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The Mediating Effect of Skills Application on the Relationship between Learning and Continuous Improvement

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Perceived urgency for the upskilling of employees is rapidly increasing within political, social, and economic institutions. This brings the danger that companies invest in training and development of employees without understanding its effects in order to enjoy sustainable learning in the workplace. This study explored the mediating role of skills application in the relationship between learning and continuous improvement in a knowledge-intensive company. An employee survey from 2015 of a knowledge-intensive company with a sample of 3,730 employees was utilized to perform mediation analysis with structural equation modelling through the bootstrapping method. The analysis confirmed that learning affects continuous improvement by affecting skills application. The investigated effects are statistically significant and positive. The results provide empirical support on the mediating role and the importance of skills application to see the benefits of learning measures in the workplace. This research is relevant for knowledge-intensive organizations as a way to understand that learning activities in the workplace alone are not sufficient to influence continuous improvement of processes, products, and better ways of working.

Keywords: human capital, in-company training, sustainable learning, continuous improvement

Introduction

Learning in the workplace is not a temporary fashion of the last decades, but a product of continuous development (e.g., Marshall, 1925; Taylor, 1911). With the rise of modern industrial enterprises, the demands on the skills of employees have become more complex, while companies have become increasingly interested in developing the workforce under their directions. For example, in 1871, the American printing press manufacturer R. Hoe & Company built its school within its factory. Some years later, General Electric (GE) established practical training and educational courses for the apprentices (Wright, 1908). Since the 1920s, learning in the workplace is no longer a rarity for German companies such as Siemens, AEG, or Thyssen (Büchter, 2002; Pawlowsky & Bäumer, 1996). In the meantime, not

only the world of work but also workplace learning has changed fundamentally in its practical manifestations under constant pressure from globalization, technological progress, international standards and political agendas (World Economic Forum, 2019). In the 1920s, only job-specific training of the employees was the focus of companies, whereas today it also includes general training. Not only employers but also employees themselves think that it is crucial to get training to be in step with changes in the workplace (World Economic Forum, 2016). The absence of a discussion on investment in human capital in the beginning of 20th century is an interesting fact, which shows how companies were acting with respect to the development of knowledge, skills, and competencies of their employees, but in contradiction with theoretical foundations that considered human capital as a factor to be minimized and not as a source of competitive advantage (Coase, 1937; Gutenberg, 1998). Gutenberg (1998) described the firm as a production function and wholly ignored the human factor like competencies, skills, and knowledge. Production for him was the essence. Employees are the costs in his production function, and each enterprise strives for maximisation of return on invested capital. Human capital did not receive any attention in Coase's (1937) argumentations either. Only in the second half of the 20th century, the Chicago School representatives, such as Mincer (1962, 1975), Schultz (1959, 1960, 1972) and Becker (1993), integrated the Human Capital Theory into economic analysis. However, the Human Capital Theory aligned on assumptions of neo-classic theory, such as perfect competition, and therefore has limitations for current conditions (Acemoglu & Pischke, 1998). Today, acquisition of human capital does not end with education in school, at university, or in apprenticeship programs, companies also invest in the general training of their employees. The top 5 training segments sourced on the market in 2014 were training related to Information Technology (IT), Leadership, Learning Technologies, Sales, and Content Development (Harward, 2014). It is estimated that corporations spent around 362 billion US dollars in 2017 on corporate training activities worldwide (Statista, 2018). For example, Boeing announced in 2017 an investment of '$100 million for workforce development in the form of training, education, and other capabilities development to meet the scale needed for rapidly evolving technologies and expanding markets' (Boeing, 2017). A recent study by the Capgemini Research Institute among organizations with high automation maturity revealed that organizations that offer full-scale training to their employees enjoy a higher level of employee productivity. Also, upskilling supports career progression, boosts employee morale, and the workforce is more supportive to carry out new responsibilities (Crummenerl, Buvat, Ghosh, Yardi, & Khadikar, 2018). The existing empirical research focused more on direct relations between in-company train-

ing or learning and dependent variables such as performance, productivity, innovation, morale, quality (e.g., Sisyuk, 2018). In this study, the mediating variable 'skills application' is included to achieve a better understanding of learning in the workplace and its impact on continuous improvement, which is defined as a latent construct.

