

Decius, Julian; Knappstein, Michael; Schaper, Niclas; Seifert, Andreas

Article — Published Version

Investigating the multidimensionality of informal learning: Validation of a short measure for white-collar workers

Human Resource Development Quarterly

Provided in Cooperation with:

John Wiley & Sons

Suggested Citation: Decius, Julian; Knappstein, Michael; Schaper, Niclas; Seifert, Andreas (2021) :
Investigating the multidimensionality of informal learning: Validation of a short measure for white-
collar workers, Human Resource Development Quarterly, ISSN 1532-1096, Wiley Periodicals, Inc.,
Hoboken, USA, Vol. 34, Iss. 1, pp. 45-74,
<https://doi.org/10.1002/hrdq.21461>

This Version is available at:

<https://hdl.handle.net/10419/287833>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.




You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<http://creativecommons.org/licenses/by/4.0/>

Investigating the multidimensionality of informal learning: Validation of a short measure for white-collar workers

Julian Decius¹  | Michael Knappstein²  | Niclas Schaper¹  |
Andreas Seifert¹ 

¹Institute of Psychology, Paderborn University, Paderborn, Germany

²Department of Business Psychology & HR, International School of Management, Dortmund, Germany

Correspondence

Julian Decius, University of Bremen, Faculty of Business Studies and Economics, Max-von-Laue-Str. 1, 28359 Bremen, Germany.
Email: julian.decius@uni-bremen.de

Abstract

The challenges resulting from increasing digitalization and globalization require flexible continuing education for white-collar workers. Especially informal learning becomes increasingly important in the modern workplace. Practitioners want to promote informal learning among employees, researchers want to unveil conducive contextual conditions for informal learning, but they lack an appropriate, validated measure. Based on the octagon model of informal workplace learning (Decius et al., *Human Resource Development Quarterly*, 2019, 30, 495–535) and an existing 24-item scale for blue-collar workers, we present a short version of eight items for use among white-collar workers. Using three independent samples of 695, 500, and 3134 German employees, we show that the second-order factor structure—following the multidimensional octagon model—has a better fit compared with a model in which all items load on a single factor. The short scale is strongly correlated with the original full scale. The scale's reliability is satisfying ($\alpha = 0.76/0.77/0.85$; $\omega = 0.78/0.78/0.86$), considering the heterogeneous conceptual nature of informal learning. Regarding criterion validity, we found theoretically expected correlations with job demands, job autonomy, knowledge/skill acquisition, age, and self-directed learning

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2021 The Authors. *Human Resource Development Quarterly* published by Wiley Periodicals LLC.

orientation. Furthermore, the scale reveals measurement invariance across sociodemographic characteristics of gender and educational background. We also discuss implications for research and practice of the new informal learning measure among white-collar workers.

KEYWORDS

informal workplace learning, measure, short scale, validation, white-collar workers

1 | INTRODUCTION

Develop or die: Organizations in global competition must be able to cope with dynamic and constantly evolving work environments and adapt quickly (Regan & Delaney, 2011). This is only possible, however, if employees—the heart of the organization—continuously expand their skills and knowledge through learning. Although formal training is also important (Bell et al., 2017; Blume et al., 2010), most vocational learning takes place informally (Cerasoli et al., 2018; Eraut, 2011). According to Cerasoli et al. (2018), informal workplace learning (IWL) consists of “non-curricular behaviors and activities pursued in service of knowledge and skill acquisition that take place outside formally-designated learning contexts. Such activities are predominantly self-directed, intentional, and field-based. Informal learning behaviors are not syllabus-based, discrete, or linear” (p. 204). Typical informal learning behaviors include applying one's own solutions to work problems, reflecting on work processes, sharing experiences with colleagues, and seeking feedback on one's own work results (Decius et al., 2019).

Because of the high relevance of IWL, research recently called for a theoretically sound scale to operationalize this kind of learning (Cerasoli et al., 2018; Jeong et al., 2018). Previous approaches have lacked a theoretical foundation or model basis (e.g., Froehlich et al., 2017; Grosemans et al., 2020; Noe et al., 2013; Wolfson et al., 2018). Decius et al. (2019), however, presented a newly developed scale for measuring IWL, building on the dynamic model of informal learning by Tannenbaum et al. (2010), and extending this four-factor model to an eight-factor model (octagon model of informal workplace learning). Their scale contains eight factors with three items each and allows a differentiated assessment of IWL. This measure seems to be useful for studies that focus on informal learning. In case that IWL shall be included only as an additional construct, a 24-item scale might be less feasible, because long surveys tend to undermine respondents' motivation to complete them (Krosnick, 1999).

Based on these test economic considerations, Decius et al. (2019) also presented a short version consisting of eight items that cover each factor of the octagon model with one item. However, the authors also mentioned the lack of validation of this short scale by now. In addition, this original scale was developed for the target group of blue-collar workers. For the important occupational group of white-collar workers, who account for most of all employees in Western countries (van Horn & Schaffner, 2003), there is still no empirical validation available. In contrast to blue-collar workers “who perform predominantly manual work,” white-collar workers (e.g., employees working in professional, clerical, managerial or administrative jobs) “perform predominantly ‘brain work’” (Schreurs et al., 2011, p. 48). White-collar jobs “include more autonomy and more challenging tasks than blue-collar jobs, ... are usually physically lighter, and the risk of accidents is smaller compared to blue-collar jobs” (Toppinen-Tanner et al., 2002).

Research has shown that blue-collar workers and white-collar workers differ in some occupational constructs related to learning (cf. Cerasoli et al., 2018; Kyndt & Baert, 2013), including stress and recovery factors, everyday procrastination, job satisfaction events, and meaningful work perception (Hammer & Ferrari, 2002; Lips-Wiersma et al., 2016; Locke, 1973; Schreurs et al., 2011), and do not differ in others, for example, burnout (Toppinen-Tanner

et al., 2002). These differences partly reflect the personal characteristics of the employees and different work demands of manual and thinking work. A study by Huang (2011) in China and Japan found that white-collar workers have higher levels of motivational work characteristics (i.e., autonomy, significance, and learning). He argues the reason is that white-collar workers have intellectually more difficult and challenging jobs than blue-collar workers.

However, regarding IWL, we are not aware of any comparative quantitative study. In line with Huang, we assume that the learning demands of white-collar workers are higher in terms of frequency, but that the basic informal learning processes of blue-collar workers and white-collar workers hardly differ. In both domains, there is a need to share knowledge, seek feedback, and reflect on problem-solving (Crans et al., 2021; Decius et al., 2019; Grosemans et al., 2020; Noe et al., 2013), and in both domains, the social environment, including supervisor feedback, plays an important role (Decius et al., 2021; Hilkenmeier et al., 2021; Zia et al., 2021). Nevertheless, we consider it necessary to first validate a scale developed for blue-collar workers in the white-collar context before it can be used regularly.

In this study, we thus examine whether the IWL short scale by Decius et al. (2019) for blue-collar workers is a valid and reliable instrument for use among white-collar workers. We focus on the instrument's criterion validity and construct validity, considering factorial, convergent, and discriminant validity. For our validity hypotheses, we rely on the demand-control-support model (Karasek & Theorell, 1990) and the framework of learning outcomes by Kraiger et al. (1993). Consequently, our validation results additionally strengthen the nomological network of IWL (Cerasoli et al., 2018). We analyze three independent samples of white-collar workers using structural equation modeling (SEM), also checking for measurement invariance across sociodemographic characteristics of gender and educational background.

By validating a short scale for capturing IWL among white-collar workers, we enable the scientific community to investigate IWL more thoroughly in quantitative empirical studies. The advantage of our short scale is that it adequately reflects the content breadth and multidimensionality of IWL by considering all eight conceptual components of the underlying octagon model with one item each. Using our new validated short scale, scholars can measure IWL as an additional construct beyond their actual research question instead of overburdening their respondents with the long version of an IWL scale or deciding against including IWL in the questionnaire for test economic reasons. In consequence of more quantitative studies on IWL, we expect a higher quality of future meta-analyses; the only meta-analysis on IWL to date had to include related constructs of IWL at the expense of conceptual rigor (Cerasoli et al., 2018). As a further theoretical contribution, we empirically test for the first time the conceptual structure of the octagon model in a different target group than for which it was developed (i.e., blue-collar workers; Decius et al., 2019), and thus examine the boundary conditions of the model in terms of generalizability (Busse et al., 2017).

Managers can use the measure to survey the extent of IWL of their employees and to promote IWL individually, as part of a comprehensive personnel development strategy (Bell et al., 2017; Kraiger & Ford, 2021). Employees can use the instrument in a self-assessment to find out more about their current informal learning, following a protean career approach (Hall et al., 2018). Our main contribution thus is to provide science and practice with an economic measure of IWL for white-collar workers.

2 | THEORETICAL BACKGROUND

2.1 | Existing measures for informal workplace learning

The literature to date contains various instruments for operationalizing IWL, which have been validated with different samples and target groups; Table 1 gives an overview. Most measures have been validated with specific samples, that is, teachers (studies 1, 2, 8 in Table 1), nurses or other hospital employees (studies 3, 11, 13), employees from manufacturing firms (studies 4, 14, 15), police officers (study 5), managers (studies 6, 7), and socio-educational employees (study 9). Some studies use generic or combined samples (studies 10, 12, 13, 14, 16). Most studies examined content validity (studies 2, 4, 5, 7, 9, 10, 11, 13, 14, 15, 16). Some studies give indications of convergent (studies

TABLE 1 Characteristics of measures for informal learning at the workplace

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
1 Kwaknan	2003	18 items in 3 subscales	Collaborative activities (6 items); individual activities (7); instructional activities (5)	Behavior	$\alpha = 0.77$; 0.65; 0.58	No information on validation; structural testing using EFA	542 Dutch school teachers	Based on interviews with 16 secondary school teachers
2 Lohman	2005	Frequency query for nine learning activities (including an open category "other activities")	No subscales available	Behavior	$\alpha = 0.63$	Only content validation with two expert interviews and field piloting with nine people	318 Teachers at public schools and employees in personnel development (USA)	Based on qualitative studies from previous literature
3 Berings et al.	2007	29 items in 10 subscales on 2 factors (5 subscales per factor)	1. Learning through work experience (3 items); Adding something new (3); Searching for information (3); Information meetings/coaching (5); Reflecting by oneself (5); 2. Learning by talking about technical nursing skills (2); Putting things into perspective (2); Organizing patient care (2); Finding information (2); Taking initiatives (2)	Behavior, Cognitions	1. factor: $\alpha = 0.79$; 0.79; 0.80; 0.87; 0.81; 2. factor: $\alpha = 0.67$; 0.77; 0.83; 0.85; 0.80	Indications of convergent, divergent and criterion validity	372 Dutch nurses	Based on interviews according to the situational response design (Endler & Hunt, 1966) with 45 persons from the nursing sector

TABLE 1 (Continued)

