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The Mediating Role of Teachers' Digital Competence in the Relationship Between Curriculum Management and Smart Learning

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Abstract :
This study explores the mediating role of teachers' digital competence in the relationship between curriculum management and smart learning. Using a quantitative, correlational survey design, the study sampled 219 teachers from State Islamic Senior High Schools in Samarinda, selected via simple random sampling. Data were analysed using JASP V.0.16 for simple linear regression and mediation effects. The findings reveal positive and significant relationships between curriculum management and teachers' digital competence, curriculum management and smart learning, and teachers' digital competence and smart learning. Moreover, teachers' digital competence partially mediates the relationship between curriculum management and smart learning. These results highlight that effective curriculum management enhances teachers' readiness to utilise digital technology and directly contributes to the successful implementation of smart learning in madrasahs. This research provides insights into improving curriculum management practices to enhance digital competence and facilitate smart learning.

INTRODUCTION

The integration of digital technologies into education has become an essential factor in maintaining the relevance of teaching, enhancing student engagement, and improving instructional practices (Sarva et al., 2023; Wechsler & Hellmich et al., 2023). As societies increasingly rely on digital tools, the need for digital competence in education becomes more pronounced. This shift not only influences how teachers prepare and deliver content but also how students interact with and absorb information. Evidence suggests that integrating digital skills into teaching can significantly improve the quality of education, particularly in areas with limited access to traditional resources (Polin et al., 2023; Goagoses et al., 2024). The importance of cultivating these competencies cannot be overstated, as the ability to leverage technology can bridge educational gaps, increase motivation, and meet the evolving demands of 21st-century learning. Therefore, this study is vital in understanding how digital competence impacts curriculum management and smart learning, making it an important step in improving educational practices globally.

To examine the relationship between curriculum management, digital competencies, and smart learning, this study draws upon various theoretical frameworks.

The DigCompEdu framework, which assesses teachers' digital competence, provides the foundation for understanding how educators can integrate technology into their teaching practices. Additionally, the theory of smart learning environments, which emphasises the role of data and digital tools in personalising education (McGarr, 2024; Stan et al., 2022), helps contextualise the implementation of smart learning curricula. By combining these frameworks, the study seeks to explore the interactions between teachers' digital skills, curriculum management, and the delivery of smart learning experiences.

Despite growing recognition of digital competence as a core teaching skill, many teachers continue to face significant challenges integrating technology effectively into their teaching environments. These challenges stem from a variety of factors, including limited access to infrastructure, lack of training, and resistance to change (Trezise et al., 2024). The gap between curriculum management and teachers' digital competencies is a persistent issue that hampers the potential of digital learning systems. Furthermore, the shift towards smart learning is often hindered by insufficient support for teachers, particularly in terms of professional development and resources (Masoumi & Noroozi, 2023). These problems are particularly evident in schools with limited resources, where the adoption of digital tools is often slow, and the effective implementation of smart learning curricula is delayed or incomplete.

Previous research has extensively examined the role of digital competence in teaching, emphasising the need for continuous professional development and the integration of digital technologies into education (Zou et al., 2023; Vassilakopoulou & Hustad, 2023). Studies have also shown that smart learning environments can improve student engagement and learning outcomes when teachers are adequately prepared (Polin et al., 2023). However, much of the existing literature focuses on isolated aspects of these topics, such as technology adoption or digital tools, without addressing the interrelationship between curriculum management, teachers' digital competence, and smart learning outcomes. For example, research by Iqbal et al. (2024) underscores the role of teachers' emotional, volitional, and cognitive capacities in their readiness to adopt digital technologies. However, it does not examine how curriculum management influences this process. This study contributes to bridging these gaps by offering a comprehensive framework that links curriculum management with teachers' digital competencies and the implementation of smart learning. However, a significant gap remains in how these components work together to create an effective educational environment that embraces smart learning.

This study offers an innovative approach by integrating curriculum management and teachers' digital competencies into a cohesive framework for implementing smart learning. The research contributes to the ongoing dialogue in educational technology by examining the mediating role of digital competencies, an area that has not been sufficiently addressed in the existing literature. Moreover, this study fills a critical gap in understanding how curriculum management practices can directly enhance the implementation of smart learning, which is becoming increasingly prevalent in global educational systems. The novelty lies in its focus on the interaction between these key factors, offering insights that can inform future educational strategies and policies.

