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FROM ERROR MANAGEMENT TO WORKER LEARNING

DO GERENCIAMENTO DE ERROS À APRENDIZAGEM DO TRABALHADOR

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Resumo
O objetivo foi identificar o impacto da cultura de gerenciamento de erros na aprendizagem individual, na satisfação e no engajamento do colaborador, por meio das práticas organizacionais de suporte social e gestão aberta. A coleta de dados ocorreu em uma organização brasileira de atuação nacional, com gestão participativa, foco na melhoria de processos e compromisso com a qualidade. Foram obtidos 128 questionários válidos, analisados por meio de modelagem de equações estruturais, com estimação por mínimos quadrados parciais. Confirmaram-se sete das nove hipóteses, destacando a cultura de falhas e erros como preditora dos demais construtos, o que indica que ela pode gerar satisfação, engajamento e aprendizado do trabalhador.

Palavras-chave: Aprendizagem no local de trabalho. Cultura de gerenciamento de erros. Suporte social. Satisfação no trabalho. Modelagem de equações estruturais.

Abstract
The objective was to identify the impact of error management culture on individual learning, employee satisfaction, and engagement through organizational practices: social support and open management. Data were collected in a Brazilian organization with national operations, participative management, a focus on process improvement, and a commitment to quality. We obtained and analyzed 128 valid questionnaires using structural equation modeling with partial least squares estimation. Seven of the nine hypotheses were confirmed, highlighting the culture of failures and errors as a predictor of the other constructs, meaning that it can generate employee satisfaction, engagement, and learning.

Keywords: Workplace learning. Error management culture. Social support. Job satisfaction. Structural equation modeling.

Introduction

Failures and errors are part of human experience; even with rigorous technology or processes, they cannot be eliminated, and even successful leaders accumulate more failures than successes throughout their careers (Kiss & Kun, 2024). Errors are tasks or routines performed incorrectly, such as a driver speeding above the limit, while failures are undesirable outcomes, such as a patient dying after surgery instead of leaving the hospital healthier than before entering it (Dahlin et al., 2017).

Cannon and Edmondson (2001, p.162) broadly define failure as a deviation from expected and desired results, including avoidable errors and inevitable negative outcomes from experiments and risks, as well as interpersonal failures, such as misunderstandings and conflicts. This research adopts this definition, using 'errors' and 'failures' interchangeably. According to Brewster and Brookes (2024), some UN Sustainable Development Goals are reflected in management practices that promote a socially supportive learning environment and encourage productivity, innovation, and job satisfaction. Considering the current levels of complexity, dynamism, and uncertainty in the workplace, errors or failures are byproducts of organizational processes (Barbarini & Bido, 2016). For example, innovation is an important way for organizations to stand out in the market; however, innovating is risky and error-prone, and how organizations handle these errors determines their potential to innovate (Fischer et al., 2018).

The culture of error management encompasses organizational practices related to communication, knowledge sharing, and assistance in error situations, when an organization does not view mistakes as something negative (Natarajan & Kumar, 2023; Van Dyck et al., 2005).

The act of making mistakes is uncomfortable; they are often perceived negatively (Lauzier & Bilodeau Clarke, 2023), and in the view of Putz et al. (2013, p.511), errors are an inevitable byproduct of human work; therefore, organizational learning from mistakes is recommended for the human resources field as a tool for employee development.

We identify empirical studies on error management culture in the literature (Fischer et al., 2018; Guchait et al., 2016; Olson et al., 2023; Van Dyck et al., 2005; Wei et al., 2017); however, the culture was not addressed in its broad sense, but rather in a more restricted sense, which relates to the management of failures and errors. The objective of this research is to identify the impact of the culture of failure and error management on individual learning, employee satisfaction, and engagement, through organizational practices: helping behavior among colleagues and an open management style, which, according to Jaw and Liu (2003), consists of a manager who is approachable, uses frank and reliable communication, where the sharing of important information for the completion of work occurs naturally.

Theoretical Framework

This section defines the concepts and justifies the hypotheses that underpin the conceptual model.

Failures and Errors as Learning Opportunities

According to Keith and Frese (2008), errors at work are a nuisance; they interrupt workflow and correcting them can be time-consuming and frustrating. Some errors can have serious consequences for individuals and organizations. Despite this, errors can be used as inputs for learning.

Learning from failure is a complex process, and managers can act through three important actions: (1) identifying the failure, (2) analyzing the failure, and (3) participating in deliberate experimentation (Cannon & Edmondson, 2005).

Errors can serve as a form of feedback (i.e., when the goal was not achieved or someone makes a mistake or error), and as such, they provide valuable information to the individual on how to change the course of action to ultimately achieve a goal, improve a process, or rethink a behavior (Van Dyck et al., 2005).

Past individual failures and successes have a complementary (i.e., positive) effect on individual performance, meaning that learning from individual failures increases as the volume of successful previous experiences increases (KC et al., 2013).

Organizational factors, such as leaders' behavior, colleagues' behavior, and shared principles and values, can influence learning from errors within the organization (Barbarini & Bido, 2016).

