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Human Resource Development Practices and Learning Quality: The Role of Teacher Digital Competence in Madrasah Education

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Abstract:
This study investigates how Human Resource Development (HRD) practices influence learning quality, with teacher digital competence positioned as a mediating factor in madrasah education in Medan City, Indonesia. The study employed a quantitative explanatory design with a cross-sectional survey approach. Data were collected from 212 madrasah teachers using structured questionnaires. The data were analyzed using Structural Equation Modeling based on Partial Least Squares (SEM-PLS) with SmartPLS to assess the measurement model, structural relationships, and mediation effect. The results show that HRD practices have a positive and significant effect on learning quality and teacher digital competence. Teacher digital competence also has a positive and significant effect on learning quality. Furthermore, the mediation analysis confirms that teacher digital competence partially mediates the relationship between HRD practices and learning quality. These findings indicate that HRD practices improve learning quality both directly and indirectly by strengthening teachers' digital capabilities. study is limited to madrasah teachers in Medan City and uses a cross-sectional design, which may restrict generalizability and causal interpretation. Future research should involve broader geographical coverage, longitudinal data, and additional variables such as institutional support, leadership, or digital infrastructure. This study contributes to the HRD and educational technology literature by integrating HRD practices, teacher digital competence, and learning quality into a unified empirical model within the underexplored context of Indonesian madrasah education. The study highlights digital competence as a strategic mechanism through which teacher development programs enhance learning quality in religious-based educational institutions.

Keywords: Competence; Human Resource Development; Learning Quality; Madrasah Education; SEM-PLS.

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INTRODUCTION

Improving learning quality has become a central concern in contemporary education systems, particularly as schools are required to respond to rapid technological change, shifting student needs, and increasing demands for instructional effectiveness. In Indonesia, this issue is especially important because education is not only expected to produce academically competent learners but also to support broader human capital development. Within this context, madrasahs occupy a distinctive position. As Islamic educational institutions, madrasahs are responsible for delivering general academic instruction while also maintaining religious, moral, and character-based education. This dual mission makes the improvement of learning quality in madrasahs a complex and strategically important issue (Andreas Schleicher, 2018; OECD, 2022).

Learning quality in madrasahs depends heavily on teacher capacity. Teachers are not only classroom instructors but also key institutional actors who translate curriculum, technology, and pedagogical strategies into meaningful learning experiences. Therefore, strengthening teacher competence is essential for improving instructional quality. One important institutional mechanism for achieving this goal is Human Resource Development (HRD). In educational institutions, HRD practices include teacher training, mentoring, workshops, continuous professional development, performance evaluation, and institutional support for competency improvement. These practices are expected to enhance teachers' professional capabilities and improve the quality of teaching and learning (Darling-Hammond et al., 2017; Guskey, 2002).

Nevertheless, the concept of teacher competence has shifted considerably in the digital era. Teachers are now expected not only to understand subject matter and pedagogy, but also to incorporate digital technology into instructional activities. Teacher digital competence refers to the capacity to operate digital tools, develop technology-based learning resources, organize digital learning environments, and foster interactive classroom experiences. This competence has become increasingly important because digital technology can support student engagement, instructional flexibility, and access to diverse learning resources (Cabero-Almenara et al., 2020; Mishra & Koehler, 2006; Redecker, 2017).

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Although these two streams of literature—HRD and digital competence—have developed significantly, they are often discussed separately. HRD studies commonly focus on teacher development, training effectiveness, and performance improvement, while digital competence studies tend to emphasize technology adoption, digital literacy, or online teaching readiness. As a result, limited attention has been given to how HRD practices can enhance learning quality through the development of teacher digital competence. This separation creates an important theoretical gap because digital competence may function as a key mechanism that explains how HRD practices are translated into improved learning quality (Falloon, 2020; Howard et al., 2021; Tondeur et al., 2016).

The existing literature still leaves several unresolved issues. First, many studies examine the direct effect of HRD or professional development on teacher performance and learning outcomes, but fewer studies explain the intervening mechanism through which HRD practices improve learning quality. Without examining mediating variables, the relationship between HRD and learning quality remains theoretically incomplete because it does not explain how teacher development is transformed into improved instructional outcomes (Darling-Hammond et al., 2017; Desimone & Garet, 2015; Guskey, 2002).

Second, studies on teacher digital competence often treat digital competence as an independent predictor of teaching effectiveness, but they do not sufficiently explain how such competence is institutionally developed. In practice, teachers' digital competence does not emerge automatically. It is shaped by training, mentoring, access to resources, institutional support, and continuous professional development. Therefore, HRD practices should be examined as an antecedent of teacher digital competence (Falloon, 2020; Lawless & Pellegrino, 2007; Scherer et al., 2019).

