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Interactive Flat Panel Service Readiness in Coastal Primary Schools Based on Teachers' Experiences

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ABSTRACT

This study was conducted to evaluate the service quality of Interactive Flat Panels (IFPs) by examining the gap between teachers' expectations and perceptions in coastal primary schools in Gorontalo City. A quantitative descriptive-evaluative approach was employed using the SERVQUAL framework, which covered tangibles, reliability, responsiveness, assurance, and empathy. The respondents comprised 90 teachers from nine coastal primary schools in Dumbo Raya and Hulonthalangi Districts. Data were collected using 10 paired expectation–perception statements rated on a five-point Likert scale and four open-ended questions. The instrument demonstrated adequate validity and high reliability, with Cronbach's Alpha coefficients of 0.956 for the expectation scale and 0.879 for the perception scale. The results showed a mean expectation score of 4.70 and a mean perception score of 4.35, producing an overall SERVQUAL gap of −0.35. The largest gap occurred in assurance (−0.71), particularly in IFP training and the competence of support personnel, followed by responsiveness (−0.47). Open-ended responses also identified internet connectivity, hands-on training, and technical assistance as major needs. These findings indicated that IFP improvement should move beyond device provision toward stronger service readiness, teacher competence, technical support, and sustainable enabling infrastructure.

Informasi Artikel

Kata Kunci:

SERVQUAL; Interactive Flat Panel; mutu layanan; digitalisasi pembelajaran; sekolah dasar pesisir

ABSTRAK

Penelitian ini dilakukan untuk mengevaluasi mutu layanan *Interactive Flat Panel* (IFP) berdasarkan kesenjangan antara harapan dan persepsi guru pada sekolah dasar pesisir Kota Gorontalo. Penelitian menggunakan pendekatan kuantitatif deskriptif-evaluatif dengan kerangka SERVQUAL yang mencakup dimensi *tangibles, reliability, responsiveness, assurance,* dan *empathy*. Responden terdiri atas 90 guru dari sembilan sekolah dasar pesisir di Kecamatan Dumbo Raya dan Hulonthalangi. Data dikumpulkan menggunakan 10 pasangan pernyataan harapan–persepsi berskala Likert lima poin dan empat pertanyaan terbuka. Instrumen menunjukkan validitas yang memadai serta reliabilitas tinggi, dengan Cronbach's Alpha sebesar 0,956 untuk harapan dan 0,879 untuk persepsi. Hasil penelitian menunjukkan rata-rata harapan sebesar 4,70 dan persepsi sebesar 4,35, sehingga diperoleh gap SERVQUAL keseluruhan sebesar −0,35. Kesenjangan terbesar terdapat pada dimensi *assurance* (−0,71), terutama pada pelatihan penggunaan IFP dan kompetensi pendamping, diikuti *responsiveness* (−0,47). Jawaban terbuka juga menunjukkan bahwa konektivitas internet, pelatihan praktik langsung, dan dukungan teknis menjadi kebutuhan utama guru. Temuan ini menunjukkan bahwa peningkatan layanan IFP perlu diarahkan dari penyediaan perangkat menuju penguatan kesiapan layanan, kompetensi guru, dukungan teknis, dan infrastruktur pendukung yang berkelanjutan.

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1. Introduction

Digital transformation has changed the way technology is used in teaching and learning, shifting from a supplementary presentation tool toward an interactive medium that enables teachers to integrate visual materials, videos, simulations, digital writing, and collaborative activities within a single platform. The Interactive Flat Panel (IFP), also commonly referred to as an interactive smart board, represents one of the technologies increasingly adopted to support digitally enhanced learning. The use of digital smart boards has been reported to support interactive learning within a TPACK framework, while interactive whiteboards have also been perceived as useful tools for enriching classroom interaction and supporting technology-assisted instruction [1,2]. Luo et al., for example, showed that perceived usefulness is an important element in the acceptance of interactive whiteboards and is closely related to how the technology supports instructional processes [2].