The primary objective of this study is to examine the relationships among curriculum management, smart learning, and teachers' digital competencies at State Islamic Senior High School in Samarinda. The study addresses the following research questions:

1. Is there a positive and significant relationship between curriculum management (CM) and teachers' ICT competencies (TDC)?
2. Is there a positive and significant relationship between TDC and smart learning (SL)?
3. Is there a positive and significant relationship between CM and SL?
4. Does TDC mediate the relationship between CM and SL?

The hypotheses are grounded in the assumption that effective curriculum management will enhance teachers' digital competencies, thereby facilitating the successful implementation of smart learning. By addressing these questions, this study aims to offer practical insights to improve curriculum management practices, develop educators' digital competencies, and advance the integration of smart learning into educational systems.

RESEARCH METHODS

This study employs a quantitative research design with a correlational approach to examine the relationships between Curriculum Management (CM), Teacher Digital Competence (TDC), and Smart Learning (SL). This design was chosen because it allows analysis of relationships among variables based on teacher perceptions, offering a clearer understanding of how these factors interact in the context of education. The correlational approach enables the identification of associations between the involved factors without direct intervention, providing findings that are more representative on a larger scale (Singh, 2003; Wagner, 2015).

The research was conducted at two State Islamic Senior High Schools in Samarinda, namely State Islamic Senior High School 1 and State Islamic Senior High School 2. The location was selected based on the relevance of these schools to the research topic, particularly in terms of curriculum management and the use of technology in teaching. Both schools represent Islamic senior high schools that implement varying degrees of technology-supported education, making them ideal for exploring the relationships between curriculum management, digital competence, and smart learning.

Data were collected through a survey using a Likert-scale-based questionnaire with five response options: Always (5), Often (4), Rarely (3), Sometimes (2), and Never (1). This instrument was designed to measure three key variables: Curriculum Management (CM), Teacher Digital Competence (TDC), and Smart Learning (SL). The questionnaire was first piloted with 30 teachers from State Islamic Senior High Schools in Balikpapan and Kutai Kartanegara to ensure clarity and comprehension. This data collection technique enabled the researcher to gather in-depth information on teachers' perceptions of the educational practices at their respective schools.

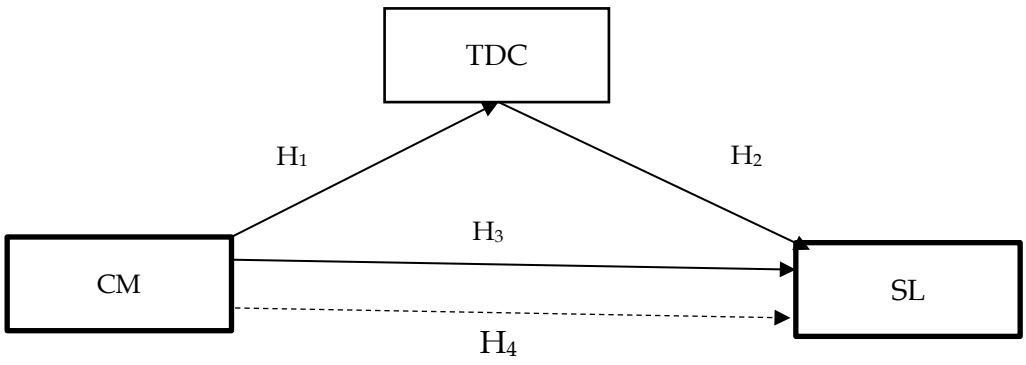

Figure 1. Research Conceptual Framework

Figure 1: Conceptual framework for this study, focusing on the relationships between Curriculum Management (CM), Teacher Digital Competence (TDC), and Smart Learning (SL). The framework shows that TDC acts as a mediator between CM and SL, with hypothesized relationships denoted as H1, H2, H3, and H4. These hypotheses aim to test the direct relationships between CM and TDC (H1), TDC and SL (H2), CM and SL (H3), and the mediating effect of TDC on the CM-SL relationship (H4). The diagram visually represents how each variable is interconnected, suggesting that curriculum management influences teachers' digital competencies, which, in turn, enhances the implementation of smart learning.

The collected data were analysed using JASP V.0.16, which enabled the application of a simple linear correlation test (Product-Moment) to identify relationships between variables. The strength of correlation was categorised into five levels: very weak ($r < 0.20$), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79), and very strong (0.80–1.00). Data validity was assessed using the Kolmogorov-Smirnov test; $p < 0.05$ indicated non-normality and $p > 0.05$ indicated normality (Ghasemi & Zahediasl, 2012). Additionally, the instrument's reliability was assessed using Cronbach's alpha, with values above 0.6 considered acceptable.

