

System, Information, and Service Quality in Digital Gross Motor Assessment: The Mediating Role of User Trust in Early Childhood Education

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ABSTRACT

Digital assessment can support systematic monitoring of children's gross motor development, but its effectiveness depends not only on technological availability but also on system quality, information quality, service quality, and users' trust. This study examined the relationships among these factors in early childhood daycare settings. A quantitative cross-sectional explanatory study was conducted among 200 users of a digital gross motor development assessment system from 20 daycare centers in Batam City. Data were collected through a structured questionnaire and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. Direct and indirect effects were tested using bootstrapping with 10,000 subsamples. System Quality, Information Quality, and Service Quality were positively associated with User Trust and perceived digital assessment effectiveness. Information Quality ($\beta = 0.352$) and User Trust ($\beta = 0.369$) showed the strongest direct relationships with perceived effectiveness, while System Quality had the strongest relationship with User Trust ($\beta = 0.467$). User Trust significantly mediated the relationships of System Quality ($\beta = 0.172$), Information Quality ($\beta = 0.090$), and Service Quality ($\beta = 0.056$) with perceived digital assessment effectiveness. Digital assessment in early childhood education is more likely to be perceived as effective when it provides reliable system performance, high-quality information, adequate support, and strong user trust. The findings extend the Information Systems Success Model to daycare-based gross motor assessment and highlight the importance of trustworthy, pedagogically meaningful digital assessment systems.

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1. INTRODUCTION

Gross motor development monitoring is an essential component of early childhood care because children's ability to perform movements involving large muscle groups—such as walking, running, jumping, balancing, throwing, and climbing—provides important information about their physical growth and developmental readiness. Fundamental motor skills not only support children's participation in physical activities but also contribute to their confidence, physical literacy, social interaction, and long-term health-related behavior. Accordingly, regular and accurate developmental assessment is necessary to identify children who may require additional stimulation or professional intervention. Recent evidence indicates that structured assessment and developmentally appropriate interventions can substantially improve young children's fundamental motor competence (Roscoe et al., 2024). Large-scale research has also demonstrated the importance of regular developmental assessment for detecting potential gross motor delays and understanding the factors associated with children's motor development (Xiong et al., 2024). Therefore, daycare centers need effective assessment mechanisms that enable caregivers and educators to document developmental progress consistently, accurately, and continuously.

The rapid digitalization of educational and childcare services has created opportunities to transform conventional developmental assessments into integrated digital assessment systems. Digital assessment can facilitate systematic data recording, accelerate the calculation and interpretation of assessment results, present longitudinal information on children's development, and improve communication among caregivers, daycare managers, parents, and relevant professionals. Emerging technological approaches have demonstrated that video-based data, automated movement recognition, and machine-learning models can support more objective assessment of children's gross motor performance. For example, Chun et al. (2024) developed an automated model capable of evaluating toddlers' gross motor behaviors and predicting their overall gross motor status with promising accuracy. Similarly, child-specific digital datasets have been developed to support artificial intelligence-based recognition of developmental movements, indicating the growing potential of technology-assisted developmental monitoring (Kim et al., 2023). Nevertheless, the effectiveness of a digital assessment system is determined not merely by the availability of the technology but by whether the system is reliable, understandable, responsive, and trusted by its users.

This issue is particularly relevant to daycare centers in Batam City. As a rapidly developing urban and industrial area, Batam has experienced increasing demand for childcare services from working parents and families requiring reliable institutional support for children's development. Daycare centers are consequently expected to provide not only supervision and basic care but also accountable developmental monitoring that can inform parents about their children's progress. In practice, however, developmental assessments may still depend on paper-based forms, fragmented records, subjective observation, and irregular reporting. These conditions may reduce the consistency of assessment, complicate longitudinal monitoring, and delay the identification of children requiring further developmental stimulation. The adoption of digital assessment could address these limitations, but technology integration in early childhood settings remains influenced by educators' knowledge, beliefs, perceived usefulness, and willingness to incorporate digital resources into their professional practices (Sosa-Alonso et al., 2025). Consequently, evaluating the effectiveness of digital assessment in Batam's daycare centers requires attention to both technological characteristics and users' psychological responses to the system.

Theoretically, this study is primarily grounded in the DeLone and McLean Information Systems Success Model, which explains information-system effectiveness through interrelated dimensions that include system quality, information quality, service quality, system use, user satisfaction, and net benefits. In the context of digital assessment, system quality refers to users' perceptions of the technical performance of the application, including its reliability, accessibility, ease of use, response speed, security, and functional integration. A digital assessment system that operates consistently and allows caregivers to enter, retrieve, and review developmental records without technical difficulty is more likely to support effective monitoring. Information quality concerns the accuracy, completeness, relevance, timeliness,

clarity, and interpretability of the developmental information generated by the system. Assessment results must accurately represent children's gross motor performance and be sufficiently clear to support educational or caregiving decisions. Service quality, meanwhile, reflects the adequacy of technical assistance, responsiveness, guidance, training, and problem resolution provided to system users. Contemporary applications of the DeLone and McLean model continue to show that these quality dimensions are central to evaluating the effectiveness and benefits of digital systems across organizational contexts (Rahmatullah et al., 2025; Rulinawaty et al., 2024).

Although system, information, and service quality may directly enhance digital-assessment effectiveness, these relationships may also depend on user trust. User trust refers to caregivers' and daycare managers' willingness to rely on the digital assessment system because they believe that it is technically dependable, provides credible information, protects sensitive child data, and is supported by a responsible service provider. Trust is particularly important in child-development assessment because the system processes personal information and produces results that may influence decisions regarding stimulation, communication with parents, or referrals to developmental professionals. A technically sophisticated system may remain underutilized when users doubt the accuracy of its results, fear the misuse of children's data, or believe that technical problems will not be handled adequately. An exploratory meta-analysis of digital-platform research found that system-related characteristics, service quality, structural assurance, provider reputation, perceived usefulness, and security-related considerations are important antecedents of users' trusting intentions (Oesterreich et al., 2025). Thus, high system quality, accurate and relevant information, and responsive support services may strengthen trust, which subsequently encourages users to depend on the platform and employ it consistently in developmental monitoring.

The effectiveness of digital assessment in this study refers to the extent to which the system supports accurate, efficient, consistent, timely, and useful monitoring of children's gross motor development. An effective system should reduce administrative burdens, minimize fragmented documentation, facilitate comparisons across assessment periods, assist caregivers in identifying developmental patterns, and provide information that can be communicated meaningfully to parents. However, the use of digital technology in early childhood settings must remain developmentally appropriate and pedagogically grounded. A systematic review by Chu et al. (2024) shows that digital technologies in early childhood can support learning and development when their use is interactive, meaningful, and situated within appropriate educational experiences, although concerns remain regarding excessive screen exposure and reduced physical activity. In the context of the present study, digital assessment is not intended to replace children's physical activities or caregivers' professional observations. Instead, it functions as a supporting system through which direct observations of children's movements can be documented, processed, interpreted, and followed up more systematically. Its effectiveness therefore depends on the interaction between technological quality, informational credibility, institutional support, and users' confidence in relying on the system.

Previous studies have examined digital technology adoption in early childhood education, automated motor-development assessment, information-system quality, digital-platform trust, and information-system effectiveness. Nevertheless, these research streams have largely developed separately. Studies of children's motor development have tended to focus on developmental predictors, assessment instruments, intervention outcomes, or automated recognition accuracy, while information-systems research has generally been conducted in e-government, higher education, banking, electronic commerce, and other commercial digital-service contexts. Limited empirical research has integrated system quality, information quality, service quality, user trust, and digital-assessment effectiveness within daycare-based gross motor development monitoring, particularly in Indonesia and Batam City. The novelty of this study, therefore, lies in extending the Information Systems Success Model to an early childhood developmental-assessment context and positioning user trust as a mediating mechanism linking three quality dimensions to assessment effectiveness. Accordingly, this study aims to analyze the direct effects of system quality, information quality, and service quality on the effectiveness of digital assessment for monitoring gross

motor development, as well as their indirect effects through user trust among users of digital assessment systems in daycare centers in Batam City.