However, the successful implementation of technology in schools does not depend solely on device capability. Teachers and school leadership play a central role in determining whether technology can be integrated meaningfully into educational practice. Zhang et al. identified a relationship between technology leadership and teachers' ICT competency, indicating that organizational readiness and leadership support are associated with teachers' ability to use technology effectively [3]. Within the broader context of technological transformation, Adams and Thompson emphasized that school leaders need to be prepared to manage technology-driven change, while professional development, organizational support, and digital leadership capacity are essential for effective educational technology implementation [4–7]. This body of literature suggests that educational technology should not be treated merely as hardware, but rather as part of a service ecosystem involving user competence, technical support, leadership, and organizational responsiveness to teachers' needs.

Previous studies on smart boards and interactive whiteboards have predominantly examined their pedagogical benefits and their effects on instructional processes and learning outcomes. Izadpanah reported that smart technology use was associated with student engagement and academic performance among elementary school learners [8]. Obaid examined the effect of smart boards on student engagement in English learning [9], while Imoke et al. investigated the relationship between interactive smart whiteboards and academic performance among student teachers [10]. Orhani explored the contribution of smart boards to mathematics learning [11], Wong et al. examined their use in vocabulary and guided writing instruction [12], and Rogulska and Tarasova investigated interactive whiteboards in language teaching [13]. In addition, Tosuntaş et al. demonstrated that TPACK, acceptance and use of interactive whiteboards, and the transition process associated with their implementation were related to teacher performance [14]. Collectively, these studies show that previous research has largely focused on pedagogical effectiveness, technology acceptance, instructional use, and user performance.

Although these perspectives are important, they do not fully address the issue of service quality surrounding technology use. A device may function properly but still fail to provide an optimal user experience when teachers encounter limited access, technical disruptions, delayed assistance, insufficient training, or support that does not match their needs. The SERVQUAL approach is relevant for examining these issues because it evaluates service quality by comparing users' expectations with their actual perceptions of the services received. SERVQUAL, developed by Parasuraman et al., measures service quality through five major dimensions: tangibles, reliability, responsiveness, assurance, and empathy [15]. The model has subsequently been adapted to various digital service environments. Delgado et al., for example, applied SERVQUAL to assess the quality of an e-learning platform and demonstrated that dimensions such as empathy, assurance, and tangibility remain relevant in digital service contexts [16]. In Indonesia, Theresiawati et al. also incorporated service-quality dimensions into the evaluation and improvement of e-learning, emphasizing reliability, responsiveness, assurance, empathy, and tangible aspects as important elements in service enhancement [17].

The need to evaluate IFP service quality has become increasingly relevant in the context of Indonesia's educational digitalization policy. The national Digital Learning Program has expanded the provision of IFPs at the primary-school level. As of 17 February 2026, the allocation of IFPs for primary schools had reached 149,268 educational institutions, with the delivery reported as fully completed. The policy also recognizes laptops, internet connectivity, storage media, and electricity support as part of the broader digital learning ecosystem [18]. These developments indicate that the policy challenge is shifting from expanding access to digital devices toward ensuring that the technology can be used effectively and sustainably in instructional practice.

Within this context, teachers represent the primary users who directly experience the quality of IFP-related services in schools. Their experience is determined not only by whether an IFP is available, but also by whether the device is ready for use, operates reliably, is supported by adequate facilities, receives timely technical assistance when problems occur, is accompanied by sufficient training, and is supported by school personnel in ways that reflect teachers' actual needs. Accordingly, the present study adapts the five SERVQUAL dimensions to the context of IFP services, covering the condition of facilities, operational reliability, responsiveness to technical problems, assurance through training and

competent assistance, and empathy toward teachers' needs.

Despite the growing body of research on smart boards, studies that specifically evaluate the gap between teachers' expectations and perceptions of IFP services remain relatively limited compared with studies focusing on instructional effectiveness, technology acceptance, and student learning outcomes. This research gap is particularly apparent at the primary-school level and in geographically specific settings such as coastal schools. Existing literature has tended to examine technology in terms of implementation and pedagogical benefits, while the service quality experienced by teachers as end users has received comparatively less attention.