Culture of Failure and Error Management

According to Frese and Keith (2015), organizations often focus solely on error prevention as their strategy for dealing with errors. Beyond error prevention, organizations need to manage errors to handle them effectively after they occur. Error management aims to minimize negative consequences and maximize positive effects.

A culture of failure and error management involves organizational practices and procedures related to communicating about errors, sharing knowledge about errors, providing support in error situations through analysis and proposals to resolve failures and errors, and fostering learning Van Dyck et al. (2005, p.1230).

Communicating the occurrence of errors is a key action in failure and error management because it provides a mutual help channel among colleagues in error situations. For example, if employees know that a coworker is experiencing failures and errors, they can contribute proposals to address or minimize their causes and effects (Van Dyck et al., 2005).

Error management can influence innovation and creativity in companies through three interconnected ways: 1 - dealing with errors and limiting negative consequences; 2 - errors leading to new situations, encouraging exploration and supporting experimentation; 3 - no blame and open communication (Fischer et al., 2018).

Peer Social Support

According to Halbesleben and Wheeler (2015, p.1632), receiving help from a coworker leads to the perception that they are a source of support, and in the view of Turner et al. (2010), coworkers should act as a source of social support, helping employees to protect, replenish, and reinvest energy into other work activities.

Social support is a management practice that can promote team-focused citizenship because when team members experience emotional and instrumental support and reciprocity, pro-team behaviors and concern for colleagues become an internally shared assumption within the team (Bowling et al., 2004; Stoverink et al., 2018).

One factor that could hinder the practice of social support among colleagues is the lack of reciprocity in cases of help needed, because what demonstrates social support, according to Zhou and George (2001, p.685), is the moment when colleagues offer help and support to a coworker in their professional

activities, whether by sharing knowledge or experiences already encountered, encouraging, and moral support.
Social support has been operationalized in two dimensions: the affective dimension refers to the degree of social and emotional integration among coworkers and supervisors, while the instrumental dimension refers to collaboration between coworkers and supervisors in carrying out work activities (Martín Arribas, 2007).
If a failure and error management culture involves communication, knowledge sharing, assistance, analysis, and proposals for resolving failures and errors among colleagues fosters learning (Van Dyck et al. 2005, p.1230), and considering that social support occurs when colleagues offer help and support to a coworker in their professional activities, whether by sharing knowledge or experiences already encountered, providing encouragement and moral support, or with the intention of sharing ideas and knowledge within the team (Zhou & George, 2001, p.685), the following hypothesis is proposed:

H1: The culture of failure and error management positively influences colleagues' social support.

Open Management
According to Jaw and Liu (2003), open management is characterized by transparent management that shares information with employees, gives team members access to ideas and new projects, and fosters an environment of innovation and a focus on process improvements.
Internal communication is an essential structural integrator mechanism, as top management should incorporate employee participation and an effective communication system throughout the organization to disseminate information and plan goals (Ketokivi & Castañer, 2004).
Trust among managers, subordinates, and colleagues is an important condition for managerial and organizational effectiveness and has been recognized by scholars since the late 1950s (Thomas et al., 2009).
A culture of managing failures and errors relates to error communication, knowledge sharing, and support in error situations through analysis and proposals for resolving failures and errors (Oliveira et al., 2023; Van Dyck et al., 2005, p.1230). In this context, the organization creates an environment that allows employees to act, with leadership and the team's support, after the event in which the error occurred. This creates space for dialogue and learning. The fear of communicating problems to managers, as well as of sharing opinions and suggestions, may lead to a low volume of failure and error reports to senior management for problem-solving (Breen et al., 2005).

H2: The culture of failure and error management positively influences open management.

Job Satisfaction
Job satisfaction enters the 21st century as one of the multiple concepts that address affectivity in the work environment or, more specifically, as an emotional bond between the individual and their work (Siqueira, 2008).
Job satisfaction is defined by perceptions of how much employees like their work and how well the work environment meets their needs, values, or personal characteristics; the higher the level of job satisfaction (Ellickson & Logsdon, 2002).
Job satisfaction increases productivity at the organizational level, improves performance and employee retention, and generates subsequent economic benefits (Galup et al., 2008). Therefore, it is influenced by an individual's emotions, perspectives, and preferences regarding their work, based on individual differences.
Several organizational factors, such as compensation, rewards, supervisor-subordinate relationships, additional benefits, human resources policies, and promotion opportunities, determine employees' job satisfaction (Kanwar et al., 2012).

According to a 2012 survey by the Society for Human Resource Management (SHRM), compensation plans are a main factor in job satisfaction, ranking only behind relationships with managers, the organization's financial stability, learning and development opportunities, and stability (Abraham, 2012). Job satisfaction is influenced by emotions, perspectives, and individual preferences regarding one's work (Chen, 2008).

Organizational practices such as internal communication and openness to knowledge sharing constitute the concept of open management (Jaw & Liu, 2003). Studies indicate that supervisors who adopted an open communication process with their subordinates achieved higher employee satisfaction than those who did not (Richmond et al., 1982). Open communication in teamwork fosters mutual trust among team members; colleagues are viewed not as competitors but as collaborators (Atapattu & Huybers, 2022). Therefore, it is hypothesized:

H3: Open management positively influences job satisfaction.