2. METHODS

2.1. Research Design

This study employed a quantitative approach with an explanatory correlational research design to examine the relationships among system quality, information quality, service quality, user trust, and the effectiveness of digital assessment for monitoring children's gross motor development. The quantitative approach enabled the proposed relationships and hypotheses to be examined systematically using numerical data and statistical procedures. The explanatory correlational design was used to determine the direction and magnitude of the direct and indirect relationships among the constructs included in the research model.

A cross-sectional survey was conducted because all variables were measured during a single research period. Data collection took place from March to May 2026 among personnel working in daycare centers in Batam City. During this period, respondents evaluated the technical quality of the digital assessment system, the quality of the information generated by the system, the quality of the support services, their trust in the system, and the effectiveness of the system in supporting gross motor development monitoring.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used as the primary data-analysis technique. The analysis was performed using SmartPLS 4. PLS-SEM was selected because the proposed model involved multiple latent constructs, reflective indicators, and mediation relationships. The analysis examined the direct effects of system quality, information quality, and service quality on user trust and digital assessment effectiveness. It also examined the indirect effects of the three quality dimensions on digital assessment effectiveness through user trust.

Because the data were collected at one point in time, the findings reflected respondents' perceptions and experiences during the research period. Therefore, the interpretation of causal relationships was based on the proposed theoretical model and the estimated structural relationships rather than on temporal evidence.

2.3. Digital Assessment System Under Study

The object examined in this study was a web-based application referred to as the Digital Gross Motor Development Assessment System (DGMAS). The application was developed locally by an educational-technology team in collaboration with early childhood education specialists and representatives of the participating daycare centers. It was accessible through computers, tablets, and internet-enabled mobile devices. Its main features included user authentication, child-profile management, age-based assessment forms, gross motor observation checklists, digital scoring, observational notes, storage and retrieval of previous records, comparison across assessment periods, and automatic report generation.

DGMAS was used to document direct observations of children's gross motor performance rather than replace professional assessment by teachers or caregivers. The indicators assessed included walking, running, jumping, static and dynamic balance, throwing, climbing, movement coordination, and body control according to age-appropriate developmental criteria. To use the system, an authorized user selected the child's profile and assessment period, observed the child during structured activities or physical play, entered the relevant scores and notes, and reviewed the data before final submission. The system subsequently generated a digital or printable report containing the child's assessment results, developmental summary, observational notes, and comparisons with previous assessment periods. These reports were used to support continued monitoring, communication with

parents, additional stimulation, and decisions concerning further professional assessment when required.

At the time of data collection, respondents had used the system for periods ranging from less than one year to more than three years. Among the 200 respondents, 58 respondents (29.0%) had less than one year of experience, 104 respondents (52.0%) had one to three years of experience, and 38 respondents (19.0%) had more than three years of experience. All 20 participating daycare centers used the same core application, gross motor indicators, scoring rubric, data-entry procedure, access-control structure, and report format. Differences among daycare centers were limited to user accounts, registered children, assessment schedules, and the internal assignment of assessment responsibilities. This standardization ensured that all respondents evaluated the same digital assessment system.

2.3. Population and Sample

2.3.1. Population

The accessible population consisted of 238 personnel working in 20 daycare centers in Batam City. The population included teachers, caregivers, daycare coordinators, administrators, and managers who were involved in observing, recording, assessing, reporting, or managing information concerning children's gross motor development.

These personnel were selected as the target population because they had direct knowledge of the developmental-assessment practices implemented in their respective institutions. Their experiences enabled them to evaluate the technical reliability and usability of the digital assessment system, the quality of the assessment information generated, the quality of technical and operational support, their trust in the system, and the effectiveness of the system in supporting gross motor development monitoring.

The unit of analysis was the individual user of the digital assessment system. Each respondent therefore completed the questionnaire based on their own experience of using, testing, operating, or interacting with the system rather than representing the official opinion of the daycare institution.

2.3.2. Sample

The study employed non-probability sampling using a purposive sampling technique. Purposive sampling was used because respondents were required to possess specific knowledge and experience related to digital assessment and gross motor development monitoring.

Respondents were included when they met the following criteria:

1. They worked as teachers, caregivers, coordinators, administrators, or managers at daycare centers in Batam City.
2. They were actively involved in childcare, learning, developmental observation, developmental assessment, reporting, or daycare management.
3. They had used, tested, operated, or received sufficient exposure to a digital system for recording or assessing children's development.
4. They had adequate knowledge of the digital assessment system implemented or evaluated in their respective daycare centers.
5. They had worked at the daycare center for at least six months.
6. They voluntarily agreed to participate and completed the research questionnaire.

Personnel who had never interacted with the digital assessment system or did not have adequate knowledge of its functions were excluded because they could not reasonably evaluate its system quality, information quality, service quality, trustworthiness, and effectiveness.

The initial sample target was at least 150 usable responses, with a preferred target of approximately 200 responses. This target was established by considering the complexity of the

structural model, the number of predictors directed toward the endogenous constructs, and the need to obtain stable bootstrapping estimates.

A total of 220 questionnaires were distributed to eligible personnel from the 20 participating daycare centers. Of these, 207 questionnaires were returned, resulting in a response rate of 94.1%. The returned questionnaires were screened for completeness, duplicate submissions, response-pattern irregularities, and compliance with the respondent inclusion criteria.

Seven questionnaires were excluded during data screening. Four questionnaires contained substantial missing responses, two demonstrated uniform or straight-lining response patterns, and one was identified as a duplicate submission. Consequently, 200 valid questionnaires were retained and included in the final PLS-SEM analysis. The usable response rate was therefore 90.9% of the total questionnaires distributed.

2.3.3. Respondent Characteristics

The final sample consisted of 200 respondents representing different professional positions, educational backgrounds, lengths of employment, developmental-assessment experience, and digital-assessment experience. Based on professional position, 82 respondents, or 41.0%, were daycare teachers; 56 respondents, or 28.0%, were caregivers; 24 respondents, or 12.0%, were daycare coordinators; 20 respondents, or 10.0%, were administrators; and 18 respondents, or 9.0%, were daycare managers. Teachers, therefore, represented the largest professional group in the final sample. Regarding educational background, 30 respondents, or 15.0%, had completed senior high school or an equivalent qualification; 38 respondents, or 19.0%, held diploma qualifications; 116 respondents, or 58.0%, held bachelor's degrees; and 16 respondents, or 8.0%, held postgraduate degrees. Most respondents, therefore, had completed undergraduate education. Regarding length of employment, 48 respondents, or 24.0%, had worked in their daycare centers for between six months and two years. A total of 92 respondents, or 46.0%, had worked for more than two to five years, while 60 respondents, or 30.0%, had worked for more than five years. These results indicated that most respondents had sufficient familiarity with the operational and developmental-assessment practices of their institutions. In terms of developmental-assessment experience, 32 respondents, or 16.0%, had less than one year of experience; 96 respondents, or 48.0%, had between one and three years of experience; and 72 respondents, or 36.0%, had more than three years of experience. Regarding digital-assessment experience, 58 respondents, or 29.0%, had used digital assessment systems for less than one year; 104 respondents, or 52.0%, had between one and three years of experience; and 38 respondents, or 19.0%, had more than three years of digital-assessment experience. Thus, most respondents had between one and three years of experience using digital systems for developmental assessment.

Table 1. Characteristics of the Respondents

Characteristic	Category	Frequency	Percentage
Professional position	Teacher	82	41.0%
	Caregiver	56	28.0%
	Daycare coordinator	24	12.0%
	Administrator	20	10.0%
	Manager	18	9.0%
Educational background	Senior high school or equivalent	30	15.0%
	Diploma	38	19.0%
	Bachelor's degree	116	58.0%
	Postgraduate degree	16	8.0%
Length of employment	6 months–2 years	48	24.0%
	More than 2–5 years	92	46.0%
	More than 5 years	60	30.0%
Developmental-assessment experience	Less than 1 year	32	16.0%

Characteristic	Category	Frequency	Percentage
Digital-assessment experience	1–3 years	96	48.0%
	More than 3 years	72	36.0%
	Less than 1 year	58	29.0%
	1–3 years	104	52.0%
	More than 3 years	38	19.0%

2.4. Data Collection Technique

Primary data were collected using a structured, closed-ended questionnaire administered to eligible personnel from the participating daycare centers in Batam City. Data collection was conducted from March to May 2026 using both online and printed questionnaires. The questionnaire consisted of three sections: research information and informed consent; respondents' demographic and professional characteristics; and measurement items for system quality, information quality, service quality, user trust, and digital assessment effectiveness.

