

Date Received : July 2026
Date Revised : August 2026
Date Accepted : August 2026
Date Published : August 2026

THE MEDIATING ROLE OF TEACHERS' INNOVATIVE BEHAVIOUR IN LINKING CURRICULUM INNOVATION AND INSTITUTIONAL RESOURCES TO LEARNING QUALITY IN ISLAMIC EARLY CHILDHOOD EDUCATION

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Keywords:

Inovasi Kurikulum;
Pendidikan Anak
Usia Dini Islam;
Mutu Belajar; Partial
Least Squares; Studi
Simulasi; Perilaku
Inovatif Guru

ABSTRACTS

Reformasi kurikulum telah memasuki pendidikan anak usia dini Islam dengan harapan bahwa mutu belajar akan membaik, namun mekanisme di tingkat kelas yang mengubah kurikulum baru menjadi praktik yang bermutu pada Raudhatul Athfal masih jarang dijelaskan secara terang. Penelitian ini menguji, pada tataran spesifikasi model dan pengujian ilustratif, apakah perilaku inovatif guru memediasi hubungan antara inovasi kurikulum, kompetensi digital guru, kepemimpinan instruksional, dan iklim belajar yang suportif dengan mutu belajar pada pendidikan anak usia dini Islam. Kajian ini diposisikan secara eksplisit sebagai studi simulasi yang bersifat metodologis dan bukan sebagai survei empiris. Model hipotetis dispesifikasikan lalu diuji secara ilustratif menggunakan data sintetis yang terdiri atas 300 observasi simulasi yang dibangkitkan untuk mereproduksi struktur respons survei guru Raudhatul Athfal. Pemodelan persamaan struktural berbasis partial least squares diterapkan dengan bootstrap 5.000 subsampel untuk memeriksa jalur langsung dan jalur tidak langsung. Di dalam data simulasi tersebut model pengukuran memenuhi seluruh ambang batas, dengan reliabilitas komposit antara 0,905 dan 0,921 serta rasio heterotrait-monotrait tidak lebih dari 0,65. Perilaku inovatif guru diprediksi oleh keempat anteseden, yang secara bersama-sama menjelaskan 45 persen variansnya, sementara model menjelaskan 36 persen varians mutu belajar. Inovasi kurikulum berhubungan dengan mutu belajar melalui mediasi parsial komplementer, sedangkan ketiga anteseden lainnya menunjukkan pola mediasi indirect-only melalui perilaku inovatif. Karena seluruh observasi bersifat simulasi, hasil ini menunjukkan koherensi dan keterestimasian model yang diajukan dan bukan bukti empiris mengenai guru Raudhatul Athfal yang sesungguhnya. Replikasi

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	empiris dengan data lapangan diperlukan sebelum klaim pada tingkat populasi dapat diajukan.
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Curriculum Innovation; Islamic Early Childhood Education; Learning Quality; Partial Least Squares; Simulation Study; Teacher Innovative Behaviour	Curriculum reform has entered Islamic early childhood education in the expectation that learning quality will improve, yet the classroom-level mechanism that turns a new curriculum into quality practice in Raudhatul Athfal is still rarely specified. This study examines, at the level of model specification and illustrative testing, whether teachers’ innovative behaviour mediates the relationships linking curriculum innovation, teacher digital competence, instructional leadership, and a supportive learning climate to learning quality in Islamic early childhood education. The study is positioned explicitly as a simulation-based methodological contribution rather than as an empirical survey. The hypothesised model was specified and then tested illustratively using a synthetic dataset consisting of 300 simulated observations generated to reproduce the response structure of a survey of Raudhatul Athfal teachers. Partial least squares structural equation modelling was applied, and a bootstrap of 5,000 subsamples was used so that direct and indirect paths could be examined. Within the simulated dataset the measurement model met all thresholds, with composite reliability between 0.905 and 0.921 and heterotrait-monotrait ratios not exceeding 0.65. Teachers’ innovative behaviour was predicted by all four antecedents, which jointly accounted for 45 per cent of its variance, while the model accounted for 36 per cent of the variance in learning quality. Curriculum innovation was associated with learning quality through complementary partial mediation, whereas the three remaining antecedents showed an indirect-only pattern through innovative behaviour. Because all observations are simulated, the results demonstrate the coherence and estimability of the proposed model and do not constitute empirical evidence about actual Raudhatul Athfal teachers. Empirical replication with field data is required before any population-level claim can be made.

A. INTRODUCTION

The quality of early childhood education shapes a child’s development long before formal schooling begins, and within the Islamic stream of Indonesian education this concern carries an additional dimension. Raudhatul Athfal, the Islamic kindergarten operating under the Ministry of Religious Affairs, is expected to cultivate not only the cognitive and social capacities of the child but also early religious character and *akhlak*, so that the quality of its teaching acquires both a developmental and a moral significance (Masnipal & Tri Yugo, 2025; Ainnin & Ismail, 2024). Recent assessments indicate that overall learning quality can meet national standards, although performance remains uneven across institutions and is closely related to the way teachers work (Masnipal & Tri Yugo, 2025; Zunaidah & Rokhmah, 2023). The institution stands between national curriculum policy and a distinctive religious mission, and how well it serves children is closely tied to what teachers actually do in the classroom.

Curriculum reform has reached this setting through the Merdeka agenda, which grants teachers wider latitude to design learning that suits the needs of young children, and through its adoption in madrasah and Raudhatul Athfal under the Ministry of Religious Affairs (Hunaepi & Suharta, 2024; Dermawan et al., 2026). The expectation attached to such reform is that a better curriculum will be followed by better learning,

yet the situation is more complex, because a curriculum is only as strong as the teaching that enacts it. Studies of how the Merdeka curriculum has been received repeatedly point to a distance between policy intention and classroom enactment, with teachers reporting uneven understanding of its core components and practical obstacles that slow implementation (Suci et al., 2025; Wahyuningtyas et al., 2023). In early childhood settings, readiness to plan, deliver, and assess under the new curriculum varies, and institutional support is often thin (Ashfarina et al., 2023; Umar et al., 2025). Curriculum innovation is a structural input and learning quality is an outcome, which leaves an intermediate mechanism to be specified.

This study proposes that the intermediate mechanism is teachers' innovative behaviour. The construct has a long history in organisational research, where Scott and Bruce (1994) modelled individual innovation as a sequence running from problem recognition to implementation, and where De Jong and Den Hartog (2010) refined its measurement into four connected activities, namely opportunity exploration, idea generation, idea promotion, and idea implementation. Applied to teaching, innovative behaviour describes a teacher who notices a classroom problem, designs a new response, persuades colleagues or leaders, and then puts that response to work with children. Recent educational research treats this behaviour as a lever for school improvement, since it marks the point at which abstract policy becomes concrete pedagogy (Izzati et al., 2023; K. Li et al., 2024). A reform that widens teacher discretion does not by itself raise quality, because it creates room for innovative behaviour, and it is that behaviour which is expected to translate a new curriculum into developmentally appropriate practice. Curriculum innovation is therefore expected to be associated with learning quality both directly, through the content it supplies, and indirectly, through the innovative behaviour it invites.