The interactions within the workgroup, especially the social support received from colleagues, can significantly contribute to job satisfaction (Ducharme & Martin, 2000; Vuong et al., 2023).

Orgambídez-Ramos and Almeida (2017, p.41) concluded that social support is a key factor in promoting job satisfaction. The creation, formal or informal, of contacts between people is a strategy to strengthen support among colleagues. According to Steinardt et al. (2003), employees who work cooperatively to achieve common goals experience a sense of cohesion and satisfaction. Based on this, the following hypothesis is proposed:

H4: Colleague social support positively influences job satisfaction.

Worker Engagement

Kahn (1990) was the first researcher to use the term employee engagement and define it as "the level of energy, dedication, and absorption of employees toward the organization." According to Schaufeli et al. (2002, p.74), there is an interesting approach that defines work engagement as "a positive, satisfying, and work-related state of mind characterized by vigor, dedication, and absorption." Despite several studies published on employee engagement, interest in the topic remains (Saks & Gruman, 2014). Organizations seek to measure individuals' engagement levels because it is a relevant topic in human resources development (HRD), as more engaged employees tend to perform better at work and intend to stay with the organization (Soane et al., 2012). Employee engagement is defined in various ways; however, some definitions focus on the emotional state of the employee and include feelings such as enthusiasm, commitment, motivation, and passion (Burnett & Lisk, 2019). Among the factors that influence engagement, vigor refers to the level of emotional energy, mental resilience, and persistence during work. Dedication is characterized by feelings of enthusiasm, pride, and significance, as well as being strongly involved in the work (Jeong et al., 2016). Absorption, another variable we propose for measuring engagement, denotes a state of total immersion or concentration in the work itself, to the extent that one forgets how much time has passed (Schaufeli et al., 2002). Open management is characterized by transparency and the sharing of information with employees. The leader allows the team to share ideas and new projects, providing an environment of innovation and focusing on process improvements (Jaw & Liu, 2003). Based on the contributions of the cited authors, we propose the following hypothesis:

H5: Open management positively influences worker engagement.

Engagement also occurs when individuals perceive that colleagues are participating in the search for a solution to a problem caused by a failure or error, mainly because they believe their participation will help solve the problem (Bäck et al., 2018). In the hospital context, Othman and Nasurdin (2013) found a significant effect of supervisor social support on engagement, but not of colleagues' social support. In

the academic context, Othman et al. (2021) found a significant effect of colleagues' social support (β = 0.58). In the present research, it is hypothesized:

H6: Colleague social support positively influences worker engagement.

According to Wójcik-Karpacz (2018, p.61), engagement at work is primarily expressed through employees' behaviors, such as dedication to daily activities, extra effort to achieve positive results, and support for causes or actions within the organization. Employee engagement means that people who work are committed to the organization and their work (Segalla & DeNisi, 2019); even during leisure or rest, an engaged professional does not stop thinking about their activities, as this is not even uncomfortable for them. In many cases, when overtime is necessary, they do it without complaints if it is needed to deliver a complete, quality job within the deadline. Factors such as cooperation, fair treatment, solid company policies, and team spirit, among others, can increase job satisfaction, thereby leading to greater employee engagement (Abraham, 2012).

H7: Job satisfaction positively influences worker engagement.

Individual Learning in the Workplace

Learning can be defined as any process in which living beings demonstrate permanent changes in ability that are not solely due to biological maturation or aging (Illeris, 2007). The constructive handling of errors is considered an important factor in individual learning processes Rach et al. (2013, p.21), and the development of individuals and humanity is closely related to trying something new, making mistakes, and then trying to improve. According to the authors' study, innovations are not possible without making mistakes because any innovation involves actions in a new, therefore unknown, environment (Frese & Keith, 2015, p.662). Learning in the workplace occurs through contact with colleagues and individual participation in social learning activities; it is learning through experience and knowledge from others (Leicher & Mulder, 2016). Furthermore, committed and highly motivated employees are more likely to engage in ongoing learning and development activities, especially when they perceive long-term benefits for the organization and their own careers (Burnett & Lisk, 2019). Learning behaviors are evident when individuals seek information, share information, question problem-solving assumptions, ask questions, seek feedback, and experiment (Edmondson, 1999). Fredrickson (2003, p.698) states that positive emotions related to engagement at work tend to stimulate the desire to learn and create knowledge. Thus, according to the author, it seems plausible that work engagement can, in turn, lead individuals to expand their capabilities by learning new skills and creating new knowledge. Previous research provides empirical evidence that workplace engagement can increase employees' motivation to learn (Sonnentag, 2003). Therefore, it is hypothesized that:

H8: Worker engagement positively influences individual learning in the workplace.