The research instrument was adapted rather than adopted verbatim from established studies on information-system success, digital trust, educational technology, and digital assessment. The original indicators were modified to reflect the specific context of the Digital Gross Motor Development Assessment System, daycare personnel, children's developmental data, and gross motor development monitoring.

The instrument consisted of 66 item-level statements measuring five constructs: System Quality (12 items), Information Quality (12 items), Service Quality (12 items), User Trust (12 items), and Effectiveness of Digital Assessment (18 items). The construct sources, number of questionnaire items, and examples of the measurement statements are summarized in Table 2.

Table 2. Sources and Examples of Measurement Items

Construct	Number of items	Main sources	Example item
System Quality	12	DeLone and McLean (2003); Blöbaum (2021); Rulinawaty et al. (2024); Rahmatullah et al. (2025); Oesterreich et al. (2025)	"The digital assessment system is easy to operate during children's gross motor observations."
Information Quality	12	DeLone and McLean (2003); Hooda et al. (2023); Rulinawaty et al. (2024); Chun et al. (2024); Rahmatullah et al. (2025)	"The system produces accurate information about children's gross motor development."
Service Quality	12	DeLone and McLean (2003); Hooda et al. (2023); Rulinawaty et al. (2024); Rahmatullah et al. (2025); Oesterreich et al. (2025)	"Technical assistance is provided promptly when users experience problems."
User Trust	12	Blöbaum (2021); Hooda et al. (2023); Oesterreich et al. (2025)	"I can rely on the system to support gross motor development monitoring."
Digital Assessment Effectiveness	18	DeLone and McLean (2003); Kim et al. (2023); Chun et al. (2024); Xiong et al. (2024); Deng et al. (2025); Rahmatullah et al. (2025)	"The digital assessment system improves the accuracy of gross motor development assessment."
Total	66		

The adaptation process involved reviewing the conceptual definition and dimensions of each construct, selecting indicators that were relevant to the research model, and modifying the wording to

fit the daycare-based gross motor development context. Generic expressions such as “information system,” “digital platform,” or “system output” were replaced with more specific expressions such as “digital assessment system,” “children’s gross motor development,” “assessment information,” and “daycare personnel.” Items concerning security and trust were also contextualized to address the protection and authorized use of children’s personal and developmental information.

Because the questionnaire was administered to Indonesian-speaking respondents, the adapted items were translated into Indonesian. The translation emphasized conceptual equivalence rather than literal word-for-word translation. The translated version was reviewed by individuals familiar with English, Indonesian, early childhood education, and educational technology to ensure that the meaning of each item remained consistent with the original construct. Ambiguous or highly technical expressions were simplified without changing their conceptual meaning.

Before the main data collection, content validation was conducted by four experts representing early childhood education, gross motor development, educational technology and information systems, and quantitative research methodology. The experts assessed the relevance, clarity, representativeness, and contextual appropriateness of each item. Their assessment indicated that the five constructs and their dimensions adequately represented the research model. However, several wording revisions were recommended to improve clarity and contextual consistency.

The principal revisions included simplifying technical terminology, consistently referring to the object as the digital assessment system, clarifying statements concerning service providers and technical support, and making items related to data privacy, assessment reports, and developmental-monitoring decisions more understandable to daycare personnel. Repetitive wording was reduced, and several statements were reformulated so that each item measured only one principal idea. No construct or dimension was removed, and all 66 items were retained after the expert review process.

A pilot test was subsequently conducted with 30 respondents who had characteristics similar to those of the target population. The pilot respondents were recruited from daycare centers that were not included in the main survey and were not included in the final sample. The pilot test examined the clarity of the instructions, comprehensibility of the items, appropriateness of the response scale, questionnaire completion process, and preliminary internal consistency of the constructs.

The pilot test showed that the questionnaire structure and five-point response scale could be understood and completed by the target respondents. The preliminary assessment did not identify any construct requiring item deletion. Feedback from the pilot respondents resulted in minor revisions to the questionnaire instructions and the simplification of several statements containing technical terminology. Following these revisions, all 66 items were retained for the main survey.

For the PLS-SEM analysis, the 66 item-level statements were organized into 22 theoretically defined measurement indicators. Each indicator was represented by three closely related questionnaire items measuring the same underlying aspect of the corresponding construct. Accordingly, the 12 System Quality items were organized into four indicators (SQ1–SQ4), the 12 Information Quality items into four indicators (IQ1–IQ4), the 12 Service Quality items into four indicators (SRQ1–SRQ4), the 12 User Trust items into four indicators (UT1–UT4), and the 18 Digital Assessment Effectiveness items into six indicators (EDA1–EDA6).

For each indicator, responses to the three corresponding questionnaire items were combined to obtain a single indicator score prior to the PLS-SEM analysis. Thus, the 22 indicators reported in the measurement model do not represent a reduction from 66 to 22 items through item deletion. Instead, they represent aggregated indicator scores derived from the complete set of 66 questionnaire items. No questionnaire item was removed during this process.

This aggregation procedure was used to represent the theoretically defined dimensions of each construct in a more parsimonious measurement model. The final measurement model therefore consisted of 22 reflective indicators representing the five latent constructs. Indicator reliability, internal consistency reliability, convergent validity, and discriminant validity were subsequently assessed using these 22 indicator scores.

All items were measured using a five-point Likert scale ranging from 1, “strongly disagree,” to 5, “strongly agree.” The same response scale was used across all constructs to maintain consistency and facilitate questionnaire completion and statistical analysis.

Table 3. Questionnaire Response Scale

Score	Response category
1	Strongly disagree
2	Disagree
3	Neither agree nor disagree
4	Agree
5	Strongly agree

Before questionnaire distribution, the researcher contacted the managers or coordinators of the participating daycare centers to explain the objectives and procedures of the study and obtain institutional permission. Online questionnaire links and printed forms were subsequently distributed to personnel who met the inclusion criteria. Respondents were specifically instructed to answer the measurement items based on their experience with the digital assessment system examined in this study rather than other applications or paper-based assessment procedures.

Participation was voluntary, and informed consent was obtained before respondents completed the questionnaire. Respondents received information regarding the research objectives, confidentiality of their responses, and their right to discontinue participation without penalty. The questionnaire did not collect personally identifying information about children. Permission to conduct the study was obtained from the managers or authorized representatives of the participating daycare centers.

2.5. Data Analysis

The returned questionnaires were coded, tabulated, and screened before statistical analysis. Data screening included an examination of incomplete questionnaires, duplicate submissions, missing values, straight-lining patterns, implausible responses, and compliance with the respondent inclusion criteria. Seven questionnaires were removed during this process, leaving 200 valid responses for the final analysis.

The data were analyzed using PLS-SEM with SmartPLS 4. The analysis was conducted in two stages: assessment of the measurement model and assessment of the structural model. All constructs were specified as reflective constructs.

The measurement model was evaluated using indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Indicator reliability was assessed using outer loadings. Outer-loading values of at least .708 were considered satisfactory because they indicated that the construct explained approximately 50% or more of the indicator variance. Indicators with outer loadings between .40 and .70 were evaluated by considering their effects on composite reliability, average variance extracted, theoretical relevance, and content validity.

Internal consistency reliability was assessed using Cronbach’s alpha, rho_A, and composite reliability. Values between .70 and .95 were regarded as acceptable. Convergent validity was assessed using average variance extracted, with values above .50 indicating that a construct explained more than half of the variance in its indicators.

Discriminant validity was evaluated using the heterotrait–monotrait ratio of correlations. HTMT values below .85 met the conservative criterion, whereas values below .90 were considered acceptable for conceptually related constructs. Bootstrapped confidence intervals were also examined to ensure that the HTMT values did not include 1.00.

After the measurement model met the required reliability and validity criteria, the structural model was evaluated. The structural-model assessment included collinearity statistics, standardized path coefficients, coefficients of determination, effect sizes, and predictive relevance.

Collinearity was assessed using variance inflation factor values. Values below 3 were preferred, while values below 5 indicated that critical collinearity was absent. The explanatory power of the model was assessed using the coefficient of determination for user trust and digital assessment effectiveness.