RESULTS AND DISCUSSION

Results

Validity and reliability tests were conducted on 30 teachers who possessed characteristics similar to those of the main sample. The following table presents the complete results for all three variables, serving as a summary of the validity and reliability testing.

Table 1. Results of Validity and Reliability Tests

Variable	Item–Total Correlation	Cronbach's Alpha	Interpretation
CM	0.519-0.877 > 0.30, p < .05	0.856	Valid & Reliable
TDC	0.654-0.910 > 0.30, p < .05	0.891	Valid & Reliable
SL	0.481-0.887 > 0.30, p < .05	0.871	Valid & Reliable

Table 1 presents the results of the validity and reliability tests for the research instrument all items within the CM, TDC, and SL constructs. The item–total correlations are significant and exceed the recommended threshold of 0.30 ($p < 0.05$), indicating that all items are valid. The reliability tests yield Cronbach's (α) value ranging from 0.871 to 0.891, which are above the acceptable minimum of 0.70, demonstrating that all three variables have reliable coefficients. These findings confirm that all measurement instruments used in the subsequent analyses are both valid and reliable.

Normality testing was conducted for all variables using the Kolmogorov–Smirnov statistic. The results of the normality tests for the CM, TDC, and SL variables as show in Table 2.

Table 2. Results of Normality Tests for CM, TDC, and SL

Variable	Kolmogorov–Smirnov (D)	p-value	Interpretation
CM	0.079	0.389	Normal
TDC	0.082	0.348	Normal
SL	0.083	0.334	Normal

Table 2 presents the results of the normality tests for the three variables, all of which show significance values greater than 0.05 ($p > .05$). Thus, the data are normally distributed and meet the normality assumption required for subsequent analyses.

Descriptive Statistics

Before conducting inferential analyses, the descriptive statistical results for the three SL variables had been obtained. The descriptive statistics offer an initial overview of the data distribution and the central tendencies of each variable, as shown in Table 3.

Table 3. Descriptive Statistics of CM, TDC, and SL

Decriptive Catagory	CM	SL	TDC
Valid	129	129	129
Missing	0	0	0
Mean	82.13	82.02	82.13
Std. Deviation	6.203	5.829	6.228
Minimum	68.00	67.00	68.00
Maximum	96.00	95.00	96.00

Table 3 presents the descriptive statistics, indicating that all 129 responses are valid with no missing data. The lowest mean score is 82.02, with the highest standard deviation of 6.228, and values ranging from a minimum of 67 to a maximum of 96. These results suggest that the three variables are at relatively high levels and display a balanced distribution among the respondents.

Hypothesis Testing

Hypothesis testing was conducted to describe the relationships among the variables proposed in the study.

Curriculum Management and Teachers' Digital Competence

The following section presents the findings regarding the relationship between CM and TDC to test H1. The results of the analysis are shown in table 4.

Table 4. Linear Regression Results between CM and TDC

Model	R	R^2	F	p	Predictor	Standardized β	t	p
M_1	0.986	0.972	4,393	<.001	TDC	0.986	66.281	<.001

Based on Table 4, the correlation coefficient between CM and TDC is 0.986, which falls within the 'very strong' category (Daly & Cohen, 1978). The R^2 value of 0.972 indicates that CM explains 97.20% of the variance in teachers' digital competence (Goss-Sampson, 2022). The ANOVA table shows an $F_{\text{-count}}$ of 4.393 with $p < .001$, demonstrating a significant relationship between CM and TDC. The standardized coefficients further reveal a t-value of 66.281 with $p < .001$, confirming the significance of the model. Therefore, the proposed hypothesis is supported, indicating a significant positive association between curriculum management and teachers' digital competence.

Teachers' Digital Competence and Smart Learning

The following section presents the results of hypothesis testing for H2, which examines the relationship between TDC and SL, as shown in Table 5.

