

EFFECTIVENESS OF ONLINE TRAINING PROGRAMS IN ENHANCING EMPLOYEE SKILLS: A STRUCTURAL EQUATION MODELING APPROACH

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Abstract:

The increasing digitalization of workplaces has transformed organizational learning and development practices. Online training programs have become a strategic mechanism for enhancing workforce capabilities and sustaining competitive advantage. This study investigates the effectiveness of online training programs in enhancing employee skills using a Structural Equation Modeling (SEM) framework. A quantitative research design was adopted, and data were collected from 312 employees across IT, banking, and manufacturing sectors. The study examines the relationships among Training Design Quality, Technology Support, Learner Engagement, and Employee Skill Enhancement. Using AMOS-based SEM analysis, the findings reveal that Training Design Quality and Technology Support significantly influence Learner Engagement, which in turn strongly predicts Employee Skill Enhancement. The mediation effect of Learner Engagement was found to be statistically significant. The model demonstrates good fit indices (CFI = 0.94, RMSEA = 0.052). The study contributes to HRM literature by offering an empirically validated model explaining how online training enhances employee competencies.

Keywords: Online Training, Employee Skill Development, Structural Equation Modeling, HR Analytics, Learner Engagement, Digital Learning

I. INTRODUCTION

Digital transformation has reshaped human resource development practices across industries. Organizations increasingly rely on online training platforms to upgrade employee competencies in a flexible and cost-effective manner. Unlike traditional classroom training, online learning environments provide scalability, accessibility, and personalized learning experiences. Despite widespread adoption, questions remain regarding the actual effectiveness of online training in enhancing measurable employee skills. This study develops and validates a Structural Equation Model (SEM) to examine the direct and indirect relationships between online training characteristics and employee skill enhancement.

REVIEW OF LITERATURE

The growing integration of digital technologies into organizational learning systems has significantly transformed traditional training paradigms. Contemporary research suggests that the effectiveness of online training programs is influenced by multiple interrelated factors, including instructional design quality, learner motivation, technological infrastructure, and organizational support mechanisms. These determinants collectively shape learning experiences and subsequent skill acquisition outcomes. Instructional design has been consistently identified as a primary predictor of training success. Well-structured content, clear learning objectives, multimedia integration, and interactive elements enhance cognitive engagement and knowledge retention. Studies emphasize that interactive learning modules, including scenario-based exercises and problem-solving simulations, foster deeper conceptual understanding compared to passive content delivery methods. The incorporation of gamification elements—such as leaderboards, rewards, and real-time feedback—has also been shown to improve learner motivation and participation levels.

Learner motivation plays a critical mediating role in digital training environments. Unlike traditional classroom settings, online platforms require higher levels of self-regulation and intrinsic motivation. Empirical evidence indicates that motivated learners demonstrate greater persistence, engagement, and transfer of learning to workplace performance. Furthermore, digital readiness, defined as employees' familiarity and comfort with technological tools, significantly influences training outcomes. Organizations with technologically competent workforces report higher completion rates and improved learning effectiveness.

Technological infrastructure is another essential component affecting online training success. Reliable internet connectivity, user-friendly learning management systems (LMS), and technical support services create a conducive digital learning ecosystem. Inadequate technological support may lead to frustration, reduced engagement, and lower perceived effectiveness of training programs. Organizational support, particularly managerial encouragement and a culture that values continuous learning, enhances the perceived relevance of training initiatives. Supervisory reinforcement and opportunities to apply newly acquired skills in the workplace strengthen learning transfer and competency development.

Although prior studies have explored the individual determinants of online training effectiveness, most investigations rely on correlation or regression-based analyses. There remains a paucity of research employing Structural Equation Modeling (SEM) to simultaneously examine measurement validity and structural relationships among latent constructs. In particular, limited empirical evidence exists within the Indian organizational context assessing the mediating role of learner engagement in linking online training characteristics to employee skill enhancement. Addressing this gap, the present study adopts a SEM framework to provide a comprehensive, theory-driven evaluation of online training effectiveness, thereby contributing to both methodological rigor and contextual relevance in HRM research.

RESEARCH GAP

Despite the expanding body of literature on online training effectiveness, several methodological and contextual limitations remain evident. A substantial proportion of prior studies have employed basic statistical techniques such as correlation and multiple regression analysis to examine relationships between training variables and performance outcomes. While these approaches provide preliminary insights, they do not adequately account for the complexity of latent constructs underlying training effectiveness, such as instructional quality, technological readiness, and learner engagement. The absence of measurement model validation limits the robustness and generalizability of many earlier findings.