The contribution of each exogenous construct to the corresponding endogenous construct was assessed using the f^2 effect size. Values of approximately .02, .15, and .35 were interpreted as small, medium, and large effects, respectively. Predictive relevance was assessed using Q^2 , with values above zero indicating that the model possessed predictive relevance for the endogenous constructs.

The statistical significance of the direct and indirect effects was examined using a nonparametric bootstrapping procedure with 10,000 bootstrap subsamples and bias-corrected confidence intervals. A relationship was considered statistically significant when its p-value was below .05 and its corresponding confidence interval did not include zero.

The mediating role of user trust was examined through the specific indirect effects of system quality, information quality, and service quality on digital assessment effectiveness. Mediation was supported when the corresponding bootstrapped indirect effect was statistically significant. The direct and indirect effects were evaluated jointly to determine the form of mediation.

Complementary partial mediation was identified when both the direct and indirect effects were statistically significant and had the same direction. Indirect-only mediation was identified when the indirect effect was statistically significant, but the corresponding direct effect was not significant.

All hypotheses were evaluated at a significance level of 5%. A hypothesis was supported when the estimated relationship had the expected direction, and the corresponding p-value was below .05 or its confidence interval did not include zero. The findings were reported using standardized path coefficients, t statistics, p values, confidence intervals, R^2 values, f^2 effect sizes, and predictive-relevance measures.

3. FINDINGS AND DISCUSSION

3.1. Measurement Model Assessment (Outer Model)

The measurement model was assessed through indicator reliability, internal consistency reliability, convergent validity, discriminant validity, and collinearity assessment. The evaluation followed the recommended criteria for PLS-SEM analysis.

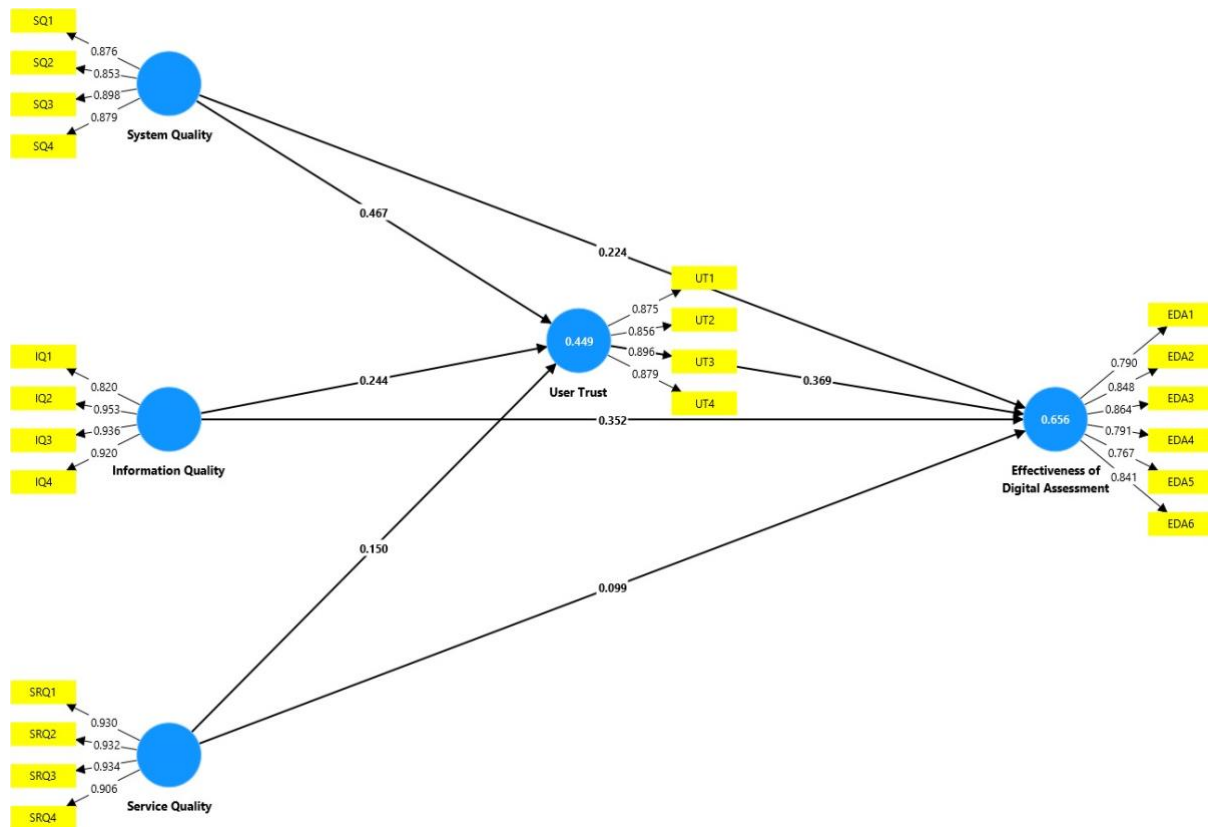


Figure 1. Outer Model

Based on figure 1, all indicators of Effectiveness of Digital Assessment show outer loadings ranging from 0.767 to 0.864, while Information Quality indicators range from 0.820 to 0.953. The System Quality indicators have values between 0.853 and 0.898, followed by Service Quality ranging from 0.906 to 0.934, and User Trust ranging from 0.856 to 0.896. Since all outer loading values exceed the recommended threshold of 0.70, all indicators are considered valid and reliable measures of their respective constructs. These results confirm that the measurement model has achieved satisfactory indicator reliability and demonstrates that the items used are appropriate for measuring Effectiveness of Digital Assessment, Information Quality, Service Quality, System Quality, and User Trust.

3.1.1. Indicator Reliability (Outer Loading)

Indicator reliability was assessed using outer loading values. Indicators are considered reliable when their loading values exceed the recommended threshold of 0.70. The measurement model comprised 22 aggregated indicators derived from the 66 item-level questionnaire statements; therefore, Table 4 reports outer loadings for the 22 aggregated indicators rather than for the 66 individual statements.

Table 4. Outer Loading Values

Construct	Indicator	Outer Loading
Effectiveness of Digital Assessment	EDA1	0.790
	EDA2	0.848
	EDA3	0.864
	EDA4	0.791
	EDA5	0.767
	EDA6	0.841
Information Quality	IQ1	0.820
	IQ2	0.953
	IQ3	0.936

Construct	Indicator	Outer Loading
System Quality	IQ4	0.920
	SQ1	0.876
	SQ2	0.853
	SQ3	0.898
	SQ4	0.879
Service Quality	SRQ1	0.930
	SRQ2	0.932
	SRQ3	0.934
	SRQ4	0.906
User Trust	UT1	0.875
	UT2	0.856
	UT3	0.896
	UT4	0.879

Based on Table 4, all indicators demonstrate outer loading values above 0.70, ranging from 0.767 to 0.953. Therefore, all measurement items meet the criteria for indicator reliability and were retained in the measurement model.

3.1.2. Internal Consistency, Reliability and Convergent Validity

Internal consistency reliability was evaluated using Cronbach's Alpha, rho_A, and Composite Reliability (rho_c), while convergent validity was assessed using Average Variance Extracted (AVE).

Table 5. Construct Reliability and Validity

Construct	Cronbach Alpha	rho_A	Composite Reliability	AVE
Effectiveness of Digital Assessment	0.900	0.904	0.924	0.669
Information Quality	0.929	0.944	0.950	0.826
Service Quality	0.944	0.950	0.960	0.856
System Quality	0.900	0.903	0.930	0.769
User Trust	0.899	0.900	0.930	0.768

All constructs show Cronbach's Alpha, rho_A, and Composite Reliability values exceeding 0.70, confirming satisfactory internal consistency reliability. Furthermore, all AVE values exceed 0.50, indicating adequate convergent validity. Although Service Quality demonstrates a relatively high composite reliability value (0.960), all indicators were retained because each item represents theoretically relevant aspects of service quality.

3.1.3. Collinearity Assessment (VIF)

Collinearity among indicators was examined using the Variance Inflation Factor (VIF). A VIF value below 5 indicates the absence of critical collinearity problems.