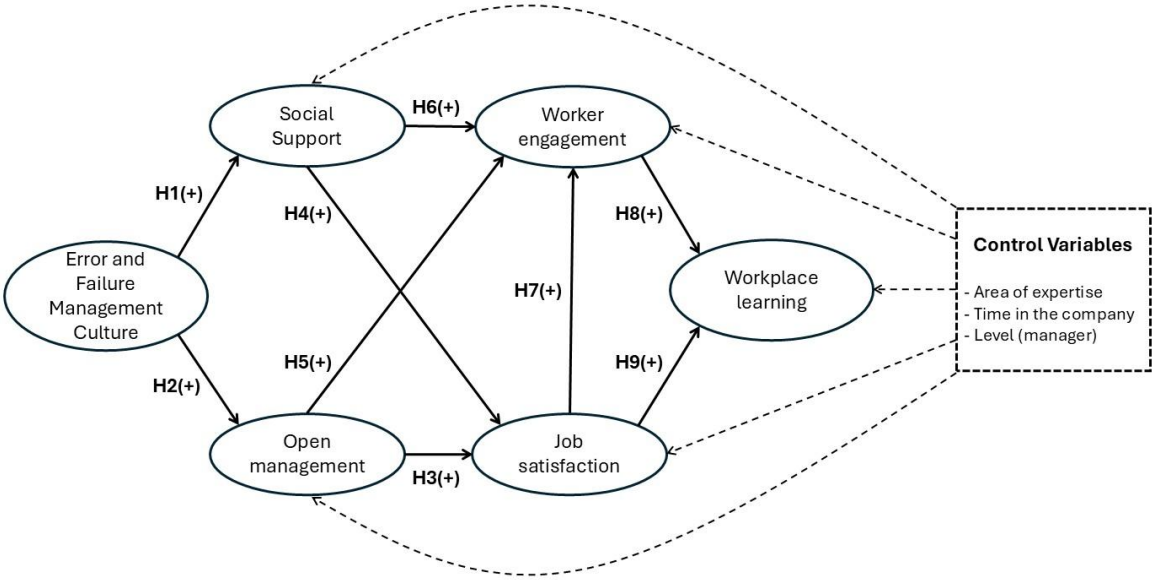
Individual learning occurs through risks, changes in perception, new experiences, and changes in behavior (Aksu & Özdemir, 2005). If changes influence learning in behavior, then colleagues' behavior can affect satisfaction. Tsai et al. (2007) explored the influence of job satisfaction on employees' learning commitment. Given individuals' willingness to invest more time and effort in learning, a motivation to devote more time and energy to acquiring knowledge is identified. The results revealed that job satisfaction, related to relationships with colleagues, significantly influenced employees' learning commitment. Based on this, the following hypothesis is proposed:

H9: Job satisfaction positively influences individual learning in the workplace.

Structural Model

Based on the study's objective, the concepts and hypotheses presented in the previous sections, the model shown in Figure 1 was established. As control variables, the area of operation, length of service, and hierarchical level were considered.

Figure 1 - Structural model with the hypotheses



Source: Prepared by the authors.

Note: Workplace learning is a second-order latent variable measured by the latent variables: 'importance' and 'frequency.' Worker engagement is a second-order latent variable measured by the latent variables: "vigor" and 'absorption." Social support is a second-order latent variable measured by the latent variables 'affective' and 'instrumental."

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Methodological Procedures

The research is classified as descriptive in nature and quantitative in character. The study strategy is based on bibliographic research and data collection (survey).

Data Collection Instrument

The first level of this structural model pertains to the culture of error management, measured using an adapted 14-item scale developed by Van Dyck et al. (2005, p.1240). Coworkers' supportive behavior was measured using nine items adapted from a social support scale developed by Ducharme and Martin (2000). Open management was measured using a 6-item scale adapted from Jaw and Liu (2003, p.240). Worker engagement was assessed using Siqueira´s (2014, p.154) 10-item scale, which considers the two first-order latent variables: vigor and absorption. The scale used to measure job satisfaction was developed by Siqueira (2008, p.272). The scale used to gather data on the worker's individual learning was developed by Chan (2003), adapted by Bido et al. (2011), and consists of two first-order latent variables: importance of individual learning and frequency of learning. After translating and adapting the scales, a pilot study was conducted with 43 professionals in education and 37 in the service sector, which allowed final adjustments to the items before the definitive application. The control variables considered were: activity area (factory or administrative), length of employment, and hierarchical level (manager or non-manager). We used a five-point Likert scale, with 1 = strongly disagree and 5 = strongly agree. After

the control-variable questions, six items assessed the type and frequency of failures and errors to determine whether they occurred in the respondent's routine at work and how they were handled.

Data Collection

The sample was obtained through non-probabilistic convenience sampling. The sample size was calculated using G*Power software, considering a statistical power of 0,80, a medium effect size (f^2) of 0,15, and a significance level of 0,05 (Cohen, 1988; Hair Jr et al., 2017; Ringle et al., 2014). For data collection, a Brazilian organization operating nationwide was selected because the studies identified in the theoretical framework only presented cases from abroad, which sparked interest in applying the model within a national industry. The chosen company stood out for communicating its ethical principles to employees and the market, practicing participative management, focusing on process improvement, and committing to quality certification by competent, reputable institutions. Its communicated values included respect for the individual, excellence (passion for creating innovative products), commitment (owner's spirit), and transparency (honesty). These factors were decisive in selecting the company for this study. After discussions, we finalized the academic research proposal and signed a confidentiality agreement to ensure the company's name and any information deemed an industrial secret remain confidential. We collected data in early 2020 using a printed questionnaire, yielding a sample of 128 cases, which is sufficient to detect R^2 values of 10% or higher as significant at the 5% level (sensitivity analysis in G*Power 3).