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
4 Coetzer	2007	31 items in 4 subscales	Work environment characteristics (13 items); Supervisors' proximate support for learning (7); (Dis)satisfaction with learning (4); Sources and methods of learning (7)	Learning potential of the workplace, behavior	all $\alpha > 0.70$ (no exact values given)	Only content validation with nine respondents	464 employees in small manufacturing firms	Based on qualitative interviews, prior research, and other questionnaires
5 Doornbos et al.	2008	25 items in 6 subscales	Learning from peer colleagues (5 items); learning individually (3); learning from outsiders (5); learning from new and less experienced colleagues (6); learning together (3); learning from expert colleagues (3)	Behavior, Cognitions	$\alpha = 0.83$; 0.73; 0.81; 0.86; 0.76; 0.71	Content validity screening with seven HRD professionals; structural testing using EFA	473 Dutch police officers	Based on a previous interview study among police officers
6 Choi and Jacobs	2011	12 items in 3 subscales	Learning with others (3 items); Self-experimentation (3); External scanning (3)	Behavior	$\alpha = 0.69$; 0.76; 0.68	Indications of convergent validity; structural verification using CFA	203 Korean bank managers	Adapted version by Lohman (2005)

(Continues)

TABLE 1 (Continued)

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
7 Noe et al.	2013 ^a	9 items in 3 factors	Learning from oneself (3 items); Learning from others (3); Learning from non-interpersonal sources (3)	Behavior	$\alpha = 0.71$ (no α values given for the subscales)	Piloting with a manager, quantitative content validation with 47 business students; structural examination by means of CFA	180 restaurant managers from the American theme gastronomy	Building on the existing literature
8 van Rijn et al.	2013	11 items in 3 subscales	Keeping up-to-date (4 items); Asking for feedback from supervisors (2); Knowledge sharing (5)	Behavior	$\alpha = 0.75$; 0.81; 0.85	Structural testing using CFA	323 teachers from Dutch vocational training institutions	Use of a scale by Geijssels et al. (2009) for "Keeping up to date" and adapted scales by van Woerkom (2003) for "Getting feedback from superiors" and "Sharing knowledge"
9 Kyndt, Govaerts et al.	2014	19 items in 3 subscales	Generic (10 items), job-specific (5), organizational-level (4) learning outcomes	Learning outcomes	$\alpha = 0.88$; 0.79; 0.78	Piloting with a socio-educational specialist and a language specialist; indication of convergent and discriminant validity; structural testing using CFA	1186 Flemish socio-educational employees	Based on the literature and a classification scheme from practice ("Flemish competence profile of the Forum on Education in Socio-Educational Care Work")

TABLE 1 (Continued)

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
10 Nikolova et al.	2014	12 items in 4 subscales (equally distributed)	Learning through reflection; through experimentation; from colleagues; from supervisor	Learning potential of the workplace, behavior, cognition	$\alpha = 0.91$; 0.90; 0.83; 0.90	Indications of convergent, divergent, and construct validity; structural testing using CFA	1013 Dutch professionals from various industries	Not specifically described reference to three taxonomies from the literature, whose correspondence to the scale is little apparent
11 Takase et al.	2016	20 items in 5 subscales	Learning through reflection (4 items); from practice (5); from feedback (5); from others (3); from training (3)	Behavior, Cognitions	$\alpha = 0.88$; 0.80; 0.84; 0.84; 0.69 (overall: 0.91)	Item review for face validity by seven nursing experts; pilot test with 10 nurses; examination of contrast validity; structural testing using CFA	502 Japanese nurses	Based on a review of the literature
12 Froehlich et al.	2017 ^b	12 items in 4 subscales	Feedback-seeking from the supervisor (3 items); Feedback-seeking from the colleagues (3); Help-seeking (2); Information-seeking (4)	Socially related learning behavior	α (total sample) = 0.86; 0.83; 0.66; 0.69	Piloting by feedback from experts (not described in detail); structural review by means of CFA	Total sample = 780, divided into four sub-samples: 115 Dutch rescue service employees; 613 Dutch university employees; 77 employees of an Austrian IT company; 90 employees of an Austrian chamber	Based on the behavioral items from the scale of learning conditions for non-formal and informal learning (Kyndt et al., 2009)

(Continues)

TABLE 1 (Continued)

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
13 Wolfson et al.	2018	9 items in 3 subscales (equally distributed)	Feedback/Reflection-Based Learning (3 items); Vicarious Learning (3); Learning Through Experimentation/New Experiences (3)	Behavior, Cognitions	Sample 1: $\alpha = 0.75$; 0.72; 0.74; Sample 2: $\alpha = 0.84$; 0.83; 0.81; Sample 3: $\alpha = 0.84$; 0.81; 0.81	Quantitative piloting with 32 scientific and student participants; indications of convergent validity; structural verification using CFA	Sample 1: 400 persons, purchased via Amazon Mechanical Turk (MTurk); Sample 2: 1707 American hospital employees; sample 3: 407 American hospital employees	Item development based on definitions from the literature
14 Kortsch et al.	2019	12 items in 4 subscales	Three factors by Noe et al. (2013), subscale added: Learning from new media (3 items)	Behavior	Sample 1: $\alpha = 0.65$; 0.65; 0.75; 0.74; Study 2: $\alpha = 0.51$; 0.61; 0.66; 0.61	Piloting with representatives of the Chamber of Crafts; structural testing by means of CFA	Sample 1: 131 German employees from various sectors; Study 2: 483 employees from German small and medium-sized craft enterprises	Based on the scale of Noe et al. (2013); extension based on (not further described) qualitative case studies in crafts
15 Decius et al.	2019	24 items in 8 subscales	Trying and applying own ideas (3 items); Model learning (3); Direct feedback (3); Vicarious feedback (3); Anticipatory reflection (3); Subsequent reflection (3); Extrinsic intent to learn (3); Intrinsic intent to learn (3)	Behavior, cognitions, motivation, and attitudes toward learning	$\alpha = 0.82$ (Sample 1)/0.88 (Sample 2); 0.77/0.80; 0.82/0.83; 0.86/0.91; 0.76/0.76; 0.82/0.82; 0.76/0.77; 0.88/0.92	Piloting by means of "thinking aloud" interviews with 15 industrial employees; indications of convergent, discriminatory and criterion validity; structural examination by means of CFA	2 samples: 546 and 349 industrial employees from German SMEs	Theoretically sound foundation: based on the octagon model, which is an extension of the model of Tannenbaum et al. (2010); item development based on 12 interviews with managers in German SMEs

TABLE 1 (Continued)

Authors	Year	Items	Subscales	Type of IWL	Reliability	Validation	Samples	Foundation of the instrument structure
16 Grosemans et al.	2020	13 items in 3 subscales, 2 of which address informal learning	Informal learning activities using personal sources (6 items); Informal learning activities using environmental sources (3); Formal learning activities (4)	Behavior	$\alpha = 0.89$; 0.81; 0.83	Piloting by employee interviews (N = 20); indications of convergent, discriminant and predictive validity, group-related measurement invariance; structural testing by means of CFA	3232 Flemish professionals in various sectors	Deductive approach based on definitions and items of previous measuring instruments

Note: CFA, confirmatory factor analysis; EFA, exploratory factor analysis; IWL, informal workplace learning; SMEs, small- and medium-sized enterprises.

^aNoe et al. (2013) stated that the three subscales of their instrument correlate such strongly that the authors decided to use a single factorial solution despite a good model fit of the three-factorial solution. Therefore, they only provided an overall value for internal consistency (Cronbach's alpha).

^bThe scale of Froehlich et al. (2017) was already presented for the first time in an earlier research paper, but only by naming sample items for each subscale (see Froehlich et al., 2014).

3, 6, 9, 10, 13, 15, 16) and discriminant (studies 3, 9, 10, 15, 16) validity as well as criterion validity (studies 3, 10, 15, 16).

Except for the survey on the frequency of different learning activities by Lohman (2005), all measures mentioned in Table 1 have several subscales; IWL is thus mostly seen as a multidimensional construct. However, not all studies examined the claimed subscale structure by factor analysis (studies 1 and 5 in Table 1 used exploratory factor analysis only, studies 6–16 used confirmatory factor analysis).

However, the multidimensionality of informal learning is reflected to varying degrees in the scales. All measures include behavioral components of learning (e.g., trying things out by oneself or sharing experiences with others). Sometimes cognitive components (e.g., reflection) also play a role (studies 3, 5, 10, 11, 13, 15). Only one scale considers motivational components (e.g., intrinsic learning intention; study 15). Informal learning, however, conceptually consists of own experiences and actions, observing the actions of others, receiving feedback from colleagues and sharing experiences with them, reflecting on own experiences, and having the intention to learn (Decius et al., 2019; Tannenbaum et al., 2010). This breadth of content of informal learning is only accounted for by one IWL scale in Table 1 (study 15). This scale is also the only one that builds on a theoretical model: the octagon model of informal workplace learning (Decius et al., 2019). The authors of the other measures used qualitative case studies and interview results (1, 3, 4, 14), prior (qualitative) studies (2, 4, 5), prior scales (4, 6, 8, 12, 14, 16), classifications used in practice (9), or literature research only (7, 10, 11, 13), to develop items and determine the scale structure.

The long version of the instrument by Decius et al. (2019); that is, study 15 in Table 1 contains 24 items in eight subscales and was validated with German blue-collar workers. The short version, which has not yet been sufficiently validated, contains eight items. Decius et al. developed the short scale by conducting an explorative factor analysis with the 24 items of the validated full version of the measure—with the specification to extract only one factor. As a second step, they selected the item with the highest factor load from the three items of each factor of the octagon model to ensure complete coverage of all eight IWL components. This short version provides the basis for the scale validation among white-collar workers in this study.

2.2 | The octagon model of informal workplace learning

The octagon model of informal workplace learning (Decius et al., 2019) is an extension of the dynamic model of informal learning by Tannenbaum et al. (2010). The model of Tannenbaum et al. (2010) is considered dynamic because the four factors, *experience/action*, *feedback*, *reflection*, and *intent to learn*, can trigger each other and can be run through once or several times in any order during the learning process. According to Tannenbaum et al. (2010), the learning process is particularly efficient when all four factors are covered in the process.

The octagon model contains the four components of the dynamic model, each of which is further divided into two subcomponents (see Figure 1): *trying/applying own ideas* (e.g., experimenting with new solutions to problems) and *model learning* (e.g., observing the actions of colleagues, in the sense of social-cognitive theory, Wood & Bandura, 1989) are assigned to *experience/action* on the higher-ordered level; *direct feedback* (e.g., obtaining evaluations of one's own work performance) and *vicarious feedback* (e.g., exchange of experience without direct reference to one's own work performance) are assigned to *feedback* (cf. Tannenbaum et al., 2010); *anticipatory reflection* (e.g., planning problem-solving steps in advance) and *subsequent reflection* (e.g., considering possibilities for improvement after completion of the work task) are assigned to *reflection* (based on the reflection typology of Schön, 1983); and *extrinsic intent to learn* (e.g., learning for taking advantage of career opportunities) and *intrinsic intent to learn* (e.g., learning for the joy of learning) are assigned to *intent to learn* (in the sense of self-determination theory, Ryan & Deci, 2000). Thus, the octagon model is a multilevel model with a core factor *informal learning*, four components on the first level, and eight components on the second level.