Table 6. VIF Values

Indicator	VIF
EDA1	2.102
EDA2	3.637
EDA3	3.752
EDA4	2.141

Indicator	VIF
EDA5	1.870
EDA6	2.359
IQ1	2.173
IQ2	6.531
IQ3	5.523
IQ4	3.685
SQ1	2.467
SQ2	2.445
SQ3	3.390
SQ4	3.066
SRQ1	4.691
SRQ2	4.700
SRQ3	4.931
SRQ4	3.515
UT1	2.489
UT2	2.418
UT3	3.326
UT4	3.042

Most indicators demonstrate acceptable VIF values below 5. However, IQ2 (VIF = 6.531) and IQ3 (VIF = 5.523) exceed the recommended threshold, indicating possible redundancy among Information Quality indicators. Nevertheless, these indicators were retained because they represent theoretically important aspects of information quality and maintain content validity.

3.1.4. Discriminant Validity Assessment

Discriminant validity was assessed using the Heterotrait-Monotrait Ratio (HTMT). A value below 0.90 indicates adequate discriminant validity.

Table 7. HTMT Ratio

Relationship	HTMT
Information Quality – EDA	0.679
Service Quality – EDA	0.419
System Quality – EDA	0.669
User Trust – EDA	0.774
Service Quality – Information Quality	0.262
System Quality – Information Quality	0.403
User Trust – Information Quality	0.496
System Quality – Service Quality	0.351
User Trust – Service Quality	0.392
User Trust – System Quality	0.671

All HTMT values range from 0.262 to 0.774, indicating that all constructs are empirically distinct.

3.2. Inner Model Result

The structural model was evaluated through the coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and hypothesis testing using bootstrapping.

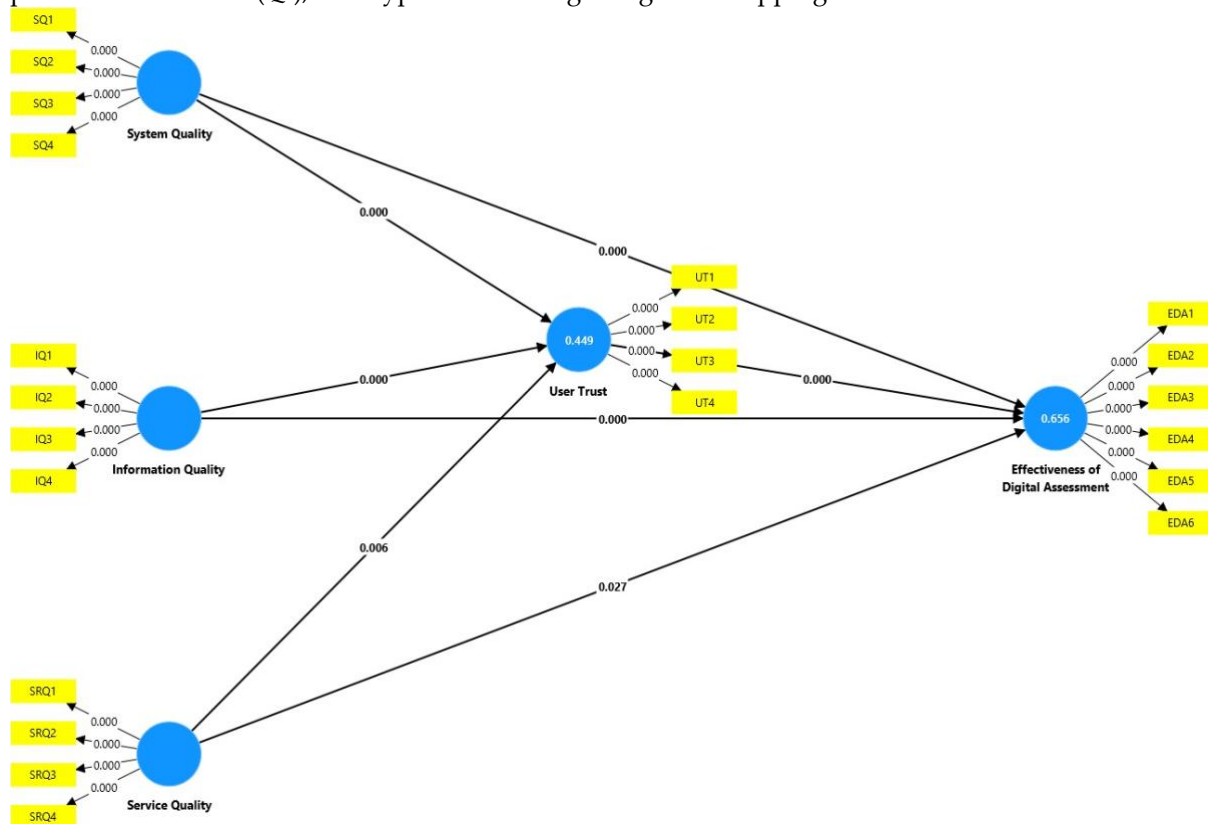


Figure 2. Inner Model

3.2.1. Path Coefficients (β)

Path coefficients (β) are used to evaluate the direction and strength of the relationships between latent variables. The path coefficient values range from -1 to +1, where positive values indicate a positive relationship between constructs.

Table 8. Path coefficients

Relationship	Path coefficients
Information Quality -> Effectiveness of_Digital Assessment	0.352
Information Quality -> User Trust	0.244
Service Quality -> Effectiveness of_Digital Assessment	0.099
Service Quality -> User Trust	0.150
System Quality -> Effectiveness of_Digital Assessment	0.224
System Quality -> User Trust	0.467
User Trust -> Effectiveness of_Digital Assessment	0.369

Based on the results, Information Quality has a positive effect on Effectiveness of Digital Assessment ($\beta = 0.352$) and User Trust ($\beta = 0.244$). Service Quality shows a positive relationship with Effectiveness of Digital Assessment ($\beta = 0.099$) and User Trust ($\beta = 0.150$). Furthermore, System Quality has a positive effect on Effectiveness of Digital Assessment ($\beta = 0.224$) and demonstrates the strongest influence on User Trust ($\beta = 0.467$). In addition, User Trust positively affects Effectiveness of Digital

Assessment ($\beta = 0.369$). These results indicate that improvements in system quality, information quality, service quality, and user trust contribute positively to enhancing the effectiveness of digital assessment.

3.2.2. Coefficient of Determination (R^2)

The coefficient of determination (R^2) measures the explanatory power of the structural model by indicating the proportion of variance in endogenous constructs explained by their predictor variables.

Table 9. Coefficient of Determination (R^2)

	R-square	R-square adjusted
Effectiveness of_Digital Assessment	0.656	0.649
User Trust	0.449	0.441

The R^2 value for Effectiveness of Digital Assessment is 0.656 (Adjusted $R^2 = 0.649$), indicating that 65.6% of the variance in digital assessment effectiveness can be explained by Information Quality, Service Quality, System Quality, and User Trust, while the remaining 34.4% is explained by other factors outside the model. Meanwhile, User Trust has an R^2 value of 0.449 (Adjusted $R^2 = 0.441$), meaning that 44.9% of the variance in User Trust is explained by Information Quality, Service Quality, and System Quality. These results indicate that the structural model has moderate explanatory power.

3.2.3. Effect Size (f^2)

The f^2 effect size evaluates the contribution of each exogenous construct to the endogenous variable. According to common guidelines, f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively.

Table 10. Effect Size (f^2)

Relationship	f-square
Information Quality -> Effectiveness of_Digital Assessment	0.278
Information Quality -> User Trust	0.091
Service Quality -> Effectiveness of_Digital Assessment	0.024
Service Quality -> User Trust	0.036
System Quality -> Effectiveness of_Digital Assessment	0.089
System Quality -> User Trust	0.318
User Trust -> Effectiveness of_Digital Assessment	0.218

The results show that Information Quality has a medium effect on Effectiveness of Digital Assessment ($f^2 = 0.278$) and a small effect on User Trust ($f^2 = 0.091$). Service Quality demonstrates a small effect on both Effectiveness of Digital Assessment ($f^2 = 0.024$) and User Trust ($f^2 = 0.036$). System Quality has a small effect on Effectiveness of Digital Assessment ($f^2 = 0.089$) but a medium effect on User Trust ($f^2 = 0.318$). Furthermore, User Trust has a medium effect on the Effectiveness of Digital Assessment ($f^2 = 0.218$). These findings indicate that System Quality contributes strongly to building User Trust, while Information Quality and User Trust provide important contributions to improving digital assessment effectiveness.