The early childhood sector makes this mechanism particularly salient, because young children learn through relationships, play, and responsive interaction rather than through transmission, so the quality of their education is highly sensitive to how a teacher works. A curriculum cannot script those interactions, and a digital tool cannot supply them, and reviews of the field document how much of the variation in early childhood quality is attributable to teacher practice rather than to provided resources (X. Li et al., 2024). A model that positions innovative behaviour between resources and quality is therefore well suited to the way early learning is produced.

Curriculum innovation is not the only resource that may reach learning quality through teacher behaviour, since literature identifies three further antecedents. The first is teacher digital competence. As classrooms absorb digital tools and media, teachers' technological skill has become part of professional competence rather than an optional addition, and in Islamic early childhood settings it is increasingly tied to the integration of religious content (Ainnin & Ismail, 2024; Disonglo & Limpot, 2023). Systematic reviews show that digital competence develops unevenly among early career teachers and is related to willingness to experiment (Masoumi & Noroozi, 2023), while among early childhood teachers, attitudes toward digital technology are related to actual competence and to readiness for meaningful technology integration (Merjovaara et al., 2024; Scherer et al., 2023). Scoping reviews frame this competence as a precondition for innovative and high-quality practice rather than a guarantee of it (H.

Li et al., 2024), so digital competence is most plausibly related to innovative behaviour, which in turn supports quality.

The second antecedent is instructional leadership. Research links what principals do with how teachers behave, and a more recent strand focuses on the leadership practices that release teacher innovation. Within Raudhatul Athfal, transformative and instruction-oriented leadership has been associated with improvement in the quality of Islamic early childhood education through the management of curriculum, personnel, and the wider community (Islamiyah et al., 2024; Zunaidah & Rokhmah, 2023). Authentic leadership has likewise been associated with teaching innovation through mediators such as perceived insider status and wellbeing (Lu et al., 2025). The common thread is that leadership rarely touches learning outcomes directly, since it operates by shaping the conditions and the behaviour of teachers, which makes innovative behaviour a plausible mediator of its association with quality.

The third antecedent is a supportive learning climate, understood here as the collegial relationships, the psychological safety, and the institutional backing that surround a teacher's daily work. A climate in which interpersonal risk taking is safe is regarded as necessary for innovative behaviour, since teachers are unlikely to attempt unfamiliar practices where mistakes are penalised. In early childhood education the professional learning community has been studied as the concrete form such a climate frequently takes, and collaborative and supportive climates are repeatedly associated with teaching quality (Olmo-Extremera et al., 2025; Silva et al., 2025; Yang et al., 2023). For Islamic institutions this climate is also bound up with the strengthening of management and of the professional culture that distinguishes higher performing madrasah and Raudhatul Athfal (Zakariyah, 2024), so the climate is better understood as a source of innovative behaviour than as a direct correlate of quality.

These four resources acquire a particular meaning in Islamic early childhood education, and the distinction matters for the way innovative behaviour is conceptualised in this study. In a general early childhood setting, innovative behaviour is bound mainly by developmental appropriateness and by institutional feasibility. In Raudhatul Athfal a further boundary applies, because any new practice is expected to remain consistent with Islamic values and with the formative aims of religious education. Curriculum innovation in this setting is not simply the adoption of new content but the adaptation of that content so that the integration of Islamic values is preserved. Digital innovation is valued less for its novelty than for the extent to which it serves Islamic educational objectives, including the presentation of religious content in a form that young children can absorb. Play-based learning, which is the pedagogical core of early childhood practice, is expected to carry character formation and *akhlak* alongside cognitive and social goals, and the habituation of worship, known as *pembiasaan ibadah*, is treated as part of learning quality rather than as an addition to it. Teachers' innovative behaviour in Raudhatul Athfal is therefore a bounded form of innovation, in which idea generation and implementation pass through a judgement of religious appropriateness before they pass through a judgement of pedagogical feasibility (Ainnin & Ismail, 2024; Dermawan et al., 2026; Zakariyah, 2024). This is the conceptual difference that distinguishes the present model from a general model of

teacher innovation, and it is carried through into the way curriculum innovation and learning quality are operationalised below.

Taken together, the four antecedents share a single structure, since each is a resource on which a teacher may draw and none of them teaches a child. Teachers do that, and they do it well when they behave innovatively. The wider literature on innovative work behaviour supports this logic, since innovative behaviour has repeatedly been positioned as the mediator between organisational resources and valued outcomes in fields beyond education (Ghani et al., 2023; Gautam & Gautam, 2024; Zafar et al., 2023). Three strands of prior work can therefore be distinguished. Previous studies have established that curriculum reform in Indonesia is implemented unevenly and that teacher readiness is a recurring constraint, that leadership, climate, and digital competence are each correlated with teaching quality, and that innovative work behaviour mediates between resources and outcomes in organisational settings outside education. What remains unexplained is whether this mediating structure holds in Islamic early childhood education, where the outcome includes religious character formation and where curriculum innovation is the focal antecedent of policy concern, since much of the existing evidence in this setting is descriptive or correlational and does not model the behavioural path between antecedent and outcome (Nalbantoğlu & Bümen, 2024). Learning quality is understood here in developmental terms that include appropriate and engaging practice, an environment and assessment that support learning, and holistic outcomes that, within the Islamic stream, include early character and religious formation (Alsubaie, 2024; Masnipal & Tri Yugo, 2025).

The contribution of this study is accordingly threefold. It specifies a behavioural mechanism that links curriculum reform to learning quality in a setting where that mechanism has usually been assumed rather than modelled. It places four resources within a single structure so that their relative pathways can be compared instead of being examined one at a time. It defines innovative behaviour, curriculum innovation, and learning quality in terms that are specific to Islamic early childhood education rather than borrowed unchanged from general school research. Table 1 positions the study against the strands of previous work summarised above, distinguishing what those studies have established, what they leave unexplained, and what the present study adds.

Table 1. Positioning of the present study in relation to previous research

Strand of previous work	Representative studies	What has been established	What remains unexplained	Position of the present study
Implementation of curriculum reform in Indonesia	Suci et al. (2025); Wahyuningtyas et al. (2023); Ashfarina et al. (2023); Umar et al. (2025)	Uneven teacher understanding and readiness slow the enactment of the Merdeka curriculum	Whether teachers' behaviour, rather than understanding alone, accounts for the distance between curriculum and quality	Specifies innovative behaviour as the intermediate construct between curriculum innovation and learning quality

Strand of previous work	Representative studies	What has been established	What remains unexplained	Position of the present study
Leadership and institutional culture in madrasah and Raudhatul Athfal	Islamiyah et al. (2024); Zunaidah & Rokhmah (2023); Zakariyah (2024)	Instructional and transformative leadership and institutional culture are associated with the quality of Islamic education	Whether the association operates directly or through teacher-level behaviour	Estimates direct and indirect pathways simultaneously within one model
Teacher digital competence in early childhood education	Masoumi & Noroozi (2023); Merjovaara et al. (2024); Scherer et al. (2023); H. Li et al. (2024)	Digital competence develops unevenly and is a precondition for innovative pedagogy	Whether it relates to learning quality independently of innovative practice	Specifies digital competence as an antecedent of innovative behaviour rather than of quality
Innovative work behaviour as a mediator	Scott & Bruce (1994); De Jong & Den Hartog (2010); Ghani et al. (2023); Gautam & Gautam (2024); Zafar et al. (2023)	Innovative behaviour mediates between organisational resources and valued outcomes outside education	Whether the same structure holds where the outcome is pedagogical and includes religious formation	Transfers the mediating structure to Islamic early childhood education and tests it illustratively
Quality of Islamic early childhood education	Masnipal & Tri Yugo (2025); Ainnin & Ismail (2024); Dermawan et al. (2026)	Quality is uneven across Raudhatul Athfal and includes akhlak and religious habituation	Which classroom-level mechanism accounts for the variation	Operationalises quality to include akhlak and pembiasaan ibadah and links it to a behavioural antecedent

Source: Authors' construction based on the cited literature (2026)

Three research questions follow from this positioning.

