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Pedagogical and Contextual Factors Associated with Teachers' Implementation of Digital Character Education in Bandung Elementary Schools

Darda Abdullah Sjam[1], Cep Miftah Khoerudin[2]

[1] Department of Elementary School Teacher Education, Faculty of Teacher Training and Education, Universitas Pasundan, Bandung, Indonesia. Email: darda.abdullah@unpas.ac.id[1]
[2] Department of Pancasila and Civic Education, Faculty of Teacher Training and Education, Universitas Pasundan, Bandung, Indonesia. Email: cepmiftahkhoerudin@unpas.ac.id[2]

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ABSTRACT
This study examined the pedagogical and contextual factors associated with teachers' reported implementation of digital character education in Bandung elementary schools. Primary data were collected through a Google Forms questionnaire distributed with the assistance of participating schools. Participation was voluntary. Of the 360 teacher responses collected, 359 met the criteria for statistical analysis. We examined five predictors, digital pedagogical competence, character education self-efficacy, principal support, collaboration between schools and families, and digital resource adequacy, using descriptive statistics, internal consistency assessments, and multiple linear regression with HC3 robust standard errors. The results revealed positive associations between all five predictors and teachers' reported implementation of digital character education. Digital pedagogical competence and character education self-efficacy demonstrated the strongest standardized associations. The regression model explained 44.6% of the variation in reported implementation, indicating the relevance of both teachers' professional capabilities and their educational environments. The findings emphasize the importance of integrating character education into digital instructional practices rather than focusing exclusively on technology use. However, the cross-sectional design, voluntary recruitment, reliance on teachers' self-reports, limited construct validation evidence, and inability to account for potential dependence among teachers from the same schools constrain the interpretation of the results. The findings therefore represent statistical associations rather than evidence of causal effects or improvements in students' character development.

Keywords: Digital Character Education, Digital Pedagogical Competence, Teacher Self-Efficacy, School–Family Collaboration, Elementary Education.
JEL Classification: I21, I29, O33.

I. Introduction

Digital tasks have made familiar questions of honesty, respect and responsibility more visible in elementary classrooms. Pupils may copy an online answer, share an unreliable claim or respond unkindly in a class group. These situations require more than technical instruction: teachers must turn them into opportunities for ethical judgment. Choi (2016) situates digital citizenship within responsible participation, while Lauricella et al. (2020) found that early-grade teachers address its competencies unevenly. The issue is therefore not whether technology is used, but how teachers connect its use with responsible conduct. Character education is enacted through explanation, example, discussion and repeated classroom routines. Döring et al. (2024) documented these practices among primary teachers; Brown et al. (2023) found positive but heterogeneous effects across character education programs. Both accounts suggest that the presence of

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a program does not establish how consistently its principles are enacted. In digital lessons, modeling respectful communication and proper attribution requires purposeful choices rather than incidental use of a learning platform. A similar gap appears in digital citizenship research. Tadlaoui-Brahmi et al. (2022) found that some primary-level activities emphasize technology tasks without supporting critical participation. Chauhan (2025) identifies opportunities for discussing values through animated narratives, but a digital resource does not teach ethics on its own. Here, digital character education denotes teachers' reported practices of connecting digital activities with honesty, respect, responsibility and reflection. It is not a measure of pupils' moral internalization.

Indonesian research provides a relevant, though incomplete, foundation. Hidayat et al. (2022) described habituation, integration and imitation in virtual character education. Damanik et al. (2026) examined differing approaches to Pancasila values in digital lessons across three Jakarta elementary schools. These accounts illustrate possible practices but do not determine which conditions are associated with their frequency among teachers. Bandung offers a distinct setting in which schools share broad national expectations while teachers may experience different resources and forms of support. The Sundanese values discussed by Widaningsih and Herlambang (2025) provide cultural context, not additional variables in this model. One proposed correlate is perceived digital pedagogical competence: teachers' capacity to select and adapt technology for purposeful learning. Caena and Redecker (2019) emphasize pedagogical uses of digital resources, and Scherer et al. (2019) link technology adoption to teachers' attitudes and judgments. Evidence from Indonesian secondary education similarly associates teacher competence with information-technology use (Amahoru et al., 2024). However, adoption is not equivalent to character-oriented teaching. The present study examines the latter as a separate outcome.

Character education self-efficacy concerns confidence in responding to ethical situations, including dishonesty or disrespect during digital activities. It differs from knowing how to operate a platform. Tschannen-Moran and Woolfolk Hoy (2001) underline the relevance of efficacy beliefs to instructional action, although such beliefs require careful measurement. This distinction supports examining competence and task-specific efficacy together rather than treating them as a single form of readiness. School conditions may also shape what teachers do. Principal support can provide guidance and opportunities for collaborative planning; accessible devices, reliable connectivity and suitable materials can make planned activities feasible. Zeng et al. (2025) associate school leaders' digital leadership with support for technology integration, while Petko (2012) separates willingness, skill and available tools. Neither study directly tests digital character education. Their value here lies in explaining why leadership and resource adequacy warrant separate consideration. Children's digital conduct also extends beyond school. Goodall and Montgomery (2014) distinguish meaningful parental engagement from simple contact with schools. Febiantoni et al. (2025) developed an application-based school–family partnership for character education among older pupils; its context differs from the present elementary-school setting. Accordingly, school–family collaboration is assessed here through teachers' perceptions of shared expectations, communication and joint responses to digital conduct, rather than through independent reports from parents.

Existing studies illuminate value education, digital citizenship, technology adoption, leadership and family engagement, but they rarely examine these elements together against the same teacher-level outcome. Studies of technology use cannot establish whether teachers address ethical issues, while qualitative accounts of character education do not estimate the relative associations of perceived competence, efficacy and school context. This distinction defines the study's empirical gap and limits its claim of novelty to an integrated, teacher-reported implementation model. The study examines the associations of perceived digital pedagogical competence, character education self-efficacy, perceived principal support, school–family collaboration and perceived digital resource adequacy with teachers' reported implementation of digital character education in Bandung elementary schools. Implementation encompasses ethical lesson planning, responsible digital modeling, guided reflection and character-related feedback. Using a cross-sectional survey, the analysis estimates their concurrent relationships while adjusting for selected teacher characteristics. It does not test an intervention, infer causal effects or assess students' moral development.