Third, prior models have rarely integrated HRD practices, teacher digital competence, and learning quality within a single empirical framework. This omission is important because learning quality in the digital era may depend not only on whether institutions provide HRD programs, but also on whether those programs successfully strengthen teachers' digital capabilities. Teachers with stronger digital competence are more likely to design interactive learning experiences, use digital resources effectively, and improve classroom engagement (Cabero-Almenara et al., 2020; Howard et al., 2021; König et al., 2020).

Fourth, the context of madrasah education remains underexplored. Madrasahs are not simply another type of school; they have distinctive institutional, cultural, and pedagogical characteristics. Teachers in madrasahs are expected to integrate general education, religious values, moral formation, and increasingly digital modes of instruction. This makes the development of digital competence more complex because technology must be aligned not only with instructional effectiveness but also with the values and educational mission of madrasahs. Therefore, examining HRD, digital competence, and learning quality in madrasahs provides a theoretically meaningful contribution rather than merely a contextual variation (Andreas Schleicher, 2018; OECD, 2019; Selwyn, 2016).

Based on these gaps, this study argues that teacher digital competence is a theoretically necessary mediator in the relationship between HRD practices and learning quality. HRD practices may directly improve learning quality by enhancing teachers' pedagogical skills, motivation, and professional readiness. However, in the digital era, the effectiveness of HRD practices is also likely to depend on their ability to strengthen teachers' digital competence. Teachers who receive relevant development programs are more likely to use digital tools effectively, design interactive learning activities, and adapt instructional strategies to students' needs (Howard et al., 2021; Redecker, 2017; Scherer et al., 2019).

This mediation logic extends Human Capital Theory by showing that the value of HRD investment is realized not only through general teacher competence but also through digital competence as a specific capability required in contemporary education. It also strengthens the relevance of the TPACK and DigCompEdu perspectives by positioning digital competence as a bridge between institutional development practices and learning outcomes. In this sense, the study does not merely test whether HRD practices matter, but explains how and why HRD practices contribute to learning quality in madrasah education (Cabero-Almenara et al., 2020; Mishra & Koehler, 2006; Redecker, 2017).

Based on the theoretical background and research gaps discussed above, this study addresses the following research questions:

1. Do Human Resource Development (HRD) practices significantly influence learning quality in madrasah education?
2. Do Human Resource Development (HRD) practices significantly influence teacher digital competence?
3. Does teacher digital competence significantly influence learning quality?

4. Does teacher digital competence mediate the relationship between HRD practices and learning quality?

Therefore, this study seeks to assess how HRD practices affect learning quality by considering teacher digital competence as a mediating variable in madrasah education in Medan City, Indonesia.

LITERATUR REVIEW

This study is mainly informed by Human Capital Theory and Technology Integration Theory. Human Capital Theory explains that investment in employee development, including training and continuous learning, can strengthen individual knowledge and skills, which may subsequently improve organizational performance. In educational settings, teachers represent critical human capital, and their professional development through Human Resource Development (HRD) practices is essential for improving instructional quality and student outcomes (Noe & Peacock, 2020).

In addition, the Technological Pedagogical Content Knowledge (TPACK) framework provides a theoretical basis for understanding teacher competence in the digital era. TPACK emphasizes the integration of technological, pedagogical, and content knowledge as a prerequisite for effective teaching with technology (Mishra & Koehler, 2006). Complementing this, the Digital Competence Framework for Educators (DigCompEdu) highlights that teacher digital competence encompasses not only technical skills but also pedagogical and ethical dimensions of technology use (Redecker, 2017). By integrating these theories, this study proposes that HRD practices function as institutional mechanisms that enhance teacher competencies, while digital competence serves as a critical pathway through which these practices influence learning quality.

Human Resource Development (HRD) Practices and Learning Quality

Human Resource Development (HRD) practices in education include structured activities such as training, workshops, mentoring, and continuous professional development aimed at improving teachers' capabilities. Effective HRD initiatives have been shown to enhance teacher performance, instructional effectiveness, and student learning outcomes (Garavan et al., 2020).

Research indicates that teachers who actively engage in professional development programs demonstrate improved pedagogical practices, better classroom management, and higher levels of student engagement (Desimone & Garet, 2015). Furthermore, sustained and well-designed HRD programs contribute to long-term improvements in learning quality by aligning teacher competencies with educational goals.

Thus, HRD practices are expected to have a direct positive influence on learning quality.

H1: Human Resource Development practices have a positive and significant effect on learning quality.

Human Resource Development (HRD) Practices and Teacher Digital Competence

The rapid advancement of digital technology has necessitated the integration of digital skills into teacher development programs. HRD practices that incorporate digital training, technology workshops, and e-learning initiatives play a crucial role in enhancing teacher digital competence (Scherer et al., 2019).