Next, the paper presents a review of the theoretical and empirical concepts of learning, skills application, and continuous improvement in the workplace. It is followed by a methodological approach, which includes the determination of the theoretical model and hypotheses to be tested empirically. Results of the performed empirical analysis, their discussion, research limitations, and recommendations for future research are provided at the end of the paper.

Literature Review

Learning and skills Application as an Aspect of Human Capital

The importance of learning in workplace was recognized by Taylor (1911) who stressed that 'the most important object of both the workmen and the management should be the training and development of each individual in the establishment, so that he can do (at his fastest pace and with the maximum of efficiency) the highest class of work for which his natural abilities fit him' (p. 70). However, the rationales and impact of investment in some components of human capital such as training were explained theoretically and empirically with works of the Chicago School of Economics representatives of the Human Capital Theory (Becker, 1993; Mincer, 1962, 1975; Schultz, 1959, 1960, 1972). Later, the representatives of the Organizational Learning Theory, Argyris (1995) and Senge (1990), contributed with their work to the concept of 'learning organization.' The core of this concept is to enlarge people's capacity to accumulate intellectual capital and to work productively towards organizational target achievement.

Learning in the workplace may occur in different forms: on-the-job and off-the-job, formal and informal (Kauffeld, 2010). Organizations, especially with integrated learning and development departments, are aligning with the 70:20:10 formula to define a balance for learning and development activities in the workplace. For instance., Siemens AG. 70 means that 70% of development takes place on the job as part of the daily work activities; 20 describes that 20% of development occurs through feedback, through working with others and through seeing good and bad examples; 10 stands for 10% of development, which happens through formal training and development activities (Hartwig, 2012). Nevertheless, the origin of the 70:20:10 formula is quite mysterious. Some of the publications on the 70:20:10 formula cited sources from Lombardo and Eichinger (1996) and McCall, Lombardo, and Morrison (1988). McCall et al. (1988) emphasize the impor-

tance of learning from experience in the context of executive development. They surveyed 191 successful executives to understand the reasons for their success. In addition, they mentioned the lack of research on the impact of classroom training, as well as on-the-job training. Lombardo and Eichinger (1996) published results on a survey of successful executives done earlier by McCall et al. (1988). The findings are that successful executives learned roughly 70% from challenging jobs, 20% from other people, and 10% from training courses and reading. The 70:20:10 formula as an anchor for training and development in the workplace did not appear in those two sources. Furthermore, the study by Clardy (2018) found that the evidence for 70:20:10 is weak and suggested to revise the 70% rule of informal learning in spite of its application in practice. He also opted for redefining the focus of formal and informal work-based learning. Kajewsky and Madsen (2014) stated: 'there is a lack of empirical data supporting 70:20:10 and [...] there is also a lack of certainty about the origin' (p. 3). The newest report published by Training Industry (2018) claimed the 70:20:10 formula and referred to the 55:25:20 model. The proposed ratio represents the amount of learning from on-the-job training, social interaction, and formal training activities.

Regarding the definition of learning in the workplace, the OECD (2002) offered the following one: 'Job-related continuing education and training refers to all organized, systematic education and training activities in which people take part in order to obtain knowledge and/or learn new skills for a current or a future job, to increase earnings, to improve job and/or career opportunities in a current or another field and generally to improve their opportunities for advancement and promotion' (pp. 7–8). There are various other definitions, such as 'Training – the planned and systematic modification of behaviour through learning events, programs and institutions that enables individuals to achieve the levels of knowledge, skills and competence needed to carry out their work effectively' (Armstrong, 2011, p. 249). In alignment with definitions, workplace training aims to improve knowledge, skill, etc. and its applications in return to improve performance, which can be defined depending on the context. Thus, skills application is related to the ability to apply acquired knowledge (North, Reinhardt, & Sieber-Suter, 2018). In line with the research question, the focus lies on learning at the workplace, which takes place through in-company training, experience, etc., and which leads to the accumulation of human capital in the form of skills and, consequently, its application.