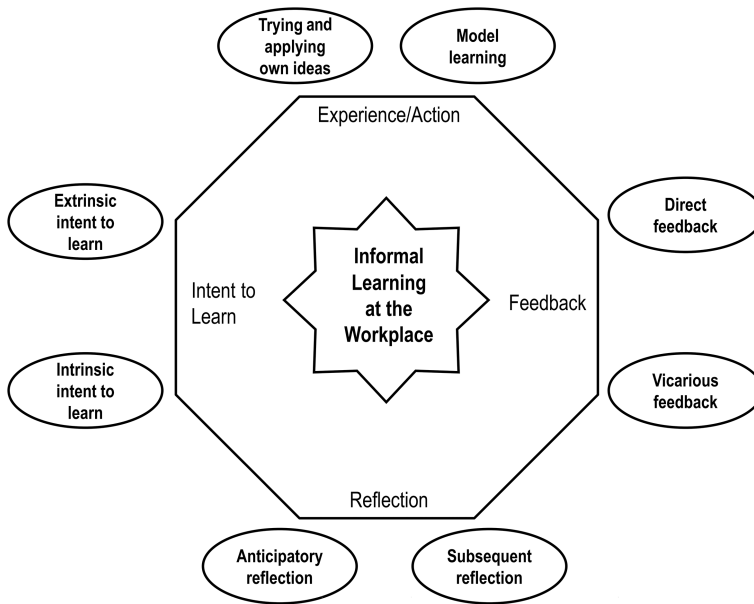


FIGURE 1 Octagon model of informal workplace learning. Retrieved from Decius et al. (2019). This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited

3 | HYPOTHESES REGARDING CRITERION AND CONSTRUCT VALIDITY

In the following, we present why we use job autonomy (decision latitude), job demands, knowledge/skill acquisition, and age as antecedents/outcomes of IWL, and self-directed learning orientation as a conceptually similar construct to test for *criterion validity*. We also argue why we use the demographic characteristics gender, school type, and educational level for the examination of *construct validity* in terms of measurement invariance.

3.1 | Criterion validity

For criterion validity, we first consider two commonly studied work characteristics that are often considered antecedents of learning: job autonomy and job demands (Kyndt & Baert, 2013; Parker, 2017). The job demand-control model and its successor, the demand-control-support model (Karasek, 1979; Karasek & Theorell, 1990), postulate that job autonomy and job demands shape the development and learning of employees. Employees in “active jobs” (i.e., high autonomy and simultaneously high demands) learn and develop especially strongly because both the need to learn (job demands) and sufficient opportunities (job resources) are given. Literature reviews support this assumption (Taris & Kompier, 2004; Wielenga-Meijer et al., 2010). However, work demands ought not to be excessively high, as this can reverse the positive learning effect (van Ruysseveldt & van Dijke, 2011).

Due to the sound theoretical foundation, the empirical evidence, and the high practical relevance of job autonomy (decision latitude) and job demands—they can be regarded as organizational levers for learning from a managerial perspective (Cerasoli et al., 2018)—we select these constructs for testing criterion validity. As an empirical basis, we refer to the only meta-analysis published so far on informal learning by Cerasoli et al. (2018). The meta-analysis showed correlations (ρ ; i.e., corrected population correlation) between IWL and control/autonomy ($\rho = 0.31$) and between IWL and demands ($\rho = 0.13$). In line with the demand-control-support model, we expect correlations

similar to Cerasoli et al.'s results between IWL and job autonomy (decision latitude) and between IWL and job demands in our study. We, therefore, assume a lower correlation between IWL and job demands, compared with IWL and job autonomy.

Hypothesis 1. *IWL and job autonomy (decision latitude) show a moderate positive relationship.*

Hypothesis 2. *IWL and job demands show a low positive relationship.*

In principle, it can be assumed that learning leads to learning outcomes under appropriately positive conditions. For criterion validity, we, therefore, consider knowledge/skill acquisition as a typical learning outcome that covers the first two dimensions of Kraiger et al.'s (1993) established framework of learning outcomes, distinguishing cognitive (e.g., amount of knowledge), skill-based (e.g., performance), and affective (e.g., attitudes) learning outcomes. Specifically, crucial workplace learning outcomes include core skills and professional competence (Cerasoli et al., 2018; Crouse et al., 2011; Decius et al., 2021; Park et al., 2020). For instance, Rowold and Kauffeld (2008) found positive predictive associations from IWL to professional, social, and method competence as a result of multiple regression analyses. Decius et al. (2021) showed a positive relationship between IWL and newly acquired competency. Cerasoli et al. (2018) meta-analytically revealed a positive correlation between IWL and knowledge/skill acquisition ($\rho = 0.41$). In our study, we expect a similarly high correlation between these constructs.

Hypothesis 3. *IWL and knowledge/skill acquisition show a moderate to high positive relationship.*

As a further validity criterion, we consider employee age. Kyndt and Baert (2013) noted that there is a general consensus in research on the negative relationship between age and formal workplace learning. The reason for this is assumed to be that the knowledge gained from experience increases with age, so that further learning is not unimportant, but subjectively loses value for the employee. In particular, the learning intention seems to be less prevalent among older employees (e.g., Sanders et al., 2011). For age and IWL, however, results are rather mixed (see Kyndt & Baert, 2013, for an overview). Nevertheless, some studies have also shown a decrease in IWL with age (e.g., Livingstone & Stowe, 2007; van der Klink et al., 2014). Chan and Auster (2003) showed that subjectively perceived age correlates even more negatively with IWL than chronological age. Cerasoli et al.'s (2018) meta-analysis also demonstrated a slight negative correlation between age and IWL ($\rho = -0.07$). Following these empirical findings, we expect a similar association in our study.

Hypothesis 4. *IWL and age show a low negative relationship.*

As a particular aspect of criterion validity, we examine the relationship of the IWL short scale with a conceptually related workplace learning construct: self-directed learning orientation (SDLO). SDLO refers to “a tendency to take an active and self-starting approach to learning activities and situations and to persist in overcoming barriers and setbacks to learning” (Raemdonck, Meurant, et al., 2014, p. 87). SDLO is considered a relatively stable construct that favors employees' recognition and active taking of learning opportunities in their daily work lives (Gijbels et al., 2010). Employees who show a fundamental willingness to learn and seize learning chances should be predestined for informal learning, which exhibits a high degree of self-direction. Research indeed showed medium to high correlations between IWL and SDLO (r between 0.33 and 0.61), considering SDLO as an important learning predictor (Decius et al., 2021; Gijbels et al., 2010; Gijbels et al., 2012; Raemdonck, Gijbels, et al., 2014). We expect that IWL and SDLO, although two distinct constructs, are strongly connected.

Hypothesis 5. *IWL and SDLO show a strong positive relationship.*

3.2 | Measurement invariance

To test construct validity, we investigate whether the IWL short scale proves to be invariant across different demographic subgroups. In order to reasonably compare group means, at least configural, metric, and scalar measurement invariance is required (Sass, 2011; Vandenberg & Lance, 2000). We selected sociodemographic characteristics for invariance testing that researchers often use as control variables for empirical studies in learning contexts: gender and educational background. In reviews (Kyndt & Baert, 2013; Park et al., 2020) and the meta-analysis by Cerasoli et al. (2018), no consistent, substantial influences of these variables on IWL were found. Neither is there any theoretical reason to expect such effects. The IWL short scale should achieve constant measurement accuracy regardless of demographic influences. Therefore, the following three hypotheses regarding the measurement invariance arise:

Hypothesis 6. *The IWL scale shows measurement invariance among gender subgroups (male vs. female).*

Hypothesis 7. *The IWL scale shows measurement invariance among school type subgroups (secondary school types vs. higher school types¹).*

Hypothesis 8. *The IWL scale shows measurement invariance among educational level subgroups (vocational education/apprenticeship and bachelor's degree vs. master's degree and diploma).*

4 | METHODS AND DESIGN

4.1 | Sample 1

We surveyed a sample of 695 employees from white-collar professions in Germany (45.0% male, 55.0% female; age: $M = 36.2$, $SD = 13.1$, $Min = 18$, $Max = 66$) on voluntary basis using an online questionnaire, between July 11 and August 6, 2019. Considering the educational background, 2.6% did not finish any systematic vocational education, 43.7% finished a vocational education, 49.2% got a graduate academic degree, 4.0% miscellaneous. Exactly 61.5% stated that they worked in their learned occupations, 38.5% had learned another occupation and were now working outside their field of vocational education. The participants had, on average, 16.4 years of professional experience ($SD = 13.6$).

IWL was measured using the 24-item scale (Decius et al., 2019), which contains the eight-item short version (see Table 2). In addition to a demographic part, the questionnaire also contained items to measure job autonomy/decision latitude (Richter et al., 2000; 3 items, e.g., "I am used to make many independent decisions in my work."), job demands (Richter et al., 2000; 3 items, e.g., "There is often a lot of work to be done by me."), and knowledge/skill acquisition (Decius et al., 2019; 3 items, e.g., "After I have learned something new for myself, I have a much better understanding of my tasks at work than before."). For all items, we used 6-point Likert scales (1 = *Not agree at all*, 2 = *Largely not agree*, 3 = *Rather not agree*, 4 = *Rather agree*, 5 = *Largely agree*, 6 = *Fully agree*).

4.2 | Sample 2

As part of a larger study running from March 1 to March 22, 2021, we conducted a survey of >4000 white-collar employees. From this dataset, we drew a subset of $N = 500$ cases using a random algorithm for the present manuscript (50.2% male, 49.2% female; age: 12.8% between 20 and 29, 22.6% between 30 and 39, 28.0% between 40 and 49, 29.4% between 50 and 59, and 6.6% over 60 years). The subset did not differ significantly from the rest of the sample in gender, age, and educational background. Considering the educational background, 3.4% did not

TABLE 2 Item descriptives of Samples 1, 2, and 3

Cp.	No.	Items in German	Items in English	Sample 1				Sample 2				Sample 3			
				M	SD	Skew	Kurtosis	M	SD	Skew	Kurtosis	M	SD	Skew	Kurtosis
TA	1.	Ich setze meine eigenen Ideen zum Verbessern der Aufgaben bei der Arbeit ein.	I use my own ideas to improve tasks at work.	4.78	0.95	-0.67	0.63	4.54	1.34	-0.88	0.17	4.43	1.33	-1.04	0.58
ML	2.	Ich schaue, wie andere im Unternehmen arbeiten, um meine Arbeit zu verbessern.	I look at how others work in the company to improve my work.	4.44	1.15	-0.54	-0.17	3.88	1.50	-0.44	-0.63	3.67	1.39	-0.40	-0.52
DF	3.	Ich frage bei meinen Kollegen nach, wenn ich nicht sicher bin, wie gut ich gearbeitet habe.	I ask my colleagues when I am not sure how well I worked.	3.28	1.44	-0.12	-0.89	3.67	1.54	-0.24	-0.91	3.40	1.43	-0.17	-0.79
VF	4.	Ich frage meine Kollegen, welche Methoden und Tricks sie bei der Arbeit nutzen.	I ask my colleagues about the methods and tricks they use at work.	4.52	1.15	-0.75	0.59	4.07	1.40	-0.54	-0.43	3.86	1.37	-0.55	-0.28
AR	5.	Vor einer neuen Aufgabe denke ich darüber nach, wie ich meine Arbeit am besten mache.	Before starting a new task, I think about how I can do my work best.	4.97	0.91	-0.80	0.87	4.98	1.10	-1.17	1.48	4.64	1.24	-1.19	1.30
SR	6.	Wenn ich mit einer neuen Aufgabe fertig bin, denke ich darüber nach, was ich beim nächsten Mal noch besser machen könnte.	When I have finished a new task, I think about what I still could do better next time.	4.77	1.04	-0.96	1.15	4.71	1.20	-0.87	0.37	4.39	1.26	-0.83	0.40
EI	7.	Ich möchte für mich selbst bei der Arbeit etwas dazulernen, weil ich dann im Unternehmen Karriere machen kann.	I want to learn something new at work for myself because then I can pursue my career at the company.	4.36	1.41	-0.67	-0.23	4.08	1.60	-0.54	-0.79	3.85	1.48	-0.39	-0.69

TABLE 2 (Continued)

Cp.	No.	Items in German	Items in English	Sample 1				Sample 2				Sample 3			
				M	SD	Skew	Kurtosis	M	SD	Skew	Kurtosis	M	SD	Skew	Kurtosis
II	8.	Ich möchte für mich selbst etwas dazulernen, weil ich dann Probleme bei der Arbeit schneller lösen kann.	I want to learn something new for myself because then I can solve problems at work faster.	5.14	0.88	-1.01	1.55	5.08	1.09	-1.36	1.95	4.75	1.21	-1.31	1.82

Note: S1, Sample 1; S2, Sample 2; S3, Sample 3. S1 N varies between 693 and 695; S2 N is 500; S3 N is 3134. SD Skewness S1 = 0.28; SD Skewness S2 = 0.36; SD Skewness S3 = 0.42; SD Kurtosis S1 = 0.81; SD Kurtosis S2 = 1.00; SD Kurtosis S3 = 0.97.