Furthermore, limited attention has been given to examining mediation mechanisms that explain how online training translates into measurable skill enhancement. In particular, learner engagement—representing cognitive, emotional, and behavioral involvement in digital learning environments—has rarely been empirically tested as a mediating variable using advanced analytical techniques. Without such analysis, the explanatory pathways linking training inputs to employee competencies remain insufficiently understood. Another notable gap concerns contextual diversity. Much of the existing research focuses on single-sector samples, thereby restricting the applicability of findings across industries. Multi-sectoral empirical validation is essential to ensure that conclusions are not confined to specific organizational settings.

To address these gaps, the present study adopts a Structural Equation Modeling (SEM) approach. SEM enables simultaneous assessment of measurement validity and structural relationships among latent constructs, while also facilitating mediation analysis. By applying this rigorous analytical framework across multiple sectors, the study provides a more comprehensive and generalizable understanding of online training effectiveness in enhancing employee skills.

4. Objectives of the Study

1. To develop a structural model explaining online training effectiveness.
2. To examine the impact of Training Design Quality on Learner Engagement.
3. To analyze the influence of Technology Support on Learner Engagement.
4. To assess the impact of Learner Engagement on Employee Skill Enhancement.
5. To test the mediating role of Learner Engagement.

5. Conceptual Framework

The proposed conceptual framework is grounded in Human Capital Theory and Engagement Theory, which suggest that organizational investments in training resources enhance employee competencies through psychological involvement and active participation. The model consists of four latent constructs:

- Training Design Quality (TDQ)
- Technology Support (TS)
- Learner Engagement (LE)
- Employee Skill Enhancement (ESE)

The model proposes that Training Design Quality (TDQ) and Technology Support (TS) act as exogenous variables influencing Learner Engagement (LE), which functions as a mediating construct. Learner Engagement, in turn, directly influences Employee Skill Enhancement (ESE), the endogenous outcome variable.

Training Design Quality (TDQ) refers to the clarity of learning objectives, instructional structure, interactivity, multimedia integration, and assessment mechanisms embedded within the online training program. High-quality instructional design enhances cognitive stimulation and encourages active participation.

Technology Support (TS) represents the adequacy of digital infrastructure, platform usability, internet reliability, and technical assistance provided during training. A supportive technological environment minimizes disruptions and enhances learning continuity.

Learner Engagement (LE) reflects the degree of cognitive focus, emotional involvement, and behavioral participation exhibited by employees during online training. Engagement is conceptualized as the psychological mechanism that translates training inputs into measurable learning outcomes.

Employee Skill Enhancement (ESE) denotes the improvement in technical competencies, problem-solving abilities, communication skills, and job-related capabilities following online training participation.

The framework posits that while instructional design and technological support provide structural conditions for learning, it is the level of learner engagement that ultimately determines whether skill enhancement occurs. Therefore, engagement functions as a mediating mechanism linking training characteristics to performance-related outcomes.

Hypothesized Paths

- H1: Training Design Quality (TDQ) positively influences Learner Engagement (LE).
- H2: Technology Support (TS) positively influences Learner Engagement (LE).
- H3: Learner Engagement (LE) positively influences Employee Skill Enhancement (ESE).
- H4: Learner Engagement mediates the relationship between Training Design Quality (TDQ) and Employee Skill Enhancement (ESE).
- H5: Learner Engagement mediates the relationship between Technology Support (TS) and Employee Skill Enhancement (ESE).

Sample

The study was conducted using data collected from 312 employees working across three major sectors: Information Technology (IT), Banking, and Manufacturing. A stratified random sampling technique was adopted to ensure proportional representation from each sector, thereby enhancing the generalizability of findings. Stratification minimized sector-specific bias and enabled cross-industry validation of the proposed structural model. The selected sample size exceeds the minimum threshold recommended for Structural Equation Modeling (SEM), ensuring adequate statistical power and model stability.