Continuous Improvement and How it is Defined

Imai (1992) brought Total Quality Management (TQM), Quality Circle, Lean Management, Kamban, Zero-Defect Strategy, Productivity Improvement,

Just-in-Time Production into one easy-to-understand concept: Kaizen. He characterizes 'Kaizen' as a continuous improvement by summing up individual ideas involving all employees from all areas of an organization. Kaizen starts from the realization that there is no organization without problems, and no day should pass without any improvement in the organization: every product, every process, every activity can still be improved. However, Kaizen is not a Japanese invention, but the guiding principle of evolution 'survival of the fittest,' which runs in small steps and whose engine is in constant competition and in a constant struggle for the best possible adaptation (Darwin & Wallace, 1858). In the Western world, Kaizen is referred to as 'Continuous Improvement Process' (CIP) and means 'improvement of quality and productivity, continuously and consistently in small steps, so that the customer is sustainably satisfied' (Kostka & Kostka, 2008, p. 12). The continuous improvement of the processes means for all members of the organization, on the one hand, to continually learn, to be adaptable to changing requirements, and, on the other hand, to continually improve what already exists. Here, the customers are an essential orientation because they decide on the quality of the products and services (Imai, 1992). For example, Toyota has created the principle 'Do the right thing for the company, its employees, the customer, and society as a whole' (Liker, 2004, p. 72) The customer is at the heart of Toyota's organizational goals, and its needs are placed at the beginning of the product development and production process. The first question in the Toyota Production System is: 'What does the customer expect from this process?' (Ohno, 1988, pp. 8–9). It is continually trying to improve the quality of the process since the quality assurance of the process ensures the quality of the finished product. The focus of this research is continuous improvement expressed through new ways of working, process improvement, and innovation.

Empirical Studies

After Mincer (1962, 1975), Schultz (1959, 1960, 1972) and Becker (1993) laid its foundation, numerous scientists have dealt with human capital theory and investigated the impact of investment in learning activities in the workplace (e.g., on-the-job, off-the-job training). The main focus of empirical studies before the 1990s was on the analysis of the effects of in-company training on wages and productivity.

From 1990, the number of studies analyzing the wage effects decreased. Instead, the studies dwelled upon the effects of training on performance, fluctuation, promotion, knowledge, skills, quality, safety, and other variables gained in importance. However, the empirical analysis has been treated very differently by scientists, and their studies vary concerning their data sources, variable definitions, methodology, effects, and even partly contra-

dict one another. The review of 267 empirical studies conducted by Sisyuk (2018, 2019) provides an overview of data sources, independent and dependent variables utilized in those studies, as well as the measured empirical effects. Among those studies,15 studies used innovation, quality, and customer service as dependent variables (e.g., Dostie, 2014; Shen & Tang, 2018). No empirical study that examined the relationship between learning and continuous improvement by utilizing the mediation role of skills application by focusing on a knowledge-intensive company could be found. There is also a limited number of studies exploring the non-linear relationship between independent and dependent variables by involving mediating variables.

'The Knowledge Ladder' from North and Kumta (2018) showed theoretically that learning, skills application and performance or task achievement are connected, therefore, this model may also be utilized to test the relationship between learning, skills application and continuous improvement as continuous improvement aims to enhance business performance, and enhancement of business performance is what companies strive for.