The first column contains the initials for the component (Cp.) of the octagon model to which the item is associated: TA, trying/applying own ideas; ML, model learning; DF, direct feedback; VF, vicarious feedback; AR, anticipatory reflection; SR, subsequent reflection; EI, extrinsic intent to learn; II, intrinsic intent to learn. This measure is non-proprietary (free) and may be used without permission. English items were translated from original German items using a translation/back-translation procedure; empirical evidence regarding the English version is still pending.

finish any systematic vocational education, 30.8% finished a vocational education, and 65.8% got a graduate academic degree. Exactly 50.6% worked as professionals and 24.6% as leaders.

IWL was measured with the eight-item short scale; SDLO was measured with a six-item short scale based on the items of Gijbels et al. (2010). An example item is: "I can spot a good learning opportunity, long before others can." The Likert scales used were the same as in Sample 1.

4.3 | Sample 3

We surveyed a sample of 3134 employees from white-collar professions in Germany (49.3% male, 50.7% female; age: 9.4% between 20 and 30, 24.4% between 30 and 40, 29.0% between 40 and 50, 30.7% between 50 and 60, and 6.4% over 60). Considering the educational background, 2% did not finish any systematic vocational education, 39.8% finished a vocational education, and 58.2% got a graduate academic degree. Exactly 74.3% worked as professionals and 16.6% as leaders. Exactly 29.2% had more than 25 years of professional experience, 14.5% between 21 and 25 years, 14.8% between 16 and 20 years, 13.9% between 11 and 15 years, 13.4% between 6 and 10 years, 7.9% between 3 and 5 years, and 6.4% less than 3 years.

The online survey was part of a bigger study about important competences in times of Covid-19. Hence, the study took part between May 28 and June 2, 2020. The eight-item IWL short scale was included as a result measure for specific degrees of competences. The Likert scale used was the same as in Samples 1 and 2.

4.4 | Analysis strategy

For all three samples, we examined the factorial validity applying a CFA with maximum likelihood method and effects coding as a scaling approach (Little et al., 2006), using R (version 3.6.2, R Core Team, 2019) and the package lavaan (Rosseel, 2012). In Sample 1, we imputed missing values (0.1% in IWL items; 3.9% in total) using full information maximum likelihood (FIML) method, which is recommended for SEM by Kline (2016); Samples 2 and 3 did not contain missing values.

We compared two competing models (see Figure 2): Model A consists of the eight items that load onto the general factor IWL. Each item represents one IWL component from the lowest level of the octagon model. Model B contains—as an additional level—the four factors, *experience/action*, *feedback*, *reflection*, and *intent to learn*, from the frameworks of Tannenbaum et al. (2010) and Decius et al. (2019). Following the octagon model, two items from the eight-item short scale are assigned to each of the four factors in Model B: trying/applying own ideas (TA) and model learning (ML) to *experience/action*; direct feedback (DF) and vicarious feedback (VF) to *feedback*; anticipatory reflection (AR) and subsequent reflection (SR) to *reflection*; and extrinsic intent to learn (EI) and intrinsic intent to learn (II) to *intent to learn*. Model A thus shows a 1–0–8 structure; Model B reproduces the structure of the octagon model and shows a 1–4–2 structure (Figure 2). We also checked the reliability of the IWL scale for both samples considering the values for internal consistency (Cronbach's alpha, McDonald's omega).

Using Sample 1, we tested the hypotheses 1–4 regarding criterion validity, applying SEM in lavaan (Rosseel, 2012). We modeled the latent relationships of job demands, job autonomy (decision latitude), knowledge/skill acquisition, age, and IWL. Using Sample 2, we examined the criterion validity of IWL with SDLO (hypothesis 5), also with SEM in a latent model. Using Sample 3, we applied CFA multi-group comparisons to test for the hypotheses 6–8 regarding construct validity, that is, measurement invariance among male and female white-collar workers, and among different school types and educational backgrounds. We investigated three levels of measurement invariance needed for group mean comparisons—configural, metric, and scalar invariance (Vandenberg & Lance, 2000)—by comparing the model fit of each higher level of invariance to the next lower level. Configural invariance implies that the model structure in the different groups fits the data equally well; metric invariance implies additionally that the factor loadings of the manifest indicators

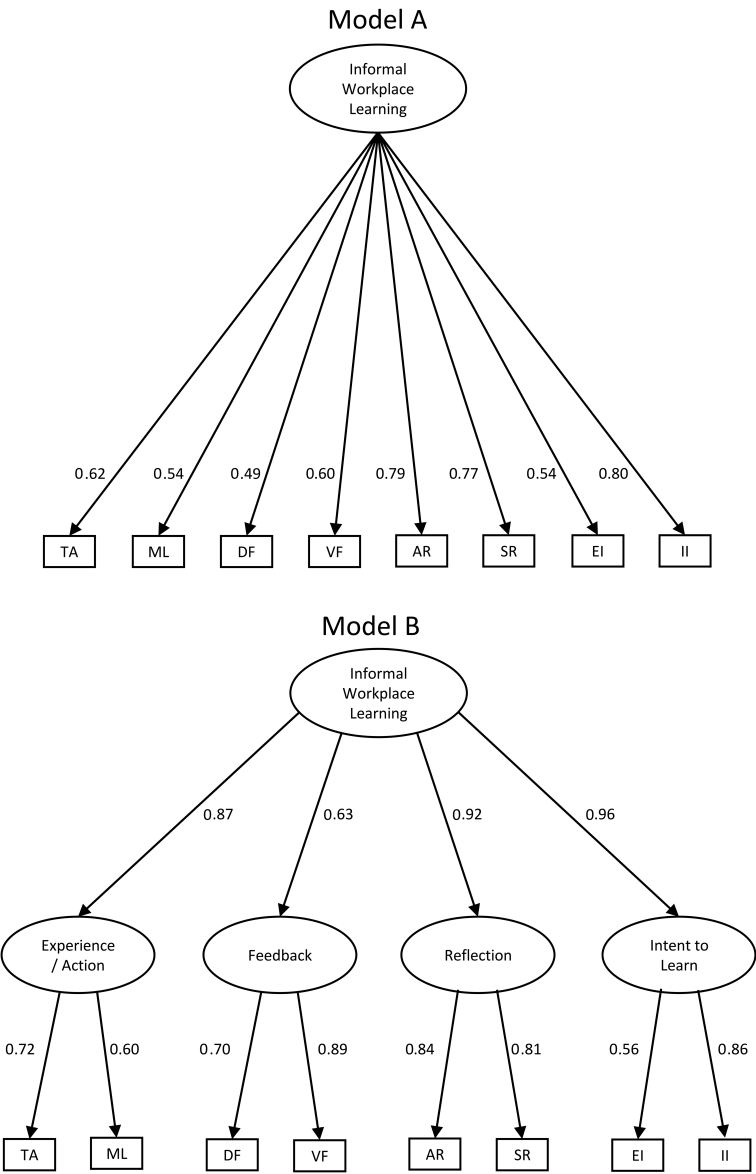


FIGURE 2 Results for two competing confirmatory factor analysis models in Sample 3. $N = 3134$. Coefficients presented are standardized factor loading coefficients. For the sake of clarity, residual coefficients are omitted. AR, anticipatory reflection; DF, direct feedback; EI, extrinsic intent to learn; II, intrinsic intent to learn; ML, model learning; SR, subsequent reflection; TA, trying/applying own ideas; VF, vicarious feedback

(items) on the latent constructs are equally high in the different groups; scalar invariance additionally implies that the intercepts of the manifest indicators are equally high in the different groups.

5 | RESULTS

Table 2 provides the descriptive statistical results for the eight items of the IWL short scale in all three samples. All absolute values for skewness and kurtosis are <2 , indicating approximate normal distribution of the underlying data (Cain et al., 2017; Kline, 2016, p. 76).

Note that in Sample 1, the eight items were measured as part of the 24-item total scale, while in Samples 2 and 3 only the eight-item short scale was used. Based on the Sample 1 data, the eight-item short scale correlates with the 24-item total scale by $r = 0.94$, as well as with the 16-item remainder scale (total scale without the eight items of the short scale) by $r = 0.87$. The high correlations imply that the more economical short scale captures the construct of informal learning very similarly to the long version.

5.1 | IWL model structure

For model fit evaluation, we relied on χ^2 and the following global model fit criteria recommended by Kline (2016, p. 269): comparative fit index (CFI), standardized root mean square (SRMR), root mean square error of approximation (RMSEA). According to Weston and Gore (2006), the minimum requirements for a decent model are these values: CFI ≥ 0.90 , RMSEA ≤ 0.10 , and SRMR ≤ 0.10 ; a good fit can be assumed if CFI ≥ 0.95 , RMSEA ≤ 0.06 , and SRMR ≤ 0.08 . For model comparison, we also used the Akaike information criterion (AIC) and the Bayesian information criterion (BIC); in both cases, a lower value indicates a superior model (Kline, 2016, p. 287).

The results of the comparison of Model A (in which the eight items load on a latent general factor IWL) and Model B (in which two items load on a latent IWL component and the four IWL components load on a latent general factor IWL) are shown in Table 3. Model A did not provide a satisfactory fit and failed to meet the minimum requirements. Model B proved to be superior and yielded a good fit.

The structures of the competing models are shown in Figure 2, along with the standardized factor loadings based on Sample 3. The factor loadings in the superior Model B vary in a satisfactory range between 0.49 and 0.84 (Sample 1) respectively, 0.42 and 0.88 (Sample 2) respectively, 0.56 and 0.89 (Sample 3) at the lower (indicator) level, and between 0.66 and 0.96 (Sample 1) respectively, 0.49 and 0.96 (Sample 2) respectively, 0.63 and 0.96 (Sample 3) at the higher level.