Data Analysis

We analyzed the data with structural equation modeling using PLS estimation (PLS-SEM: Partial Least Squares Structural Equation Modeling). This technique is more flexible regarding the required sample size and does not assume multivariate normality (Hair Jr. et al., 2017). We conducted five rounds in SmartPLS 3.2.9 to refine and evaluate the measurement and structural models.

Results Presentation and Analysis

Table 1 presents the respondent profile, showing that most respondents are aged 31-40, have more than 3 years at the company, and hold a high school diploma; more than two-thirds are from the manufacturing sector.

Table 1 – Descriptive statistics of the respondents

Age Range (years)	n
up to 20	5
from 21 to 30	36
from 31 to 40	65
from 41 to 50	21
from 51 to 60	1
more than 60	
Total	128

Company Time (years)	n
up to 1	9
from 1 to 3	45
from 3 to 5	28
from 5 to 7	13
from 7 to 10	17
More than 10	16
Total	128

Education	n
Incomplete high school	3
Complete high school	59
Incomplete undergraduation	25
Complete undergraduation	30
Incomplete graduation	2
Complete graduation	8
Master's Degree	1
Total	128

Area of Expertise	n
Administrative	36
Factory	92
Third party	0
Total	128

Hierarchical Position	n
Team	117
Manager	11
Total	128

Source: Research results.

To highlight the occurrence of errors and failures in this company, Table 2 presents the frequency of these events, measured through five questions.

Table 2 – Frequency of failures and errors

Frequency of failures and errors	n
Never	2
Rarely	52
Sometimes	71
Frequently	3
Very often	0
Total	128

% Registered and Reported	n
None (0%)	16
25%	14
50%	17
75%	38
All (100%)	43
Total	128

% Analyzed and Discussed	n
None (0%)	10
25%	14
50%	30
75%	34
All (100%)	40
Total	128

% Resolved	n
Nenhum (0%)	8
25%	14
50%	23
75%	34
All (100%)	49
Total	128

% of failures that resulted in new procedural instructions	n
None (0%)	21
25%	15
50%	30
75%	31
All (100%)	31
Total	128

Source: Research results.

Table 3 shows that all LVs had a median of 4.0 or higher on a 1-5 scale, indicating that respondents overall evaluate these constructs positively.

Table 3 – Descriptive statistics of the latent variables' scores

Latent variable	1st quartile	Mean	Median	3rd quartile	Standard deviation	Variance coefficient
Error and Failure Management Culture	3,9	4,2	4,4	4,8	0,73	17%
Social Support	4,0	4,2	4,3	4,8	0,72	17%
Open management	3,3	3,8	4,0	4,4	0,84	22%
Job satisfaction	4,0	4,3	4,5	4,9	0,79	18%
Worker engagement	3,9	4,2	4,5	4,9	0,83	20%
Workplace learning (frequency)	3,3	3,8	4,0	4,4	0,83	22%
Workplace learning (importance)	4,7	4,6	5,0	5,0	0,72	15%

Source: Research results.
Note: The scores for each latent variable were calculated as the average of their items, with a minimum of 1,0 and a maximum of 5,0.

4.1 Measurement Model Evaluation

The measurement model was evaluated in terms of convergent validity (significant factor loadings greater than 0,7, and average variance extracted above 0,5), discriminant validity at the level of latent variables (LV) and at the item level (cross-loadings less than factor loadings), and reliability, measured by composite reliability, following the criteria recommended by Hair Jr et al. (2017). The first-order latent variables 'vigor' and 'absorption' did not demonstrate discriminant validity; therefore, they were combined into the second-order latent variable 'engagement.' Table 4 presents the results, indicating that the validity and reliability criteria were met after removing 4 items from a total of 56. The LVs with removed items were Individual Learning (1 item, remaining 5), Open Management (1 item, remaining 5), and Job Satisfaction (2 items, remaining 9). Since the number of items per LV was well above the minimum recommended (between 3 and 5 items per latent variable), it is understood that there was no capitalization on chance (Hair Jr. et al., 2009). The cross-loadings table was omitted due to space limitations; it is available from the first author.

Table 4 – Correlation matrix between the latent variables of the structural model

LV of the structural model	1	2	3	4	5	6
1 - Workplace learning	0,889					
2 - Worker engagement	0,757	0,892				
3 - Open management	0,537	0,595	0,725			
4 - Error and Failure Management Culture	0,512	0,568	0,541	0,705		
5 - Job satisfaction	0,678	0,771	0,629	0,596	0,789	
6 - Social Support	0,473	0,595	0,541	0,570	0,683	0,914
Cronbach's Alpha	0,873	0,948	0,804	0,921	0,938	0,931
Composite reliability	0,884	0,887	0,862	0,932	0,947	0,911
Average Variance Extracted (AVE)	0,792	0,797	0,526	0,497	0,622	0,837

Source: Research results.
Legend: The values on the diagonal are the square root of AVE, and the values outside the diagonal are correlations between the LVs. Since the correlations are lower than the diagonal values, discriminant validity is confirmed (Hair Jr. et al., 2017).
Note: The matrix, which includes only the first-order LVs, also showed adequate convergent validity, discriminant validity, and reliability.