Therefore, this study conceptualizes the IFP not only as an instructional device but also as an educational technology service, whose quality is shaped by the interaction among devices, infrastructure, technical assistance, support personnel competence, and school responsiveness to teachers' needs. The novelty of this study lies in the specific application of SERVQUAL analysis to IFP services in coastal primary schools, with teachers positioned as the principal users of the service. This approach makes it possible to identify gaps between expected and perceived service quality across the five SERVQUAL dimensions and to determine which aspects require the greatest improvement.

Accordingly, this study aimed to analyze teachers' expectations and perceptions of IFP services in coastal primary schools in Gorontalo City, measure service-quality gaps across the dimensions of tangibles, reliability, responsiveness, assurance, and empathy, and identify priority areas for service improvement. The findings are expected to provide an empirical basis for schools to strengthen digital learning services that extend beyond device provision toward a more comprehensive level of service readiness capable of supporting effective and sustainable IFP use.

2. Method

2.1 Research Design, Setting, and Participants

This study employed a quantitative descriptive-evaluative design to evaluate the service quality of Interactive Flat Panels (IFPs) by examining the gap between teachers' expectations and their actual perceptions. The evaluation was based on the SERVQUAL framework, which comprises five service-quality dimensions: tangibles, reliability, responsiveness, assurance, and empathy. This approach enabled IFP service quality to be assessed simultaneously in terms of the level of service expected by teachers and the services they actually experienced when using IFPs for teaching.

The study was conducted in primary schools located in the coastal areas of Gorontalo City and administratively situated within Dumbo Raya and Hulonthalangi Districts. The study did not include all primary schools within the two districts. Instead, it specifically focused on schools located along the coastal area in which IFPs were used.

Nine primary schools participated in the study, comprising five schools in Dumbo Raya District and four schools in Hulonthalangi District. A total of 90 teachers participated, including 49 teachers from Dumbo Raya and 41 teachers from Hulonthalangi. The distribution of respondents across the participating schools is presented in Table 1.

Table 1. Distribution of Respondents by School and District

District	School	Number of Teachers
Dumbo Raya	SDN No. 45 Dumbo Raya	8
Dumbo Raya	SDN No. 46 Dumbo Raya	7
Dumbo Raya	SDN No. 47 Dumbo Raya	7
Dumbo Raya	SDN No. 48 Dumbo Raya	9
Dumbo Raya	SDN No. 51 Dumbo Raya	18
Subtotal: Dumbo Raya		**49**
Hulonthalangi	SDN No. 38 Hulonthalangi	15
Hulonthalangi	SDN No. 42 Hulonthalangi	10
Hulonthalangi	SDN No. 43 Hulonthalangi	8
Hulonthalangi	SDN No. 44 Hulonthalangi	8
Subtotal: Hulonthalangi		**41**
Total	**9 schools**	**90**

The participating schools were purposively selected based on their geographical location in the coastal area and their relevance to IFP implementation. Following school selection, eligible participants were teachers who had used or had direct access to an IFP for instructional activities. Teachers without direct experience of using an IFP were excluded. Accordingly, the unit of analysis was the teacher as the direct user of IFP-related services in coastal primary schools.

2.2 Research Instrument

The research instrument consisted of three sections. The first section measured teachers' expectations regarding IFP services, whereas the second measured their perceptions of the IFP services they actually experienced at school. The two scales were constructed in parallel so that each expectation statement had a corresponding perception statement measuring the same service attribute.

Each scale consisted of 10 statements representing the five SERVQUAL dimensions. The tangibles dimension was measured by Items 1–2, addressing arrangements for accessing the IFP and the adequacy of the equipment and supporting facilities. Reliability was measured by Items 3–4, focusing on the readiness of the IFP before instruction and its operational stability throughout the learning process. Responsiveness was measured by Items 5–6, addressing the availability of personnel who could be contacted when difficulties occurred and the speed with which IFP-related problems

were addressed. Assurance was represented by Items 7–8 and covered IFP training and the competence of personnel providing assistance. Empathy was measured by Items 9–10 and assessed whether the support provided matched teachers' needs and whether schools listened and responded to teachers' needs and suggestions regarding IFP use.