Table 4 provides an overview of the mean scores, standard deviations, correlation coefficients, and internal consistency values between Sample 1 variables. The reliability of the IWL scale in Sample 1, $\alpha = 0.76$ and $\omega = 0.78$, is rather satisfactory (Hair et al., 2010)—comparable to the value of $\alpha = 0.79$ in Decius et al.'s (2019) study with blue-collar workers—especially if one considers the scale's heterogeneity in terms of content. The reliability values in Sample 2, $\alpha = 0.77$ and $\omega = 0.78$, and in Sample 3, $\alpha = 0.85$ and $\omega = 0.86$, are even higher.² The item-total correlation corrected (discriminatory power) ranges from 0.35 to 0.57 (Sample 1), from 0.34 to 0.57 (Sample 2), and from 0.49 to 0.70 (Sample 3), respectively—in the optimal range for validity and reliability from 0.30 to 0.80 (Lienert & Raatz, 1998, p. 255).

Following methodological recommendations (Farrell, 2010; Fornell & Larcker, 1981), we calculated the average variance extracted (AVE) for IWL, job autonomy (decision latitude), job demands, and knowledge/skill acquisition in Sample 1 based on the latent factor loadings (except for the demographic variable age), and the shared variance (SV; i.e., the squared correlation) across the constructs. An AVE value > 0.50 provides evidence of convergent validity (Hair et al., 2010). AVE values that are greater than SV values between two constructs provide evidence of discriminant validity (Farrell, 2010). Since the AVE values of the constructs in Sample 1 are > 0.50 , ranging between 0.54 (job autonomy) and 0.79 (IWL; knowledge/skill acquisition), this indicates convergent validity. The SV values between the constructs range between 0.03 (job demands and knowledge/skill acquisition) and 0.40 (IWL and knowledge/skill acquisition); so, all AVE values are higher than the SV values, which indicates discriminant validity.

5.2 | Criterion validity

Using an SEM based on Sample 1 data to examine the hypotheses 1–4 of criterion validity, which we consider as antecedents/outcomes of IWL, we modeled the constructs IWL, job autonomy (decision latitude), job demands,

TABLE 3 Comparison of the competing model structures

Model characteristics	Model A			Model B		
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
χ^2	169.722	254.481	1549.613	108.294	96.155	466.657
df	20	20	20	16	16	16
p value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CFI	0.874	0.767	0.847	0.923	0.920	0.955
SRMR	0.054	0.083	0.077	0.043	0.056	0.050
RMSEA [90% CI]	0.104 [0.090, 0.118]	0.153 [0.137, 0.170]	0.156 [0.150, 0.163]	0.091 [0.075, 0.108]	0.100 [0.081, 0.120]	0.095 [0.087, 0.102]
AIC	15,790.034	12,911.975	77,199.835	15,736.606	12,761.648	76,124.879
BIC	15,899.088	13,013.126	77,296.636	15,863.835	12,879.657	76,245.880

Note: Sample 1 N = 695; Sample 2 N = 500; Sample 3 N = 3134. AIC, Akaike information criterion; BIC, Bayesian information criterion; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square.

Model A: Eight items load on latent general factor IWL. Model B: Two items each load on one latent IWL component; these four components load on latent general factor IWL.

TABLE 4 Means, SDs, and correlations among Sample 1 variables

Construct	M	SD	1	2	3	4	5
1. Informal workplace learning	4.53	0.70	(0.76/0.78)				
2. Job autonomy (Decision latitude)	4.35	1.09	0.32***	(0.78/0.78)			
3. Job demands	4.06	1.04	0.16***	0.28***	(0.81/0.81)		
4. Knowledge/skill acquisition	4.80	0.88	0.50***	0.33***	0.14***	(0.92/0.92)	
5. Age	36.15	13.14	−0.12**	0.23***	0.15***	0.00	-

Note: N varies between 594 and 695. Internal consistency values (Cronbach's alpha/McDonald's omega) are reported in parentheses. For informal workplace learning, these values refer to the structure of Model B.

** $p < 0.01$, *** $p < 0.001$.

knowledge/skill acquisition, and the demographic variable age as covariant. The model resulted in an acceptable fit, $\chi^2(125) = 527.793$, $p < 0.001$; CFI = 0.906; SRMR = 0.066; RMSEA = 0.068, 90% CI = [0.062, 0.074]. The CFA revealed the following latent correlations of IWL with the other constructs (in brackets are the meta-analytical *corrected population correlations* from Cerasoli et al., 2018, as comparison values): job autonomy 0.51 (0.30); job demands 0.24 (0.13), knowledge/skill acquisition 0.63 (0.41); age − 0.11 (−0.07). All relationships are significant ($p < 0.001$; except for age, $p = 0.003$). The tendency of the findings is basically consistent with the meta-analysis; for instance, analogous to Cerasoli et al. (2018), our study shows a significantly higher association of job autonomy with IWL compared with job demands with IWL. These results provide evidence for hypotheses 1, 2, 3, and 4.

To examine the relationship of IWL with the conceptually related construct SDLO (hypothesis 5), we calculated the latent correlation between IWL and SDLO using SEM, based on Sample 2 data. The model showed an acceptable fit, $\chi^2(72) = 199.847$, $p < 0.001$; CFI = 0.940; SRMR = 0.046; RMSEA = 0.060, 90% CI = [0.050, 0.069]. As expected, the correlation was high (0.70); thus, hypothesis 5 is supported. In addition, we calculated the values for AVE and SV (as in Sample 1). The AVE of IWL is 0.69, and of SDLO it is 0.45. Because the AVE of IWL is higher than the SV of the two constructs (0.49), we can consider IWL a distinct construct despite its high correlation with SDLO.

5.3 | Measurement invariance

Table 5 presents the results of the measurement invariance tests with Sample 3 data for the superior IWL Model B, separately for the three demographic characteristics gender, school type, and educational level. All models of configural invariance have a strong model fit, so we can assume configural invariance for the characteristics. Setting the item loadings equal across the subgroups (male vs. female; secondary school types vs. higher school types; vocational education/apprenticeship and bachelor's degree vs. master's degree and diploma) did not significantly change the model fit, so we can assume metric invariance. If, additionally to the loadings, the intercepts over the subgroups are set equal, there are no significant changes for gender and educational level either; we can therefore assume scalar invariance for these characteristics. For school type, however, there was a significant decrease in χ^2 ($\Delta\chi^2 = 9.912$, $p = 0.042$) when comparing the scalar invariance model with the metric invariance model. We thus examined if there is at least partial scalar measurement invariance, considering the modification indices and theoretical insights (Vandenberg & Lance, 2000). The highest modification index³ regarding the intercepts (6.87) was found for the item *extrinsic intention to learn* (i.e., “I want to learn something new at work for myself because then I can pursue my career at the company”). It seemed conceptually plausible that there could be different levels of employees' career-oriented learning intention among lower and higher school types. This assumption is in line with previous empirical research (Kyndt, Onghena, et al., 2014). Therefore, when testing for partial scalar measurement invariance, we removed the equality constraint for the intercepts of this item across the two school type subgroups. The

TABLE 5 Measurement invariance results for informal workplace learning (Sample 3, Model B)

Characteristic/model	χ^2	df	CFI	RMSEA	SRMR	Comparison	Δdf	$\Delta \chi^2$
Gender								
InvMod 1: Configural invariance	497.521	32	0.953	0.097	0.046			
InvMod 2: Metric invariance	505.514	36	0.953	0.091	0.047	InvMod 2 versus InvMod 1	4	7.993 [†]
InvMod 3: Scalar invariance	513.678	40	0.952	0.087	0.048	InvMod 3 versus InvMod 2	4	8.164 [†]
School type								
InvMod 1: Configural invariance	467.756	32	0.956	0.093	0.045			
InvMod 2: Metric invariance	471.194	36	0.956	0.088	0.046	InvMod 2 versus InvMod 1	4	3.438 [†]
InvMod 3: Scalar invariance	481.106	40	0.955	0.084	0.047	InvMod 3 versus InvMod 2	4	9.912*
InvMod 4: Partial scalar invariance (Item EI)	474.220	39	0.956	0.085	0.046	InvMod 4 versus InvMod 2	3	3.026 [†]
Educational Level								
InvMod 1: Configural invariance	439.590	32	0.956	0.093	0.045			
InvMod 2: Metric invariance	441.772	36	0.956	0.088	0.045	InvMod 2 versus InvMod 1	4	2.182 [†]
InvMod 3: Scalar invariance	447.182	40	0.956	0.083	0.045	InvMod 3 versus InvMod 2	4	5.409 [†]

Note: InvMod, Invariance Model. $N = 3134$. CFI, comparative fit index; EI, extrinsic intention to learn; RMSEA, root mean square error of approximation; SRMR, standardized root mean square.

[†]Nonsignificant, * $p < 0.05$.

comparison of this adapted model with the metric invariance model did not result in a significant difference in model fit so that we can assume partial scalar invariance. Overall, these results provide evidence for hypotheses 6 and 8 on measurement invariance for the characteristics gender and educational level. Hypothesis 7 on measurement invariance for school types, however, can only be supported partially.

6 | DISCUSSION

Our results show that the IWL short scale is a reliable, valid, and economic instrument for white-collar workers. By transferring the short scale of Decius et al. (2019) from the blue-collar context to the white-collar context and subsequently validating it, we took up the original scale authors' suggestion: "The measure for blue-collar workers ... can serve as a starting point for the development of this instrument [for white collar workers]. ... Research has to examine the scale's transferability to other target groups and contexts in the future" (p. 521). The validation for white-collar workers—who represent the majority of all employees (van Horn & Schaffner, 2003)—offers a high degree of generalizability and broad applicability of this measure in many business sectors. However, for informal learning in contexts other than white-collar workers, adaptations of the scale may be necessary. Decius et al.'s (2019) scale, for instance, has also been used in modified form among soccer referees (Paulsen & Decius, 2018) and students in

higher education (Decius & Schaper, 2019). Analogously, we recommend not to overestimate the generalizability of our IWL short scale and to consider adaptations and further validations depending on the application domain.

We would like to emphasize the satisfying internal consistency of the scale, especially although the items are heterogeneous and capture a multidimensional construct. Each item represents a component of the octagon model of informal workplace learning by Decius et al. (2019). Since the scale contains only eight items, it is adequately applicable also for studies that do not focus on IWL. Nevertheless, the short scale shows a high correlation with the long version; this indicates that despite the reduction in the number of items, the construct IWL is still adequately covered. The results of Sample 1 reveal the theoretically and empirically expected correlations of IWL with other constructs. Hypotheses 1, 2, 3, and 4 are supported, which indicates criterion validity. The short scale is also associated with SDLO as expected (hypothesis 5) but is also a distinct construct. In addition, we found measurement invariance among the demographic characteristics of subgroups for gender (hypothesis 6) and educational level (hypothesis 8), and partially for school type (hypothesis 7). An important strength of our study is the large and heterogeneous samples of white-collar workers (Sample 1: $N = 695$, Sample 2: $N = 500$; Sample 3: $N = 3134$). In the following, we discuss some limitations of our study and present implications for theory and practice.

6.1 | Limitations

The first limitation is that we only examined specific aspects of validity. For example, we did not investigate the predictive validity of the scale regarding performance criteria. Future studies could address this in longitudinal designs and include objective performance data and external judgments by supervisors in addition to self-reported data. Furthermore, the validation of a scale is not completed with the examination of psychometric criteria: further research might evaluate the consequential validity of the scale, that is, determine whether the scale is used in the intended sense and what consequences are drawn from the measurement results during application (Messick, 1995).