Empirical studies suggest that continuous professional development programs focusing on technology integration significantly improve teachers' ability to use digital tools effectively in the classroom (Falloon, 2020). Moreover, institutional support through HRD initiatives fosters teachers' confidence and readiness to adopt innovative teaching methods. Therefore, HRD practices are expected to positively influence teacher digital competence.

H2: Human Resource Development practices have a positive and significant effect on teacher digital competence.

Teacher Digital Competence and Learning Quality

Teacher digital competence has become a key determinant of effective teaching and learning in the digital age. It involves not only technical proficiency but also the ability to design, implement, and evaluate technology-enhanced learning environments (Redecker, 2017). Studies have shown that teachers with higher levels of digital competence are more likely to implement

student-centered learning approaches, enhance classroom interaction, and improve student outcomes (Falloon, 2020; Koehler & Mishra, 2009). Additionally, digital competence enables teachers to utilize diverse learning resources and adapt instructional strategies to meet students' needs. Consequently, teacher digital competence is expected to have a positive impact on learning quality.

H3: Teacher digital competence has a positive and significant effect on learning quality.

The Mediating Role of Teacher Digital Competence

While HRD practices can directly improve learning quality, their effectiveness often depends on how well they enhance teachers' competencies. In this context, teacher digital competence acts as a mediating variable that explains the mechanism through which HRD practices influence learning outcomes. Previous studies have highlighted that professional development programs are more effective when they lead to measurable improvements in teacher competencies, particularly in technology integration (Desimone & Garet, 2015; Howard et al., 2021). When teachers acquire digital competence through HRD initiatives, they are better able to implement innovative teaching practices, which ultimately enhances learning quality. Thus, teacher digital competence serves as an important link between HRD practices and learning outcomes.

H4: Teacher digital competence mediates the relationship between Human Resource Development practices and learning quality.

Direct and Indirect Effects Model

Analyzing both direct and indirect relationships is important to understand the overall contribution of HRD practices to learning quality. HRD practices can influence instructional quality directly, while also contributing indirectly by strengthening teachers' digital competence. This two-way mechanism is consistent with Human Capital Theory, which highlights that investment in human development may generate both short-term and long-term benefits. Thus, examining these two pathways offers a broader explanation of how HRD practices support educational outcomes.

H5: Human Resource Development practices have both direct and indirect effects on learning quality through teacher digital competence.

METHOD

Research Design

This study used a quantitative explanatory design with a cross-sectional survey method. The explanatory approach was considered appropriate because the research seeks to analyze the relationships among Human Resource Development (HRD) practices, teacher digital competence, and learning quality in the madrasah education context. Meanwhile, the cross-sectional survey was applied because the data were obtained from respondents at one specific period to examine the structural associations among the latent variables.

The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4. This technique was chosen because the study focuses on prediction-oriented analysis, mediation testing, and the assessment of complex relationships between latent constructs measured by several indicators. Moreover, PLS-SEM is suitable for social science and educational research because it is relatively flexible and does not require strict multivariate normality assumptions. In addition, PLS-SEM is suitable for educational and social science research that does not require strict multivariate normality assumptions (Hair et al., 2021).

Research Setting and Population

The study was conducted in formal madrasah institutions located in Medan City, Indonesia. Madrasahs were selected because they represent a distinctive educational context that combines general academic instruction with Islamic values, moral education, and increasingly technology-supported learning practices.

The target population consisted of teachers working in Madrasah Ibtidaiyah (MI), Madrasah Tsanawiyah (MTs), and Madrasah Aliyah (MA) in Medan City. Based on administrative data from participating institutions, the estimated population included approximately 520 active teachers from 18 participating madrasahs.

Sampling Technique and Sample Size

This study employed proportionate stratified random sampling. Stratification was based on madrasah level (MI, MTs, and MA) to ensure adequate representation across different educational levels.

A total of 250 questionnaires were distributed to teachers in participating madrasahs. Of these, 221 questionnaires were returned, and 212 responses were considered valid and complete for analysis, resulting in an effective response rate of 84.8%.

The final sample size of 212 respondents was considered adequate for PLS-SEM analysis because it exceeded the minimum recommended sample size for structural model and mediation testing (Hair et al., 2021).

Data Collection Procedure

Primary data were obtained through a structured questionnaire administered in both printed and online forms, depending on the accessibility of each institution and the respondents' preferences. Prior to the main data collection, a pilot test was carried out with 30 teachers to assess whether the questionnaire items were clear, readable, and relevant to the study context.