RQ1: Do curriculum innovation, teacher digital competence, instructional leadership, and a supportive learning climate predict teachers' innovative behaviour?

RQ2: Does teachers' innovative behaviour predict learning quality?

RQ3: Does teachers' innovative behaviour mediate the relationships between these antecedents and learning quality?

Because field data from Raudhatul Athfal teachers were not available at the time of writing, these questions are addressed here through an explicitly illustrative procedure. A synthetic dataset of 300 simulated observations, generated to reproduce the response structure typical of a survey of early childhood teachers, is used to demonstrate that the specified model is estimable, that its measurement structure is internally coherent, and that the hypothesised mediating pathways can be recovered and reported. The study is therefore a simulation-based methodological contribution rather than an empirical survey. No claim is made about the actual behaviour of Raudhatul Athfal teachers or about the actual quality of learning in those institutions, and every result reported below should be read as a property of the specified model within simulated data. This position is maintained consistently in the method, the results, the discussion, and the conclusion.

B. METHOD

This study employed a quantitative, cross-sectional design analysed with variance-based structural equation modelling. The design is suited to the aim, which is to test a network of relationships among latent constructs and to estimate the indirect paths that define mediation. Partial least squares structural equation modelling was chosen rather than the covariance-based method because the model is prediction-oriented, contains several reflectively measured constructs, and includes a mediating variable whose indirect paths are central to the research questions (Hair et al., 2019). The analysis used 300 simulated observations. This number exceeds the minimum required for the most complex regression in the model and satisfies the common rule of thumb for stable partial least squares estimation (Hair et al., 2022), and it was set for that reason rather than because it corresponds to a realised sample of teachers.

The status of the data requires explicit statement, since it governs how every result below may be read. The dataset analysed here is synthetic. It was constructed so that it reproduces the response structure of a survey of early childhood teachers, preserving the six-construct design, the item wording, and the positively skewed response distribution typical of such samples, and it was generated so that the measurement and structural properties of the model could be examined transparently. The 300 observations are simulated cases and do not represent 300 actual Raudhatul Athfal teachers. No respondent was surveyed, no institution was sampled, and no population parameter is estimated. Every coefficient reported below is a property of the specified model within simulated data, and none of them constitutes empirical evidence about teachers, classrooms, or institutions. The synthetic dataset encodes only the 24 indicator items and does not encode demographic attributes, so an empirical replication would additionally report a complete respondent profile, including gender, age, teaching experience, level of education, the status of the Raudhatul Athfal as state or private, and region, so that the representativeness of the sample could be judged. In keeping with this position, the term simulated observations is used throughout in place of participants or respondents, and the verbs predicts and is associated with are used in place of causes, produces, or leads to.

The instrument contained 24 items distributed equally across six constructs, with four reflective indicators each, measured on a five-point Likert scale ranging from strongly disagree to strongly agree. Curriculum innovation was operationalised through the adoption of new curriculum content, the integration of Islamic values into thematic and play-based units, alignment with the Merdeka curriculum as implemented in Raudhatul Athfal, and openness to revising learning materials. Teacher digital competence covered the use of digital tools and media, the creation of digital resources, troubleshooting, and the pedagogical integration of technology. Instructional leadership captured instructional guidance, feedback on teaching, goal setting for learning, and support for pedagogical improvement. The supportive learning climate reflected collegial collaboration, psychological safety, encouragement to experiment, and institutional support for new ideas. Teachers' innovative behaviour was specified through the four dimensions of De Jong and Den Hartog (2010), namely opportunity exploration, idea generation, idea promotion, and idea implementation. Learning quality was operationalised through developmentally appropriate and play-based practice, child engagement, the quality of the learning environment together with assessment that supports learning, and holistic outcomes that, within the Islamic stream, include early character or *akhlak* and the habituation of worship known as *pembiasaan ibadah*. Because the study is set in Islamic early childhood education, the constructs of curriculum innovation and learning quality were adapted so that the integration of Islamic values and the formation of *akhlak* form part of how innovation and quality are defined, following the conceptual distinction set out in the introduction. The indicator framework draws on validated scales, with innovative behaviour following De Jong and Den Hartog (2010) and the remaining constructs adapted from the literature cited above. For empirical application the instrument would require back translation, expert content validation, and pilot testing before administration, none of which was carried out for the present illustrative analysis. The constructs and their indicators are summarised in Table 2, and the hypothesised model is shown in Figure 1.

Table 2. Constructs, indicators, and operational focus

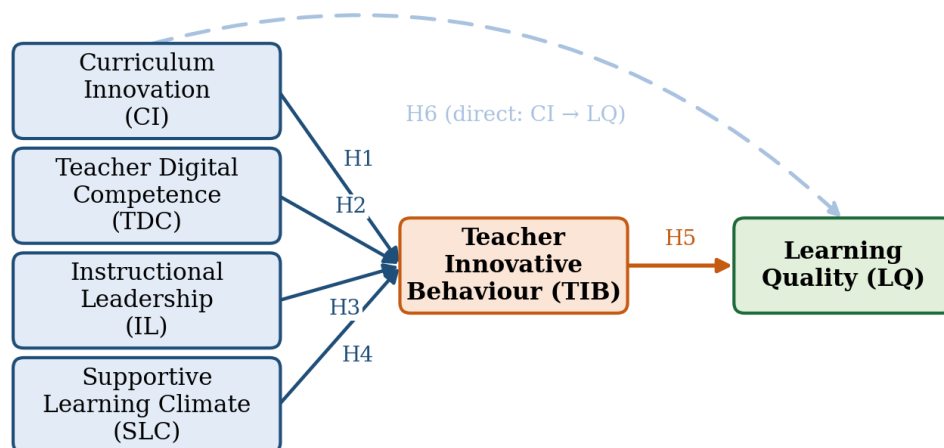
Construct (code)	Items	Indicator focus
Curriculum Innovation (CI)	4	New curriculum content; integration of Islamic values into thematic and play-based units; alignment with the Merdeka curriculum in RA; revising learning materials
Teacher Digital Competence (TDC)	4	Use of digital tools and media; creating digital resources; troubleshooting; pedagogical integration of technology
Instructional Leadership (IL)	4	Instructional guidance; feedback on teaching; goal setting for learning; support for pedagogical improvement
Supportive Learning Climate (SLC)	4	Collegial collaboration; psychological safety; encouragement to experiment; institutional support for new ideas
Teacher Innovative Behaviour (TIB)	4	Opportunity exploration; idea generation; idea promotion; idea implementation