3.2.4. Predictive Relevance (Q^2)

Predictive relevance (Q^2) evaluates the predictive capability of the structural model using the blindfolding procedure. A Q^2 value greater than zero indicates that the model has predictive relevance,

while values of approximately 0.02, 0.15, and 0.35 indicate small, medium, and large predictive relevance, respectively.

Table 11. Predictive Relevance (Q^2)

Construct	Q^2
Effectiveness of Digital Assessment	0.427
User Trust	0.337

Both endogenous constructs demonstrate Q^2 values greater than zero, confirming that the model has predictive relevance. Effectiveness of Digital Assessment demonstrates strong predictive relevance, while User Trust shows moderate predictive relevance.

3.3. Hypothesis Testing

3.3.1 Direct Effects

Table 12. Direct Effects

Relationship	β	95% Confidence Interval	T Statistics	P Values	Decision
System Quality $\rightarrow$ User Trust	0.467	0.324 – 0.610	6.457	<0.001	Supported
Information Quality $\rightarrow$ User Trust	0.244	0.117 – 0.367	3.851	<0.001	Supported
Service Quality $\rightarrow$ User Trust	0.150	0.045 – 0.257	2.765	0.006	Supported
System Quality $\rightarrow$ Effectiveness of Digital Assessment	0.224	0.099 – 0.340	3.662	<0.001	Supported
Information Quality $\rightarrow$ Effectiveness of Digital Assessment	0.352	0.267 – 0.438	8.017	<0.001	Supported
Service Quality $\rightarrow$ Effectiveness of Digital Assessment	0.099	0.007 – 0.182	2.215	0.027	Supported
User Trust $\rightarrow$ Effectiveness of Digital Assessment	0.369	0.248 – 0.497	5.692	<0.001	Supported

The direct path analysis provides important insights into the relationships among System Quality, Information Quality, Service Quality, User Trust, and Effectiveness of Digital Assessment. The results of hypothesis testing are presented in Table 12.

1. H1: System Quality has a positive and significant effect on User Trust.

The analysis indicates that System Quality has a strong positive influence on User Trust, with a path coefficient of 0.467 and a T statistic of 6.457 ($p < 0.001$). This finding supports H1, indicating that a reliable, accessible, and well-functioning digital assessment system can significantly increase users' confidence in the system. A higher level of system quality encourages users to perceive the digital assessment platform as dependable and trustworthy.

2. H2: Information Quality has a positive and significant effect on User Trust.

The relationship between Information Quality and User Trust shows a positive and significant effect, with a path coefficient of 0.244 and a T statistic of 3.851 ($p < 0.001$). This result supports H2, suggesting that accurate, relevant, complete, and timely information generated by the digital assessment system contributes to increasing users' trust. Users are more likely to rely on the system when the information provided is perceived as credible and useful.

3. H3: Service Quality has a positive and significant effect on User Trust.

Service Quality demonstrates a positive and significant relationship with User Trust, with a path coefficient of 0.150 and a T statistic of 2.765 ($p = 0.006$). This finding supports H3, indicating that responsive support services, technical assistance, and adequate guidance provided to users contribute to strengthening trust in the digital assessment system.

4. H4: System Quality has a positive and significant effect on Effectiveness of Digital Assessment.

The results show that System Quality positively affects the Effectiveness of Digital Assessment, with a path coefficient of 0.224 and a T statistic of 3.662 ($p < 0.001$). This supports H4, demonstrating that a system with better functionality, reliability, and usability improves the effectiveness of digital assessment implementation.

5. H5: Information Quality has a positive and significant effect on Effectiveness of Digital Assessment. Information Quality has the strongest direct effect among the quality dimensions on Effectiveness of Digital Assessment, with a path coefficient of 0.352 and a T statistic of 8.017 ($p < 0.001$). This supports H5, indicating that accurate and meaningful assessment information plays an important role in improving the effectiveness of digital assessment processes.
6. H6: Service Quality has a positive and significant effect on Effectiveness of Digital Assessment. The analysis reveals that Service Quality has a positive but relatively smaller influence on Effectiveness of Digital Assessment, with a path coefficient of 0.099 and a T statistic of 2.215 ($p = 0.027$). This supports H6, suggesting that although service support contributes to improving digital assessment effectiveness, its influence is lower compared with system and information quality.
7. H7: User Trust has a positive and significant effect on Effectiveness of Digital Assessment. User Trust shows a significant positive effect on Effectiveness of Digital Assessment, with a path coefficient of 0.369 and a T statistic of 5.692 ($p < 0.001$). This supports H7, indicating that users who have greater confidence in the digital assessment system are more likely to perceive the system as effective and beneficial for monitoring and managing assessment activities.

Overall, the direct effect results confirm that System Quality, Information Quality, Service Quality, and User Trust significantly contribute to improving the Effectiveness of Digital Assessment. Among these relationships, Information Quality and User Trust demonstrate the strongest direct influences, emphasizing the importance of reliable information and user confidence in achieving effective digital assessment implementation.

3.3.1 Indirect Effects

Table 13. Indirect Effects

Relationship	β Indirect	95% Confidence Interval	T Statistics	P Values	Decision
System Quality → User Trust → Effectiveness of Digital Assessment	0.172	0.097 – 0.275	3.728	<0.001	Supported
Information Quality → User Trust → Effectiveness of Digital Assessment	0.090	0.040 – 0.147	3.281	0.001	Supported
Service Quality → User Trust → Effectiveness of Digital Assessment	0.056	0.016 – 0.101	2.566	0.010	Supported

The indirect effect analysis examines the mediating role of User Trust in the relationship between System Quality, Information Quality, Service Quality, and Effectiveness of Digital Assessment. The results are presented in Table 13.

1. H8: User Trust mediates the relationship between System Quality and Effectiveness of Digital Assessment.
The indirect effect of System Quality on Effectiveness of Digital Assessment through User Trust is positive and significant, with a path coefficient of 0.172, a T statistic of 3.728, and $p < 0.001$. These results support H8, indicating that System Quality not only directly improves digital assessment effectiveness but also enhances effectiveness by increasing users' trust in the system.
2. H9: User Trust mediates the relationship between Information Quality and Effectiveness of Digital Assessment.
The indirect effect of Information Quality on Effectiveness of Digital Assessment through User Trust is significant, with a path coefficient of 0.090, a T statistic of 3.281, and $p = 0.001$. This supports H9,

showing that high-quality information strengthens User Trust, which subsequently contributes to improving digital assessment effectiveness.

3. H10: User Trust mediates the relationship between Service Quality and Effectiveness of Digital Assessment.

The mediation analysis shows that Service Quality has a significant indirect effect on Effectiveness of Digital Assessment through User Trust, with a path coefficient of 0.056, a T statistic of 2.566, and $p = 0.010$. This supports H10, indicating that service quality contributes to digital assessment effectiveness by developing users' trust in the system.

Overall, the mediation results demonstrate that User Trust plays an important mediating role between system-related factors (System Quality, Information Quality, and Service Quality) and Effectiveness of Digital Assessment. These findings highlight that improving technological and service aspects alone is insufficient; building user confidence is also essential to maximize the effectiveness of digital assessment systems.

3.4. Discussion

3.4.1. Quality Dimensions as Antecedents of User Trust

The results show that System Quality, Information Quality, and Service Quality all had positive and significant effects on User Trust, but their relative strengths differed. System Quality was the strongest antecedent of trust ($\beta = 0.467$, $p < 0.001$), followed by Information Quality ($\beta = 0.244$, $p < 0.001$) and Service Quality ($\beta = 0.150$, $p = 0.006$). This pattern supports the DeLone and McLean Information Systems Success Model by showing that users' confidence develops from a combination of dependable technology, credible information, and adequate service support rather than from a single quality dimension (DeLone & McLean, 2003). It is also consistent with evidence that system, information, and service quality contribute to trust and favorable evaluations of digital systems (Hooda et al., 2023; Oesterreich et al., 2025; Rahmatullah et al., 2025; Rulinawaty et al., 2024).