Instrument Development

Data were collected using a structured questionnaire designed based on established scales from prior HRM and training effectiveness literature. All measurement items were assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The instrument measured four latent constructs:

- Training Design Quality (TDQ) – 5 items
(e.g., clarity of objectives, interactive content, relevance of materials)
- Technology Support (TS) – 4 items
(e.g., platform usability, system reliability, technical assistance)
- Learner Engagement (LE) – 5 items
(e.g., active participation, focus during sessions, motivation to complete modules)
- Employee Skill Enhancement (ESE) – 6 items
(e.g., improvement in technical skills, communication ability, problem-solving competence)

The Items were reviewed for content validity by academic experts and HR professionals to ensure conceptual clarity and contextual relevance. Reliability and Validity: Reliability Analysis. Internal consistency reliability was assessed using Cronbach's Alpha: TDQ = 0.89, TS = 0.86, LE = 0.91, ESE = 0.93, All values exceed the recommended threshold of 0.70, indicating high internal consistency and reliability of measurement scales.

Composite Reliability (CR)

Composite Reliability values for all constructs were greater than 0.70, confirming construct reliability within the SEM framework. CR provides a more robust reliability estimate than Cronbach's Alpha in latent variable modeling.

Convergent Validity

Convergent validity was assessed using Average Variance Extracted (AVE). All constructs reported AVE values above 0.50, indicating that more than 50% of variance in observed variables is explained by the latent construct. Together, these results confirm that the measurement model satisfies reliability and validity requirements.

Data Analysis Using Structural Equation Modeling (SEM)

SEM was employed using AMOS 24 to simultaneously evaluate the measurement model and structural relationships among constructs. A two-step approach was adopted: (1) Confirmatory Factor Analysis (CFA) and (2) Structural Model testing.

Measurement Model (Confirmatory Factor Analysis)

Confirmatory Factor Analysis was conducted to validate the factor structure and assess model fit. The following goodness-of-fit indices were obtained:

- Chi-square/df = 2.41
- Comparative Fit Index (CFI) = 0.94
- Tucker-Lewis Index (TLI) = 0.92
- Root Mean Square Error of Approximation (RMSEA) = 0.052
- Goodness-of-Fit Index (GFI) = 0.91

Interpretation of Fit Indices

- A Chi-square/df value below 3 indicates acceptable model fit.
- CFI and TLI values above 0.90 indicate good comparative model fit.
- RMSEA below 0.06 suggests excellent approximation to the population covariance matrix.
- GFI above 0.90 confirms overall model adequacy.

All indices collectively demonstrate that the measurement model fits the data well.

Factor Loadings

All standardized factor loadings exceeded 0.65 and were statistically significant at $p < 0.001$, confirming strong relationships between observed indicators and their respective latent constructs. This establishes convergent validity within the CFA framework. The reliability analysis confirms internal consistency of constructs, while CFA results demonstrate satisfactory construct validity and measurement model fit. These findings justify proceeding to structural model testing to evaluate hypothesized relationships and mediation effects.

Structural Model Results

The structural model was assessed using AMOS to examine the hypothesized relationships among the latent constructs. The standardized path coefficients indicate statistically significant relationships in the proposed model. Specifically, Training Design Quality (TDQ) demonstrates a positive and significant influence on Learner Engagement (LE) ($\beta = 0.48, p < 0.001$), suggesting that well-structured instructional content, clarity of objectives, and interactive learning components substantially enhance employees' cognitive and behavioral involvement in online training programs. Similarly, Technology Support (TS) shows a significant positive effect on Learner Engagement ($\beta = 0.36, p < 0.001$), indicating that reliable digital infrastructure, user-friendly platforms, and adequate technical assistance facilitate active participation and sustained attention during training sessions.

Further, Learner Engagement exhibits a strong and statistically significant impact on Employee Skill Enhancement (ESE) ($\beta = 0.62, p < 0.001$). The magnitude of this coefficient highlights engagement as a critical explanatory mechanism through which digital training initiatives translate into measurable improvements in technical, problem-solving, and communication skills.

Among all structural paths, the relationship between LE and ESE is the strongest, emphasizing the central role of psychological involvement in achieving effective learning outcomes.

Mediation analysis using bootstrapping techniques confirms significant indirect effects. The indirect pathway from TDQ to ESE through LE ($\beta = 0.30$) and from TS to ESE through LE ($\beta = 0.22$) are both statistically significant. These findings indicate that Learner Engagement partially mediates the relationship between online training characteristics and employee skill enhancement. In other words, while instructional design and technological support directly foster engagement, their influence on skill development primarily operates through increased learner involvement. This partial mediation underscores that engagement serves as a key mechanism linking digital training inputs to competency outcomes, thereby strengthening the theoretical validity of the proposed SEM framework.