Research Model and Hypotheses

The Human Capital Theory (e.g., Becker, 1993) on investment in training did not consider 'in-company training' as a construct and did not measure it through indicators. It considers training as an input factor and measures its effects on some of the output factors, such as productivity or performance. Various empirical studies proved a positive relationship between training and productivity, performance, and other variables. However, the number of studies exploring the role of mediating variables between training and an independent variable is quite yet limited (Sisyuk, 2018, 2019). North and Kumta (2018) derived 'The Knowledge Ladder' based on the constructivism theory. It visualizes clear interrelations for terms like symbols, data, information, knowledge (know what and why), action (know-how), competence and competitiveness and shows, for example, how information gained in training is related to knowledge, skills application or concrete outcome. The model for this research is developed based on 'The Knowledge Ladder' to demonstrate a relationship between in-company training, skills application, and continuous improvement. The indicators of the latent construct 'continuous improvement' are derived based on the literature review.

The overall objective of this research is to improve our understanding of the impact of learning in the workplace. Consequently, the hypotheses to be tested are formulated as follows:

H1 *The relationship between learning and continuous improvement is positive and significant.*

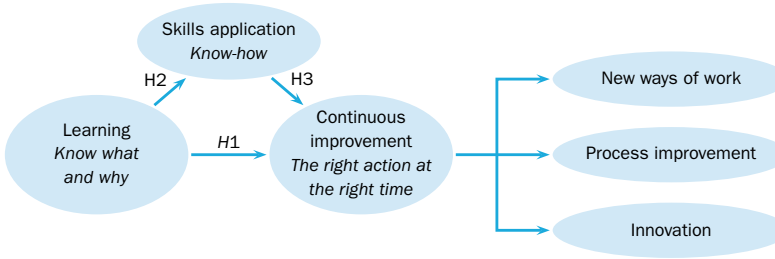

Figure 1 Research Model (developed based on North and Kumta, 2018; Ohno, 1988)

H2 *The relationship between learning and skills application is positive and significant.*

H3 *The relationship between skills application and continuous improvement is positive and significant.*

H4 *Impact of learning on continuous improvement through skills application is significantly stronger than the direct effect of learning on continuous improvement.*

Methodology

Quantitative data from an employee survey of an operational unit of a knowledge-intensive company were analyzed to test the defined hypotheses. This survey was conducted in 2015 with a response rate of approximately 65%, which led to a sample of 3,730 employees. Participants were asked to rate survey statements using a five-point Likert scale of how much each statement applies (from 'agree' to 'disagree'). Table 1 summarizes the selected survey items that empirically represent the variable 'learning,' 'skills application,' and hypothetical construct 'continuous improvement,' and that were processed for further analysis.

The variable 'learning' was measured within the survey as follows:

- Only on-the-job and off-the-job training measures initiated and paid by current employer exclusively.
- Only on-the-job and off-the-job training measures received during employment by the current employer.

The variable 'skills application' measured was based on whether the employees are applying what they learn, what they know, and what they are capable of in their daily jobs and whether the organization gives them the possibilities to apply their skills.

The variable 'continuous improvement' measured through employee participation in continuous improvement by using new ways to approach chal-

Table 1 Variables 'Learning,' 'Skills Application' and Latent Construct 'Continuous Improvement'

Variable (construct/indicator)		Survey statement
Learning	X	There are continuous learning opportunities for me to improve my skills for my current and future jobs
Skills	M	I fully apply my skills and abilities in my work
Continuous improvement	Y_1	People here are open to trying new and different ways of addressing our business challenges
	Y_2	We continually work to ensure our processes are as efficient as possible
	Y_3	In my organizational unit, we do an excellent job anticipating new products, solutions, and services that our internal and external customers will value

Notes Adapted from from an employee survey 2015 of a knowledge-intensive company.