All statements were rated on a five-point Likert scale ranging from 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, to 5 = strongly agree. Higher expectation scores represented higher standards of IFP services expected by teachers, whereas higher perception scores indicated more favorable evaluations of the services they actually experienced.

The third section consisted of four open-ended questions designed to obtain contextual information concerning: (1) the condition of the IFP and supporting facilities; (2) the most frequently experienced difficulties in using the IFP; (3) the types of training or assistance teachers still required; and (4) the main aspects requiring improvement to make IFP services easier to use, more reliable, and more beneficial for teaching and learning. These responses were used as supporting data to facilitate interpretation of the quantitative findings.

2.3 Data and Instrument Quality Assessment

Before the main analysis, the dataset underwent a data-screening procedure to ensure data quality. The screening process included checking response completeness, coding consistency, conformity of scores with the valid 1–5 scale range, and possible data-entry errors. Incomplete responses or values outside the predetermined scale range were verified before being included in the statistical analysis.

The empirical quality of the instrument was subsequently examined through item validity and reliability analyses. Item validity was assessed by examining the relationship between each item score and the corresponding total score using Pearson correlation. The internal consistency of the expectation and perception scales was evaluated separately using Cronbach's Alpha. A Cronbach's Alpha coefficient of at least 0.70 was considered indicative of acceptable internal consistency.

2.4 Data Analysis

Quantitative data were analyzed at three levels: individual indicators, SERVQUAL dimensions, and overall IFP service quality. First, descriptive statistics, including means and standard deviations, were calculated separately for expectation (E) and perception (P) scores for each indicator.

Scores for each SERVQUAL dimension were obtained by averaging the two indicators corresponding to that dimension. IFP service quality was subsequently evaluated using SERVQUAL gap analysis by calculating the difference between perception and expectation scores as follows: **Gap = P – E.**

where P represents the mean perception score and E represents the mean expectation score. A positive gap indicated that the IFP services experienced by teachers exceeded their expectations, a zero gap indicated that the services matched their expectations, and a negative gap indicated that the services had not met teachers' expectations.

The more negative the gap value, the greater the discrepancy between the expected and experienced service. Therefore, indicators or dimensions with the largest negative gaps were regarded as the highest priorities for service improvement. Gap scores were calculated for each indicator and subsequently aggregated across the five SERVQUAL dimensions. The dimensions were then ranked according to their gap scores to determine priority areas for improving IFP service quality in coastal primary schools.

Responses to the four open-ended questions were analyzed through content categorization. All responses were read comprehensively and grouped according to recurring themes, particularly those related to supporting facilities, technical and infrastructure problems, training or assistance needs, and priorities for service improvement. The resulting categories were used to provide contextual explanations for the SERVQUAL findings. Thus, the open-ended data served as complementary evidence to explain why particular indicators or dimensions exhibited relatively larger service-quality gaps.

3. Result and Discussion

3.1 Result

Quantitative data were obtained from 90 teachers across nine primary schools located in the coastal areas of Gorontalo City. All respondents provided complete responses to the 10 expectation items and 10 perception items; therefore, all 90 respondents were included in the quantitative analysis. Initial data screening confirmed that all responses were within the predetermined 1–5 scale range and that no quantitative data were missing.

Item validity was examined using Pearson correlations between each item score and the total scale score. With 90 respondents, the critical correlation coefficient at the 5% significance level was 0.207. The item-total correlations ranged from 0.723 to 0.899 for the expectation scale and from 0.525 to 0.857 for the perception scale. All coefficients exceeded the critical value and were statistically significant at $p < 0.001$. Reliability analysis yielded Cronbach's Alpha coefficients of 0.956 for the expectation scale and 0.879 for the perception scale. Both values exceeded the 0.70 criterion, indicating adequate internal consistency.