Table – 1 Descriptive Statistics– Interpretation

Variable	Mean	Std. Deviation
DQ	3.87	0.62
TS	3.74	0.59
LE	3.92	0.64
ESE	4.01	0.58

Table 1 presents the descriptive statistics for the four key constructs examined in the study: Training Design Quality (TDQ), Technology Support (TS), Learner Engagement (LE), and Employee Skill Enhancement (ESE). The mean scores for all variables range between 3.74 and 4.01 on a five-point Likert scale, indicating generally positive perceptions among respondents regarding the effectiveness of online training programs. Among the constructs, Employee Skill Enhancement (ESE) reports the highest mean value ($M = 4.01$, $SD = 0.58$), suggesting that employees perceive a noticeable improvement in their skills following participation in online training initiatives. This finding reflects the overall effectiveness of digital training interventions in enhancing competencies such as technical proficiency, communication ability, and problem-solving skills. Learner Engagement (LE) records a mean score of 3.92 ($SD = 0.64$), indicating a relatively high level of cognitive and behavioral involvement during online training sessions. The slightly higher standard deviation compared to other constructs suggests moderate variability in engagement levels among participants, possibly due to differences in motivation or digital readiness.

Training Design Quality (TDQ) shows a mean of 3.87 ($SD = 0.62$), implying that respondents generally perceive instructional content, structure, and interactivity to be well-designed. The moderate standard deviation indicates consistent perceptions across the sample. Technology Support (TS) has the lowest mean score ($M = 3.74$, $SD = 0.59$), although it remains above the neutral midpoint (3.00). This suggests that while technological infrastructure is viewed positively, there may still be room for improvement in areas such as platform usability, system reliability, or technical assistance. Overall, the relatively low standard deviation values (all below 0.70) indicate limited dispersion around the mean, reflecting consistency in responses. The descriptive statistics provide preliminary evidence that employees hold favorable perceptions of online training quality, engagement, and skill outcomes, thereby justifying further inferential analysis using Structural Equation Modeling.

Table 2 - Correlation Matrix – Interpretation

Variable	TDQ	TS	LE	ESE
TDQ	1	0.54	0.63	0.58
TS	0.54	1	0.59	0.55
LE	0.63	0.59	1	0.72
ESE	0.58	0.55	0.72	1

Table 2 represents the Pearson correlation coefficients among the four latent constructs: Training Design Quality (TDQ), Technology Support (TS), Learner Engagement (LE), and Employee Skill Enhancement (ESE). All correlations are positive and statistically significant, indicating meaningful associations among the study variables. The strongest correlation is observed between Learner Engagement (LE) and Employee Skill Enhancement (ESE) ($r = 0.72$), suggesting a strong positive relationship. This implies that higher levels of engagement during online training are associated with greater improvement in employee skills. The magnitude of this coefficient indicates substantial practical relevance and supports the theoretical assumption that engagement is a central mechanism influencing skill development.

The correlation between Training Design Quality (TDQ) and Learner Engagement (LE) ($r = 0.63$) is moderately strong, indicating that well-designed instructional content significantly enhances employee involvement in training activities. Similarly, Technology Support (TS) and Learner Engagement (LE) show a positive relationship ($r = 0.59$), suggesting that adequate digital infrastructure facilitates active participation. The correlations between TDQ and ESE ($r = 0.58$), and TS and ESE ($r = 0.55$), are moderate and positive. These findings indicate that both instructional quality and technological support are directly associated with skill enhancement. However, none of the correlation coefficients exceed 0.80, suggesting the absence of multicollinearity concerns and supporting discriminant validity among constructs.

Overall, the correlation matrix provides preliminary evidence of significant associations, justifying the use of Structural Equation Modeling (SEM) to test causal and mediating relationships.

Table 3: Regression Weights (SEM Output) – Interpretation

Path	Estimate	S.E	C.R	P	Result Shows
TDQ → LE	0.48	0.07	6.85	***	p < 0.001 (Highly significant)
TS → LE	0.36	0.06	5.92	***	p < 0.001 (Highly significant)
LE → ESE	0.62	0.08	7.74	***	p < 0.001 (Highly significant)

Table 3 presents the standardized regression weights derived from the structural model. These coefficients indicate the strength and direction of relationships among the latent constructs. The path from Training Design Quality (TDQ) to Learner Engagement (LE) is positive and significant ($\beta = 0.48$, C.R. = 6.85, $p < 0.001$). The critical ratio (C.R.) exceeds the threshold of 1.96, confirming statistical significance. This suggests that improvements in instructional design significantly increase employee engagement during online training. Similarly, Technology Support (TS) to Learner Engagement (LE) shows a significant positive effect ($\beta = 0.36$, C.R. = 5.92, $p < 0.001$). Although slightly weaker than TDQ, technological infrastructure remains a substantial predictor of engagement. The strongest structural relationship is observed between Learner Engagement (LE) and Employee Skill Enhancement (ESE) ($\beta = 0.62$, C.R. = 7.74, $p < 0.001$). This indicates that engagement has a powerful influence on skill improvement outcomes. The high beta value demonstrates strong predictive capability within the model.