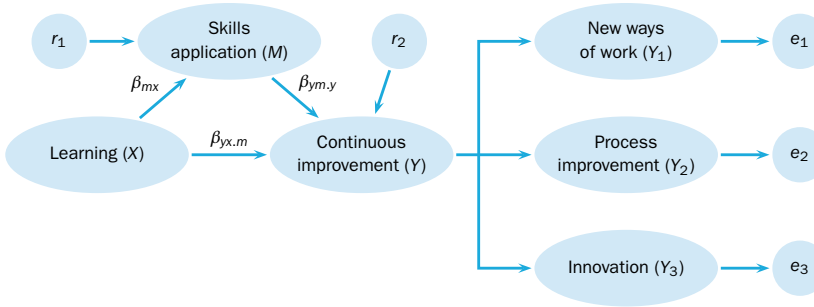

Figure 2 Pathway of a Mediation Process in the Partial Mediation Model for Learning

lenges within daily work; by improving processes and by working on innovations in products and services.

Accordingly, the research model to test the defined hypotheses is designed in Figure 2 in alignment on the methodology described by Byrne (2001) and Hayes (2018).

Figure 2 shows a path diagram for the relationships between the three variables: learning (x), skills application (m), and continuous improvement (y). The variables that are impacted by other variables, skills application and continuous improvement, are endogenous. The variable learning that impacts skills application and continuous improvement without being affected by them is an exogenous variable. The variables learning and skills applications are assumed to be observed variables, and the variable continuous improvement is a latent variable represented through 3 indicators.

The variables learning and skills application are measured with a single item. Behavioural constructs with one single-item can be successfully included in SEM when the indicator possesses a high degree of reliability

Table 2 Test for Normality

Variable	Skew	CR	Kurtosis	CR
Learning	1.902	47.064	3.404	42.108
Skills	0.652	16.140	–0.682	–8.435
Innovation	0.719	17.779	–0.186	–2.301
Process improvement	0.777	19.222	–0.510	–6.312
New ways of work	0.951	23.523	0.117	1.449
Multivariate			11.211	40.606

and validity (Petrescu, 2013). The criteria to justify the use of single-item measures were assessed based on the 'Criteria for Assessing the Potential Use of Single-Item Measures' (Fuchs & Diamantopoulos, 2009). For the variables learning and skills application, the justification criteria are concreteness of construct, diverse sample population, high semantic redundancy, and problematic to monitor changes.

βmx is the coefficient for X for predicting M, and $\beta ym.x$ and $\beta yx.m$ are the coefficients predicting Y from both M and X, respectively. $\beta yx.m$ is the direct effect of X. The direct effect, $\beta yx.m$, is the pathway from the exogenous variable to the outcome while controlling for the mediator. The product $\beta mx \times \beta ym$ quantifies the indirect effect of x on y through m. The indirect effect describes the pathway from the exogenous variable to the outcome through the mediator. The total effect is the sum of the direct and indirect effects of the exogenous variable on the outcome, $\beta yx.m + \beta mx*?ym$. e1, e2, and e3 are measurement errors associated with observed variables. $r1$ and $r2$ are the residual terms representing errors in the prediction of endogenous factors from exogenous factors.

The mediation analysis with structural equation modelling using bootstrap methods was executed in SPSS Amos 25.0.0 to test the derived hypothesis. The quality of the sample data set and descriptive statistics analysis were performed in SPSS Statistics 25.

Results

Due to the low percentage of missing data in the selected data set, the listwise deletion of missing values was performed. Fifty-seven cases (1,5%) were deleted, and 3,673 cases left for the analysis. The conclusion of data reliability was made based on the Cronbach alpha coefficient of 0.74 (Peterson, 1994). The results of the normality test for the sample of 3,673 cases are presented in Table 2.