The stronger effect of System Quality on User Trust may reflect the immediate visibility of technical performance in daycare work. Teachers and caregivers repeatedly interact with the application when entering observations, retrieving children's records, and preparing reports. Stable access, ease of operation, reliable data processing, and security therefore provide direct evidence that the system is technically dependable. This issue is particularly important because the system stores sensitive information about children and supports decisions concerning developmental stimulation and possible referral. In such settings, trust is strengthened when users perceive that the technology reduces uncertainty, performs consistently, and protects developmental data (Blöbaum, 2021; Horváth, 2025; Oesterreich et al., 2025).

Information Quality also contributed meaningfully to trust because users must believe that the outputs correspond to the observations they entered and are sufficiently accurate, complete, timely, and understandable for developmental monitoring. Prior studies similarly indicate that relevant and comprehensible information supports confidence, satisfaction, and continued reliance on digital platforms (Alterkait & Alduaij, 2024; Hooda et al., 2023; Srimulyo et al., 2024). Service Quality had the smallest effect on trust, although it remained statistically significant. A plausible explanation is that technical support is used mainly when difficulties occur, whereas system performance and assessment information are encountered during routine daily use. Nevertheless, responsive assistance, clear guidance, and competent problem resolution remain important for reducing uncertainty and sustaining confidence, especially among users with different levels of digital experience (Al-Fraihat et al., 2020; Ashrafi et al., 2023).

3.4.2. Direct Determinants of Digital Assessment Effectiveness

All four predictors had positive and significant direct effects on the Effectiveness of Digital Assessment. User Trust produced the strongest overall direct effect ($\beta = 0.369$, $p < 0.001$), while Information Quality was the strongest of the three quality dimensions ($\beta = 0.352$, $p < 0.001$). System Quality had a smaller but substantive effect ($\beta = 0.224$, $p < 0.001$), whereas Service Quality had the weakest direct effect ($\beta = 0.099$, $p = 0.027$). Together, these results indicate that digital assessment becomes effective when the application works reliably, produces useful developmental information, receives adequate operational support, and is trusted by its users. This extends the DeLone and McLean model to daycare-based gross motor monitoring and is consistent with previous applications of the model in educational and public digital services (DeLone & McLean, 2003; Rahmatullah et al., 2025; Rulinawaty et al., 2024).

Information Quality may have exerted the strongest quality-related effect because assessment outputs are the system component most directly connected to pedagogical action. Daycare personnel use the generated information to interpret gross motor performance, compare development across assessment periods, communicate progress to parents, and decide whether children require additional stimulation or further observation. Therefore, accurate, relevant, timely, and interpretable information is closer to the intended outcome than technical infrastructure alone. Research on technology-assisted motor assessment likewise emphasizes the value of structured datasets, more objective measurement, longitudinal monitoring, and actionable outputs (Chun et al., 2024; Deng et al., 2025; Kim et al., 2023). Accurate and continuous developmental monitoring is also essential for identifying patterns that may indicate the need for early support (Roscoe et al., 2024; Xiong et al., 2024).

System Quality remained important because reliable access, usability, integration, security, and response speed enable users to complete assessment tasks with fewer technical barriers. However, technical quality primarily functions as an enabling condition: a system may operate smoothly but still provide limited educational value when its information is unclear or not relevant to developmental decisions. This helps explain why its direct coefficient was lower than that of Information Quality. Service Quality had the smallest direct effect, which may reflect the standardized use of the same core application, scoring procedure, and report format across the participating daycare centers. In this context, support services may protect continuity and solve occasional problems rather than directly determine the quality of each observation or report. Even so, training and responsive assistance remain necessary for sustainable integration of digital tools into professional practice (Sosa-Alonso et al., 2025).

The strong direct effect of User Trust indicates that system benefits depend on users' willingness to rely on its outputs. Trust reduces hesitation in entering sensitive data, retrieving historical records, interpreting reports, and incorporating digital information into developmental decisions. Digital assessment should nevertheless remain a support for direct professional observation rather than a replacement for pedagogically grounded interactions and physical activity. Its value lies in making observational evidence more systematic, traceable, and communicable while preserving teachers' and caregivers' professional judgment (Chu et al., 2024).

3.4.3. The Mediating Role of User Trust

User Trust significantly mediated the effects of System Quality ($\beta = 0.172$, $p < 0.001$), Information Quality ($\beta = 0.090$, $p = 0.001$), and Service Quality ($\beta = 0.056$, $p = 0.010$) on digital assessment effectiveness. Because each corresponding direct effect was also positive and significant, and the direct and indirect effects pointed in the same direction, all three relationships represent complementary partial mediation. Thus, System Quality, Information Quality, and Service Quality improve effectiveness both directly and indirectly through the trust they generate. Trust strengthens, but does not replace, the operational contribution of the three quality dimensions.

The largest indirect effect originated from System Quality. This is consistent with its position as the strongest antecedent of trust: reliable operation, accessibility, security, and functional consistency

provide the foundation on which users decide whether the system is dependable. Once this confidence is established, users are more willing to integrate the application into recurring observation and reporting activities. This mechanism is consistent with research showing that technological reliability, structural assurance, and provider responsibility reduce uncertainty and support continued reliance on digital platforms (Blöbaum, 2021; Hooda et al., 2023; Horváth, 2025; Oesterreich et al., 2025).

The indirect effect of Information Quality indicates that credible outputs generate additional benefits by increasing confidence in the system. Users are more likely to rely on developmental reports when they perceive the information as accurate, transparent, understandable, and consistent with observed performance. This interpretation is consistent with research linking information quality and transparency to trust in digital environments (Alami et al., 2022; Li et al., 2023) and with evidence that explainability and perceived reliability influence willingness to accept algorithm-supported decisions (Glikson & Woolley, 2020; Longoni et al., 2020). The indirect effect was smaller than the direct effect because information quality has an immediate practical role in assessment and reporting in addition to its trust-building role.

Service Quality also demonstrated complementary partial mediation. Responsive assistance and competent support directly help users overcome technical or procedural problems, while indirectly increasing confidence that the system is backed by a responsible provider. Its relatively small direct and indirect effects suggest that service support is a facilitating mechanism rather than the principal source of assessment value. However, weak or unavailable assistance could still undermine trust and interrupt use, particularly when new personnel require training or when daycare centers encounter technical problems.

3.4.4. Implications for Daycare-Based Gross Motor Monitoring in Batam

The findings should be interpreted within the organizational context of daycare centers in Batam. The participating institutions serve families that require reliable childcare and accountable developmental information, while their personnel combine caregiving, teaching, observation, reporting, and administrative responsibilities. A digital assessment system is therefore valuable when it reduces fragmented documentation and transforms direct observations into information that can be retrieved, compared, and communicated efficiently. The strong effects of Information Quality and User Trust suggest that implementation priorities should extend beyond providing software. Daycare centers need common gross motor indicators, clear scoring guidance, understandable report formats, data-protection procedures, and training that connects system use with daily pedagogical practice.

For teachers and caregivers, high-quality digital reports can support the planning of gross motor activities, comparison of children's progress over time, early recognition of possible developmental concerns, and decisions about additional stimulation or referral. Reports can also provide a more structured basis for communication with parents, provided that the results are explained as developmental monitoring rather than clinical diagnosis. Technology-based assessment research demonstrates the potential of digital tools to support more systematic and efficient motor monitoring, while early childhood research emphasizes that technology must remain meaningful, developmentally appropriate, and embedded in professional practice (Chu et al., 2024; Chun et al., 2024; Deng et al., 2025; Kim et al., 2023; Roscoe et al., 2024; Xiong et al., 2024).

At the institutional level, the comparatively weak effect of Service Quality implies that support should be targeted rather than treated as a substitute for system and information quality. Daycare managers should establish clear channels for technical assistance, periodic refresher training, role-based access, and procedures for checking the completeness and consistency of entered observations. Developers should prioritize stable performance, transparent data processing, interpretable longitudinal reports, and privacy safeguards. These measures can strengthen trust and help translate digital infrastructure into sustained educational value.

Finally, the effectiveness construct in this study was measured through users' perceptions. The findings therefore demonstrate perceived improvements in accuracy, efficiency, continuity, reporting,

and decision support, but they do not by themselves prove objective gains in assessment accuracy or the detection of motor delay. Future research should compare digital results with validated developmental instruments, assess inter-rater agreement, record completion and reporting time, examine the consistency of repeated assessments, and evaluate whether digital reports improve pedagogical decisions and parent communication. Such evidence would complement the present user-centered findings and provide a stronger basis for evaluating the educational effectiveness of digital assessment in early childhood settings.