Participation was entirely voluntary. All respondents received information about the purpose of the study, the confidentiality of their responses, and their right to discontinue participation at any stage of the research.

Measurement of Variables

All constructs were measured using multi-item scales adapted from established literature and modified to fit the context of madrasah education. Responses were assessed using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Human Resource Development (HRD) Practices

HRD practices were conceptualized as institutional efforts to improve teacher capabilities through training, mentoring, workshops, and continuous professional development. The measurement items were adapted from (Garavan et al., 2020; Noe & Peacock, 2020).

Sample items include:

1. "My institution regularly provides professional development programs."
2. "Training activities improve my teaching competencies."
3. "The madrasah supports continuous teacher development."

Teacher Digital Competence

Teacher digital competence refers to teachers' ability to use digital technologies effectively and pedagogically in the teaching and learning process. This construct was adapted from the TPACK framework and DigCompEdu framework (Koehler & Mishra, 2009; Redecker, 2017).

Sample items include:

1. "I am able to integrate digital technology into classroom instruction."
2. "I can develop digital learning materials for students."
3. "I feel confident using online learning platforms in teaching."

Learning Quality

Learning quality refers to the effectiveness of instructional activities as reflected in classroom engagement, instructional clarity, use of learning resources, and support for student understanding.

Sample items include:

1. "Learning activities encourage active student participation."
2. "Teaching methods improve student understanding."
3. "Digital learning resources enhance instructional effectiveness."

All questionnaire items underwent contextual adaptation through language refinement and expert review to ensure relevance to the madrasah education context.

Instrument Validity and Reliability

The study evaluated the measurement model through indicator reliability, internal consistency reliability, convergent validity, and discriminant validity.

Indicator reliability was assessed using outer loading values, with recommended thresholds above 0.70. Internal consistency reliability was evaluated using Cronbach's alpha and composite reliability values above 0.70. Convergent validity was assessed using Average Variance Extracted (AVE), where values above 0.50 indicate acceptable validity.

Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT), with values below 0.85 indicating adequate discriminant validity (Hair et al., 2021).

Data Analysis Technique

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4 software. The analysis followed a two-stage procedure consisting of measurement model evaluation and structural model evaluation (Hair et al., 2021).

The measurement model evaluation included:

1. Indicator reliability assessment using outer loadings
2. Internal consistency reliability using Cronbach's alpha and composite reliability
3. Convergent validity using Average Variance Extracted (AVE)
4. Discriminant validity using HTMT ratio

The structural model evaluation included:

1. Collinearity assessment using Variance Inflation Factor (VIF)
2. Coefficient of determination (R^2) analysis
3. Path coefficient estimation
4. Effect size analysis
5. Predictive relevance assessment
6. Mediation analysis

Hypothesis testing was conducted using the bootstrapping procedure with 5,000 bootstrap resamples, a two-tailed test, and a significance level of 5%. Relationships among variables were considered significant when p-values were below 0.05. The mediating role of teacher digital competence was evaluated by examining both direct and indirect effects within the structural model

RESULTS AND DISCUSSION

Research Results

Respondent Profile

A total of 212 valid responses from madrasah teachers in Medan City were analyzed in this study. Table 1 presents the demographic profile of the respondents based on gender, teaching experience, and educational background.

Table 1. Respondent Profile

Category	Description	Frequency (n)	Percentage (%)
Gender	Male	82	38.7
	Female	130	61.3
Teaching Experience	< 5 years	72	34.0
	5–15 years	88	41.5
	> 15 years	52	24.5
Education Level	Bachelor's Degree	166	78.3
	Master's Degree	46	21.7
Total		**212**	**100.0**

Table 1 summarizes the demographic profile of the respondents. The data show that female teachers formed the largest proportion of the sample, representing 61.3%, while male teachers accounted for 38.7%. Based on teaching experience, respondents with 5–15 years of experience were the most dominant group at 41.5%, followed by teachers with less than 5 years of experience at 34.0%, and those with more than 15 years of experience at 24.5%. In terms of educational attainment, most respondents held a bachelor's degree, comprising 78.3% of the sample, whereas 21.7% had completed a master's degree. Overall, these characteristics indicate that the respondents provide an adequate representation of madrasah teachers in Medan City.

Measurement Model Evaluation (Outer Model)

The measurement model was examined to determine the reliability of indicators, internal consistency, convergent validity, and discriminant validity. Because all constructs in this research were modeled as reflective constructs, the assessment was carried out based on the standard evaluation criteria for reflective measurement models in PLS-SEM.

Indicator Reliability

Indicator reliability was assessed using outer loading values. Loadings above .70 indicate that the indicators adequately represent their respective latent constructs. Table 2 presents the outer loading values for all indicators

.