The multivariate kurtosis value of 11.211 is Mardia's coefficient. Critical ratio (CR) values of 40.606 > 1.96 mean there is significant non-normality. This result is unsurprising because, strictly speaking, the data collected using rating scales violates the assumptions of normal distribution. The

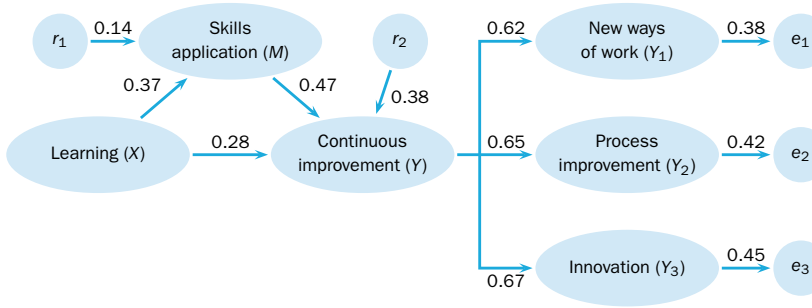

Figure 3 Pathway of a Mediation Process in the Partial Mediation Model of Learning ($n = 3.673$, $p < 0.001$)

bootstrap procedure within the SEM framework was applied to handle the multivariate nonnormal data as recommended by West, Finch, and Curran (1995). The bootstrap was executed on 5,000 samples using the maximum likelihood (ML) estimator and 95% bias-corrected confidence intervals for each of the bootstrap estimates.

The goodness-of-fit test statistics of the model achieved the required quality level. The fit index root mean square error of approximation (RMSEA) of 0.034 indicated a close fit of the model with the degrees of freedom. Regarding the quality of model matching, the value of the goodness of fit index (GFI) indicated that the model structure represents 99.8% of all empirical variances and covariances. Also, the adjusted goodness of fit index (AGFI) with a value of 0.992 confirms the imputed model structure. As reflected by the comparative fit index (CFI) = 0.995, the normed fit index (NFI) = 0.994, the relative fit index (RFI) = 0.985, the incremental index of fit (IFI) = 0.995, and the Tucker-Lewis index (TLI) = 0.988 make the model extremely well-fitting. In addition, the root mean square residual (RMR) value of 0.014 shows that only a variance fraction of 1.4% could not be explained. ML-estimated likelihood ratio χ^2 value of 20.6 with 4 degrees of freedom and ($p < 0.001$) will be not used as an indicator of goodness of fit between the model and the data, as χ^2 is highly sensitive to sample size (Byrne, 2001, pp. 79–88).

Figure 3 shows the model with standardized estimates of path coefficients and factor loading for the latent construct to address the research question by exploring the direct and indirect pathways by which learning influenced continuous improvement within an organization.

All estimated paths for the direct and indirect effects were statistically significant at level $p < 0.001$. The exogenous variable learning has a significant influence on mediator variable skills application. It also has a significant influence on endogenous latent construct continuous improvement

Table 3 Bootstrap ML Estimates

Paths	SE	SE-SE	Mean	Bias	SE-Bias	CR
Skills ← Learning	0.017	0.000	0.371	0.000	0.000	21.80
CI ← Learning	0.022	0.000	0.278	0.000	0.000	12.64
CI ← Skills	0.020	0.000	0.456	0.000	0.000	22.80
Innovation ← CI	0.016	0.000	0.673	0.000	0.000	42.06
Process improvement ← CI	0.016	0.000	0.650	0.000	0.000	40.63
New ways ← CI	0.017	0.000	0.619	0.000	0.000	36.41

Table 4 Bootstrap Confidence Intervals

Paths	Estimate	Lower	Upper	*p*
Skills ← Learning	0.371	0.337	0.403	0.000
CI ← Learning	0.277	0.235	0.320	0.000
CI ← Skills	0.456	0.416	0.495	0.000
Innovation ← CI	0.673	0.640	0.705	0.000
Process improvement ← CI	0.650	0.617	0.682	0.000
New ways ← CI	0.619	0.586	0.652	0.000

in the presence of mediator variable skills application. Therefore, skills application mediates the path between learning and continuous improvement. The results of the testing model by using the bootstrap method are presented in tables 3 and 4.

