.1108/13632541311300151

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *The Academy of Management Review*, *26*(3), 356–376. https://doi.org/10.2307/259182

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here? *Journal of Management*, *30*(6), 805–835. https://doi.org/10.1016/j.jm.2004.05.002

Maznevski, M. L., & Chudoba, K. M. (2000). Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science*, *11*(5), 473–492. https://doi.org/10.1287/orsc.11.5.473.15200

McBain, R. (2007). The practice of engagement: Research into current employee engagement practice. *Strategic HR Review, 6*(6), 16–19. https://doi.org/10.1108/14754390780001011

McGrath, J. E. (1964). *Social psychology: A brief introduction*. Holt.

Nicklich, M., Blank, M., & Pfeiffer, S. (2022). *Ausbildungspersonal im Fokus. Studie zur Situation der betrieblichen Ausbilder*innen 2021* [Focus on training staff. Study on the situation of in-company trainers in 2021]. Retrieved August 31, 2023, from https://wap.igmetall.de/APIF-2021.htm

Ning, W., & Inan, F. A. (2023). Impact of social media addiction on college students' academic performance: An interdisciplinary perspective. *Journal of Research on Technology in Education*, 1–16. https://doi.org/10.1080/15391523.2023.2196456

Noble, C., & Billett, S. (2017). Learning to prescribe through co-working: Junior doctors, pharmacists and consultants. *Medical education*, *51*(4), 442–451. https://doi.org/10.1111/medu.13227

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill series in psychology. McGraw-Hill.

O'Leary, M. B., & Cummings, J. N. (2007). The spatial, temporal, and configurational characteristics of geographic dispersion in teams. *MIS Quarterly*, *31*(3), 433–452. https://doi.org/10.2307/25148802

O'Hara-Devereaux, M., & Johansen, R. (1994). *Globalwork: Bridging distance, culture, and time (3rd ed.). The Jossey-Bass management series*. Jossey-Bass.

Organisation for Economic Co-operation and Development. (OECD) (2021). *Implications of the COVID-19 pandemic for vocational education and training*. OECD. https://doi.org/10.1787/55afea00-en

Paeßens, J., Ma, B., & Winther, E. (2023). Effectiveness of collaboration in VET: Measuring skills for solving complex vocational problems with a multidimensional authentic technology-based assessment. *International Journal for Research in Vocational Education and Training*, *10*(1), 46–67. https://doi.org/10.13152/IJRVET.10.1.3

Patton, M. Q. (2001). *Qualitative research & evaluation methods* (3rd ed.). Sage.

Price, S., & Lusznat, R. (2018). Do trainees feel that they belong to a team? *The Clinical Teacher*, *15*(3), 240–244. https://doi.org/10.1111/tct.12664

Qualtrics XM. (2022). *Qualtrics XM*. https://www.qualtrics.com/

Richter, N., Cepeda Carrión, G., Roldán, J., & Ringle, C. M. (2016). European management research using partial least squares structural equation modeling (PLS-SEM). *European Management Journal*, *33*(1), 1–3. http://doi.org/10.1016/j.emj.2014.12.001

Rigdon, E. E., Sarstedt, M., & Ringle, C. M. (2017). Comparing results from CB-SEM and PLS-SEM. Five perspectives and five recommendations. *Marketing ZFP*, *39*(3), 4–16. http://doi.org/10.15358/0344-1369-2017-3-4

Ringle, C. M., Wende, S., & Becker, J. M. (2022). *SmartPLS 4*. https://www.smartpls.com

Ryan, R. M., & Deci, E. L. (2018). *Self-determination theory: Basic psychological needs in motivation, development, and wellness* (Paperback edition). The Guilford Press.

Salas, E., Rosen, M. A., Burke, C. S., & Goodwin, G. F. (2009). The wisdom of collectives in organizations: An update of the teamwork competencies. In E. Salas, G. F. Goodwin & C. S. Burke (Eds.), *Team effectiveness in complex organizations: Cross-disciplinary perspectives and approaches* (pp. 39–79). Routledge.