Construct (code)	Items	Indicator focus
Learning Quality (LQ)	4	Developmentally appropriate practice; child engagement; learning environment and assessment for learning; akhlak and habituation of worship (pembiasaan ibadah)

Source: Authors' construction based on the cited literature (2026)

Hypothesised Research Model

Simulation-based illustrative specification



H7-H10: TIB is hypothesised to mediate each antecedent's association with Learning Quality

Figure 1. Hypothesised research model. Curriculum innovation, teacher digital competence, instructional leadership, and a supportive learning climate are hypothesised to predict teachers' innovative behaviour (H1–H4), which is hypothesised to predict learning quality (H5). Curriculum innovation also has a hypothesised direct path to learning quality (H6), and innovative behaviour is hypothesised to mediate the relationship between each antecedent and learning quality (H7–H10).

Source: Authors' construction (2026).

Before analysis the simulated data were screened for missing values, out-of-range entries, and undifferentiated responding, and none of these compromised the dataset. Item-level skewness ranged from -0.66 to -0.48 and kurtosis from -0.56 to 0.04 , which indicates the mild negative skew typical of positively worded educational items and presents no obstacle to partial least squares, a method that makes no distributional assumption. The analysis followed the two-stage procedure in which the measurement model is evaluated before the structural model is interpreted (Hair et al., 2019). At the measurement stage, internal consistency was assessed with Cronbach's alpha and composite reliability, convergent validity with indicator loadings and average variance extracted, and discriminant validity with the Fornell-Larcker criterion and the heterotrait-monotrait ratio (Fornell & Larcker, 1981; Henseler et al., 2015). At the structural stage, collinearity was checked with the variance inflation factor, and explanatory and predictive assessment relied on the coefficient of determination, the

effect size, and the predictive relevance obtained from cross-validated redundancy. Path coefficients and their significance were established with a bootstrapping procedure of 5,000 subsamples, which yields the standard errors, t values, and percentile confidence intervals reported below. Mediation followed the approach developed for partial least squares path modelling, in which the significance of the bootstrapped indirect effect is the primary criterion and the pattern of direct and indirect paths determines the type of mediation (Nitzl et al., 2016). Because all constructs were measured by self-report within a single instrument, common method bias was assessed with Harman's single-factor test and the full collinearity approach, in which each construct is regressed on the others and the resulting variance inflation factor is compared against 3.3 (Kock, 2015). These diagnostics are reported so that the analytical procedure is complete and replicable, although within simulated data they describe the properties of the generated responses rather than the response tendencies of actual teachers. The complete procedure is shown in Figure 2.

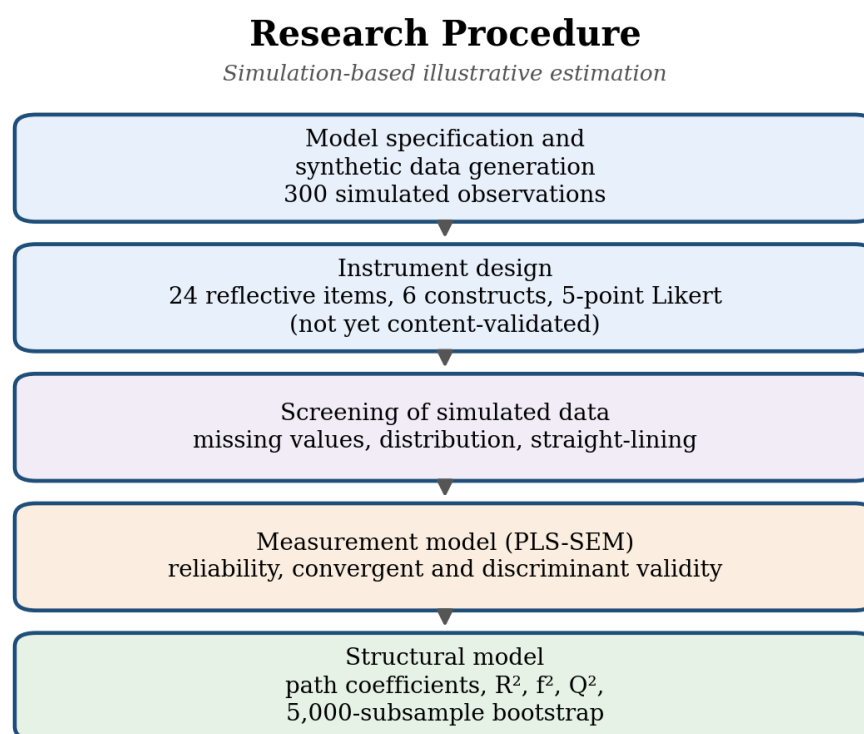


Figure 2. Research procedure, from model specification and generation of the simulated dataset through instrument design, data screening, measurement model assessment, and structural model estimation with bootstrapping.

Source: Authors' construction (2026).

C. RESULT AND DISCUSSION

Findings

The measurement model was evaluated first. Every reflective indicator loaded strongly on its intended construct, with loadings ranging from 0.813 to 0.884, comfortably above the common benchmark of 0.708 at which an indicator already explains most of the variance of its construct. Internal consistency was sound across all six constructs, with Cronbach's alpha between 0.861 and 0.885 and composite reliability between 0.905 and 0.921, both within the range that signals reliable measurement

without the redundancy that very high values can indicate. Convergent validity was supported by the average variance extracted, which ranged from 0.705 to 0.744 and therefore exceeded the 0.50 threshold by a wide margin, meaning that each construct accounted for at least 70 per cent of the variance in its indicators. These indices describe the internal properties of the simulated dataset and should not be read as evidence that the instrument has been empirically validated among actual Raudhatul Athfal teachers. Item-level descriptive statistics and loadings are reported in Table 3, and the reliability and convergent validity indices in Table 4.