Table 2. Item Validity of the Expectation and Perception Scales

Item	Expectation r	Perception r	Result
1	0.879	0.669	Valid
2	0.869	0.525	Valid
3	0.829	0.668	Valid
4	0.840	0.617	Valid
5	0.801	0.762	Valid
6	0.896	0.685	Valid
7	0.723	0.657	Valid
8	0.853	0.812	Valid
9	0.884	0.857	Valid
10	0.899	0.800	Valid

The descriptive analysis showed that teachers' mean expectation scores for IFP services ranged from 4.63 to 4.82, whereas mean perception scores ranged from 4.07 to 4.68. All indicators produced negative gap scores because the mean perception scores were lower than the corresponding expectation scores.

Table 3. Expectation, Perception, and SERVQUAL Gap Scores by Indicator

No.	Service Indicator	Expectation Mean ± SD	Perception Mean ± SD	Gap (P−E)	Rank
1	Arrangements for IFP use	4.68 ± 0.54	4.44 ± 0.70	−0.23	6
2	Adequacy of equipment and supporting facilities	4.71 ± 0.46	4.57 ± 0.56	−0.14	8
3	IFP readiness before instruction	4.66 ± 0.48	4.52 ± 0.58	−0.13	9
4	IFP stability during instruction	4.73 ± 0.44	4.68 ± 0.54	−0.06	10
5	Availability of personnel/operator to contact	4.68 ± 0.47	4.18 ± 1.12	−0.50	3
6	Speed of response to IFP-related problems	4.70 ± 0.46	4.26 ± 1.02	−0.44	4
7	Training or hands-on practice in IFP use	**4.82 ± 0.38**	4.08 ± 0.99	**−0.74**	**1**
8	Competence of personnel providing assistance	4.73 ± 0.44	**4.07 ± 1.12**	**−0.67**	**2**
9	Assistance corresponding to teachers' difficulties	4.63 ± 0.55	4.29 ± 0.78	−0.34	5
10	Follow-up on teachers' needs and suggestions	4.66 ± 0.48	4.47 ± 0.66	−0.19	7

The largest negative gap occurred for training or hands-on practice in IFP use (−0.74), followed by the competence of personnel providing assistance (−0.67). The availability of personnel or operators who could be contacted when difficulties occurred showed a gap of −0.50, while the speed of response to IFP-related problems had a gap of −0.44. The smallest gap was found for IFP stability during instruction (−0.06).

When the indicators were aggregated into the five SERVQUAL dimensions, negative gaps were identified across all dimensions. The highest mean expectation score was found for assurance (4.78), whereas the highest mean perception score occurred for reliability (4.60).

Table 4. Expectation, Perception, and Gap Scores by SERVQUAL Dimension

Dimension	Expectation Mean ± SD	Perception Mean ± SD	Gap (P−E)	Priority
Tangibles	4.69 ± 0.47	4.51 ± 0.57	−0.19	4
Reliability	4.69 ± 0.42	**4.60 ± 0.53**	**−0.09**	5
Responsiveness	4.69 ± 0.43	4.22 ± 1.04	**−0.47**	**2**
Assurance	**4.78 ± 0.38**	4.07 ± 0.87	**−0.71**	**1**
Empathy	4.64 ± 0.49	4.38 ± 0.68	−0.27	3
Overall	**4.70 ± 0.40**	**4.35 ± 0.58**	**−0.35**	—

Assurance showed the largest negative gap (−0.71), followed by responsiveness (−0.47), empathy (−0.27), tangibles (−0.19), and reliability (−0.09). Overall, the mean expectation score was 4.70 compared with a mean perception score of 4.35, resulting in an overall SERVQUAL gap of −0.35. Based on the magnitude of the gaps, the priority order was assurance, responsiveness, empathy, tangibles, and reliability.