Sarin, S., & McDermott, C. (2003). The effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product development teams. *Decision Sciences*, *34*(4), 707–739. https://doi.org/10.1111/j.1540-5414.2003.02350.x

Schilirò, D. (2021). Digital transformation, COVID-19, and the future of work. *International Journal of Business Management and Economic Research*, *12*(3), 1945–1952.

Schlicht, J. (2019). *Kommunikation und Kooperation in Geschäftsprozessen: Modellierung aus pädagogischer, ökonomischer und informationstechnischer Perspektive* [Communication and cooperation in business processes: A pedagogical, economical, and information-based model]. Wbv.

Schwendimann, B. A., De Wever, B., Hämäläinen, R., & Cattaneo, A. A. P. (2018). The state-of-the-art of collaborative technologies for initial vocational education: A systematic literature review. *International Journal for Research in Vocational Education and Training*, *5*(1), 19–41. https://doi.org/10.13152/IJRVET.5.1.2

Schwieger, D., & Ladwig, C. (2018). Reaching and retaining the next generation: Adapting to the expectations of Gen Z in the classroom. *Information Systems Education Journal*, *16*(3), 45–54.

Serinikli, N. (2019). Transformation of human resources in digitalization: Y, Z and alpha generations. In C. Akar & H. Kapucu (Eds.), *Contemporary challenges in business & life sciences* (1st ed., pp. 181–187). IJOPEC.

Shockley, K. M., Allen, T. D., Dodd, H., & Waiwood, A. M. (2021). Remote worker communication during COVID-19: The role of quantity, quality, and supervisor expectation-setting. *The Journal of applied psychology*, *106*(10), 1466–1482. https://doi.org/10.1037/apl0000970

Silva, A. L., & Merino, G. S. A. (2017). Potentialities of remote teams in the innovation process in an organization through the design management. *Strategic Design Research Journal*, *10*(3), 204–214. https://doi.org/10.4013/sdrj.2017.103.02

Stamm, M. M. (2013). Migrants as ascenders: Reflections on the professional success of migrant apprentices. *Education + Training*, *55*(2), 112–127. https://doi.org/10.1108/00400911311304779

Staples, D. S., & Zhao, L. (2006). The effects of cultural diversity in virtual teams versus face-to-face teams. *Group Decision and Negotiation*, *15*(4), 389–406. https://doi.org/10.1007/s10726-006-9042-x

Steiner, I. D. (1972). *Group processes and productivity. Social psychology: A series of monographs, treatises, and texts*. Academic Press.

van Merriënboer, J. J. G., & Kirschner, P. A. (2018). *Ten steps to complex learning: A systematic approach to four-component instructional design* (3rd ed.). Routledge.

Weber, S. (2013). Sense of workplace learning. *Vocations and Learning*, *6*(1), 1–9. https://doi.org/10.1007/s12186-012-9092-y

Weimann, P., Hinz, C., Scott, E., & Pollock, M. (2010). Changing the communication culture of distributed teams in a world where communication is neither perfect nor complete. *Electronic Journal of Information Systems Evaluation*, *13*(2), 187–196.

West, M. A., & Markiewicz, L. (2004). *Building team-based working: A practical guide to organizational transformation*. Blackwell Publishing. http://doi.org/10.1002/9780470774700

Wiedemann, J., Watzdorf, E. V., & Richter, P. (2013). *TeamPuls- TeamPuls Teamdiagnose. Verfahrensdokumentation, Durchführungsanleitung, Fragebogen, Auswertungsbeispiel sowie übergreifendes Auswertungsbeispiel. Leibnitz Institut für Psychologie (ZPID)*. https://doi.org/10.23668/PSYCHARCHIVES.6588

Wong, S. I., & Berntzen, M. N. (2019). Transformational leadership and leader –member exchange in distributed teams: The roles of electronic dependence and team task interdependence. *Computers in Human Behavior*, *92*, 381–392. https://doi.org/10.1016/j.chb.2018.11.032

Yang, S. B., & Ok Choi, S. (2009). Employee empowerment and team performance. *Team Performance Management: An International Journal*, *15*(5/6), 289–301. https://doi.org/10.1108/13527590910983549
Zander, L., Mockaitis, A. I., & Butler, C. L. (2012). Leading global teams. *Journal of World Business*, *47*(4), 592–603. https://doi.org/10.1016/j.jwb.2012.01.012

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