Table 3. Item descriptive statistics, normality, and outer loadings

Item	Mean	SD	Skew.	Kurt.	Loading
CI1	3.90	0.94	-0.56	-0.23	0.849
CI2	3.90	0.98	-0.63	-0.14	0.857
CI3	3.87	0.99	-0.66	-0.02	0.870
CI4	3.88	0.94	-0.48	-0.36	0.838
TDC1	3.90	1.00	-0.66	-0.18	0.843
TDC2	3.91	0.97	-0.59	-0.34	0.836
TDC3	3.91	0.95	-0.58	-0.14	0.848
TDC4	3.90	0.94	-0.58	-0.17	0.833
IL1	3.91	0.93	-0.60	-0.12	0.841
IL2	3.88	0.98	-0.64	-0.07	0.846
IL3	3.90	0.97	-0.56	-0.48	0.884
IL4	3.91	0.95	-0.54	-0.34	0.813
SLC1	3.91	1.00	-0.62	-0.31	0.870
SLC2	3.88	0.94	-0.52	-0.18	0.851
SLC3	3.90	0.96	-0.54	-0.34	0.876
SLC4	3.89	0.95	-0.61	-0.19	0.852
TIB1	3.90	0.94	-0.66	-0.06	0.836
TIB2	3.91	0.95	-0.53	-0.36	0.832
TIB3	3.92	0.94	-0.62	-0.04	0.846
TIB4	3.88	0.97	-0.66	-0.10	0.870
LQ1	3.94	0.93	-0.50	-0.56	0.861
LQ2	3.89	0.98	-0.66	-0.07	0.871
LQ3	3.90	1.01	-0.63	-0.42	0.853
LQ4	3.89	0.96	-0.66	0.04	0.818

Source: Simulated data, 300 simulated observations (2026)

Table 4. Construct reliability and convergent validity

Construct (code)	Items	Loadings	α	CR	AVE
Curriculum Innovation (CI)	4	0.838–0.870	0.876	0.915	0.729
Teacher Digital Competence (TDC)	4	0.833–0.848	0.861	0.905	0.705
Instructional Leadership (IL)	4	0.813–0.884	0.868	0.910	0.716
Supportive Learning Climate (SLC)	4	0.851–0.876	0.885	0.921	0.744
Teacher Innovative Behaviour (TIB)	4	0.832–0.870	0.868	0.910	0.716
Learning Quality (LQ)	4	0.818–0.871	0.873	0.913	0.724

Source: Simulated data, 300 simulated observations (2026)

Read together, these indices describe a measurement model that is reliable and at the same time economical within the simulated data. The narrow band of loadings, none below 0.81 and none above 0.89, indicates that the four indicators of each construct behave as interchangeable manifestations of one underlying variable, which is the assumption that reflective measurement requires. The average variance extracted, which exceeds 0.70 for every construct, shows that genuine common variance rather than measurement error dominates each set of indicators. For an instrument adapted to the Islamic early childhood context, where constructs such as curriculum innovation and learning quality carry meanings specific to the setting, this level of internal coherence indicates that the six constructs were separated cleanly in the specification before any relationship among them was examined. Whether the same coherence would be obtained from Raudhatul Athfal teachers is an empirical question that the present analysis cannot answer.

Discriminant validity was examined next, since it is the property that distinguishes a credible measurement model from a fragile one. The Fornell-Larcker criterion was satisfied for every construct, because the square root of the average variance extracted of each construct, ranging from 0.840 to 0.862, exceeded that construct's correlation with any other construct. The more demanding heterotrait-monotrait criterion told the same story, with ratios ranging from 0.31 to 0.65, well below the conservative threshold of 0.85 and far from the value of one that would indicate two constructs measuring the same thing (Henseler et al., 2015). The constructs are therefore distinct within the estimated model, which is the precondition for interpreting the relationships among them. The Fornell-Larcker matrix appears in Table 5 and the heterotrait-monotrait ratios in Table 6. Collinearity among the structural predictors was negligible, with variance inflation factors for the four antecedents ranging from 1.28 to 1.42, so the path coefficients are not distorted by overlapping among the predictors and can be interpreted as distinct contributions. With respect to common method variance, no substantial evidence of common method bias was detected using the applied diagnostic procedures, since Harman's single-factor test attributed 37.3 per cent of the variance to a single factor, below the 50 per cent mark, and the maximum full collinearity variance inflation factor of 2.12 remained under the 3.3 threshold (Kock,

2015). These procedures do not establish that common method bias is absent, and in the present case they characterise simulated responses rather than data gathered from teachers.

Table 5. Discriminant validity: Fornell-Larcker criterion

Construct	CI	TDC	IL	SLC	TIB	LQ
Curriculum Innovation (CI)	0.854					
Teacher Digital Competence (TDC)	0.395	0.840				
Instructional Leadership (IL)	0.369	0.380	0.846			
Supportive Learning Climate (SLC)	0.400	0.458	0.343	0.862		
Teacher Innovative Behaviour (TIB)	0.540	0.468	0.451	0.493	0.846	
Learning Quality (LQ)	0.443	0.360	0.267	0.278	0.564	0.851

Source: Simulated data, 300 simulated observations (2026). Diagonal values are the square root of AVE.

Table 6. Discriminant validity: heterotrait-monotrait ratio (HTMT)

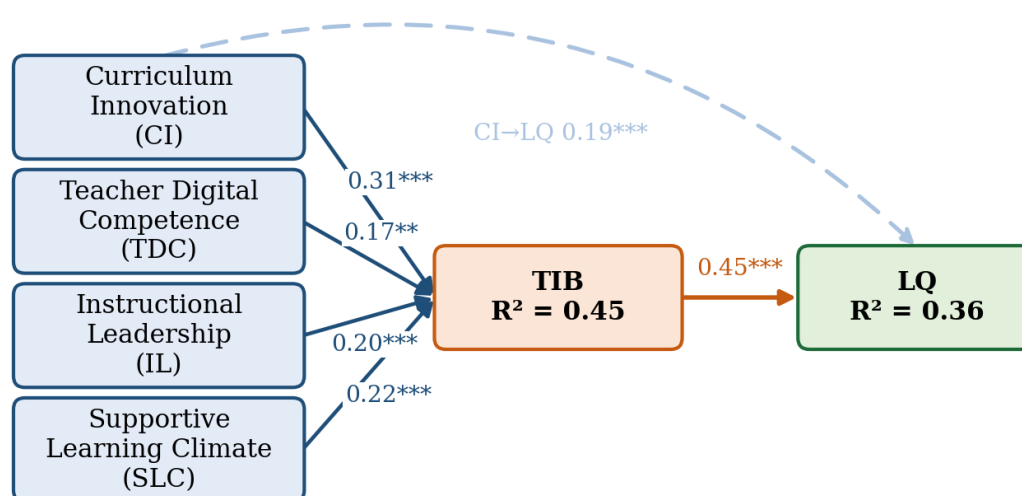
Construct	CI	TDC	IL	SLC	TIB	LQ
Curriculum Innovation (CI)	–					
Teacher Digital Competence (TDC)	0.454	–				
Instructional Leadership (IL)	0.422	0.440	–			
Supportive Learning Climate (SLC)	0.453	0.523	0.392	–		
Teacher Innovative Behaviour (TIB)	0.618	0.540	0.519	0.563	–	
Learning Quality (LQ)	0.505	0.415	0.308	0.318	0.648	–

Source: Simulated data, 300 simulated observations (2026). All values are below the 0.85 threshold.

The structural model accounted for a meaningful share of the variance in the two endogenous constructs. Teachers' innovative behaviour returned a coefficient of determination of 0.45, meaning that the four antecedents jointly accounted for 45 per cent of its variance, while learning quality returned a coefficient of determination of 0.36. Predictive relevance was indicated by cross-validated redundancy values of 0.43 for innovative behaviour and 0.32 for learning quality, both clearly above zero. A goodness-of-fit index of 0.54 was also computed, and it is reported here for descriptive completeness only, for the reasons set out below. The estimated structural model with its standardised path coefficients is displayed in Figure 3, and the complete set of path tests, with effect sizes and decisions, is reported in Table 7.