The open-ended responses were analyzed as complementary data to describe teachers' experiences with IFP use. The first question yielded 90 responses, the second and third questions each yielded 89 responses, and the fourth question yielded 88 responses. Regarding the condition of the IFP and supporting facilities, most respondents described the devices as being in good, adequate, normal, or functional condition for instructional use. Nevertheless, several respondents reported limitations related to internet stability, electricity, supporting equipment, audio, and the physical space used for the IFP.

Internet or network connectivity emerged as the most frequently reported problem, appearing in 52 of 89 responses (58.4%). Electricity or power-related issues appeared in 17 responses (19.1%), while limitations related to devices, space, access, or IFP mobility appeared in 13 responses (14.6%). Thirteen respondents (14.6%) reported no significant difficulties. Other responses referred to operational issues such as the use of particular features, connections between the IFP and other devices, HDMI cables, applications, and screen responsiveness.

Regarding training and support needs, 54 of 89 respondents (60.7%) reported a need to improve their ability to operate the IFP and use its features or applications. Forty-one respondents (46.1%) specifically requested hands-on training, workshops, technical guidance, or continuing assistance. In addition, 27 respondents (30.3%) identified a need to improve their pedagogical use of IFPs, including developing interactive learning media, quizzes, simulations, digital content, and IFP-supported learning activities. Six respondents (6.7%) stated that previous training was sufficient or that they did not currently require additional training.

Improved internet quality and stability represented the most frequently identified service-improvement priority, appearing in 45 of 88 responses (51.1%). Technical support, device maintenance, or the availability of personnel/operators was identified in 33 responses (37.5%), while teacher training and assistance appeared in 27 responses (30.7%). Additional IFP units were mentioned in 14 responses (15.9%), and improvements to supporting infrastructure, including electricity, room conditions, and supporting equipment, also appeared in 14 responses (15.9%).

Table 5. Major Themes Identified from Teachers' Open-Ended Responses

Aspect	Emerging Theme	n	%
Difficulties in IFP use (N=89)	Internet/network connectivity	52	58.4
	Electricity/power	17	19.1
	Devices, space, access, or mobility	13	14.6
	No significant difficulties	13	14.6
Training needs (N=89)	IFP operation, features, and applications	54	60.7
	Hands-on training/workshops/assistance	41	46.1
	Pedagogical use and interactive media	27	30.3
	No additional training currently required	6	6.7
Improvement priorities (N=88)	Internet/network connectivity	45	51.1
	Technical support and maintenance	33	37.5
	Teacher training and assistance	27	30.7
	Additional IFP units	14	15.9
	Supporting infrastructure	14	15.9

Note: A single response could contain more than one theme; therefore, percentages within each group do not necessarily sum to 100%.

3.2 Discussion

The findings indicate that the service quality of Interactive Flat Panels (IFPs) in coastal primary schools in Gorontalo City did not fully meet teachers' expectations. This was reflected in an overall SERVQUAL gap of −0.35, resulting from a mean expectation score of 4.70 and a mean perception score of 4.35. Importantly, both scores were relatively high. Thus, the central issue was not that teachers perceived IFP services as poor, but rather that the services they experienced remained below the standards they expected. This distinction is important because the implementation of digital devices in schools depends not only on the availability of technology but also on how effectively the technology is integrated into instruction and supported by an adequate service environment [1,2].

The most pronounced discrepancy was found in the assurance dimension, which produced the largest gap (−0.71). At the indicator level, training or hands-on practice in IFP use showed the largest gap (−0.74), followed by the competence of personnel providing assistance (−0.67). This pattern suggests that the main weakness of IFP services was not primarily the physical availability of the device, but the capacity of the school service system to develop teachers' competence, confidence, and sense of security when using the technology. Research on interactive whiteboards similarly indicates that the potential of interactive technologies does not automatically emerge from device availability; teachers' ability to integrate technological functions into instructional strategies remains important [1,2].