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II. Literature Review and Hypothesis Development

2.1. Teachers' Implementation of Digital Character Education

Character education in elementary schools' concerns more than the delivery of lessons about acceptable conduct. It is enacted through the rules teachers explain, the examples they provide, and the opportunities pupils receive to consider and practise values in ordinary learning activities. Döring et al. (2024) found that primary teachers promote values through discussion, modeling, and daily interactions rather than through a single instructional technique. The broader evidence also calls for attention to implementation: Brown et al. (2023) reported a positive average effect of character education programs, but considerable differences across studies. Such variation makes it important to examine what educators actually do, not simply whether a school has adopted a character education policy. Digital learning adds situations in which familiar values must be interpreted anew. Using online information raises questions of attribution and honesty; communication through classroom platforms requires respect and care; collaborative digital assignments call for fairness, responsibility, and sensitivity to others. Choi (2016) presents digital citizenship as involving ethical judgment and participation as well as technological knowledge. In the early grades, Lauricella et al. (2020) observed that educators address digital citizenship competencies unevenly, while Tadlaoui-Brahmi et al. (2022) found that some primary-level practices remain focused on technology-related activity without inviting critical participation. Technology use alone, therefore, should not be treated as evidence of digital character education.

For the present study, teachers' implementation of digital character education refers to the frequency with which teachers intentionally incorporate character-oriented goals and activities into technology-mediated lessons. It includes planning explicit ethical expectations, discussing honesty and responsible information use, modeling respectful digital communication, guiding pupils through moral dilemmas, and reinforcing relevant behaviors during learning. Digital storytelling and visual narratives can provide useful occasions for these practices, although the moral discussion depends on how they are used. Chauhan (2025), for example, discusses animated narratives as potential resources for developing empathy and social values; that argument does not imply that showing an animation, by itself, constitutes effective character education. The outcome in this research is consequently a teacher-level measure of reported practice over a specified recent period, rather than pupils' moral knowing, moral feeling, or moral action. Those student dimensions remain important educational aims, but they cannot be inferred directly from a questionnaire answered only by teachers. A higher implementation score indicates that the teacher reports engaging more frequently in the relevant activities; it does not establish that pupils have internalized moral values or that the activities have caused behavioral improvement. This distinction keeps the proposed model consistent with its unit of analysis and its available evidence.

2.2. Pedagogical and Contextual Conditions of Implementation

The model follows a capability–belief–context perspective on teacher practice. Ertmer and Ottenbreit-Leftwich (2010) explain technology-related teaching through knowledge, confidence, beliefs and organizational culture; Petko (2012) likewise distinguishes willingness, skill and tools. Applied cautiously to digital character education, these accounts imply that pedagogical competence and self-efficacy may matter alongside institutional support, family relationships and resources. This perspective guides variable selection but is not presented as a newly validated theory. The five predictors represent distinct, potentially correlated aspects of teachers' working conditions: competence and self-efficacy concern perceived capacities, while principal support, school–family collaboration and resource adequacy concern perceived context. Their joint estimation permits comparison of conditional associations, rather than attributing implementation to a single factor. Since all constructs are self-reported, common-method processes and construct overlap remain possible.

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2.3. Hypothesis Development

a. Perceived Digital Pedagogical Competence and Implementation

Perceived digital pedagogical competence denotes teachers' assessment of their capacity to select, evaluate, adapt, and manage digital resources for instructional purposes. The concept is wider than knowing how to operate a device. In the DigCompEdu framework, pedagogical competence includes choosing appropriate resources, organising technology-supported activities, assessing learning, and helping pupils use digital tools safely and responsibly (Caena & Redecker, 2019). In character-oriented instruction, these capabilities may enable teachers to select credible online examples, turn a digital incident into a discussion of fairness, or design assignments that require pupils to acknowledge information sources. Caena and Redecker (2019) describe educators' digital competence as the purposeful selection, adaptation and assessment of digital resources. Scherer et al. (2019) establish the importance of beliefs for technology adoption, while Amahoru et al. (2024) address competence and technology use in an Indonesian secondary setting. These studies do not measure character-oriented digital practice directly. Nevertheless, they support testing whether teachers who perceive stronger digital pedagogical competence report more frequent ethical integration in lessons. Competence and implementation are deliberately measured separately: competence concerns what a teacher believes they can do, whereas implementation concerns how often specified practices are reported during a recent period. On this basis, the first directional hypothesis is proposed.

H1: Perceived digital pedagogical competence is positively associated with teachers' implementation of digital character education in elementary schools.

b. Character Education Self-Efficacy and Implementation

Character education self-efficacy concerns teachers' beliefs in their ability to manage instructional situations that require moral guidance. It encompasses confidence in explaining academic honesty, responding constructively to disrespectful digital communication, facilitating disagreement about appropriate online behavior, and giving feedback that helps pupils understand the consequences of their choices. This belief is narrower than general teaching confidence and different from digital pedagogical competence: a teacher may know how to run a learning platform yet feel uncertain about addressing conflict or deception within it. Teacher efficacy concerns judgments of capability in specific instructional situations (Tschannen-Moran & Woolfolk Hoy, 2001). Ertmer and Ottenbreit-Leftwich (2010) distinguish confidence from knowledge in technology-related change. Digital ethical dilemmas often demand unscripted responses, making confidence in discussing misconduct and disagreement relevant even for teachers who can operate digital tools proficiently. It is plausible that teachers with stronger task-specific self-efficacy will report more frequent attempts to integrate these activities, even when digital resources and school policies are similar. This remains an association to be tested rather than a presumed effect of confidence on teaching.

H2: Character education self-efficacy is positively associated with teachers' implementation of digital character education in elementary schools.

c. Perceived Principal Support and Implementation

Teachers' work is shaped by the priorities and routines of their schools. Principal support is defined here as teachers' perceptions of the clarity of school expectations, availability of constructive guidance, recognition of relevant teaching initiatives, and opportunities to discuss or improve character-oriented digital instruction. This construct concerns leadership practices as experienced by teachers, not an externally assessed rating of principal performance. Leadership may influence whether teachers have time, feedback and encouragement to incorporate digital ethics into ordinary lessons. Zeng et al. (2025) identify professional learning and organizational support in a review of principals' digital leadership, although their focus is AI integration rather than character education. The institutional mechanism is relevant, but a direct empirical

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correspondence should not be assumed. Support should not be equated with enforcement. A principal may articulate a strong expectation for responsible digital learning without providing time for collaboration, feedback, or development. By focusing on teachers' perceptions of practical support, this study asks whether such conditions are associated with more frequent character-related digital teaching practices.

H3: Perceived principal support is positively associated with teachers' implementation of digital character education in elementary schools.

d. School–Family Collaboration and Implementation

Many of the ethical challenges encountered through digital learning continue outside school hours. Children move between classroom platforms, home devices, family messaging practices, and online content that teachers may not see. Consistency between school and home is therefore relevant to how rules about respectful communication, privacy, and responsible information use are explained and revisited. Goodall and Montgomery (2014) distinguish parental engagement with children's learning from participation in school activities alone, suggesting that the quality of cooperation matters more than the mere existence of contact. In the present study, school–family collaboration includes teachers' perceptions of communication, shared expectations, parental responsiveness and problem-solving about digital conduct. The application-based partnership developed by Febiantoni et al. (2025) illustrates a possible form of coordination, but concerns junior secondary pupils and does not establish an effect among elementary teachers. Teachers who perceive families as responsive and willing to discuss children's online behavior may find it easier to make digital responsibility a regular instructional topic. Conversely, limited communication may leave classroom expectations disconnected from pupils' experiences elsewhere. Because only teachers are surveyed, the present variable represents teacher-perceived collaboration, not independently verified parental engagement.