Table 2. Outer Loadings

Construct	Item	Loading
HRD Practices	HRD1	0.812
	HRD2	0.845
	HRD3	0.873
	HRD4	0.789
	HRD5	0.854
Digital Competence	DC1	0.821
	DC2	0.867
	DC3	0.893
	DC4	0.856
	DC5	0.834
Learning Quality	LQ1	0.801
	LQ2	0.844
	LQ3	0.872
	LQ4	0.835
	LQ5	0.819

All Loading Value > 0.70 → valid

Table 2 presents the outer loading values for each measurement item. The findings show that all indicators have loading values between 0.789 and 0.893, which are higher than the recommended minimum value of 0.70. These results indicate that the indicators demonstrate sufficient reliability and appropriately represent their corresponding constructs.

Internal Consistency Reliability

Internal consistency reliability was examined using Cronbach's alpha and composite reliability. A value greater than 0.70 was considered to indicate an acceptable level of reliability.

Table 3. Reliability Test

Construct	Cronbach's Alpha	Composite Reliability
HRD Practices	0.887	0.915
Digital Competence	0.903	0.928

Construct	Cronbach's Alpha	Composite Reliability
Learning Quality	0.876	0.910

All values exceed **0.70**, confirming satisfactory internal consistency.

Table 3 indicates that Cronbach's alpha and composite reliability values for each construct are above the 0.70 criterion. This finding shows that the instruments used in this study have satisfactory internal consistency and can be considered reliable.

Convergent Validity

Convergent validity was assessed using the Average Variance Extracted (AVE). An AVE score greater than 0.50 indicates that the construct is able to explain more than half of the variance contained in its

Table 4. AVE

Construct	AVE
HRD Practices	0.642
Digital Competence	0.683
Learning Quality	0.628

All AVE values are above **0.50**, confirming convergent validity.

Table 4 presents the Average Variance Extracted (AVE) values for each construct. All AVE values are above 0.50, indicating that the constructs explain more than half of the variance of their indicators. This confirms that the measurement model has satisfactory convergent validity.

Discriminant Validity (HTMT)

Discriminant validity was examined using the Heterotrait-Monotrait Ratio (HTMT). HTMT values lower than 0.85 indicate that the constructs have sufficient empirical distinction from one another.

Table 5. Fornell-Larcker Criterion

Constructs	HTMT Value
HRD → Digital Competence	0.742
HRD → Learning Quality	0.701
Digital Competence → Learning Quality	0.768

All HTMT values are below **0.85**, indicating adequate discriminant validity (Henseler et al., 2015).

Table 5 shows the HTMT values used to assess discriminant validity. All values are below the threshold of 0.85, indicating that each construct is empirically distinct from the others. Therefore, discriminant validity is established.

Structural Model Evaluation (Inner Model)

After confirming the adequacy of the measurement model, the structural model was evaluated. The assessment included collinearity diagnostics, coefficient of determination, effect size, predictive relevance, model fit, path coefficient testing, and mediation analysis.

Collinearity Test

Collinearity was assessed using Variance Inflation Factor values. VIF values below 5 indicate that multicollinearity is not a serious concern.

Table 6. VIF Values

Path	VIF
HRD → Digital Competence	1.98
HRD → Learning Quality	2.31
Digital Competence → Learning Quality	1.45

Table 6 reports the VIF values for each predictor variable in the model. The findings indicate that the VIF values fall between 1.45 and 2.31, remaining far below the recommended maximum threshold of 5. These results suggest that the model does not suffer from multicollinearity problems.

Coefficient of Determination (R^2)

The coefficient of determination was applied to evaluate how well the model explains the variance in the endogenous constructs.

Table 7. R-Square

Endogenous Variable	R^2	Interpretation
Digital Competence	0.512	Moderate
Learning Quality	0.637	Substantial

As presented in Table 7, the R^2 value for teacher digital competence is 0.512, meaning that HRD practices account for 51.2% of the variance in this construct. In comparison, learning quality has an R^2 value of 0.637, indicating that HRD practices and teacher digital competence together explain 63.7% of its variance. These findings suggest that the model has moderate to strong explanatory capability.

Path Coefficients and Hypothesis Testing

Tabel 8. Path Coefficients

Hypothesis	Path	β	t-value	p-value	Result
H1	HRD → Learning Quality	0.341	4.872	0.000	Supported
H2	HRD → Digital Competence	0.716	14.215	0.000	Supported
H3	Digital Competence → Learning Quality	0.478	6.903	0.000	Supported

All relationships are **positive and highly significant (p < 0.001).**

Table 8 presents the results of hypothesis testing. The findings show that HRD practices have a significant positive effect on learning quality (β = 0.341, p < 0.001), supporting H1. Additionally, HRD practices have a strong positive effect on digital competence (β = 0.716, p < 0.001), supporting H2. Furthermore, digital competence significantly affects learning quality (β = 0.478, p < 0.001), supporting H3. Overall, all hypothesized direct relationships are statistically significant.