Estimated Structural Model (standardised β)

Simulated data: 300 simulated observations



*** $p < 0.001$ ** $p < 0.01$ (dashed = direct path of the focal antecedent)

Figure 3. Estimated structural model with standardised path coefficients and explained variance within the simulated dataset. Solid paths are significant; the dashed arc is the direct path from curriculum innovation to learning quality. *** $p < 0.001$; ** $p < 0.01$.

Source: Simulated data, 300 simulated observations (2026).

Assessment of the model followed contemporary reporting practice for partial least squares, which places explanatory and predictive criteria ahead of any single fit index. A coefficient of determination of 0.45 for teachers' innovative behaviour is moderate to substantial for a behavioural outcome with four predictors, and the value of 0.36 for learning quality is meaningful given that a single mediator carries most of the explanation. The effect sizes reported in Table 7 distinguish the contribution of each predictor, the percentile confidence intervals obtained from 5,000 bootstrap subsamples show that no path estimate is unstable, and the cross-validated redundancy values indicate predictive relevance beyond the estimation sample. The goodness-of-fit index of 0.54 is not treated here as evidence of a large fit. That index has no established cut-off for variance-based structural equation modelling and is not a test of model fit in

the covariance-based sense, and current guidance discourages its use for that purpose (Hair et al., 2019), so it is reported without interpretive weight. A full predictive assessment through PLSpredict, comparing the root mean squared error of the model against a linear benchmark at the indicator level, was not conducted here and is recommended for the empirical replication of this model. Within these limits, the explanatory and predictive indices support reading the path coefficients as a stable structure within the estimated model rather than as an artefact of a particular bootstrap draw.

The first four hypotheses concerned the antecedents of teachers' innovative behaviour, and all four were supported. Curriculum innovation was the strongest predictor, with a standardised coefficient of 0.31 ($t = 5.77$, $p < 0.001$), followed by a supportive learning climate at 0.22 ($t = 4.22$, $p < 0.001$), instructional leadership at 0.20 ($t = 4.01$, $p < 0.001$), and teacher digital competence at 0.17 ($t = 3.15$, $p < 0.01$). Effect sizes followed the same ordering, with curriculum innovation reaching a medium effect and the remaining antecedents contributing small but non-trivial effects. Within the estimated model, higher innovative behaviour is predicted where the curriculum invites it, where colleagues and the institution support it, where the principal guides it, and where the teacher's own digital competence equips them for it. This ordering answers RQ1 within the simulated data.

The effect sizes sharpen this ordering. Curriculum innovation contributed a medium effect on innovative behaviour, while the supportive climate, instructional leadership, and digital competence each contributed a small effect, a profile consistent with the view that no single condition accounts for teacher innovation on its own and that the conditions are additive rather than substitutable. The same logic appeared on the outcome side, where innovative behaviour returned a medium effect size in relation to learning quality that exceeded the contribution of every structural antecedent, which underlines its position as the proximate predictor of quality in this specification.

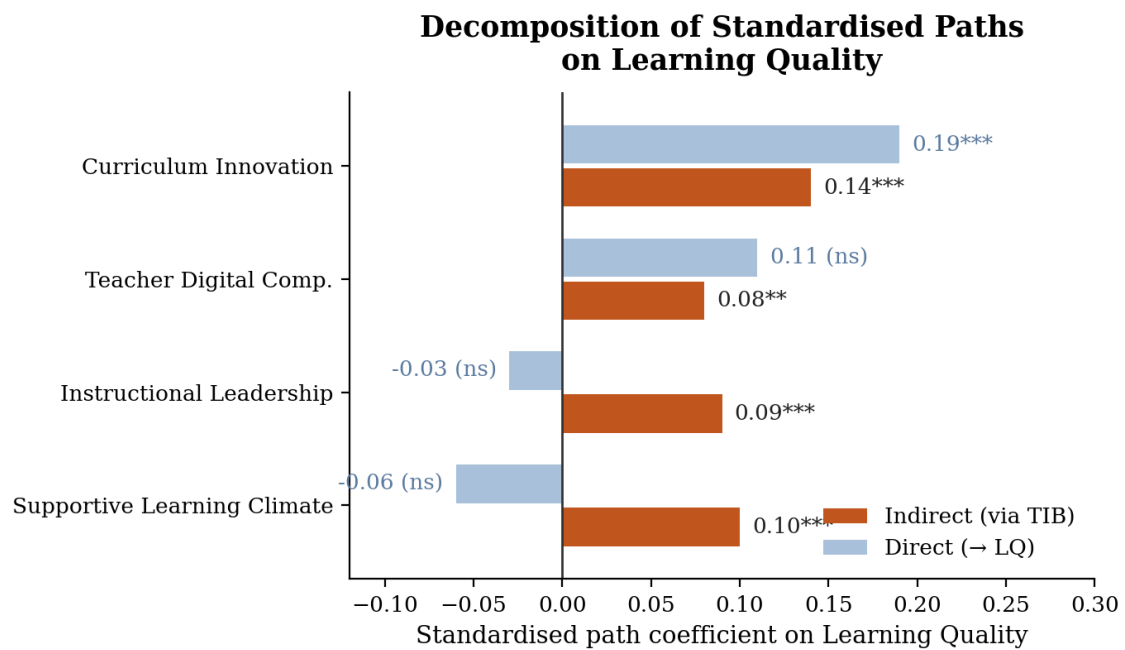
The fifth hypothesis, which links innovative behaviour with learning quality, received the strongest support of any path in the model and addresses RQ2. Teachers' innovative behaviour predicted learning quality with a standardised coefficient of 0.45 ($t = 7.50$, $p < 0.001$), the single largest contribution to learning quality. The sixth hypothesis, the direct path from curriculum innovation to learning quality, was also significant at 0.19 ($t = 3.31$, $p < 0.001$). Curriculum innovation is therefore associated with learning quality along two routes, one running directly to the outcome and one running through teacher behaviour. The direct paths of the three remaining antecedents were not significant. Digital competence showed a non-significant direct path of 0.11 ($t = 1.79$, $p = 0.07$), while instructional leadership and the supportive climate returned direct estimates close to zero. This pattern is the first indication that, within the estimated model, these three antecedents are associated with learning quality only through innovative behaviour.

Table 7. Structural model: direct path coefficients, effect sizes, and hypothesis decisions

Path	β	t	p	95% CI	f ²	Decision
H1: CI → TIB	0.312***	5.77	<0.001	[0.200, 0.411]	0.131	Supported
H2: TDC → TIB	0.169**	3.15	0.002	[0.063, 0.274]	0.037	Supported
H3: IL → TIB	0.199***	4.01	<0.001	[0.099, 0.297]	0.056	Supported
H4: SLC → TIB	0.223***	4.22	<0.001	[0.121, 0.328]	0.065	Supported
H5: TIB → LQ	0.451***	7.50	<0.001	[0.340, 0.573]	0.174	Supported
H6: CI → LQ	0.191***	3.31	<0.001	[0.075, 0.300]	0.037	Supported
–: TDC → LQ	0.112	1.79	0.073	[-0.011, 0.234]	0.013	Not sig.
–: IL → LQ	-0.027	-0.51	0.612	[-0.131, 0.079]	0.001	Not sig.
–: SLC → LQ	-0.063	-1.14	0.252	[-0.170, 0.046]	0.004	Not sig.