H4: Teacher-perceived school–family collaboration is positively associated with teachers' implementation of digital character education in elementary schools.

e. Perceived Adequacy of Digital Resources and Implementation

Character-oriented digital activities require at least some workable access to instructional tools. Teachers may intend to use digital stories, mediated discussions, or online information-evaluation tasks but find that unreliable connectivity, insufficient devices, unsuitable materials, or a lack of technical assistance restricts their choices. Perceived adequacy of digital resources refers to teachers' assessment of whether the infrastructure, accessible materials, and technical support available to them are sufficient for the activities they plan. It is not a direct inventory of school facilities. Petko (2012) considers available tools alongside teacher willingness and skill, while Ertmer and Ottenbreit-Leftwich (2010) caution that access alone rarely produces pedagogical change. Lesnawati (2025) documents uneven infrastructure and institutional capacity in higher education, which is contextually informative but not direct elementary-school evidence. These sources justify treating resource adequacy as a perceived enabling condition rather than an objective inventory or sufficient explanation of teaching practice. Teachers who perceive resources as adequate may have more opportunities to implement digital character lessons repeatedly rather than only occasionally. The expected relationship is positive, but limited resources may sometimes be offset by careful low-technology teaching strategies. The study tests the average association rather than assuming that resource provision is a sufficient condition for implementation.

H5: Perceived adequacy of digital resources is positively associated with teachers' implementation of digital character education in elementary schools.

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2.4. Conceptual Framework

Figure 1 presents the teacher-level model. The outcome is teachers' self-reported frequency of implementing digital character education during the previous eight weeks. Five predictors—perceived digital pedagogical competence (X1), character education self-efficacy (X2), principal support (X3), school–family collaboration (X4) and digital resource adequacy (X5)—are examined concurrently. H1–H5 specify positive conditional associations with implementation, not causal effects. The model brings perceived teaching capability and confidence together with organizational and family context. Predictor correlations and variance inflation factors were examined for redundancy, and preliminary reliability and measurement checks were performed. The survey relied on teachers' own reports and contained no school membership variable; consequently, ordinary least-squares regression with HC3 heteroskedasticity-consistent standard errors was used. Inference remains exploratory because this approach cannot account for potential dependence within schools.

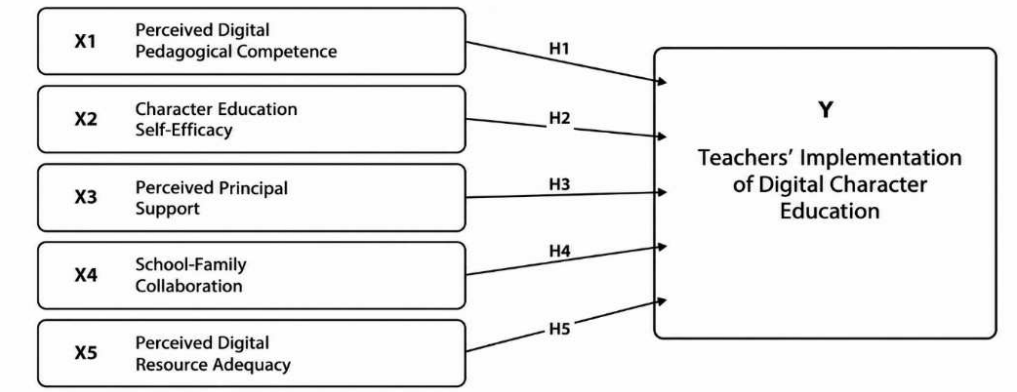


Figure 1. Conceptual framework

III. Research Method

3.1. Research Design

The study adopted a quantitative explanatory design with a cross-sectional online survey of elementary school teachers in Bandung City, Indonesia. Five teacher-reported predictors were examined: perceived digital pedagogical competence (X1), character education self-efficacy (X2), perceived principal support (X3), teacher-perceived school–family collaboration (X4), and perceived digital resource adequacy (X5). The outcome (Y) was the frequency of teachers' reported implementation of digital character education during the preceding eight weeks. The teacher was the unit of analysis, and no direct measures of pupils' moral development were obtained. Teachers completed a cross-sectional online questionnaire. The analysis assessed concurrent associations rather than change over time. Because the data did not identify specific schools, the originally considered multilevel analysis could not be undertaken. Teacher-level regression was reported with this limitation stated explicitly (McNeish & Stapleton, 2016).

3.2. Research Setting, Population, Eligibility, and Recruitment

The study was conducted among teachers in public and private elementary schools in Bandung City, Indonesia. The target population consisted of teachers who had actively participated in curriculum-related digital learning activities during the eight weeks preceding the survey. These activities included the use of educational videos, digital presentations, online assignments, learning applications, educational platforms, and other technology-mediated instructional practices. Eligible participants were teachers with active instructional responsibilities who had taught at their respective schools throughout the reference period and

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had conducted at least one digital learning activity. School personnel without teaching responsibilities and teachers who had not engaged in relevant digital instruction during this period were excluded. These criteria ensured that respondents had recent instructional experience relevant to the implementation of digital character education examined in this study.

The study initially established a recruitment target of 360 teachers, taking into consideration the research objectives, the proposed model involving five independent variables, and the practical feasibility of collecting data across elementary schools in Bandung City. This target served as an operational basis for recruitment rather than a statistically determined threshold. As emphasized by Lakens (2022), sample-size justification should consider the intended analyses, statistical precision, and available research resources. The survey yielded 360 responses, comprising 180 teachers from public schools and 180 from private schools. Following data screening and the application of the predetermined composite-scoring criteria, 359 responses were retained for the principal statistical analysis. Although the number of respondents provided a substantial empirical basis for examining the proposed associations, it should not be interpreted as establishing statistical representativeness or sufficient analytical power without further assessment.

Participants were recruited through school-assisted purposive sampling. The questionnaire was administered using Google Forms, with participating schools facilitating its distribution to teachers who met the eligibility criteria. Teachers decided individually whether to complete the questionnaire, making participation voluntary and recruitment nonprobability-based. The available recruitment records did not establish the exact number of participating schools, the number of invitations distributed, or the proportion of eligible teachers who responded. Consequently, a reliable response rate could not be calculated. These recruitment characteristics were considered when interpreting the findings, particularly regarding potential selection bias and the extent to which the results may be generalized beyond the participating teachers.