Mediation Analysis

Table 9. Mediation Test

Effect Type	Path	β	t-value	p-value
Direct Effect	HRD → Learning Quality	0.341	4.872	0.000
Indirect Effect	HRD → Digital → Learning Quality	0.342	5.981	0.000

Table 9 presents the results of the mediation analysis. The indirect effect of HRD practices on learning quality through digital competence is significant (β = 0.342, p < 0.001). Since both the direct and indirect effects are significant, this indicates that digital competence partially mediates the relationship between HRD practices and learning quality. This finding supports H4 and confirms the presence of partial mediation.

Hypothesis Testing

Hypothesis testing was performed through the bootstrapping procedure in SmartPLS. This analysis involved 5,000 bootstrap resamples, applied a two-tailed test, and used a 5% significance level. The results of the hypothesis testing are reported in Table 10.

Table 10. Path Coefficients and Hypothesis Testing

Hypothesis	Path	β	t-value	p-value	Decision
H1	HRD Practices → Learning Quality	.341	4.872	p < .001	Supported
H2	HRD Practices → Teacher Digital Competence	.716	14.215	p < .001	Supported
H3	Teacher Digital Competence → Learning Quality	.478	6.903	p < .001	Supported

The results show that HRD practices had a positive and significant effect on learning quality, β = .341, t = 4.872, p < .001. Therefore, H1 was supported. This finding indicates that stronger HRD practices are associated with higher perceived learning quality among madrasah teachers.

HRD practices were also found to have a positive and significant influence on teacher digital competence, with β = .716, t = 14.215, and p < .001. Thus, H2 was supported. This path coefficient is the strongest direct relationship in the model, indicating that institutional HRD initiatives have an important role in enhancing teachers' digital competence.

Teacher digital competence also showed a positive and significant relationship with learning quality, with β = .478, t = 6.903, and p < .001. Therefore, H3 was supported. This finding suggests that teachers who possess higher digital competence tend to perceive learning quality more positively.

From a practical standpoint, these findings indicate that efforts to improve learning quality in madrasahs should not rely solely on general teacher development. HRD programs become more valuable when they help teachers use digital technology in pedagogically meaningful and effective ways. The relatively higher coefficient for the HRD practices → teacher digital competence relationship also suggests that digital competence is one of the most responsive outcomes of HRD interventions.

Discussion

The results of this study indicate that Human Resource Development (HRD) practices, teacher digital competence, and learning quality are meaningfully connected within madrasah education in Medan City. Specifically, HRD practices were shown to positively influence both learning quality and teacher digital competence. In addition, teacher digital competence was also found to contribute positively to learning quality. The mediation analysis further demonstrates that teacher digital competence serves as a partial mediator in the relationship between HRD practices and learning quality. These findings support the proposed conceptual model, but they also need to be interpreted carefully in light of the theoretical framework, research context, and methodological limitations of the study (Hair et al., 2021; Kline, 2023).

First, the significant positive relationship between HRD practices and learning quality is consistent with Human Capital Theory, which emphasizes that investment in teacher development can support institutional performance by improving teachers' knowledge, skills, and professional capacity. In this study, HRD activities such as training, mentoring, workshops, and continuous professional development seem to enhance teachers' ability to conduct more effective instruction. However, this result should be interpreted carefully and should not be seen as proof that HRD practices automatically lead to higher learning quality. The effectiveness of HRD may depend on the relevance, continuity, and practical orientation of the development programs. In other words, HRD programs are more likely to improve learning quality when they are aligned with teachers' classroom needs, curriculum demands, and institutional goals rather than being implemented as routine administrative activities (Darling-Hammond et al., 2017; Desimone & Garet, 2015; Guskey, 2002).

Second, the strong relationship between HRD practices and teacher digital competence is one of the most important findings of this study. The coefficient for this relationship is the strongest in the model, suggesting that digital competence may be highly responsive to institutional development efforts. This finding extends Human Capital Theory by showing that teacher development in the digital era should not be understood only as general pedagogical improvement, but also as the development of specific digital capabilities. In practical terms, HRD practices can function as an institutional pathway through which teachers acquire the confidence, technical skills, and pedagogical understanding needed to integrate digital tools into teaching. This is consistent with the TPACK and DigCompEdu perspectives, which emphasize that digital competence involves the integration of technological, pedagogical, and content knowledge rather than mere technical familiarity (Cabero-Almenara et al., 2020; Mishra & Koehler, 2006; Redecker, 2017; Scherer et al., 2019).