Source: Simulated data, 300 simulated observations (2026), 5,000 bootstrap subsamples. *** $p < 0.001$; ** $p < 0.01$.

The mediation test, which addresses RQ₃, is reported in Table 8. All four indirect paths through teachers' innovative behaviour were significant. The focal indirect path from curriculum innovation to learning quality through innovative behaviour was 0.14 ($t = 4.38$, $p < 0.001$), with a bootstrap confidence interval from 0.083 to 0.208 that excludes zero. Because the direct path of curriculum innovation was also significant and pointed in the same direction as the indirect path, the mediation is complementary partial mediation, and the variance accounted for by the indirect path was approximately 42 per cent of the total. The three remaining antecedents show a different pattern. The indirect path of a supportive learning climate was 0.10 ($t = 3.69$, $p < 0.001$), that of instructional leadership was 0.09 ($t = 3.49$, $p < 0.001$), and that of digital competence was 0.08 ($t = 2.85$, $p < 0.01$), each with a bootstrap interval that excludes zero. Since none of these three antecedents returned a significant direct path, the mediation for each of them is indirect-only. The term indirect-only mediation is used throughout in preference to full mediation, because the absence of a significant direct path within one estimated model does not establish that no direct relationship exists. Within this model, the association of digital competence, instructional leadership, and the supportive climate with learning quality is transmitted entirely through teachers' innovative behaviour. The decomposition of the direct and indirect paths is shown in Figure 4.



*Simulated data: 300 simulated observations. *** $p < 0.001$; ** $p < 0.01$; ns = not significant.*

Figure 4. Decomposition of the association with learning quality into direct and indirect components, the latter through teachers' innovative behaviour, for each antecedent within the simulated dataset. *** $p < 0.001$; ** $p < 0.01$; ns = not significant.

Source: Simulated data, 300 simulated observations (2026).

Table 8. Mediation analysis: direct, indirect, and total paths on learning quality

Path	Direct β	Indirect β	Total	t	p	VAF	Mediation type
H7: CI → TIB → LQ	0.191***	0.141***	0.332	4.38	<0.001	42%	Complementary (partial)
H8: TDC → TIB → LQ	0.112 (ns)	0.076**	0.188	2.85	0.004	–	Indirect-only
H9: IL → TIB → LQ	-0.027 (ns)	0.090***	0.063	3.49	<0.001	–	Indirect-only
H10: SLC → TIB → LQ	-0.063 (ns)	0.100***	0.038	3.69	<0.001	–	Indirect-only

*Source: Simulated data, 300 simulated observations (2026). Indirect paths via TIB. *** $p < 0.001$; ** $p < 0.01$; ns = not significant.*

The variance accounted for by the indirect path places the curriculum route within the band conventionally read as complementary partial mediation, since a value of 42 per cent falls between the 20 per cent mark below which mediation is treated as negligible and the 80 per cent mark above which transmission is treated as effectively complete, which means that about two fifths of the total association between curriculum innovation and learning quality is transmitted through teacher behaviour while the remainder operates directly. For the supportive climate, instructional leadership, and digital competence, the absence of a significant direct path leaves the whole of the estimated transmission to the indirect route, so the mediated proportion approaches unity. The four antecedents therefore divide into one whose association is

shared between a direct and an indirect channel and three whose association is wholly indirect, and in all four cases the indirect path is significant, which is the pattern that the hypothesised model predicted.

A consistent picture emerges across the model. Teachers' innovative behaviour is the construct through which the four resources are related to learning quality. For curriculum innovation the channel is partial and a direct path remains, while for the three remaining antecedents the channel is indirect-only. In every case the indirect path is significant, which is the defining requirement for mediation. The model therefore answers RQ₁, RQ₂, and RQ₃ in the affirmative within simulated data, and it does so with a single mediator that carries four resources toward one outcome.

Analysis and Discussion

This study asked how curriculum innovation and three related resources are related to the quality of learning in the Islamic early childhood classroom, and it proposed teachers' innovative behaviour as the answer. The illustrative estimation supports that proposition with some precision. Innovative behaviour was predicted by all four antecedents and accounted for almost half of its own variance, and it was in turn the strongest predictor of learning quality, with every hypothesised indirect path significant. The contribution is to show that the link between curriculum reform and learning quality can be specified as a behavioural pathway that is modellable and testable, and to identify the form that pathway takes for each resource. Because the estimation rests on simulated data, what has been demonstrated is the coherence and estimability of the model rather than the magnitude of any relationship among actual teachers, and the discussion that follows is therefore an interpretation of a specified model rather than a report of empirical findings.

The focal result concerns curriculum innovation, whose relationship with learning quality took the form of complementary partial mediation, with a significant direct path of 0.19 and a significant indirect path of 0.14 through innovative behaviour. The reading suggested by this pattern is that a renewed curriculum may operate in two ways. One part of its contribution is structural and arises from the content, the sequencing, and the developmental orientation that it supplies, which corresponds to the direct path. The other part is behavioural and arises because the curriculum gives teachers something to be innovative about, which corresponds to the indirect path. This is consistent with accounts of the Merdeka curriculum in Islamic settings that attribute its potential less to the document itself than to the room it grants teachers to design learning that is responsive and rich in character formation (Hunaepi & Suharta, 2024; Dermawan et al., 2026). It also helps explain why implementation studies that examine only whether teachers understand the curriculum tend to report disappointing results (Suci et al., 2025; Wahyuningtyas et al., 2023). Understanding a curriculum is necessary but may not be sufficient, since on this model gains in quality depend on teachers acting innovatively upon what the curriculum permits. This reading is a theoretical interpretation of a simulated pattern, and empirical data would be required before it could be advanced as a finding about Raudhatul Athfal.

The three remaining antecedents behaved differently, and the difference is instructive. Digital competence, instructional leadership, and the supportive learning climate were each associated with learning quality only through innovative behaviour,

an indirect-only pattern, and none of them retained a meaningful direct path. This refines a common assumption in the school improvement literature, which sometimes treats leadership, technology, and climate as though they raise quality directly. The present specification suggests instead that their contribution may be conditional and may be realised when teachers convert the resource into innovative practice. The pattern is consistent with leadership research in Raudhatul Athfal that locates the contribution of the principal in the teacher-level practice it shapes (Islamiyah et al., 2024; Lu et al., 2025), with climate research that locates the contribution of support in the innovative behaviour it makes possible (Olmo-Extremuera et al., 2025; Silva et al., 2025), and with digital competence research that frames technological skill as an enabler of innovative pedagogy rather than a direct correlate of quality (Masoumi & Noroozi, 2023; Scherer et al., 2023; H. Li et al., 2024).