With validity and reliability established, the measurement model adjustments are complete, and the structural model evaluation can proceed as shown below.

4.2 Structural Model Evaluation (Hypotheses)

The structural model was estimated in 3 steps: (i) a model without the exogenous variable (failure and error management culture), with all control variables linked to the endogenous variables; (ii) a structural model without control variables; (iii) a structural model with the significant control variable, which is the result presented in Table 5. The adjusted R^2 values assess the proportion of the endogenous variables' variance explained by the structural model (Ringle et al., 2014). In the field of social and behavioral sciences, (Cohen, 1988) suggests that R^2 = 2% is a small effect, R^2 = 9% is a medium effect, and R^2 = 25% is a large effect. Only hypotheses H5 and H6 were not confirmed (p > 0,05). Still, it is interesting to note that the bivariate relationships are strong (r = 0,595 in Table 4) between open management and engagement, and between social support and engagement; that is, in the multivariate model (Table 5), they are not significant because job satisfaction is the strongest predictor (r = 0,771 with engagement) of the three, and they are redundant with each other (the correlations between them range from 0,54 to 0,68).

Table 5 – Results of the structural model with significant control variables

Structural relations	Hypothesis	Effect size (f^2)	Path coefficient	Valor-p	R^2 adjusted
EFM Culture → Social Support	H1(+)	0,480	0,570	0,000	0,319
Area of Expertise → Open Management	control	0,001	0,021	0,809	0,274
EFM Culture → Open Management	H2(+)	0,363	0,529	0,000	
Open Management → Job satisfaction	H3(+)	0,247	0,396	0,000	0,535
Social Support → Job satisfaction	H4(+)	0,311	0,445	0,000	
Area of Expertise → Worker engagement	control	0,079	0,176	0,010	0,610
Open Management → Worker engagement	H5(+)	0,029	0,138	0,066	
Social Support_ → Worker engagement	H6(+)	0,045	0,177	0,100	
Job satisfaction → Worker engagement	H7(+)	0,320	0,517	0,000	
Worker engagement → Workplace learning	H8(+)	0,382	0,590	0,000	0,590
Job satisfaction → Workplace learning	H9(+)	0,056	0,225	0,029	

Source: Research results (n=128).
Legend: f^2 = Cohen's effect size (1988): 0,02 = small; 0,15 = medium; and 0,35 = large. EFM Culture = Error and Failure Management Culture.
Note: Values estimated using SmartPLS 3.2.9 software, and p-values obtained through bootstrap with 5,000 repetitions. VIF < 2.3, therefore multicollinearity is not a problem in the structural model.

Predictive validity

The model demonstrated predictive validity by predicting values not used in its estimation (out-of-sample). We performed the PLSpredict analysis, which yielded positive Q^2 values (above 0,10) and lower mean squared errors (RMSE and MAE) than the linear model (LM, the naïve benchmark) for all indicators (Hair Jr. et al., 2017).

Indirect and total effects

To deepen the understanding of the relationships between the constructs of the model, we prepared the Table 6, which contains the total indirect effects, highlighting the following results: The failure and error management culture has strong relationships with all the constructs of the model, whether direct relationships (H1 and H2) or indirect relationships (Table 6); Although open management has no direct relationship with engagement (H5 not confirmed), it has a small indirect effect (0,205, p<0,01), therefore, it is a total mediation; The same can be said regarding social support, in which the total mediation is characterized by the influence being entirely indirect (0,230, p<0,01).