3.3. Research Variables and Operational Definitions

Six teacher-reported constructs were assessed. X1 and X2 captured perceived digital instructional capability and confidence about character education; X3–X5 measured perceived principal support, school–family collaboration and digital resource adequacy. Y measured the reported frequency of character-oriented digital teaching practices during the previous eight weeks. Each X construct had five agreement items, while Y had ten frequency items. The outcome concerned teacher practice, not pupils' moral knowledge, feelings or behavior. Measurement summary. X1 assessed perceived capacity to select and adapt digital resources; X2 assessed confidence in addressing ethical learning situations; X3 assessed principal guidance and support; X4 assessed school–family communication and shared expectations; X5 assessed perceived availability of digital learning resources. Each contained five agreement items (1–5). Y contained ten frequency items (1–5) on ethical planning, modeling, reflection, responsible participation and feedback during the preceding eight weeks. The ten outcome items covered ethical expectations, modeling, reflection, responsible participation and feedback. These areas informed item construction but were not assumed to be separately validated dimensions.

3.4. Online Questionnaire and Measurement Procedures

A Bahasa Indonesia Google Forms questionnaire contained 35 positively keyed items: five for each X construct and ten for Y. X1–X5 used a five-category agreement response scale (1 = strongly disagree to 5 = strongly agree), whereas Y used a five-category reported-frequency scale (1 = never to 5 = always) referring to teaching opportunities during the preceding eight weeks. These category labels capture teachers' subjective estimates; equivalent frequencies across respondents cannot be presumed because the number of digital lessons varied. Recent digital-teaching frequency was therefore retained as a separate covariate. The exported dataset comprised school type, teaching role, grade taught, teaching experience, digital teaching frequency in the reference period, participation in digital training, participation in character-education training, and the

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35 item responses. It did not contain a school identifier, a teacher identity field, Google Forms timestamps, or a record of the specific school responsible for sharing each response. Responses marked "TB" were interpreted as unavailable/not applicable and treated as missing rather than assigned a numerical score. The survey instrument was assembled for this study; the number of items and internal consistency estimates do not by themselves establish content or construct validity (Boateng et al., 2018).

3.5. Instrument Evaluation and Measurement Evidence

The questionnaire was developed specifically to measure the pedagogical and contextual factors associated with teachers' implementation of digital character education. Its items were organized into six theoretically defined constructs, with five indicators representing each independent variable and ten indicators measuring the reported implementation of digital character education. The development of the instrument was informed by the conceptual definitions and relevant literature discussed in the preceding sections. Independent expert review, cognitive interviews, and separate pilot testing were not documented; therefore, these procedures were not included among the available sources of validation evidence. Following the principles outlined by Boateng et al. (2018), instrument quality was assessed through the available empirical evidence, while recognizing that internal consistency alone cannot establish content validity, dimensionality, or the conceptual distinctiveness of the measured constructs.

Internal consistency was examined using Cronbach's alpha, supplemented by exploratory McDonald's omega estimates based on single-factor measurement assumptions. Reliability coefficients were calculated using complete item responses within each respective construct. To further examine the proposed measurement structure, a six-factor model was estimated using maximum likelihood with 225 questionnaires containing complete responses to all measurement items. The model specified each item as an indicator of its corresponding construct, while allowing correlations among the six latent factors. This analysis provided a preliminary assessment of the correspondence between the observed item relationships and the theoretically proposed measurement structure. However, because the ordinal response categories were treated as continuous and the estimation was restricted to complete cases, the results were interpreted as preliminary measurement evidence rather than definitive confirmation of construct validity. In particular, the estimates should not be considered equivalent to an ordinal confirmatory factor analysis using weighted least squares mean and variance adjusted (WLSMV) estimation (Li, 2016). Potential dependence among teachers from the same schools also remained unaccounted for in the measurement analysis.

3.6. Google Forms Distribution and Data Protection

Primary data were collected using Google Forms links distributed directly to participating schools and shared with eligible teachers. Responses were completed individually and voluntarily. The analytical dataset contained 360 records, of which 359 met the scoring criteria. Names, email addresses and pupil records were absent from the analytical extract. The study did not administer a separate written informed-consent form or obtain prior formal research ethics committee approval. These procedures are disclosed without implying that questionnaire completion constituted formally documented consent.

3.7. Data Processing, Statistical Analysis, and Hypothesis Testing

Data analysis began with screening the 360 teacher responses obtained through the online questionnaire. The instrument comprised 35 items, yielding 12,600 possible item-level responses. Of these, 168 responses (1.33%) were recorded as "TB" (not applicable) and treated as missing values rather than assigned numerical scores. Composite scores were calculated using the mean of available valid items, provided that at least four of the five items for each independent construct and eight of the ten items for the dependent construct were completed. Applying these criteria resulted in 359 respondents eligible for the main statistical analysis. For the preliminary measurement model requiring complete responses across all 35

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items, the analysis was restricted to 225 respondents. Missing responses were not imputed, and the original observed values were retained throughout the analytical process.

Descriptive statistics were used to summarize respondent characteristics and the distribution of construct scores, while internal consistency was assessed using Cronbach's alpha and exploratory McDonald's omega. Pearson correlation analysis examined the direction and strength of bivariate relationships among the six constructs. To investigate the proposed hypotheses, ordinary least-squares (OLS) multiple linear regression was conducted at the individual teacher level. The regression model included perceived digital pedagogical competence (X1), character education self-efficacy (X2), perceived principal support (X3), teacher-perceived school–family collaboration (X4), and perceived digital resource adequacy (X5) as independent variables, with teachers' reported implementation of digital character education (Y) as the dependent variable. Teaching experience, public or private school status, grade band, and the frequency of digital teaching activities during the preceding eight weeks were included as covariates to account for observed differences in teacher characteristics and instructional exposure. Additional models excluding digital teaching frequency were examined to assess the stability of the estimated associations. The regression model was specified as follows:

$$Y_i = \beta_0 + \beta_1 X1_i + \beta_2 X2_i + \beta_3 X3_i + \beta_4 X4_i + \beta_5 X5_i + \gamma^T C_i + \varepsilon_i$$

where Y_i represents the implementation score for teacher i, β_0 is the intercept, β_1–β_5 are the regression coefficients for the five independent variables, C_i denotes the observed covariates, γ represents their corresponding coefficients, and ε_i is the residual term. Heteroskedasticity-consistent HC3 standard errors were employed to obtain more reliable uncertainty estimates under potential heteroskedasticity. The results were reported using unstandardized coefficients, standardized coefficients, 95% confidence intervals, and p values. Variance inflation factors (VIFs) were examined to assess multicollinearity among the predictors, while R^2 and adjusted R^2 were used to evaluate the explanatory performance of the regression models. To account for multiple hypothesis tests, the Holm adjustment procedure was applied to the p values associated with the five primary predictors. The analysis was designed to identify associations between the proposed factors and teachers reported instructional practices rather than establish causal relationships. Because the survey did not collect information identifying respondents' individual schools, potential statistical dependence among teachers working within the same institutions could not be estimated. Although HC3 standard errors protect heteroskedasticity, they do not account for within-school correlation. Accordingly, hypothesis-test results and confidence intervals were interpreted cautiously, recognizing the limitations of the unclustered regression model. The cross-sectional design and reliance on self-reported measures further restrict the interpretation of the findings, which concern teachers' reported implementation of digital character education rather than directly observed improvements in students' moral development.