Table 5. Linear Regression Results between TDC and SL

Model	R	R^2	F	p	Predictor	Standardized β	t	p
M_1	0.933	0.870	851.4	<.001	SL	0.933	29.179	<.001

Table 5 shows a correlation coefficient of 0.933, which falls into the very strong category. The coefficient of determination (R^2) is 0.870, indicating that the TDC variable explains 87.00% of the variance in smart learning. The ANOVA results yield an $F\text{-}_{count}$ of 851.4 with $p < .001$, demonstrating a significant positive relationship between TDC and SL. The standardized coefficients indicate a t-value of 29.179 with $p < .001$, confirming the significance of the model. Therefore, the proposed hypothesis is accepted, indicating that teachers' digital competence has a positive and significant relationship with smart learning

Curriculum Management and Smart Learning

The following section presents the results of hypothesis testing for H3, which examines the relationship between CM and SL. The complete results of the analysis are shown in Table 6.

Table 6. Linear Regression Results between CM and SL

Model	R	R^2	F	p	Predictor	Standardized β	t	p
M_1	0.930	0.865	814.9	<.001	SL	0.930	28.546	<.001

Table 6 shows a correlation coefficient of 0.930, which falls within the very strong category. The coefficient of determination (R^2) is 0.865, indicating that the SL variable accounts for 86.50% of the variance in CM. The ANOVA results show an $F\text{-}_{count}$ of 814.9 with $p < .001$, demonstrating a positive relationship between CM and SL. The standardized model coefficients yield a t-value of 28.546 with $p < .001$, confirming the significance of this relationship. Therefore, the proposed hypothesis is accepted, indicating a positive and significant relationship between curriculum management and smart learning.

Mediating Role of TDC

The results of hypothesis testing for H4, which examines the relationship between CM and SL with TDC as a mediating factor, are presented in table 7.

Table 7. Relationship between CM and SL through TDC as a Mediating Factor

Path	Std. Estimate	Std. Error	z-value	p	Lower	Upper
CM → TDC → SL	0.557	0.183	3.042	0.002	0.198	0.915

Based on the output in table 7, the indirect effect of the mediating factor TDC is 0.557 with a p-value of 0.002 (< 0.05), suggesting that the effect is statistically significant of CM on SL through TDC is significant. The standardized estimate is 0.557 with a standard error of 0.183, a z-value of 3.042, and a p-value of 0.002 (< 0.01). The 95% confidence interval further confirms the presence of this mediating effect. These findings indicate that the influence of CM on SL occurs not only directly but also indirectly through the enhancement of TDC. Thus, TDC strengthens the effect of CM on SL, with CM remaining significant in the direct pathway, demonstrating a partial mediation (Baron & Kenny, 1986).

The results of all hypothesis tests form a model with the path coefficients illustrated in figure 2.

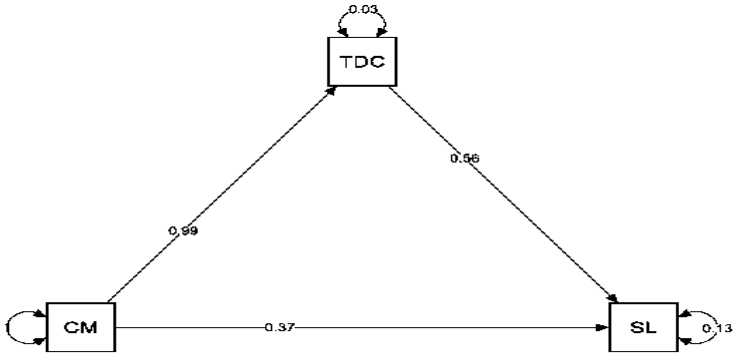

Figure 2. Structural Model of the Research Findings

Figure 2 presents the structural model examining the relationships among CM, TDC, and SL, with TDC serving as a mediating variable. The path coefficient from CM to TDC (0.99) indicates a very strong positive effect, while the path from TDC to SL (0.56) shows a moderate contribution of teachers' digital competence to smart learning. The direct path from CM to SL (0.37) remains positive but weaker than the indirect effect through TDC, suggesting that much of CM's influence on SL operates via TDC. The low residual values (0.03 for TDC and 0.13 for SL) indicate minimal unexplained variance, supporting the conclusion that strengthened curriculum management enhances smart learning, particularly through improved teachers' digital competence.

Discussion

The results of this study reveal important insights into the relationships between curriculum management, teacher digital competence, and smart learning. First, the positive and significant relationship between curriculum management and teachers' digital competence underscores the crucial role of structured professional development in enhancing educators' digital skills. These findings align with previous research, which emphasises the importance of targeted training programs to improve teachers' digital competencies in the digital era (Syahid & Dewi, 2023; Parusheva & Stenard, 2023). Furthermore, the study found that teachers' digital competence has a significant impact on smart learning, supporting the idea that teachers with higher digital proficiency can better integrate technology into their teaching, thereby creating more adaptive and innovative learning environments (Rahimi & Zhang, 2016; Erstad et al., 2021). Additionally, the positive relationship between curriculum management and smart learning highlights the need for curriculum frameworks that incorporate digital leadership and innovation to improve both teacher performance and student competencies (Ngongo et al., 2022; Timan et al., 2022).