The significance levels (***) indicating $p < 0.001$ confirm that all hypothesized direct relationships are statistically supported. The relatively high critical ratios further strengthen confidence in the robustness of the structural paths. In summary, while instructional quality and technological support significantly influence engagement, it is learner engagement that exerts the strongest direct impact on employee skill enhancement, reinforcing its mediating role within the SEM framework.

Discussion

The present study provides robust empirical evidence supporting the effectiveness of online training programs in enhancing employee skills through the mediating role of learner engagement. The findings demonstrate that Training Design Quality (TDQ) and Technology Support (TS) significantly influence Learner Engagement (LE), which in turn exerts a strong positive effect on Employee Skill Enhancement (ESE). These results reinforce the theoretical premise that the success of digital training initiatives depends not merely on content delivery but on the extent to which employees become cognitively and behaviorally involved in the learning process. High-quality instructional design emerged as a major determinant of engagement. Structured content, clarity of learning objectives, and interactive components appear to stimulate active participation and deeper information processing. This aligns with principles of instructional design theory, which emphasize learner-centered approaches and experiential learning mechanisms. When employees perceive training modules as relevant, well-organized, and interactive, they are more likely to invest effort and attention, leading to meaningful skill acquisition.

Similarly, adequate technological infrastructure was found to significantly enhance engagement levels. Reliable platforms, user-friendly interfaces, and accessible technical support reduce learning disruptions and enhance user experience. In digital learning environments, technological barriers can impede motivation and participation; therefore, the availability of seamless technological support functions as an enabling condition for effective training outcomes. The strongest structural relationship identified in the model was between Learner Engagement and Employee Skill Enhancement. This finding underscores engagement as a central psychological mechanism that translates training inputs into tangible competency development. Engagement reflects employees' focus, persistence, and emotional involvement, all of which contribute to improved knowledge retention and skill transfer to workplace contexts. The significant indirect effects further confirm that engagement partially mediates the relationship between training characteristics and skill enhancement, highlighting its explanatory importance.

Importantly, the application of Structural Equation Modeling (SEM) strengthens the empirical rigor of the study. Unlike traditional regression techniques, SEM allows for simultaneous testing of both measurement and structural models, ensuring construct validity while examining causal relationships. The satisfactory model fit indices and significant standardized path coefficients provide comprehensive validation of the proposed conceptual framework. By integrating measurement validation, mediation testing, and structural path analysis within a single analytical framework, the study offers more reliable and theoretically grounded conclusions. Overall, the findings suggest that organizations seeking measurable returns from online training investments must prioritize both pedagogical quality and technological robustness, while actively fostering learner engagement to achieve sustainable skill development outcomes.

Conclusion

The present study provides empirical validation for the effectiveness of online training programs in enhancing employee skills within contemporary organizational settings. The findings confirm that digital training initiatives yield significant competency improvements when supported by high-quality instructional design and reliable technological infrastructure. Merely adopting online platforms is insufficient; the effectiveness of such programs depends on how well training content is structured, delivered, and technologically supported. A key contribution of the study lies in identifying Learner Engagement as a vital mediating mechanism. The results demonstrate that engagement serves as the psychological bridge linking training inputs—such as instructional quality and technology support—to measurable skill development outcomes. Employees who exhibit higher levels of cognitive and behavioral involvement during online training are more likely to translate acquired knowledge into practical workplace competencies. Methodologically, the application of Structural Equation Modeling (SEM) strengthens the scientific rigor of the research by simultaneously validating measurement constructs and structural relationships. The validated model provides a reliable and replicable framework for assessing training effectiveness in diverse organizational contexts. Overall, the study contributes to HRM literature by offering a theoretically grounded and empirically tested model that can guide HR

practitioners, policymakers, and researchers in designing, evaluating, and optimizing online training interventions for sustainable employee skill development.

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