3.8. Transparency, Deviations, and Study Limitations

The survey used school-assisted purposive recruitment and teacher-level analysis. Ordinary least-squares regression with HC3 standard errors estimated the associations between the five predictors and reported implementation. Possible similarity of responses among teachers at the same school could not be modeled; this limitation conditions the interpretation of statistical uncertainty. The sample was opt-in and nonprobability-based, and all constructs were self-reported at one time point. Selection bias, socially desirable responses, common-method effects and unequal opportunities to conduct digital lessons are therefore possible. No separate written consent form or prior formal ethics committee approval was obtained. These procedural limitations are disclosed; their acceptability for publication must be assessed under the journal's applicable ethics policy. The observed associations do not establish causal effects or changes in pupils' moral development.

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IV. Results and Discussion

4.1. Respondent Characteristics and Data Screening

The dataset contains 360 responses, evenly divided between public and private schools. Classroom teachers predominate (296, 82.2%), and teaching experience averages 10.87 years (SD = 6.73). In the preceding eight weeks, 252 respondents (70.0%) reported at least six digital lessons. These figures describe the participating teachers and do not imply a probability sample of Bandung schools.

Table 1. Respondent characteristics (N = 360)

Characteristic	Category	n	%
School status	Public	180	50.0%
	Private	180	50.0%
Teaching role	Classroom teacher	296	82.2%
	Subject teacher	57	15.8%
	Other teaching role	7	1.9%
Grade band	Grades I–III	160	44.4%
	Grades IV–VI	161	44.7%
	More than one grade	39	10.8%
Digital lessons in previous 8 weeks	1–2	31	8.6%
	3–5	77	21.4%
	6–10	122	33.9%
	More than 10	130	36.1%
Professional development (12 months)	Digital: yes	205	56.9%
	Character education: yes	178	49.4%

Among 12,600 item responses, 168 (1.33%) were coded 'TB' and treated as missing. Although 225 teachers answered all 35 items, the prespecified composite thresholds retained 359 respondents for the main analysis. One record lacked sufficient X1 responses. No exact duplicate full records were found; fieldwork metadata and consent documentation were not available in the analytical extract.

4.2. Descriptive Statistics and Preliminary Measurement Quality

Table 2. Construct scores and internal consistency

Construct	Valid n	Mean	SD	α	ω*
X1 — Digital pedagogical competence	359	3.60	0.96	0.881	0.881
X2 — Character education self-efficacy	360	3.67	0.95	0.887	0.887
X3 — Principal support	360	3.41	1.00	0.891	0.891
X4 — School–family collaboration	360	3.30	1.02	0.896	0.896
X5 — Digital resource adequacy	360	3.23	1.02	0.891	0.892
Y — Implementation of digital character education	360	3.34	0.99	0.943	0.943

Character education self-efficacy had the highest predictor mean (M = 3.67), and perceived resource adequacy the lowest (M = 3.23). Implementation averaged 3.34 (SD = 0.99). Cronbach's alpha ranged from 0.881 to 0.943, indicating substantial within-scale consistency but not, by itself, confirming distinct constructs or observed classroom behavior. Alpha used construct-complete responses; omega was an exploratory single-factor estimate.

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Table 3. Pearson correlations between construct scores

	X1	X2	X3	X4	X5	Y
X1	1.000	—	—	—	—	—
X2	0.259	1.000	—	—	—	—
X3	0.239	0.283	1.000	—	—	—
X4	0.168	0.272	0.419	1.000	—	—
X5	0.018	0.091	0.176	0.207	1.000	—
Y	0.495	0.452	0.374	0.371	0.223	1.000

Digital pedagogical competence had the strongest unadjusted correlation with implementation (r = 0.495), followed by self-efficacy (r = 0.452). The largest association between predictors was principal support with school–family collaboration (r = 0.419). These values do not suggest severe bivariate redundancy.

4.3. Preliminary Confirmatory Measurement Check

The supplementary six-factor maximum-likelihood model was fitted to 225 completely observed questionnaires, treating ordinal indicators as approximately continuous. Fit statistics were $\chi^2(545) = 589.38$, $p = 0.092$, CFI = 0.990, TLI = 0.990, RMSEA = 0.019 and SRMR = 0.043. These statistics describe fit under that specification only. Complete-case selection, ordinal measurement and unmeasured school dependence limit the inference that can be drawn about construct validity.

4.4. Associations with Reported Implementation

Multiple linear regression was conducted to examine the associations between the five pedagogical and contextual factors and teachers' reported implementation of digital character education. The analysis included 359 teachers and adjusted for teaching experience, school status, grade band, and the frequency of digital learning activities. The model explained 44.6% of the observed variation in implementation scores ($R^2 = 0.446$; adjusted $R^2 = 0.427$), indicating that the predictors and covariates collectively accounted for a substantial proportion of the variation within the surveyed teachers. Heteroskedasticity-consistent HC3 standard errors were applied to the regression estimates.

Table 4. Adjusted associations with reported implementation

Path	Predictor	B	β	95% CI (B)	p	Holm p	VIF
X1	Digital pedagogical competence	0.372	0.360	[0.281, 0.463]	< .001	< .001	1.15
X2	Character education self-efficacy	0.279	0.268	[0.183, 0.374]	< .001	< .001	1.18
X3	Principal support	0.123	0.125	[0.029, 0.218]	0.010	0.010	1.34
X4	School–family collaboration	0.161	0.165	[0.070, 0.252]	< .001	0.002	1.31
X5	Digital resource adequacy	0.129	0.133	[0.051, 0.207]	0.001	0.002	1.08

As presented in Table 4, all five predictors showed positive associations with teachers' reported implementation of digital character education after accounting for the observed covariates. Digital pedagogical competence demonstrated the strongest standardized association (β = 0.360), followed by character education self-efficacy (β = 0.268). Among the contextual factors, school–family collaboration showed the largest standardized coefficient (β = 0.165), followed by digital resource adequacy (β = 0.133) and principal support (β = 0.125). These results suggest that teachers' perceived pedagogical capabilities and confidence are more strongly associated with reported implementation than the individual contextual factors examined in the model. The Holm-adjusted p values remained below the conventional 0.05 threshold for all five predictors under the fitted regression specification. The variance inflation factors ranged from 1.08 to 1.34, indicating no substantial multicollinearity among the five principal predictors. Nevertheless, statistical significance should be interpreted cautiously because the model did not account for possible dependence

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among teachers working at the same school. Although HC3 standard errors address heteroskedasticity, they do not correct for within-school correlation. The findings therefore provide evidence of positive conditional associations within the surveyed sample rather than definitive school-adjusted inference or causal relationships.