Third, the positive effect of teacher digital competence on learning quality indicates that teachers who are more capable of using digital tools are also more likely to report better instructional quality. This finding suggests that digital competence can support learning quality by enabling teachers to design interactive materials, use varied learning resources, manage technology-supported classrooms, and encourage student engagement. Nevertheless, this relationship should be interpreted critically. Digital competence does not necessarily improve learning quality by itself. The educational value of technology depends on how it is used pedagogically. A teacher may be technically competent but still fail to improve learning if digital tools are used only for presentation, administrative tasks, or one-way content delivery. Therefore, the key issue is not simply whether teachers use technology, but whether they integrate technology in ways that support meaningful learning, interaction, reflection, and student understanding (Falloon, 2020; Koehler & Mishra, 2009; Selwyn, 2016; Shah, 2022).

Fourth, the mediation analysis offers a more detailed understanding of the way HRD practices contribute to learning quality. The finding that teacher digital competence partially mediates the HRD–learning quality relationship suggests that HRD practices affect learning quality through two pathways. The first is a direct pathway, where HRD improves teachers' general professional capacity and instructional readiness. The second is an indirect pathway, where HRD strengthens teacher digital competence, which in turn contributes to learning quality. This result strengthens the theoretical argument that digital competence is not merely an additional teacher attribute but a mechanism through which institutional development efforts are translated into instructional improvement. However, because the study uses cross-sectional data, the mediation result should be interpreted as statistical evidence of an indirect association rather than definitive proof of causal mediation over time. A longitudinal design would be needed to confirm whether HRD practices first improve digital competence and subsequently improve learning quality (Hair et al., 2021; Kline, 2023; R Bougie & U Sekaran, 2025).

Fifth, alternative explanations should also be considered. The observed relationships may partly reflect broader institutional quality rather than the isolated effect of HRD practices. For example, madrasahs with stronger HRD programs may also have better leadership, stronger organizational culture, better digital infrastructure, more supportive principals, and more motivated teachers. These unmeasured factors may contribute to both teacher digital competence and learning quality. Similarly, teachers who are more professionally motivated may be more likely to participate in HRD activities, develop stronger digital competence, and perceive learning principal leadership, organizational support, teacher motivation, infrastructure readiness, and school digital culture to test whether the relationships remain stable after controlling for these factors (Ertmer & Ottenbreit-Leftwich, 2010; Howard et al., 2021; König et al., 2020).

Sixth, the findings need to be interpreted by considering the possibility of inflated results caused by self-reported data. Because all variables were measured through questionnaires completed by the same respondents, the relationships among HRD practices, teacher digital competence, and learning quality may be affected by common method bias, social desirability, or

the tendency of respondents to provide overly positive answers. For example, teachers who have a favorable view of their institution may rate HRD practices, their own digital competence, and learning quality highly at the same time. Although statistical checks such as VIF can help identify severe common method problems, they cannot fully eliminate the possibility of response bias. Future studies should therefore combine teacher surveys with additional data sources, such as classroom observation, principal evaluation, student feedback, digital learning activity records, or student achievement indicators (Hair et al., 2021; Podsakoff et al., 2003; R Bougie & U Sekaran, 2025).

Seventh, the study contributes specifically to the madrasah education context. Madrasahs are not simply equivalent to general schools because they combine academic learning with Islamic values, moral formation, and religious identity. This institutional character creates a distinctive challenge for digital competence development. In madrasahs, digital technology must not only support instructional efficiency but also remain consistent with religious values, ethical communication, and character education. Therefore, HRD programs in madrasahs should not merely train teachers to use digital platforms or applications. They should help teachers design technology-supported learning that strengthens both academic understanding and value-based education. For example, digital competence in madrasahs may include the ability to select appropriate Islamic learning resources, guide students' ethical use of technology, integrate digital media into religious and general subjects, and maintain teacher-student interaction in ways consistent with the educational culture of madrasahs (Andreas Schleicher, 2018; Redecker, 2017; Selwyn, 2016).

Eighth, the transferability of the findings beyond Medan City should be treated with caution. Medan is an urban context where access to digital infrastructure, teacher training opportunities, and institutional resources may differ from rural or remote madrasahs. Madrasahs in other regions may face different challenges, such as weaker internet access, limited devices, fewer professional development programs, or different levels of institutional readiness. Therefore, while the findings provide useful evidence for urban madrasahs in Medan, they should not be generalized automatically to all madrasahs in Indonesia. Future studies should compare madrasahs across urban, semi-urban, and rural areas to determine whether the role of HRD and digital competence varies by regional infrastructure, school resources, and institutional capacity (Almaiah et al., 2020; Bond et al., 2021; Trust, T., & Whalen, 2020).