4. CONCLUSION

This study examined the relationships among System Quality, Information Quality, Service Quality, User Trust, and the perceived effectiveness of digital assessment for monitoring children's gross motor development in daycare centers. The findings showed that the three quality dimensions were positively associated with User Trust and perceived digital assessment effectiveness. Information Quality and User Trust demonstrated the strongest direct relationships with perceived effectiveness, while System Quality showed the strongest relationship with User Trust. User Trust also significantly mediated the relationships between all three quality dimensions and perceived digital assessment effectiveness, indicating complementary partial mediation.

These findings extend the Information Systems Success Model to the context of early childhood developmental assessment by showing that technological and informational quality are associated with educational value partly through users' confidence in the system. In practice, digital assessment should therefore be designed not only to operate reliably but also to generate accurate, interpretable, timely, and pedagogically meaningful information. Within daycare settings, such systems can support the documentation of direct observations, longitudinal monitoring, communication with parents, and decisions concerning developmental stimulation, while professional judgment remains central to the assessment process.

The findings should be interpreted as evidence of perceived effectiveness rather than objective improvements in assessment accuracy or children's developmental outcomes. Future research should validate digital assessment results against established developmental instruments, incorporate objective indicators of assessment performance, and employ longitudinal or comparative designs across different early childhood settings and digital platforms.

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REFERENCES

- Alami, H., Lehoux, P., Gagnon, M. P., Fortin, J. P., Fleet, R., & Niang, M. (2022). Rethinking the implementation of digital health technologies: A systematic review of contextual factors influencing adoption and use. *BMC Health Services Research*, 22, Article 117. <https://doi.org/10.1186/s12913-022-07534-8>
- Al-Fraihat, D., Joy, M., & Sinclair, J. (2020). Evaluating e-learning systems success: An empirical study. *Computers in Human Behavior*, 102, 67–86. <https://doi.org/10.1016/j.chb.2019.08.004>
- Alterkait, M. A., & Alduaij, M. Y. (2024). Impact of information quality on satisfaction with e-learning platforms: Moderating role of instructor and learner quality. *SAGE Open*, 14(1). <https://doi.org/10.1177/21582440241233400>
- Ashrafi, A., Zareravasan, A., Rabiee Savoji, S., & Amani, M. (2023). Exploring factors influencing students' continuance intention toward online learning systems: The role of service quality and trust. *Education and Information Technologies*, 28, 11839–11865. <https://doi.org/10.1007/s10639-023-11657-7>
- Blöbaum, B. (Ed.). (2021). *Trust and communication: Findings and implications of trust research*. Springer. <https://doi.org/10.1007/978-3-030-72945-5>

- Chu, C., Paatsch, L., Kervin, L., & Edwards, S. (2024). Digital play in the early years: A systematic review. *International Journal of Child-Computer Interaction*, 40, Article 100652. <https://doi.org/10.1016/j.ijcci.2024.100652>
- Chun, S., Jeong, S., Lee, J. H., Yoon, J., Kim, J. Y., Kim, C., Han, J. S., & Park, Y. R. (2024). Comprehensive assessment and early prediction of gross motor performance in toddlers with graph convolutional networks-based deep learning: Development and validation study. *JMIR Formative Research*, 8, Article e51996. <https://doi.org/10.2196/51996>
- DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems*, 19(4), 9–30. <https://doi.org/10.1080/07421222.2003.11045748>
- Deng, W., et al. (2025). A systematic review of portable technologies for the early assessment of motor development in infancy. *npj Digital Medicine*.
- Glikson, E., & Woolley, A. W. (2020). Human trust in artificial intelligence: Review of empirical research. *Academy of Management Annals*, 14(2), 627–660. <https://doi.org/10.5465/annals.2018.0057>
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). SAGE Publications.
- Hooda, A., Gupta, P., Jeyaraj, A., & Dwivedi, Y. K. (2023). Clarifying the role of e-government trust in e-government success models: A meta-analytic structural equation modeling approach. *Australasian Journal of Information Systems*, 27. <https://doi.org/10.3127/ajis.v27i0.4079>
- Horváth, J. G. (2025). The role of digital trust in digital maturity models. *Vezetéstudomány/Budapest Management Review*, 56(9), 67–81. <https://doi.org/10.14267/VEZTUD.2025.09.05>
- Kim, H. H., Lee, J. H., Jeong, S., Chun, S., Yoon, J., Park, Y. R., & Han, J. S. (2023). Multiview child motor development dataset for AI-driven assessment of child development. *GigaScience*, 12, Article giad039. <https://doi.org/10.1093/gigascience/giad039>
- Li, X., Hess, T. J., & Valacich, J. S. (2023). Why users trust digital information systems: The role of information quality, transparency, and perceived reliability. *Information & Management*, 60(5), Article 103806. <https://doi.org/10.1016/j.im.2023.103806>
- Longoni, C., Bonezzi, A., & Morewedge, C. K. (2020). Resistance to medical artificial intelligence. *Journal of Consumer Research*, 46(4), 629–650. <https://doi.org/10.1093/jcr/ucz013>
- Oesterreich, T. D., Anton, E., Hettler, F. M., & Teuteberg, F. (2025). What drives individuals' trusting intention in digital platforms? An exploratory meta-analysis. *Management Review Quarterly*, 75, 3615–3667. <https://doi.org/10.1007/s11301-024-00477-2>
- Rahmatullah, R., Habibi, A., Khaeruddin, K., Yaqin, L. N., Alharmali, T. M., Omar Fauzee, M. S., & Mahat, J. (2025). A study of user satisfaction and net benefits in Indonesia through the DeLone and McLean model for e-government success. *Discover Sustainability*. Advance online publication. <https://doi.org/10.1007/s43621-025-01645-4>
- Ringle, C. M., Wende, S., & Becker, J.-M. (2024). *SmartPLS 4*. SmartPLS GmbH.
- Roscoe, C. M. P., Taylor, N., Weir, N., Flynn, R. J., & Pringle, A. (2024). Impact and implementation of an early years fundamental motor skills intervention for children 4–5 years. *Children*, 11(4), Article 416. <https://doi.org/10.3390/children11040416>
- Rulinawaty, R., Samboteng, L., Aripin, S., Hasanuddin, H., & Andriyansah, A. (2024). Investigating the influence of the updated DeLone and McLean information system success model on the effectiveness of learning management systems. *Cogent Business & Management*, 11(1), Article 2365611. <https://doi.org/10.1080/2331186X.2024.2365611>
- Sarstedt, M., Ringle, C. M., & Hair, J. F. (2022). Partial least squares structural equation modeling. In C. Homburg, M. Klarmann, & A. Vomberg (Eds.), *Handbook of market research* (pp. 587–632). Springer. https://doi.org/10.1007/978-3-319-57413-4_15
- Chu, C., Paatsch, L., Kervin, L., & Edwards, S. (2024). Digital play in the early years: A systematic review. *International Journal of Child-Computer Interaction*, 40, Article 100652. <https://doi.org/10.1016/j.ijcci.2024.100652>
- Sosa-Alonso, J. J., Hernández Rivero, V. M., Sanabria Mesa, A. L., & Bethencourt Aguilar, A. (2025).

Adoption of digital educational resources by early childhood education teachers: A fad or a conviction? *Computers & Education*, 232, Article 105396. <https://doi.org/10.1016/j.compedu.2025.105396>

- Srimulyo, K., Yuadi, I., Hu, C. C., Indarwati, I. S. A., Gunarti, E., & Pratiwi, F. D. (2024). A comprehensive analysis of information quality in e-learning: An example of online learning with Brainly. *TEM Journal*, 13(4), 3205–3220. <https://doi.org/10.18421/TEM134-55>
- Xiong, Y., Hu, X., Cao, J., Shang, L., Yao, Y., & Niu, B. (2024). Development of gross motor skills in children under the age of 3 years: A decision tree approach. *Frontiers in Public Health*, 12, Article 1421173. <https://doi.org/10.3389/fpubh.2024.1421173>