The large training gap further indicates that teachers required more than introductory technical instruction. In the open-ended responses, 60.7% identified a need to improve their ability to operate the IFP and use its features or applications, while 46.1% specifically requested hands-on training, workshops, technical guidance, or continuing assistance. In addition, 30.3% identified pedagogical needs such as developing interactive media, quizzes, simulations, and digital instructional content. These findings suggest that teachers' professional development needs are shifting from simply learning how to operate the device toward understanding how to use the device to improve teaching and learning. Research on technology leadership has demonstrated a relationship between technology leadership and teachers' ICT competence, indicating that teacher capacity development requires organizational and leadership support rather than relying exclusively on individual initiative [3]. Adams and Thompson also emphasize the importance of personnel readiness and capacity development when new technologies are incorporated into educational work [4], while Ghamrawi et al. highlight continuous professional development as an important response to technology-driven educational change [5].

Responsiveness produced the second-largest dimensional gap (−0.47). Its two indicators were also among the largest individual gaps: the availability of personnel or operators who could be contacted when problems occurred (−0.50) and the speed of response to IFP-related problems (−0.44). These results indicate that

teachers require not only the ability to operate IFPs independently but also a clear support structure when problems arise. In educational technology implementation, institutional responsiveness is particularly important because technical interruptions during classroom instruction can directly disrupt ongoing learning activities. The literature on technology adoption and educational leadership emphasizes organizational support, technologically informed leadership, and mechanisms through which users can obtain assistance as technology becomes embedded in everyday professional practice [4,6,7]. Although much of this literature addresses AI-based technologies, the managerial principle is relevant to IFP implementation: new technologies require human and organizational support structures to ensure consistent use.

The open-ended findings further reinforce this issue. Technical assistance, equipment maintenance, or access to responsible personnel was identified as an improvement priority by 37.5% of respondents. Consequently, teachers' needs cannot be addressed solely through one-off training when devices are initially introduced. Schools require support mechanisms that remain accessible after technology has entered routine use. In practice, such mechanisms may include a designated school-based IFP focal person, simple procedures for reporting technical problems, scheduled equipment checks, and an escalation pathway for problems that cannot be resolved at school level. This finding shifts the perspective on IFP implementation from device procurement toward management of the technology service lifecycle.

Connectivity emerged as another prominent issue in teachers' open-ended responses. Internet or network problems were identified by 58.4% of respondents, while 51.1% identified improved internet quality and stability as a service-improvement priority. Electricity-related difficulties were also reported by 19.1%. These findings are noteworthy when compared with the relatively small tangibles gap of −0.19. Teachers generally perceived the physical condition of IFPs and related facilities positively, yet functional devices were not always accompanied by sufficiently stable enabling infrastructure. Although an IFP may operate as a physical device, broader digital functions depend on connectivity, reliable electricity, and supporting equipment. Research on smart technology in education indicates that its educational potential depends on technology being consistently integrated into learning activities [8]. Enabling infrastructure should therefore be considered part of the service ecosystem rather than an additional concern after hardware has been supplied.

In contrast, reliability produced the smallest dimensional gap (−0.09). The operational stability of the IFP during instruction had a gap of only −0.06, while readiness before instruction had a gap of −0.13. These findings suggest that when IFPs were available for use, teachers generally perceived them as operationally ready and relatively stable. This represents an important positive condition because operational reliability provides a basic foundation for instructional use. Previous studies have reported the potential of smart boards and interactive whiteboards to support student engagement, interactive activities, and learning when effectively incorporated into instruction [2,9–13]. However, the present study did not directly measure student learning outcomes. The relatively strong reliability scores should therefore not be interpreted as evidence of improved academic performance, but rather as an indication that the technological foundation was comparatively functional while larger deficiencies remained in the human and service-support dimensions.

This pattern constitutes a central finding of the study: the largest service deficiencies were not located in the basic technical functioning of the device but in the human capacity and service system surrounding it. The ordering of the SERVQUAL gaps—assurance (−0.71), responsiveness (−0.47), empathy (−0.27), tangibles (−0.19), and reliability (−0.09)—shows that dimensions more closely associated with assistance, support, and organizational interaction with teachers tended to exhibit larger gaps. Conversely, the dimensions related more directly to device readiness and stability showed the smallest gaps. In other words, device distribution has established a digital foundation, but the maturity of the service structures surrounding the devices has not developed at the same pace.