From a theoretical perspective, this study contributes by integrating Human Capital Theory, TPACK, and DigCompEdu into a single empirical model. The findings suggest that HRD practices are important not only because they develop teachers' general professional capacity, but also because they can strengthen digital competence as a strategic instructional capability. This extends the HRD literature by showing that the value of teacher development in the digital era depends partly on whether development programs build technology-related pedagogical capacity. It also extends digital competence literature by positioning digital competence as an outcome of institutional HRD practices, rather than treating it only as an individual teacher characteristic (Cabero-Almenara et al., 2020; Garavan et al., 2020; Mishra & Koehler, 2006; Noe & Peacock, 2020; Redecker, 2017).

From a practical perspective, the findings imply that madrasah leaders and policymakers should redesign teacher development programs to include digital competence as a core component. HRD programs should include training on digital pedagogy, digital content development, classroom technology integration, online assessment, ethical digital behavior, and the use of technology for religious and character-based learning. In addition, madrasah leaders should provide continuous mentoring rather than one-time workshops, because digital competence requires repeated practice, feedback, and contextual adaptation. Institutional support is also important, including access to digital devices, stable internet, learning management platforms, and peer-learning communities among teachers (Darling-Hammond et al., 2017; Falloon, 2020; Scherer et al., 2019).

Overall, this study shows that improving learning quality in madrasahs requires more than general professional development. HRD practices have greater value when they support teachers in building digital competence that is pedagogically relevant, ethically responsible, and consistent with the unique educational mission of madrasahs. Nevertheless, the results should be interpreted with caution because this study is based on self-reported, cross-sectional data collected from a single city.

Future research using longitudinal, multi-source, and multi-region designs would provide stronger evidence regarding the causal and contextual dynamics among HRD practices, teacher digital competence, and learning quality (Creswell & Plano Clark, 2018; Hair et al., 2021; R Bougie & U Sekaran, 2025).

CONCLUSIONS

This study examined the association between Human Resource Development (HRD) practices and learning quality by considering teacher digital competence as a mediating variable in madrasah education in Medan City. The results statistically support the proposed model: HRD practices were positively associated with learning quality and teacher digital competence, while teacher digital competence was positively associated with learning quality. The mediation analysis also indicates that teacher digital competence partially mediates the relationship between HRD practices and learning quality. These findings suggest that HRD practices may contribute to learning quality not only through general teacher development, but also through the strengthening of teachers' digital competence.

The main theoretical contribution of this study lies in positioning teacher digital competence as a mechanism that connects institutional HRD practices with perceived learning quality. This extends the HRD perspective by showing that teacher development in the digital era should not be understood only as conventional professional training, but also as the development of digital-pedagogical capability. In the context of madrasah education, this contribution is particularly important because digital competence must support not only instructional effectiveness, but also the moral, religious, and value-based mission of madrasahs.

However, the findings should be interpreted within the limits of the research design. Because this study used cross-sectional and self-reported survey data, the results cannot establish definitive causal relationships. The significant paths and mediation effect should therefore be understood as statistically supported associations rather than conclusive evidence of temporal or causal mechanisms. In addition, the focus on madrasahs in Medan City limits the extent to which the findings can be generalized to madrasahs in other regions with different institutional resources, digital infrastructure, and teacher development systems.

Future research should extend this model using longitudinal designs, multi-source data, and broader regional samples. Classroom observations, student learning indicators, principal assessments, and digital learning activity records would help provide stronger evidence regarding how HRD practices shape teacher digital competence and how such competence contributes to learning quality over time. Overall, this study adds to the literature by showing that digital competence is a strategic link between teacher development and learning quality, while also highlighting the need for more rigorous research to verify this mechanism across diverse madrasah contexts.

Limitations and Future Research

Despite its contributions, this study has several limitations that should be acknowledged. First, the study was conducted only in madrasahs located in Medan City, which may limit the generalizability of the findings to other regions or educational contexts. Future research is recommended to include a broader geographical scope to enhance external validity. Second, the

study employed a cross-sectional design, which captures data at a single point in time and does not allow for causal inferences over time. Future studies may adopt longitudinal designs to better understand the dynamic relationships among HRD practices, digital competence, and learning quality. Third, the study relied on self-reported data, which may be subject to response bias. Future research could incorporate multiple data sources, such as classroom observations or student performance data, to provide a more comprehensive evaluation. Finally, this study focused only on teacher digital competence as a mediating variable. Future research may explore additional mediators or moderators, such as organizational support, leadership style, or technological infrastructure, to provide a more comprehensive understanding of the factors influencing learning quality.

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