Table 6 – Evaluation of indirect and total effects

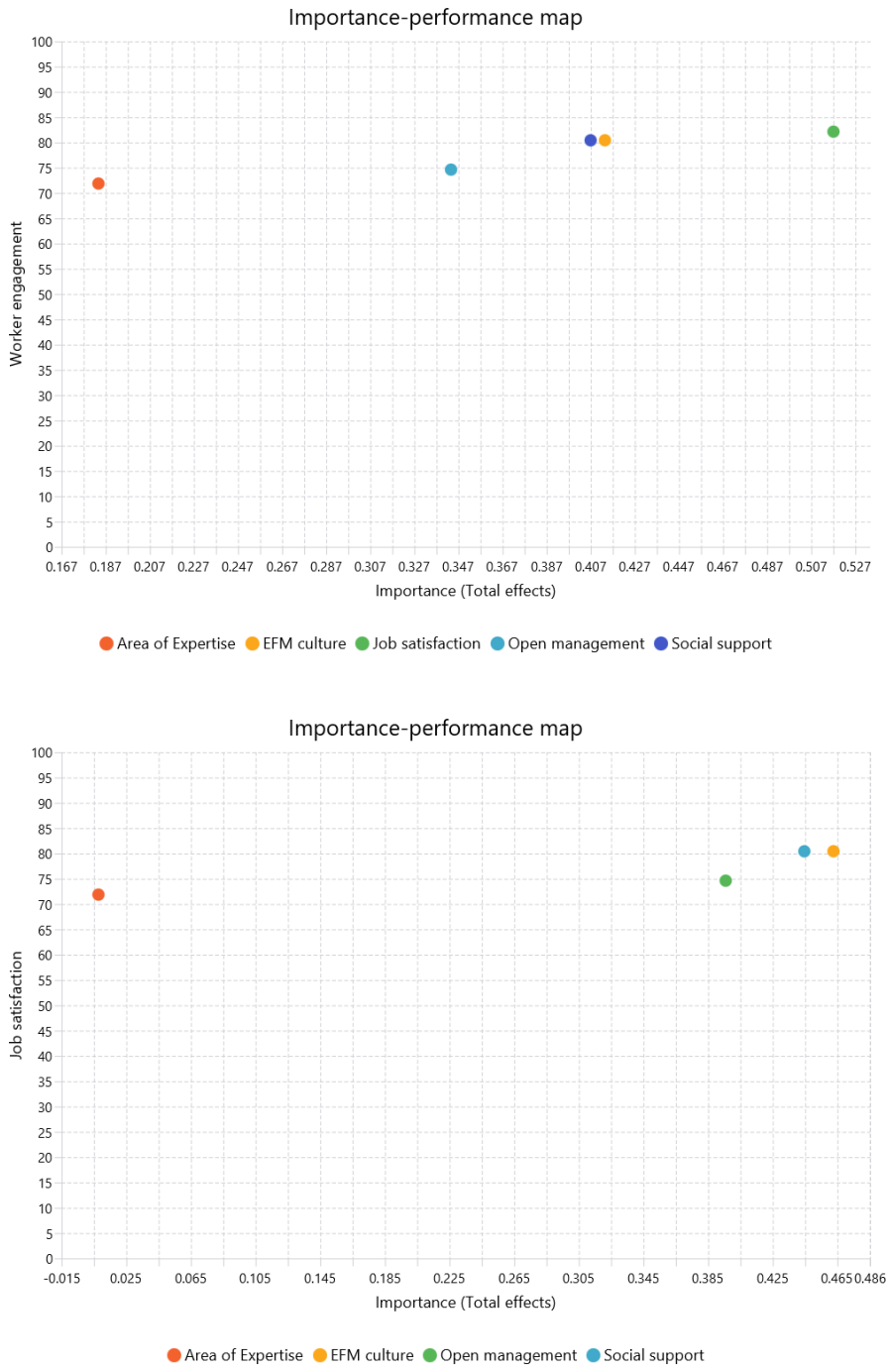
Efeitos indiretos	Efeitos indiretos	Valor-p	Efeitos totais	Valor-p
EFM Culture → Workplace learning	0,348	0,000	0,348	0,000
EFM Culture → Worker engagement	0,413	0,000	0,413	0,000
EFM Culture → Job satisfaction	0,463	0,000	0,463	0,000
Open Management → Workplace learning	0,292	0,000	0,292	0,000
Open Management → Worker engagement (1)	**0,205**	**0,006**	**0,343**	**0,000**
Job satisfaction → Workplace learning	0,305	0,000	0,530	0,000
Social Support → Workplace learning	0,340	0,000	0,340	0,000
Social Support → Worker engagement (2)	**0,230**	**0,001**	**0,445**	**0,000**

Source: Research results (n=128).
Note (1): Open Management → Job Satisfaction → Worker engagement.
Note (2): Social Support → Job Satisfaction → Worker engagement.

Importance-performance of predictors

Figure 2 complements previous analyses and is a useful resource for thinking about practical implications for management. On the horizontal axis are the standardized total effects (direct + indirect), and on the vertical axis are the mean factor scores (equivalent to those presented in Table 3, but standardized on a scale from 0 to 100). In the first analysis, an importance-performance map analysis (IPMA) was conducted for Individual Learning in the workplace, which showed that engagement and job satisfaction had high importance and high performance, respectively, and it was decided to evaluate the antecedents of both constructs. In Figure 2 (first plot), the most important predictor of worker engagement is job satisfaction, which already has a high performance (82). Open management is not as important, but its performance is at 75, so there may be managerial action to take in this dimension. The second plot in Figure 2 shows behaviors similar to those in the first, indicating that open management has the greatest potential to benefit the company in terms of job satisfaction.

Figure 2 – Importance-performance map analysis of worker engagement and job satisfaction



Source: Research results.

Discussion of the Results

The overall goal was to evaluate, through an empirical study, the impact of a culture of failure and error management on learning, employee satisfaction, and engagement, through colleagues' helping behavior and open management. Based on respondents' perceptions of error occurrence, 58% encounter error and failure situations sometimes or frequently; 63% report or record them, this aligns with the view that, in work environments characterized by effective error management, teams are more willing to examine