The standard errors determined based on bootstrapping are in the column 'SE.' There are no general limits for standard errors. The approximate standard error of bootstrap standard error itself ('SE-SE') is 0.000. In the column 'Mean' there is the mean parameter estimate computed across 5,000 bootstrap samples. Bias values of 0.000 suggest no discrepancy between the results of the bootstrap analysis and the original normal theory-based analysis. 'SE-Bias' is the approximate standard errors of the bias estimate with values of 0.000. By using the bootstrap Mean and SE columns, the critical ratio values based on the bootstrap results were calculated, additionally. They all are statistically significant at $p < 0.001$. The 95% bias-corrected confidence intervals for the standardized regression weight parameter estimates are shown together with the associated *P* values in table 5. The bias-corrected confidence interval does not include zero. Therefore, the hypothesis that the parameters are equal to zero is rejected at a significance level of less than 0.001 (Byrne, 2001).

The direct effect of learning on continuous improvement, $\beta yx.m = 0.28$. The indirect effect, $\beta mx*?ym = 0.37 \times 0.46 = 0.17$. An employee who differs by one unit in their learning is estimated to differ by 0.17 units in their participation in continuous improvement as a result of the effect of learning on skills application, which, in turn, affects continuous improvement. The

total effect of learning on continuous improvement effect reveals how much two employees who differ by one unit on learning are estimated to differ in participation in continuous improvement: $\beta yx.m + \beta mx \times \beta ym = 0.28 + 0.17 = 0.45$. All effects statistically significant, as revealed by a 95% bootstrap upper and lower level CI, are entirely above zero. Bootstrapping analysis revealed that skills application mediated the relationship between learning and continuous improvement. The total effect is stronger than the direct effect, but the direct effect is stronger than the indirect effect. The squared multiple correlations for skills application and continuous improvement are 0.14 and 0.38, respectively. That means that 14% of the variance of skills application and 38% of the variance of continuous improvement is explained by learning. In summary, all four hypotheses cannot be rejected.

Discussion

Understanding the relationship between employees' learning and skills application, and continuous improvement practice within a company was the focus of this study. The structural, partial mediation model was analyzed with an ML estimator using 5,000 bootstrap samples. It was confirmed as well-fitted to the data. In the bootstrap approach, the effects of exogenous variable learning toward endogenous variable skills application and endogenous latent construct continuous improvement have been confirmed as statistically significant at a level less than 0.001. Thus, a mediation effect of skills application in the relationship between learning and continuous improvement was established, and it can account for 0.17 of the total effect. Despite the statistical significance of the effect, it is small. The direct effect of learning is more influential than the indirect effect. In summary, the total effect of 0.45 is the strongest. All four hypotheses were supported by empirical analysis. However, the predictive power of the skills application variable with 14% is weak. The construct continuous improvement with 38% can be considered specified as well. It is an indication for further research that, besides learning and skills application, other factors impact continuous improvement. In addition, skills application may also be specified as a latent construct. The specified model is a simple one and may be extended by further variables such as knowledge, leadership, job satisfaction. A second limitation of the study is non-random sampling. Thus, future research should include data from more than one company. However, the strength of the study is the utilization of a large sample, which included answers from employees from various countries.

Overall, the study provides empirical evidence on the mediation effect of skills application in the relationship between learning and continuous improvement using data from an operational unit of a knowledge-intensive company. It also gives an overview of the available theoretical basis on

learning, skills application, and continuous improvement and summarizes what has been empirically proven on learning effects so far.

The results are relevant for operational companies in increasing employee participation in continuous improvement, setting up the right learning environment, and encourage skills application. The results showed that training should not be considered as an independent event: it needs to be connected to skills application. Both, efficient learning environment and the application of skills, are crucial to enjoying continuous improvement within an organization.

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