These findings are consistent with existing literature, which demonstrates the critical role of digital competence in fostering smart learning environments. Teachers' digital competence, which encompasses instrumental, didactic, communicative, and information-seeking skills, has been shown to facilitate the integration of digital tools into instruction (Menacho-Vargas et al., 2021; Lovren & Jablanovic, 2023). As digital competence enhances teachers' ability to utilise technology effectively, it contributes directly to smart learning by improving teaching behaviours and student outcomes,

especially in technology-rich and sustainability-focused educational settings (Cao et al., 2023; Löfving, 2024). The integration of digital literacy into curriculum management is pivotal for enhancing the delivery of competency-based curricula, as evidenced by studies in Kenyan primary schools that successfully incorporated digital tools into curriculum delivery (Luke Murithi & Mbaka, 2022; Patwardhan et al., 2023).

Moreover, the study confirms the mediating role of teacher digital competence in the relationship between curriculum management and smart learning. This aligns with previous research, which suggests that digital competence not only strengthens the effect of curriculum management on smart learning but also moderates improvements in classroom management and instructional quality (Peters et al., 2022; Soepriyanti et al., 2025). As a mediator, digital competence enables teachers to leverage digital tools more effectively, fostering more integrated and innovative learning practices that directly support the implementation of smart learning (Tejada et al., 2023; Muñoz-Castro et al., 2022). These findings emphasise the critical importance of developing digital competence as a key factor in optimising curriculum management and advancing smart learning practices across educational institutions.

Despite the consistent contributions of existing studies, significant challenges remain in effectively integrating digital competence into curriculum management. Research highlights that many prospective teachers still possess low levels of digital proficiency, which hampers the effective use of digital technologies in educational contexts (Santos & Garcias, 2022; Goss-Sampson, 2022; Albó et al., 2022). To address these gaps, more robust, practice-oriented training programs are needed that focus on the practical applications of digital technologies in teaching. Furthermore, the creation of modern digital learning environments and the continual updating of professional education systems are essential to support the systemic adoption of digital methods (Chorosova et al., 2022; Kuş & Mert, 2024). Teachers, especially in higher education, often report low to moderate levels of digital competence, underscoring the need for personalised training aligned with the demands of the digital age (Basilotta-Gómez-Pablos et al., 2022).

Finally, the evolving nature of digital competence frameworks, which are increasingly focused on emerging technologies such as artificial intelligence, underscores the need to continuously redefine digital skills to meet the demands of modern education (Howard & Tondeur, 2023; Baron & Kenny, 1986). Strengthening teachers' digital competencies and improving students' digital literacy are key to preparing educators for the challenges of the digital era (Tondeur et al., 2023; Gorina et al., 2023). This study highlights the need for comprehensive frameworks that integrate curriculum management, teacher digital competence, and smart learning to foster an adaptive, sustainable educational system capable of addressing the ever-changing demands of the digital age.

CONCLUSION

This study provides valuable insights into the relationships between curriculum management, teacher digital competence, and smart learning. The key finding is that there is a positive and significant relationship among curriculum management, teacher digital competence, and smart learning, as well as between curriculum management and smart learning. Furthermore, teacher digital competence serves as a mediator between curriculum management and smart learning, with increased digital competence

positively impacting smart learning outcomes. These findings emphasise the importance of effective curriculum management in enhancing teachers' digital readiness, which, in turn, significantly contributes to the success of smart learning initiatives. The study highlights the importance of curriculum management in shaping the quality of education through digital tools and teaching practices.

While this study makes significant contributions to understanding the interconnected roles of curriculum management, teacher digital competence, and smart learning, several limitations suggest directions for future research. The data were collected from only two public Islamic senior high schools in Samarinda, limiting the generalizability of the findings to other schools in the region or nationally. Additionally, the study focused on a single mediating variable, teacher digital competence, while other potential factors, such as digital leadership or technological infrastructure, may also influence smart learning outcomes. Future research should expand the sample to include a more diverse range of schools and regions, incorporate mixed-method approaches to deepen the understanding of smart learning dynamics, and explore additional mediating or moderating variables.

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