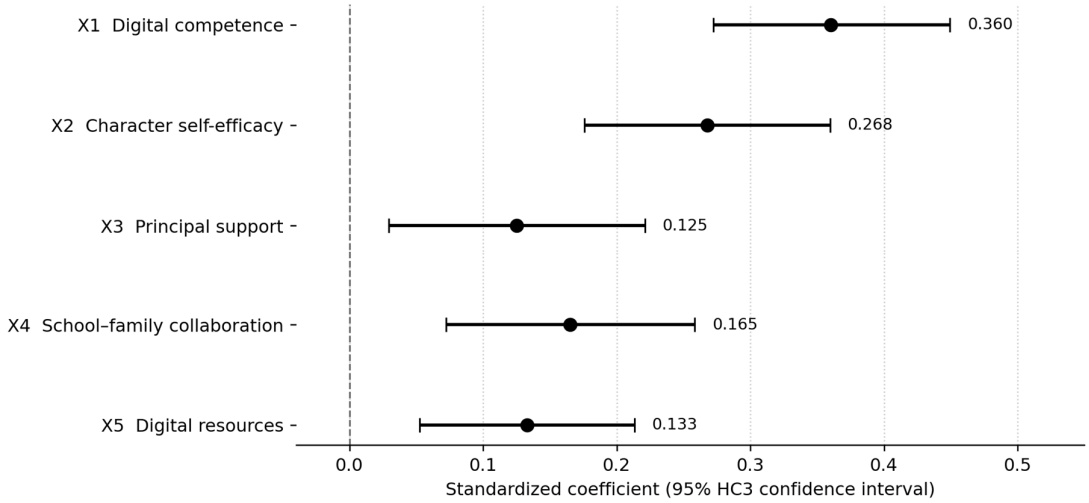


Figure 2. Adjusted regression coefficients and HC3 confidence intervals (exploratory analysis).

Sensitivity analysis

The five-predictor model had $R^2 = 0.436$. Adding school status, experience and grade band increased R^2 to 0.442, and adding digital lesson frequency raised it to 0.446. The direction of the five predictor coefficients was similar across these specifications. These comparisons do not resolve selection bias, shared-source measurement or unmeasured within-school dependence. The coefficient estimates illustrated in Figure 2 show a consistently positive pattern across the five predictors. The comparatively larger coefficients for digital pedagogical competence and character education self-efficacy highlight the relevance of teachers' perceived instructional capabilities and professional confidence. However, differences in coefficient magnitude should not be interpreted as evidence that strengthening one factor would necessarily produce a greater improvement in implementation than strengthening another.

Additional regression specifications were examined to assess the stability of the observed associations. The model containing only the five principal predictors explained 43.6% of the variation in implementation scores ($R^2 = 0.436$). Including school status, teaching experience, and grade band increased the explained variance to 44.2% ($R^2 = 0.442$). The addition of digital lesson frequency further increased R^2 to 0.446. The five predictors retained positive coefficients across these specifications, indicating that the direction of their associations was relatively stable after adjustment for the observed teacher characteristics and instructional exposure. The modest differences in explained variance suggest that the demographic and digital-exposure variables contributed limited additional explanatory information beyond the five principal predictors. However, these comparisons do not eliminate possible selection bias, shared-method influences, or unmeasured dependence among respondents from the same schools. Accordingly, the sensitivity analysis supports the consistency of the observed directional relationships within the available data, without establishing their causal or population-level validity.

4.5. Item-Level Patterns in Digital Character Education

To provide a more detailed understanding of teachers' implementation of digital character education, the analysis examined the reported frequency of ten instructional practices representing the dependent variable (Y). These practices encompass integrating character-related objectives into digital

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lessons, promoting honesty and respect in digital interactions, modeling responsible online behavior, encouraging ethical reflection, and providing feedback on students' digital conduct. Teachers reported how frequently they engaged in these practices during the preceding eight weeks using a five-point frequency scale. Table 5 presents the number of valid responses, mean scores, and proportions of teachers selecting the "often" or "always" categories for each item. This item-level analysis complements the overall implementation score by describing the specific instructional practices reported by teachers, without assuming that their frequency directly reflects effectiveness in developing students' character.

Table 5. Reported frequency of implementation practices

Code	Practice (abbreviated)	n	Mean	Often/always
Y.1	Plan character goals for digital lessons	355	3.35	47.0%
Y.2	Explain responsible conduct before digital activities	354	3.40	50.8%
Y.3	Use examples of honesty in online information	356	3.38	48.6%
Y.4	Teach respect for others' digital work	352	3.30	45.7%
Y.5	Model acknowledgement of internet sources	356	3.25	44.7%
Y.6	Model respectful language in digital communication	354	3.35	47.7%
Y.7	Discuss choices in digital ethical dilemmas	354	3.33	49.4%
Y.8	Invite reflection on consequences of digital actions	359	3.30	46.5%
Y.9	Use explicit criteria to assess digital responsibility	354	3.36	48.9%
Y.10	Provide feedback on responsible digital conduct	355	3.37	48.5%

Explaining responsible digital conduct before a lesson had the highest mean (Y.2: 3.40); modeling internet-source acknowledgement had the lowest (Y.5: 3.25). Across practices, 44.7%–50.8% of valid responses were in the 'often' or 'always' categories. The small range in means should not be interpreted as evidence of meaningful differences without formal comparison.

4.6. Discussion

The findings indicate that teachers' reported implementation of digital character education is associated with both pedagogical capabilities and the educational conditions in which they work. All five predictors showed positive associations after adjustment for the observed teacher characteristics, with perceived digital pedagogical competence and character education self-efficacy displaying the largest standardized coefficients. The model accounted for 44.6% of the variation in implementation scores within the surveyed sample. These findings suggest that digital character education involves more than access to technology or the adoption of digital learning platforms. It also concerns teachers' perceived ability and confidence to incorporate ethical considerations into instructional activities. The distinction between technology integration and character-oriented digital teaching is important. Digital tools may facilitate access to information, communication, and collaboration, but their educational use does not necessarily involve reflection on honesty, responsibility, respect, or ethical judgment. Lauricella et al. (2020) documented differences in the digital citizenship competencies addressed by early-grade educators, while Tadlaoui-Brahmi et al. (2022) identified limitations in primary-level activities that emphasize technological participation without sufficient critical engagement. The present findings extend this discussion by examining how teachers' perceived capacities and contextual conditions relate to the reported frequency of character-oriented practices. Because the evidence is cross-sectional and based on teachers' responses, these relationships should be understood as associations rather than causal effects.

a. Perceived Digital Pedagogical Competence and Reported Implementation

Perceived digital pedagogical competence demonstrated the strongest standardized association with teachers' reported implementation of digital character education ($\beta = 0.360$). Teachers who reported

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greater confidence in selecting, adapting, and evaluating digital resources also tended to report more frequent integration of ethical considerations into their instructional practices. This relationship draws attention to the pedagogical decisions underlying digital learning. For example, an online information-search activity may focus exclusively on finding answers, or it may be designed to encourage students to examine information credibility, acknowledge sources, and consider the consequences of sharing inaccurate content.