and discuss errors in a natural and positive manner (Li et al., 2025); on the other hand, errors occur in 75% to 100% of cases, indicating a low reporting rate or a perception of underreporting by 37% of the team. There is a group that does not perceive safety or advantage in communicating perceived errors, which indicates a potential audience that could benefit from the results of this study and wich may indicate that individuals with higher levels of failure aversion tend to stake their self-worth on the project and interpret encountered failure as a sign of personal incompetence (Zhang et al., 2022). Additionally, 48% of failures led to new guidelines or procedures, indicating that 52% of reported errors or failures were ignored, suggesting a lack of learning from the event and a high risk of recurrence. Another interesting insight from the descriptive statistics analysis is that the data allows us to infer that, according to the average of variables such as Culture of Management (4.2), Social Support (4.2), Job Satisfaction (4.3), Engagement (4.2), and Importance for Individual Learning (4.6)—all close to the maximum of 5—the majority of the group perceives error management practices (not limited to avoiding but understanding and learning from the event), colleagues' and leaders' support, are satisfied with the organization, engaged with daily challenges, and recognize the importance of learning from everyday events. This creates a conducive environment to deepen the organization's relationship with errors, aiming to extract the best results from what cannot be avoided with 100% certainty. Despite the favorable scenario for expanding the use of tools or the theme of this study to optimize results, perceptions of open management and individual learning frequency showed the lowest averages (3.8). This indicates areas to focus on, which could, in turn, increase the volume of reported errors and the number of new guidelines and procedures that emerge after reporting failures and errors, thereby enhancing learning and reducing the risk of the same error or failure recurring. To achieve this objective, nine hypotheses were proposed, and seven were confirmed ($p<0,05$). One notable point relates to the culture of failure and error management influencing social support (H1) $\beta = 0,570$ ($p<0,01$) and open management (H2) $\beta = 0,529$ ($p<0,01$), which addresses the research question: the more the organization consolidates social support practices so that employees feel supported in their activities, with leadership providing openness to express when necessary, the higher the job satisfaction through open management (H3) $\beta = 0,396$ ($p<0,01$) and social support from colleagues (H4) $\beta = 0,445$ ($p<0,01$), which leads to employee engagement (H7) $\beta = 0,517$ ($p<0,01$). We can observe that social support motivates learning through challenges, providing direction and advice; the focus is on the perception of the support experience along two dimensions: emotional and expert support (Kayes et al., 2024), and when employees perceive their supervisors as open to input, they are motivated to speak up (Lebel, 2016). This study also confirmed that job satisfaction precedes engagement; factors such as cooperation, fair treatment, strong company policies, and team spirit, among others, can increase job satisfaction, thereby increasing employee engagement (Abraham, 2012). The model also confirmed hypotheses regarding engagement and job satisfaction influencing individual learning in the workplace (H8) $\beta = 0,590$ ($p<0,01$) and (H9) $\beta = 0,225$ ($p<0,01$), validating the hypothesis that a culture of failure and error management promotes job satisfaction and employee engagement, which, through open management in resolving failures or errors, develop individuals within groups (Binsiddiq & Alzahmi, 2013). Although two hypotheses were not confirmed—H5 (Open Management → Engagement – 0,163, $p>0,05$) and H6 (Social Support → Engagement – 0,163, $p>0,05$)—in both cases, the indirect effects and total effects are significant, indicating that both are cases of full mediation. This result is consistent with the literature; management behavior, effective communication, timely information transfer and transparency, reduced stress, and social support are relevant to a work design that promotes job satisfaction (Kröber & Wachter, 2026).

Final Considerations

The culture of failure and error management has proven to be a strong predictor (direct or indirect) of the other constructs in the model, so that investing in its maintenance can generate employee satisfaction, engagement, and learning over time. The organization participating in this study demonstrates

performance above the midpoint of the scale across all dimensions, with open management and the frequency of individual learning showing the lowest performance. Most organizations that had invested significant money and effort into becoming 'learning organizations' (with the ability to learn from failure) struggled when it came to the day-to-day mindset and activities of learning from failure (Cannon & Edmondson, 2005). The suggestion for managers is to focus their efforts on open management and the frequency of learning to increase the volume of error and failure reports, as well as the number of new guidelines and process improvements to prevent the same error from recurring. It is understood that other companies can use the model and scales for diagnostic purposes and to implement actions that promote a culture more conducive to learning from events where errors occurred. Workers may view errors as collective learning moments, motivating them to share lessons or assist teammates to prevent similar errors (Berg et al., 2022). A methodological contribution of this research was the validation of the failure and error management culture scale in the Brazilian context. To implement a culture focused on failure and error management, top management's approval and support are recommended. According to Weinzimmer and Esken (2017), leaders play an important role during critical moments by promoting dialogue and learning from mistakes, acting as catalysts in the organizational change process. This can help turn initial failures into future successes. For organizations that may lack clarity about their employees' perceptions, replicating the study can serve as a diagnostic tool to adopt measures that reinforce a culture of error and failure management, positively influencing job satisfaction, engagement, and individual learning. This research had some important limitations that prevent the generalization of the results: (i) the sample is not probabilistic; although suitable for testing the model, it represented a specific population; (ii) it is a cross-sectional study, so causal claims cannot be made. Future studies should be longitudinal, especially action research, to better evaluate how a culture of failure and error management can promote engagement, satisfaction, and learning. Additionally, longitudinal data would make it possible to assess whether suggestions to increase perceptions of open management and the frequency of learning affect the volume of reported errors and the adoption of new procedures and guidelines following error and failure events.

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