The second limitation relates to the survey methodology: We measured IWL and the three criteria *job autonomy*, *job demands*, and *knowledge/skill acquisition* in Sample 1—and IWL and SDLO in Sample 2, respectively—simultaneously in one questionnaire. Therefore, we cannot rule out common method variance (Podsakoff et al., 2003). However, this only applies to testing the criterion validity based on Sample 1 and 2 data.

The third limitation addresses the measurement invariance test: While we found configural, metric, and scalar measurement invariance for gender and educational level, we found only configural, metric, and *partial* scalar measurement invariance for school type. Therefore, we cannot conclude with certainty that the scale works equally well in different subgroups of school type. However, further analysis showed that only the item for the extrinsic intent to learn was responsible for the lack of invariance, which we could explain theoretically. Furthermore, the difference in χ^2 between the compared models was rather small.

The fourth limitation concerns the English-language items: Because we surveyed German white-collar workers, the questionnaire was set up in German. For reporting in this article, we translated the items that differed from the original version by Decius et al. (2019) using a translation/back-translation procedure (Brislin, 1986). However, the validation of the English version is still pending. Research on cultural differences in IWL is scarce, but there is evidence of cultural influences, for example, on feedback-seeking behavior (comparable to the octagon model component *direct feedback*; Sully De Luque & Sommer, 2000). A future validation of the IWL short scale in English-speaking and other non-English-speaking contexts would, therefore, be a further milestone for IWL research.

The fifth limitation refers to the IWL scale used in Sample 1: Here we used the 24-item long scale, which contained the eight items of the short scale. In contrast to the questionnaire in Samples 2 and 3, the eight items were not presented in sequence. We assume that this is one reason for the slightly lower reliability of the short scale in Sample 1. A strength of this approach, however, is that it enabled us to evaluate the association between the short scale and the long scale. The high correlation indicates a reasonable coverage of IWL by the short scale. In addition, we would like to note that we referred to the short version of the scale from Decius et al. (2019) when selecting

items. Our goal here was to establish consistency with previous research rather than, for instance, using the long version of the scale for a new, independent selection of items for the short scale.

6.2 | Theoretical implications

By validating the IWL short scale for white-collar workers, we present an economic measure for research to operationalize IWL as a control variable or moderator when the study focus is not on IWL. To our knowledge, our scale is currently the only short scale that operationalizes IWL as a multidimensional construct based on a theoretically sound model, including behavioral, cognitive, and motivational components of IWL. Researchers can use our scale for multiple purposes, including empirical research on IWL antecedents and outcomes, effectiveness evaluation of IWL enhancing interventions, and longitudinal measures of change in IWL over shorter (daily measures) to longer (monthly or yearly measures) time periods. The main contribution of our study is, therefore, to provide a broadly applicable scale to overcome the fragmentation of IWL research. In doing so, we build on the conclusion of Cerasoli et al. (2018), who noted:

One critical need is the development and validation of a measure of [IWL]. To date, a wide variety of measures of [IWL] have been employed, with less consistency than desirable across studies. The use of a well-articulated and validated measure of [IWL] would permit better comparability across studies and accumulation of knowledge. (p. 224)

As a long-term theoretical contribution, we expect that the availability of a valid and reliable short scale will enhance the quantity of primary research on IWL and positively impact the quality of future meta-analyses. The quantity of correlations available for meta-analyses should also increase if studies include IWL as an additional construct, which would not have done so in the absence of an economic short scale. The sole comprehensive meta-analysis to date on informal workplace learning (Cerasoli et al., 2018) had to deal with the disadvantage that the primary studies operationalized IWL in several different ways. Hopefully, we can shift the scholarly focus from conceptual discussions (proposing fragmented conceptualizations of IWL) to methodological and empirical ones (identifying and testing antecedents, consequences, and moderators of IWL). The interactions between different forms of learning (e.g., IWL, formal learning, and self-regulated learning; see Choi & Jacobs, 2011; S. Richter et al., 2020) could also move closer into the research focus; our short scale could contribute to this.

Furthermore, the validation of the short scale in our study goes beyond the approach of Decius et al. (2019), who presented the short scale for blue-collar workers without examining a second-order structure within the eight items. The octagon structure in our study proved to be superior to a model in which all items load on a single latent factor. Thus, another contribution is the confirmation of the theoretical model structure of the 24-item scale for the eight-item short scale. We thereby extend existing knowledge on the boundary conditions of the octagon model in terms of its generalizability for white-collar workers (Busse et al., 2017). Future studies should pay more attention to the multidimensionality of IWL—however, scholars should also distinguish IWL more concisely from related concepts, such as self-regulated learning (Sitzmann & Ely, 2011). A concrete implication for researchers using the short scale in a latent structural equation model is to consider the theoretically reasonable second-order structure of the octagon model.⁴

Our validation results—in line with Cerasoli et al. (2018)—also add further evidence to the IWL research body regarding the coherence of learning-related hypotheses from the demand-control-support model (Karasek & Theorell, 1990) and the framework of learning outcomes (Kraiger et al., 1993). While employee age should also be considered in future studies of IWL at least as a control variable, possible differences in terms of gender, school type, and vocational education seem to be theoretically and empirically less relevant, consistent with prior research.

Because the eight items cover the eight components of the octagon model, the scale also offers the opportunity of using single items as representatives of IWL components in study contexts in which the use of the three-item version of each component (Decius et al., 2019) is not possible for test economic reasons. For instance, the item of our short scale that covers ML could be used in a diary study in which the ML component is repeatedly surveyed. However, we do not recommend a general use of one-item measures in IWL research unless absolutely necessary, as this may threaten the measure's reliability (see Fisher et al., 2016, for pros and cons on this topic). In this case, additional validation of the single items would be desirable.

6.3 | Implications for practice

In addition to research purposes, the scale is also relevant for practitioners to learn more about the IWL of employees in their own organizations. In times of global challenges such as pandemics, decentralized and flexible work and leadership structures, and increasing home office hours, IWL continues to gain importance due to its dynamic nature compared with formal learning (Watkins & Marsick, 2021). Furthermore, scholars like Autor and Dorn (2013) emphasize the polarization of labor markets toward more high-skilled and more low-skilled work and a trend away from the traditionally strong medium-skilled jobs (which may be replaced by artificial intelligence solutions). While high-skilled jobs typically cover information technology, sales, and consultancy (with a high need for creativity and innovation), low-skilled work consists of personal services that cannot be replaced digitally. From a medium-skilled employee's perspective, a high degree of IWL may be an important step for the move from medium- to high-skilled work and to avoid a downgrade into low-skilled work. This might also be in the interest of leaders responsible for the professional development of their work teams, as learning-committed leadership has been shown to be an important organizational contextual factor for employees' workplace learning (Ellinger & Cseh, 2007).

Managers should also promote IWL, because IWL "can be used as a low-cost alternative to, or perhaps in conjunction with, formal learning to improve employee performance" (Wolfson et al., 2019, p. 1283). IWL is linked to positive outcomes that benefit both employees and the organization. These include knowledge-related aspects such as professional competence, attitudes such as job involvement, and behaviors such as organizational citizenship behavior, performance, or innovative work behavior (Cerasoli et al., 2018; Decius et al., 2021; Gerken et al., 2018). However, formal training remains important as training practices are associated with job and organizational performance (Ferguson & Reio, 2010), and as training participation followed by reflection processes can increase IWL in employees through a positive spillover effect (S. Richter et al., 2020). Training programs can also help employees become more aware of IWL components and more quickly identify learning opportunities in their daily work (Cerasoli et al., 2018). Professionals in human resource development can use the short scale to evaluate training programs to promote IWL. For these evaluations, an economic measurement tool is beneficial to take repeated measures (e.g., pre and post)—our eight-item scale meets this requirement.

The practical implications of providing a validated IWL short scale for white-collar workers thus are twofold. At a tactical level, supervisors can use our short scale to evaluate how widespread informal learning occurs in their workgroup. Based on this assessment, they can support each of their employees individually depending on their current IWL status. At a corporate level, the learning and development department can identify where to invest resources in fostering IWL most suitable based on their employees or the work performed. Built on these findings, a contribution can be made to achieving efficiency and effectiveness in creating an optimal learning culture in the learning organization (Watkins & Kim, 2018). This could include, for instance, the provision of resources (e.g., time, virtual learning tools, structures for social support) or the design of job requirements (Parker, 2017).

Overall, our IWL short scale contributes to a better understanding of IWL in research and practice. We encourage scientists to take IWL more into account in their studies to expand the research body in the near future. Additionally, we encourage practitioners to take a closer look at IWL among their employees and foster this form of learning, which might become increasingly important for individual and organizational development in the next decades.

ENDNOTES

- ¹ The participants with the German school leaving certificate “Hauptschulabschluss” and “Realschulabschluss” represented the subgroup *secondary school types*; the participants with the German school leaving certificate “Fachhochschulreife” and “Allgemeine Hochschulreife” represented the subgroup *higher school types*.
- ² One reason could be that in Sample 1 the 8-item short scale was measured as part of the 24-item total scale, while in Samples 2 and 3 only the 8-item short scale was used (i.e., the eight items were presented consecutively).
- ³ All other modification indices regarding the intercepts ranged below the “ χ^2 critical value of 3.84” (Whittaker, 2012, p. 27), with the item *direct feedback* having the largest value (1.97).
- ⁴ Since only two items are combined to form a latent factor at the higher level, the same statistical effect occurs if the researcher—instead of setting up a higher-order model—allows the two items of a factor to correlate with each other. Even if there is no difference in the results of the two modeling approaches, the latter may be easier to implement.

ACKNOWLEDGMENT

Open access funding enabled and organized by Projekt DEAL.

DATA AVAILABILITY STATEMENT

The data of this study are available from the corresponding author upon reasonable request.