This interpretation is consistent with Caena and Redecker (2019), who emphasize the pedagogical dimensions of teachers' digital competence. Scherer et al. (2019) similarly demonstrate the relevance of teachers' beliefs and perceptions in explaining technology adoption, while Amahoru et al. (2024) report associations between teacher competence and educational technology use in Indonesia. However, these studies primarily address broader technology-related practices rather than the explicit integration of character education into digital lessons. The present findings provide a more specific perspective by examining teachers' reported engagement in instructional activities involving ethical guidance and responsible digital participation. The relatively strong association suggests that pedagogical competence deserves attention in understanding differences in reported implementation. Nevertheless, the direction of this relationship cannot be established. Teachers who regularly incorporate ethical discussions into digital lessons may also develop stronger perceptions of their pedagogical competence through experience. Accordingly, professional development that combines digital resource evaluation, ethical case discussions, and reflective lesson design represents a relevant area for further investigation rather than an intervention whose effectiveness has been demonstrated by this study.

b. Character Education Self-Efficacy and Reported Implementation

Character education self-efficacy exhibited the second-largest standardized association with reported implementation ($\beta = 0.268$). Teachers who expressed greater confidence in addressing character-related issues tended to report more frequent involvement in digital character education activities. This finding is particularly relevant because ethical situations arising during digital learning are not always predictable. Questions involving academic dishonesty, inappropriate communication, or conflicting viewpoints may require teachers to respond immediately while maintaining a constructive learning environment. Tschannen-Moran and Woolfolk Hoy (2001) explain teacher self-efficacy in relation to perceived capabilities for organizing and carrying out instructional actions. Ertmer and Ottenbreit-Leftwich (2010) likewise distinguish confidence from knowledge when examining technology-related changes in teaching practice. These perspectives help explain why digital pedagogical competence and character education self-efficacy may represent complementary, although distinct, aspects of teachers' professional readiness. Competence concerns perceived capability to make appropriate pedagogical use of digital resources, whereas self-efficacy concerns confidence in managing instructional situations involving ethical judgment and student behavior. The findings also correspond with Döring et al. (2024), who describe how primary school teachers promote values through everyday interactions, discussion, and modeling. In digital learning environments, such practices may require teachers to address ethical issues beyond the planned subject matter. Nevertheless, the association between self-efficacy and implementation may partly reflect shared perceptions because both variables were reported by the same respondents. Classroom observation and independent assessment would provide stronger evidence of how perceived confidence relates to actual instructional behavior.

c. Perceived Principal Support and Reported Implementation

Perceived principal support showed a positive association with teachers' reported implementation of digital character education ($\beta = 0.125$), although its standardized coefficient was smaller than those of the two teacher-related factors. Teachers who perceived clearer institutional expectations, constructive feedback, and opportunities for professional collaboration tended to report more frequent character-oriented digital teaching practices. This finding suggests that school leadership may provide an organizational setting in which teachers can incorporate ethical considerations into their instructional planning. Zeng et al. (2025)

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identify professional learning, organizational encouragement, and resource provision as relevant elements of school leaders' support for technology integration. Although their review focuses on artificial intelligence rather than digital character education, it offers a useful institutional perspective. Leadership support may help establish shared instructional priorities, particularly when teachers encounter competing curriculum demands or uncertainty about how digital responsibility should be addressed. However, the present results measure teachers' perceptions of principal support rather than independently observed leadership practices. A positive perception does not necessarily indicate that particular school policies or leadership initiatives have been implemented effectively. Moreover, the smaller standardized coefficient should not be interpreted as evidence that leadership is unimportant. Its contribution was estimated conditionally on the other predictors and covariates. Further research incorporating principal perspectives and school-level documentation would help clarify which forms of support are most closely associated with classroom implementation.

d. Teacher-Perceived School–Family Collaboration and Reported Implementation

Teacher-perceived school–family collaboration showed a positive association with implementation ($\beta = 0.165$), representing the largest standardized coefficient among the three contextual predictors. Teachers who reported more constructive communication and shared expectations with families also tended to report more frequent integration of character-related practices into digital learning. This finding is relevant because students' digital experiences extend beyond school, where expectations regarding communication, information sharing, and responsible technology use may differ. Goodall and Montgomery (2014) distinguish meaningful parental engagement in children's learning from participation in school activities alone. Their perspective suggests that educational collaboration involves more than occasional communication between teachers and parents. In the context of digital character education, communication may become relevant when schools and families seek to establish consistent expectations regarding online behavior, academic honesty, and respectful interaction. Febiantoni et al. (2025) provide an example of technology-supported school–family partnership in character education, although their study concerns junior secondary students and cannot be treated as direct evidence for the present elementary-school sample. The findings support considering school–family relationships as part of the broader context of teachers' reported practices. However, the study did not obtain responses from parents or independently assess the quality of school–family collaboration. Therefore, the observed association reflects teachers' perceptions rather than verified agreement between schools and families. Future studies involving both groups could examine whether shared expectations are reflected in consistent guidance and educational practices across home and school environments.

e. Perceived Digital Resource Adequacy and Reported Implementation

Perceived digital resource adequacy was positively associated with implementation ($\beta = 0.133$). This variable also had the lowest mean among the five predictors (3.23), indicating comparatively less favorable perceptions of resource adequacy within the surveyed sample. Teachers who considered available devices, internet connectivity, digital materials, and technical assistance more sufficient tended to report more frequent character-oriented digital learning activities. This result is consistent with the distinction between teachers' willingness, skills, and available tools discussed by Petko (2012). Ertmer and Ottenbreit-Leftwich (2010) also emphasize that technological resources operate alongside teachers' knowledge, confidence, and organizational conditions. Although Lesnawati (2025) examines digital learning infrastructure in higher education, the study provides a related perspective on how institutional resources may shape opportunities for technology-supported instruction. Resource adequacy should nevertheless be understood as an enabling condition rather than a sufficient explanation of implementation. Teachers may conduct meaningful discussions about online responsibility using relatively simple resources, such as downloaded examples or printed digital materials. Conversely, schools with extensive technological facilities may not consistently incorporate ethical reflection into digital lessons. The present study measured perceived sufficiency rather