The distinction between the partial mediation of the curriculum route and the indirect-only mediation of the three remaining routes deserves emphasis, since the two patterns carry different implications. Partial mediation means that the resource retains an independent association that does not require the mediator, so a teacher who innovates only a little would still be expected to gain something from a stronger curriculum. Indirect-only mediation means that, within the estimated model, the resource shows no independent association, so its modelled contribution is carried by the mediator. For digital competence, instructional leadership, and the supportive climate, the appropriate statement is that within the estimated model no statistically significant direct association with learning quality was observed. This is not evidence that these resources have no effect. A non-significant path in one specification may reflect the particular set of predictors, the way the constructs were measured, the properties of the simulated data, or limited statistical power, so the practical implication is that resource provision and the cultivation of innovative behaviour are best pursued together rather than that resources alone are without value. On the theoretical side, the specification extends to Islamic early childhood education the mediating role that innovative work behaviour plays in organisational settings, where it routinely stands between resources and valued outcomes (Ghani et al., 2023; Gautam & Gautam, 2024; Zafar et al., 2023). That the structure is recoverable in a model whose outcome is pedagogical and whose antecedents include a curriculum lends conceptual support to the claim that innovative behaviour is the point of conversion between resource and result (Izzati et al., 2023; K. Li et al., 2024).

The pattern also invites a specifically Islamic reading, and this is where the model departs from a general account of teacher innovation. In Raudhatul Athfal the mediator is not innovation in the abstract but innovation that remains within the boundaries of religious appropriateness, so that a teacher who explores an opportunity and implements an idea is at the same time judging whether the new practice preserves the integration of Islamic values. This filter shapes each pathway in the model. Curriculum innovation retains a direct association with quality partly because Islamic content and its sequencing carry formative value in themselves, since the habituation of worship and the modelling of *akhlak* reach the child even where the surrounding teaching is conventional. Digital competence, by contrast, shows no direct association, which is consistent with the view that in this setting technology acquires educational value only when a teacher adapts it to Islamic educational objectives, for example by turning a

digital medium into a vehicle for character formation rather than for content delivery alone. Instructional leadership in Raudhatul Athfal likewise carries a religious dimension, since the head of the institution is expected to guide not only pedagogical quality but also the fidelity of practice to Islamic values, and the indirect-only pattern suggests that this guidance reaches children through the teacher rather than around the teacher. Read in this way, teachers' innovative behaviour in Islamic early childhood education is best understood as bounded innovation, that is, a disciplined search for new practice within limits set by the religious purposes of the institution, and this is what distinguishes the construct here from innovative behaviour in general early childhood education (Ainnin & Ismail, 2024; Zakariyah, 2024; Dermawan et al., 2026). It also indicates what empirical replication should measure, namely whether teachers themselves apply this religious filter when they judge which classroom innovations are worth attempting.

The specification carries implications for those leading Raudhatul Athfal and comparable Islamic early childhood institutions, offered here as propositions to be tested rather than as established findings. Curriculum reform would be accompanied by deliberate investment in the conditions for teacher innovation and would not be treated as complete once the document is published, since on this model a substantial part of the contribution of curriculum innovation is carried by teacher behaviour. Within the Raudhatul Athfal system this points to concrete levers, namely the teacher working group known as *Kelompok Kerja Guru RA*, the madrasah supervisor or *pengawas* of the Ministry of Religious Affairs, and the in-service training that the Ministry provides, which are the channels through which digital competence and a collaborative, psychologically safe climate can be built, while the head of the Raudhatul Athfal sets the instructional direction and grants permission to experiment. Professional development of this kind, together with leadership practice that encourages experimentation, would then be central to quality rather than peripheral to it (Zakariyah, 2024; Nalbantoğlu & Bümen, 2024; Masnipal & Tri Yugo, 2025). Because innovative behaviour carries so much of the model, a monitoring system that records only inputs, such as whether a curriculum has been adopted or whether technology has been provided, would omit the construct that this model identifies as the proximate predictor of quality.

The limitations of this study are of two kinds, and the first is not an ordinary limitation. The analysis rests on a synthetic dataset built to reproduce the response structure of a survey of early childhood teachers, which means that the empirical status of every result reported above is provisional in a fundamental sense. The coefficients describe the specified model within generated data. They do not estimate any parameter in the population of Raudhatul Athfal teachers, they cannot be generalised to any institution, and they do not establish that the instrument is valid or that the hypothesised relationships hold in practice. What the analysis does demonstrate is that the model is identifiable, that its measurement structure is coherent under the assumed conditions, and that its mediating pathways can be recovered and reported in a form that an empirical study could replicate. Replication with field data from Raudhatul Athfal teachers is therefore not a desirable extension but the necessary condition for any substantive claim, and the present article should be read as the specification stage of a study whose empirical stage remains to be carried out. The second kind of limitation

concerns the design that would be used in that empirical stage. The design specified here is cross-sectional, so directional language should be read as the logic of the model rather than as established causation, particularly since a reciprocal relationship between innovative behaviour and learning quality is plausible. All constructs are measured by self-report, which can inflate relationships through common method variance. There is no child-level outcome measure and no longitudinal component, and potentially relevant antecedents such as teacher self-efficacy and workload are omitted. An empirical replication would therefore benefit from triangulating teacher self-reports with classroom observation or child-level outcome data, from a longitudinal design that establishes temporal ordering, and from the inclusion of further antecedents so that it can be tested whether innovative behaviour still mediates once a fuller set is considered.

CONCLUSION

This study specified and illustratively tested a model in which teachers' innovative behaviour mediates the relationships between curriculum innovation, teacher digital competence, instructional leadership, and a supportive learning climate on the one hand and learning quality in Islamic early childhood education on the other. Within a synthetic dataset of 300 simulated observations, all four antecedents predicted innovative behaviour, innovative behaviour was the strongest predictor of learning quality, curriculum innovation was associated with learning quality through complementary partial mediation, and the three remaining antecedents through indirect-only mediation. These results establish that the model is coherent, estimable, and reportable. They do not establish anything about actual Raudhatul Athfal teachers or about the actual quality of learning in those institutions. The contribution of the article is therefore methodological and conceptual, consisting of a specified behavioural mechanism that links curriculum reform to learning quality in a setting where that mechanism has usually been assumed, together with an operationalisation of innovation and quality that incorporates the integration of Islamic values and the formation of *akhlak*. The next necessary step is replication with field data from Raudhatul Athfal teachers, using a longitudinal design and multi-source measures, before any guidance for policy or practice is drawn from the model.

Acknowledgments: The authors thank colleagues whose feedback informed the framing of the constructs and the specification of the model. No expert content validation, pilot testing, or field administration of the instrument was carried out, since no empirical data were collected for this study.

Conflicts of Interest: The authors declare no conflict of interest.

Author Contributions: All authors contributed to the conception of the study, to the specification of the model, to the generation and analysis of the synthetic dataset, and to the interpretation of the results, as well as to the drafting and revision of the manuscript, and all approved the final version.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability: No empirical data were collected for this study. The synthetic dataset of 300 simulated observations and the code used to generate it are available from the corresponding author on reasonable request.

Disclaimer: The views expressed in this article are those of the authors and do not represent an official position of their institution or any funder.

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