ORCID

Julian Decius  <https://orcid.org/0000-0003-2361-6054>

Michael Knappstein  <https://orcid.org/0000-0003-1371-9762>

Niclas Schaper  <https://orcid.org/0000-0001-7648-7271>

Andreas Seifert  <https://orcid.org/0000-0002-1673-8451>

REFERENCES

- Autor, D. H., & Dorn, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. *American Economic Review*, 103(5), 1553–1597. <https://doi.org/10.1257/aer.103.5.1553>
- Bell, B. S., Tannenbaum, S. I., Ford, J. K., Noe, R. A., & Kraiger, K. (2017). 100 years of training and development research: What we know and where we should go. *Journal of Applied Psychology*, 102(3), 305–323. <https://doi.org/10.1037/apl0000142>
- Berings, M. G. M. C., Poell, R. F., Simons, P. R.-J., & van Veldhoven, M. J. P. M. (2007). The development and validation of the on-the-job learning styles questionnaire for the nursing profession. *Journal of Advanced Nursing*, 58(5), 480–492. <https://doi.org/10.1111/j.1365-2648.2007.04252.x>
- Blume, B. D., Ford, J. K., Baldwin, T. T., & Huang, J. L. (2010). Transfer of training: A meta-analytic review. *Journal of Management*, 36(4), 1065–1105. <https://doi.org/10.1177/0149206309352880>
- Brislin, R. W. (1986). The wording and translation of research instruments. In W. J. Lonner & J. W. Berry (Eds.), *Field methods in cross-cultural research*. Cross-cultural research and methodology series (Vol. 8, pp. 137–164). Sage.
- Busse, C., Kach, A. P., & Wagner, S. M. (2017). Boundary conditions: What they are, how to explore them, why we need them, and when to consider them. *Organizational Research Methods*, 20(4), 574–609. <https://doi.org/10.1177/1094428116641191>
- Cain, M. K., Zhang, Z., & Yuan, K.-H. (2017). Univariate and multivariate skewness and kurtosis for measuring nonnormality: Prevalence, influence and estimation. *Behavior Research Methods*, 49(5), 1716–1735. <https://doi.org/10.3758/s13428-016-0814-1>
- Cerasoli, C. P., Alliger, G. M., Donsbach, J. S., Mathieu, J. E., Tannenbaum, S. I., & Orvis, K. A. (2018). Antecedents and outcomes of informal learning behaviors: A meta-analysis. *Journal of Business and Psychology*, 33(2), 203–230. <https://doi.org/10.1007/s10869-017-9492-y>
- Chan, D. C., & Auster, E. (2003). Factors contributing to the professional development of reference librarians. *Library & Information Science Research*, 25(3), 265–286. [https://doi.org/10.1016/S0740-8188\(03\)00030-6](https://doi.org/10.1016/S0740-8188(03)00030-6)
- Choi, W., & Jacobs, R. L. (2011). Influences of formal learning, personal learning orientation, and supportive learning environment on informal learning. *Human Resource Development Quarterly*, 22(3), 239–257. <https://doi.org/10.1002/hrdq.20078>

- Coetzer, A. (2007). Employee perceptions of their workplaces as learning environments. *Journal of Workplace Learning*, 19(7), 417–434. <https://doi.org/10.1108/13665620710819375>
- Crans, S., Bude, V., Beusaert, S., & Segers, M. (2021). Social informal learning and the role of learning climate: Toward a better understanding of the social side of learning among consultants. *Human Resource Development Quarterly*(Online first), <https://doi.org/10.1002/hrdq.21429>
- Crouse, P., Doyle, W., & Young, J. D. (2011). Workplace learning strategies, barriers, facilitators and outcomes: A qualitative study among human resource management practitioners. *Human Resource Development International*, 14(1), 39–55. <https://doi.org/10.1080/13678868.2011.542897>
- Decius, J. & Schaper, N. (2019, August 16). *Validation of a scale to measure informal learning among students*. Paper presented at 18th Biennial EARLI Conference for Research on Learning and Instruction, Aachen, Germany. <https://doi.org/10.13140/RG.2.2.19698.66245>
- Decius, J., Schaper, N., & Seifert, A. (2019). Informal workplace learning: Development and validation of a measure. *Human Resource Development Quarterly*, 30(4), 495–535. <https://doi.org/10.1002/hrdq.21368>
- Decius, J., Schaper, N., & Seifert, A. (2021). Work characteristics or workers' characteristics? An input-process-output perspective on informal workplace learning of blue-collar workers. *Vocations and Learning*, 14(2), 285–326. <https://doi.org/10.1007/s12186-021-09265-5>
- Doornbos, A. J., Simons, R. J., & Denessen, E. (2008). Relations between characteristics of workplace practices and types of informal work-related learning: A survey study among Dutch police. *Human Resource Development Quarterly*, 19(2), 129–151. <https://doi.org/10.1002/hrdq.1231>
- Ellinger, A. D., & Cseh, M. (2007). Contextual factors influencing the facilitation of others' learning through everyday work experiences. *Journal of Workplace Learning*, 19(7), 435–452. <https://doi.org/10.1108/13665620710819384>
- Endler, N. S., & Hunt, J. M. (1966). Sources of behavioral variance as measured by the S-R inventory of anxiousness. *Psychological Bulletin*, 65(6), 336–346. <https://doi.org/10.1037/h0023309>
- Eraut, M. (2011). Informal learning in the workplace: Evidence on the real value of work-based learning (WBL). *Development and Learning in Organizations: An International Journal*, 25(5), 8–12. <https://doi.org/10.1108/14777281111159375>
- Farrell, A. M. (2010). Insufficient discriminant validity: A comment on Bove, Pervan, Beatty, and Shiu (2009). *Journal of Business Research*, 63(3), 324–327. <https://doi.org/10.1016/j.jbusres.2009.05.003>
- Ferguson, K. L., & Reio, T. G. (2010). Human resource management systems and firm performance. *Journal of Management Development*, 29(5), 471–494. <https://doi.org/10.1108/02621711011039231>
- Fisher, G. G., Matthews, R. A., & Gibbons, A. M. (2016). Developing and investigating the use of single-item measures in organizational research. *Journal of Occupational Health Psychology*, 21(1), 3–23. <https://doi.org/10.1037/a0039139>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.2307/3151312>
- Froehlich, D. E., Beusaert, S., & Segers, M. (2017). Development and validation of a scale measuring approaches to work-related informal learning. *International Journal of Training and Development*, 21(2), 130–144. <https://doi.org/10.1111/ijtd.12099>
- Froehlich, D. E., Beusaert, S., Segers, M., & Gerken, M. (2014). Learning to stay employable. *Career Development International*, 19(5), 508–525. <https://doi.org/10.1108/CDI-11-2013-0139>
- Geijsel, F. P., Slegers, P. J. C., Stoel, R. D., & Krüger, M. L. (2009). The effect of teacher psychological and school organizational and leadership factors on teachers' professional learning in Dutch schools. *The Elementary School Journal*, 109(4), 406–427. <https://doi.org/10.1086/593940>
- Gerken, M., Messmann, G., Froehlich, D. E., Beusaert, S. A., Mulder, R. H., & Segers, M. (2018). Informal learning at work as a facilitator of employees' innovative work behaviour. In G. Messmann, M. Segers, & F. Dochy (Eds.), *Informal learning at work: Triggers, antecedents, and consequences* (pp. 80–99). Routledge. <https://doi.org/10.4324/9781315441962-5>
- Gijbels, D., Raemdonck, I., & Vervecken, D. (2010). Influencing work-related learning: The role of job characteristics and self-directed learning orientation in part-time vocational education. *Vocations and Learning*, 3(3), 239–255. <https://doi.org/10.1007/s12186-010-9041-6>
- Gijbels, D., Raemdonck, I., Vervecken, D., & Van Herck, J. (2012). Understanding work-related learning: The case of ICT workers. *Journal of Workplace Learning*, 24(6), 416–429. <https://doi.org/10.1108/13665621211250315>
- Grosemans, I., Smet, K., Houben, E., De Cuyper, N., & Kyndt, E. (2020). Development and validation of an instrument to measure work-related learning. *Scandinavian Journal of Work and Organizational Psychology*, 5(1), 1–16. <https://doi.org/10.16993/sjwop.99>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis – A global perspective* (3rd ed.). Pearson.
- Hall, D. T., Yip, J., & Doiron, K. (2018). Protean careers at work: Self-direction and values orientation in psychological success. *Annual Review of Organizational Psychology and Organizational Behavior*, 5, 129–156. <https://doi.org/10.1146/annurev-orgpsych-032117-104631>

- Hammer, C. A., & Ferrari, J. R. (2002). Differential incidence of procrastination between blue and white-collar workers. *Current Psychology*, 21(4), 333–338. <https://doi.org/10.1007/s12144-002-1022-y>
- Hilkenmeier, F., Goller, M., & Schaper, N. (2021). The differential influence of learner factors and learning context on different professional learning activities. *Vocations and Learning*, 14(3), 411–438. <https://doi.org/10.1007/s12186-021-09266-4>
- Huang, T. P. (2011). Comparing motivating work characteristics, job satisfaction, and turnover intention of knowledge workers and blue-collar workers, and testing a structural model of the variables' relationships in China and Japan. *The International Journal of Human Resource Management*, 22(4), 924–944. <https://doi.org/10.1080/09585192.2011.555134>
- Jeong, S., Han, S. J., Lee, J., Sunalai, S., & Yoon, S. W. (2018). Integrative literature review on informal learning: Antecedents, conceptualizations, and future directions. *Human Resource Development Review*, 17(2), 128–152. <https://doi.org/10.1177/1534484318772242>
- Karasek, R. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly*, 24(2), 285–308. <https://doi.org/10.2307/2392498>
- Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life*. Basic Books.
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford.
- Kortsch, T., Schulte, E.-M., & Kauffeld, S. (2019). Learning @ work: Informal learning strategies of German craft workers. *European Journal of Training and Development*, 43(5/6), 418–434. <https://doi.org/10.1108/EJTD-06-2018-0052>
- Kraiger, K., & Ford, J. K. (2021). The science of workplace instruction: Learning and development applied to work. *Annual Review of Organizational Psychology and Organizational Behavior*, 8, 45–72. <https://doi.org/10.1146/annurev-orgpsych-012420-060109>
- Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology*, 78(2), 311–328. <https://doi.org/10.1037//0021-9010.78.2.311>
- Krosnick, J. A. (1999). Survey research. *Annual Review of Psychology*, 50(1), 537–567. <https://doi.org/10.1146/annurev.psych.50.1.537>
- Kwakman, K. (2003). Factors affecting teachers' participation in professional learning activities. *Teaching and Teacher Education*, 19(2), 149–170. [https://doi.org/10.1016/S0742-051X\(02\)00101-4](https://doi.org/10.1016/S0742-051X(02)00101-4)
- Kyndt, E., & Baert, H. (2013). Antecedents of employees' involvement in work-related learning. *Review of Educational Research*, 83(2), 273–313. <https://doi.org/10.3102/0034654313478021>
- Kyndt, E., Dochy, F., & Nijs, H. (2009). Learning conditions for non-formal and informal workplace learning. *Journal of Workplace Learning*, 21(5), 369–383. <https://doi.org/10.1108/13665620910966785>
- Kyndt, E., Govaerts, N., Verbeek, E., & Dochy, F. (2014). Development and validation of a questionnaire on informal workplace learning outcomes: A study among socio-educational care workers. *The British Journal of Social Work*, 44(8), 2391–2410. <https://doi.org/10.1093/bjsw/bct056>
- Kyndt, E., Onghena, P., Smet, K., & Dochy, F. (2014). Employees' willingness to participate in work-related learning: A multi-level analysis of employees' learning intentions. *International Journal for Educational and Vocational Guidance*, 14(3), 309–327. <https://doi.org/10.1007/s10775-014-9272-4>
- Lienert, G. A., & Raatz, U. (1998). *Testaufbau und Testanalyse (Test design and test analysis)* (6. Auflage) Grundlagen Psychologie. Beltz.
- Lips-Wiersma, M., Wright, S., & Dik, B. (2016). Meaningful work: Differences among blue-, pink-, and white-collar occupations. *Career Development International*, 21(5), 534–551. <https://doi.org/10.1108/CDI-04-2016-0052>
- Little, T. D., Slegers, D. W., & Card, N. A. (2006). A non-arbitrary method of identifying and scaling latent variables in SEM and MACS models. *Structural Equation Modeling: A Multidisciplinary Journal*, 13(1), 59–72. https://doi.org/10.1207/s15328007sem1301_3
- Livingstone, D., & Stowe, S. (2007). Work time and learning activities of the continuously employed. *Journal of Workplace Learning*, 19(1), 17–31. <https://doi.org/10.1108/13665620710719321>
- Locke, E. A. (1973). Satisfiers and dissatisfiers among white-collar and blue-collar employees. *Journal of Applied Psychology*, 58(1), 67–76. <https://doi.org/10.1037/h0035418>
- Lohman, M. C. (2005). A survey of factors influencing the engagement of two professional groups in informal workplace learning activities. *Human Resource Development Quarterly*, 16(4), 501–527. <https://doi.org/10.1002/hrdq.1153>
- Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, 50(9), 741–749. <https://doi.org/10.1037/0003-066X.50.9.741>
- Nikolova, I., Van Ruysseveldt, J., De Witte, H., & Syroit, J. (2014). Work-based learning: Development and validation of a scale measuring the learning potential of the workplace (LPW). *Journal of Vocational Behavior*, 84(1), 1–10. <https://doi.org/10.1016/j.jvb.2013.09.004>