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than objectively documenting school facilities. Further investigation could examine the relationship between actual resource availability, instructional design, and observed classroom practices.

f. Instructional Practices: From Ethical Expectations to Responsible Information Use

The item-level analysis provides additional insight into the types of digital character education activities reported by teachers. Explaining responsible conduct before digital learning activities had the highest mean score (Y.2 = 3.40), while modeling acknowledgment of internet sources had the lowest (Y.5 = 3.25). The difference was relatively small, at 0.15 scale points, and was not subjected to a formal statistical comparison. These results therefore describe variation in reported practice rather than establish meaningful differences between individual instructional activities. The observed pattern nevertheless raises a relevant pedagogical question about how general expectations are translated into specific digital behaviors. Explaining that students should behave responsibly online is different from demonstrating how to acknowledge information sources, evaluate digital content, or respond respectfully to disagreement. Tadlaoui-Brahmi et al. (2022) identify similar concerns regarding the limited critical dimensions of some digital citizenship activities. Hidayat et al. (2022) emphasize habituation and modeling in character education, while Damanik et al. (2026) describe how teachers incorporate Pancasila values into digital learning activities in Jakarta elementary schools. These studies suggest that character education may be expressed through both explicit guidance and repeated instructional examples. The present item-level results do not establish that one practice is more effective than another. Rather, they provide a descriptive basis for examining how teachers combine explanations, demonstrations, reflection, and feedback when addressing ethical conduct in digital learning. Classroom-based research would be needed to determine how these practices are enacted and experienced by students.

g. Theoretical and Practical Implications

The principal contribution of this study lies in examining teacher-related capabilities and contextual conditions within a single model of reported digital character education practices. Previous research has investigated teachers' technology adoption (Scherer et al., 2019), the promotion of values through classroom interactions (Döring et al., 2024), and school–family partnerships in character education (Febiantoni et al., 2025). By bringing these perspectives together, the present study provides empirical evidence that perceived pedagogical competence, self-efficacy, institutional support, family collaboration, and resource adequacy are concurrently associated with a specifically character-oriented instructional outcome. The findings also provide a more differentiated interpretation of teachers' professional readiness. Perceived competence and self-efficacy concern teachers' capacity and confidence to incorporate ethical considerations into digital activities, whereas leadership, family collaboration, and resources describe perceived conditions surrounding their work. This distinction is compatible with the capability–belief–context perspective informing the study. However, the regression model estimates associations rather than testing interactions or causal mechanisms among these conditions. It would therefore be premature to conclude that the contextual variables strengthen or mediate the relationships between teacher capabilities and implementation.

For educational practice, the findings point to several areas worthy of closer consideration. Teacher professional development could include evaluating digital materials for ethical relevance, developing learning activities around online dilemmas, and providing feedback on responsible digital conduct. School leaders may support such efforts through collaborative planning and opportunities for professional discussion. Communication between schools and families may also help clarify expectations about children's digital behavior, while resource planning can be connected to specific instructional needs rather than technology provision alone. These implications should be interpreted as priorities for professional reflection and further evaluation. The study did not test the effectiveness of training programs, leadership interventions, school–family initiatives, or resource investments. Consequently, the relative sizes of the regression coefficients should not be used as a direct ranking of intervention effectiveness.

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h. Research Limitations and Directions for Future Research

Several limitations should be considered when interpreting the findings. The cross-sectional design restricts conclusions to associations observed during the survey period and does not establish the temporal direction of the relationships. Participation was voluntary and based on nonprobability recruitment, which may have introduced selection bias and limits generalization to the wider population of elementary school teachers in Bandung. Moreover, the use of self-reported measures for both predictors and implementation creates the possibility of common-method variance, social desirability, and differences in respondents' interpretations of questionnaire items (Podsakoff et al., 2003). Although the scales demonstrated high internal consistency, reliability coefficients alone do not establish content validity or the distinctiveness of the proposed constructs (Boateng et al., 2018). The preliminary six-factor analysis was conducted using maximum likelihood on 225 complete questionnaires, with ordinal responses treated as continuous. Further instrument evaluation is therefore necessary before drawing stronger conclusions about the measurement structure. In addition, the absence of school-level identifiers prevented the assessment of potential dependence among teachers from the same schools. The HC3 standard errors addressed heteroskedasticity but did not account for this possible dependence, limiting the strength of statistical inference. The absence of prior formal ethics committee approval and separate written informed-consent documentation constitutes an additional procedural limitation, as disclosed in the research method. Future research could strengthen the evidence through broader recruitment, independent classroom observations, and information from students, parents, and school leaders. Longitudinal or intervention-based designs would help establish whether changes in teachers' pedagogical capabilities and school conditions precede changes in instructional practices. Further measurement studies using methods appropriate for ordinal indicators would also help assess construct validity. Such approaches could provide a clearer understanding of how digital character education is implemented and whether particular instructional practices contribute to students' ethical understanding and behavior.

V. Conclusion

Teachers' reported implementation of digital character education in Bandung elementary schools was positively associated with perceived pedagogical competence, character education self-efficacy, principal support, school–family collaboration and digital resource adequacy. Competence and task-specific efficacy showed the strongest adjusted relationships. Digital character education therefore appears more closely connected to deliberate pedagogical practice than to technology provision alone, although the cross-sectional associations do not establish causality. The study contributes a teacher-level comparison of perceived capabilities and contextual conditions within one model. For practice, it suggests examining professional learning that joins digital lesson design with ethical discussion, alongside leadership support, school–family communication and suitable resources. These are priorities for further assessment rather than interventions shown to improve pupils' moral development. The survey relied on voluntary, nonprobability recruitment and teacher self-reports, and the analysis could not estimate within-school dependence. Its preliminary measurement checks do not establish full construct validity. The absence of separate written informed consent and prior ethics committee approval is also acknowledged. Future studies should combine stronger measurement evidence with classroom observation, student perspectives and longitudinal designs to test how teaching practices relate to pupils' ethical understanding and behavior.

AI Disclosure

ChatGPT (OpenAI) was used to assist with academic language editing, drafting organization and presentation of analytical findings. All research decisions, verification of statistical calculations and references, interpretations and final approval remain the responsibility of the authors.

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Authorship Contribution

Darda Abdullah Sjam and Cep Miftah Khoerudin contributed to the conceptual development, research design, methodological framework, interpretation of findings, and preparation of the manuscript. Both authors participated in reviewing and refining the manuscript to strengthen its scientific coherence and academic quality. Both authors are responsible for approving the final version and ensuring the integrity and accuracy of the published work.

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