- Noe, R. A., Tews, M. J., & Marand, A. D. (2013). Individual differences and informal learning in the workplace. *Journal of Vocational Behavior*, 83(3), 327–335. <https://doi.org/10.1016/j.jvb.2013.06.009>
- Park, Y., Woo, H., Oh, M.-R., & Park, S. (2020). The role and related variables of workplace learning in quantitative research. *Industrial and Commercial Training*, 53(1), 29–59. <https://doi.org/10.1108/ICT-02-2020-0023>
- Parker, S. K. (2017). Work design growth model: How work characteristics promote learning and development. In J. E. Ellington & R. A. Noe (Eds.), *SIOP organizational frontiers series. Autonomous learning in the workplace* (pp. 137–161). Routledge/Taylor & Francis Group.
- Paulsen, H. & Decius, J. (2018, May 11). *How to learn refereeing: Informal learning and use of performance strategies among soccer referees*. Poster presentation. 50th annual conference of the Association for Sports Psychology (asp), Cologne, Germany. <https://doi.org/10.13140/RG.2.2.32701.00481>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *The Journal of Applied Psychology*, 88(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- R Core Team. (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.
- Raemdonck, I., Gijbels, D., & Van Groen, W. (2014). The influence of job characteristics and self-directed learning orientation on workplace learning. *International Journal of Training and Development*, 18(3), 188–203. <https://doi.org/10.1111/ijtd.12028>
- Raemdonck, I., Meurant, C., Balasse, J., Jacot, A., & Frenay, M. (2014). Exploring the concept of 'self-directedness in learning': Theoretical approaches and measurement in adult education literature. In D. Gijbels, D. V. Donche, J. T. E. Richardson, & J. D. Vermunt (Eds.), *Learning patterns in higher education: Dimensions and research perspectives. New perspectives on learning and instruction* (pp. 78–101). Routledge.
- Regan, E., & Delaney, C. (2011). Brave new workplace: The impact of technology on location and job structures. In M. Malloch, L. Cairns, K. Evans, & B. N. O'Connor (Eds.), *The SAGE handbook of workplace learning* (pp. 431–442). Sage. <https://doi.org/10.4135/9781446200940.n32>
- Richter, P., Hemmann, E., Merboth, H., Fritz, S., Hänsen, C., & Rudolf, M. (2000). Das Erleben von Arbeitsintensität und Tätigkeitsspielraum – Entwicklung und Validierung eines Fragebogens zur orientierenden Analyse (FIT) [The experience of intensity of labor and freedom of action – Development and validation of a questionnaire for oriented analysis]. *Zeitschrift für Arbeits- und Organisationspsychologie*, 44, 129–139. <https://doi.org/10.1026/0932-4089.44.3.129>
- Richter, S., Kortsch, T., & Kauffeld, S. (2020). Understanding learning spillover: The major role of reflection in the formal-informal learning interaction within different cultural value settings. *Journal of Workplace Learning*, 32(7), 513–532. <https://doi.org/10.1108/jwl-01-2020-0008>
- Rosseel, Y. (2012). Lavaan. An R package for structural equation modeling and more. *Journal of Statistical Software*, 48(2), 1–36. <https://doi.org/10.18637/jss.v048.i02>
- Rowold, J., & Kauffeld, S. (2008). Effects of career-related continuous learning on competencies. *Personnel Review*, 38(1), 90–101. <https://doi.org/10.1108/00483480910920732>
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78. <https://doi.org/10.1037/0003-066x.55.1.68>
- Sanders, J., Oomens, S., Blonk, R. W. B., & Hazelzet, A. (2011). Explaining lower educated workers' training intentions. *Journal of Workplace Learning*, 23(6), 402–416. <https://doi.org/10.1108/13665621111154412>
- Sass, D. A. (2011). Testing measurement invariance and comparing latent factor means within a confirmatory factor analysis framework. *Journal of Psychoeducational Assessment*, 29(4), 347–363. <https://doi.org/10.1177/0734282911406661>
- Schön, D. (1983). *The reflective practitioner: How practitioners think in action*. Temple Smith.
- Schreurs, B., van Emmerik, H., de Cuyper, N., Notelaers, G., & de Witte, H. (2011). Job demands-resources and early retirement intention: Differences between blue- and white-collar workers. *Economic and Industrial Democracy*, 32(1), 47–68. <https://doi.org/10.1177/0143831X10365931>
- Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin*, 137(3), 421–442. <https://doi.org/10.1037/a0022777>
- Sully de Luque, M. F., & Sommer, S. M. (2000). The impact of culture on feedback-seeking behavior: An integrated model and propositions. *Academy of Management Review*, 25(4), 829–849. <https://doi.org/10.5465/amr.2000.3707736>
- Takase, M., Imai, T., & Uemura, C. (2016). Development and examination of the psychometric properties of the Learning Experience Scale in nursing. *Nursing & Health Sciences*, 18(2), 196–202. <https://doi.org/10.1111/nhs.12244>
- Tannenbaum, S. I., Beard, R. L., McNall, L. A., & Salas, E. (2010). Informal learning and development in organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp. 303–332). Routledge.
- Taris, T. W., & Kompier, M. A. J. (2004). Job characteristics and learning behavior: Review and psychological mechanisms. In *Research in occupational stress and well-being. Exploring interpersonal dynamics* (Vol. 4, pp. 127–166). Emerald (MCB UP). [https://doi.org/10.1016/S1479-3555\(04\)04004-1](https://doi.org/10.1016/S1479-3555(04)04004-1)

- Toppinen-Tanner, S., Kalimo, R., & Mutanen, P. (2002). The process of burnout in white-collar and blue-collar jobs: Eight-year prospective study of exhaustion. *Journal of Organizational Behavior*, 23(5), 555–570. <https://doi.org/10.1002/job.155>
- van der Klink, M., Van der Heijden, B. I. J. M., Boon, J., & van Rooij, S. W. (2014). Exploring the contribution of formal and informal learning to academic staff member employability. *Career Development International*, 19(3), 337–356. <https://doi.org/10.1108/CDI-03-2013-0030>
- van Horn, C. E., & Schaffner, H. A. (2003). *Work in America: An encyclopedia of history, policy, and society*. ABC-CLIO. <http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10183750>
- van Rijn, M. B., Yang, H., & Sanders, K. (2013). Understanding employees' informal workplace learning. *Career Development International*, 18(6), 610–628. <https://doi.org/10.1108/CDI-12-2012-0124>
- van Ruysseveldt, J., & van Dijke, M. (2011). When are workload and workplace learning opportunities related in a curvilinear manner? The moderating role of autonomy. *Journal of Vocational Behavior*, 79(2), 470–483. <https://doi.org/10.1016/j.jvb.2011.03.003>
- van Woerkom, M. (2003). *Critical reflection at work: Bridging individual and organisational learning*. University of Twente.
- Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, 3(1), 4–70. <https://doi.org/10.1177/109442810031002>
- Watkins, K. E., & Kim, K. (2018). Current status and promising directions for research on the learning organization. *Human Resource Development Quarterly*, 29(1), 15–29. <https://doi.org/10.1002/hrdq.21293>
- Watkins, K. E., & Marsick, V. J. (2021). Informal and Incidental Learning in the time of COVID-19. *Advances in Developing Human Resources*, 23(1), 88–96. <https://doi.org/10.1177/1523422320973656>
- Weston, R., & Gore, P. A. (2006). A brief guide to structural equation modeling. *The Counseling Psychologist*, 34(5), 719–751. <https://doi.org/10.1177/0011000006286345>
- Whittaker, T. A. (2012). Using the modification index and standardized expected parameter change for model modification. *The Journal of Experimental Education*, 80(1), 26–44. <https://doi.org/10.1080/00220973.2010.531299>
- Wielenga-Meijer, E. G. A., Taris, T. W., Kompier, M. A. J., & Wigboldus, D. H. J. (2010). From task characteristics to learning: A systematic review. *Scandinavian Journal of Psychology*, 51(5), 363–375. <https://doi.org/10.1111/j.1467-9450.2009.00768.x>
- Wolfson, M. A., Mathieu, J. E., Tannenbaum, S. I., & Maynard, M. T. (2019). Informal field-based learning and work design. *Journal of Applied Psychology*, 104(10), 1283–1295. <https://doi.org/10.1037/apl0000408>
- Wolfson, M. A., Tannenbaum, S. I., Mathieu, J. E., & Maynard, M. T. (2018). A cross-level investigation of informal field-based learning and performance improvements. *Journal of Applied Psychology*, 103(1), 14–36. <https://doi.org/10.1037/apl0000267>
- Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *Academy of Management Review*, 14(3), 361–384. <https://doi.org/10.5465/amr.1989.4279067>
- Zia, M. Q., Bashir, M. A., Mangi, R. A., & Shamsi, A. F. (2021). A person-situation perspective of informal learning: The role of supervisor feedback environment. *European Journal of Training and Development*. <https://doi.org/10.1108/ejtd-09-2020-0142>

AUTHOR BIOGRAPHIES

Julian Decius is post-doctoral researcher at the Research Unit of Organizational Psychology, University of Bremen, Germany. Previously, he worked as a research fellow at the Chair of Work and Organizational Psychology, Paderborn University, Germany. His research interests focus on informal learning in the workplace and during studies, strategic competence development in small and medium-sized enterprises, new work and new learning, job crafting, as well as competence assessment and development of professional soccer players.

Michael Knappstein is professor for International Human Resource Management and Digital Transformation at the International School of Management (ISM) in Dortmund, Germany. His current research interests lie in sustainability, business coaching, and learning.

Niclas Schaper is full professor and holder of the Chair of Work and Organizational Psychology, Paderborn University, Germany. His research focuses on questions of competence acquisition, competence measurement and

competence management in work- and occupation-related learning. In addition, he works on strategic and methodological issues of personnel and organizational development.

Andreas Seifert is post-doctoral researcher at the Center of Educational Research and Teacher Education, Paderborn University, Germany. His fields of research are psychometric model building as well as modeling and measuring competencies in teacher education. Furthermore, he is interested in the action-oriented design of methods and statistics lectures and the evaluation of such lectures.

How to cite this article: Decius, J., Knappstein, M., Schaper, N., & Seifert, A. (2023). Investigating the multidimensionality of informal learning: Validation of a short measure for white-collar workers. *Human Resource Development Quarterly*, 34(1), 45–74. <https://doi.org/10.1002/hrdq.21461>