The empathy gap of −0.27 further supports this interpretation. Teachers required not only technical assistance but also support that corresponded to the particular difficulties they experienced and follow-up on their needs and suggestions. Effective technology implementation must therefore remain human-centered. Adams and Thompson argue that even as technology becomes increasingly capable of supporting organizational functions in schools, human relationships, empathy, contextual judgment, and personalized support remain essential components of educational leadership [4]. Fullan et al. similarly emphasize that technological development does not remove the need for human judgment and leadership capable of balancing technological efficiency with stakeholder needs [7]. Applied to IFP implementation, this suggests that service quality should not be evaluated solely by asking whether a device works, but also by asking whether teachers receive the support required to use it effectively.

The convergence between the quantitative and open-ended findings strengthens this interpretation. Quantitatively, the largest gaps occurred in training and the competence of support personnel, while the open-ended responses highlighted substantial needs for feature mastery, hands-on practice, and assistance. Responsiveness also showed a relatively large quantitative gap, while technical support and maintenance emerged prominently in teachers' qualitative responses.

Likewise, the relatively small reliability gap was consistent with the large number of teachers who described the basic condition of the devices as good or normally functioning. The convergence of these data indicates that improvement efforts should not primarily focus on replacing devices but on strengthening the service system that enables existing devices to be used effectively.

Based on these patterns, improvement in IFP service quality in coastal schools should involve several interconnected components. First, professional development should move beyond introductory device orientation toward continuous, practice-based learning. Second, schools should have designated personnel with sufficient competence to resolve basic problems and connect the school with higher-level technical support when necessary. Third, equipment maintenance should be scheduled rather than conducted only after failures occur. Fourth, internet and electricity reliability should be incorporated into school digital-service planning. Finally, schools need feedback mechanisms through which teachers' experiences with IFPs can inform service improvement. Such an approach is consistent with the view that technology leadership extends beyond the ability to use technology and includes the capacity to build an organizational environment in which technology can be used effectively [3–5].

The coastal setting is also important for interpreting the findings. The study involved nine coastal primary schools across two districts rather than all schools in Dumbo Raya and Hulonthalangi. The findings should therefore not be generalized directly to all primary schools in Gorontalo City. Instead, the contribution of the study lies in showing how a digitalization initiative is experienced by users within a specific geographical context. The prominence of internet problems and the presence of electricity-related constraints demonstrate that technology service quality in coastal settings must account for local infrastructure alongside teacher readiness and school support systems.

Overall, the findings suggest that IFP implementation in coastal primary schools has reached a stage in which the devices are generally available, functional, and relatively stable, while the surrounding service system has not reached the same level of maturity. The next phase of educational digitalization should therefore not focus exclusively on increasing the number of devices. Attention should shift from device provision toward service readiness, ensuring teacher competence, capable support personnel, timely technical assistance, stable infrastructure, and service mechanisms responsive to users' needs. Such a shift is necessary if investment in IFPs is to move beyond the physical presence of technology in schools and develop into sustainable digital learning services.

4. Conclusion

This study demonstrated that the service quality of Interactive Flat Panels (IFPs) across nine coastal primary schools in Gorontalo City had not fully met teachers' expectations. The mean expectation score of 4.70 was higher than the mean perception score of 4.35, resulting in an overall SERVQUAL gap of −0.35. Negative gaps were identified across all five SERVQUAL dimensions, with assurance showing the largest gap (−0.71), followed by responsiveness (−0.47), empathy (−0.27), tangibles (−0.19), and reliability (−0.09).

At the indicator level, the largest gaps were found in training or hands-on practice in IFP use (−0.74) and the competence of personnel providing assistance (−0.67). In contrast, device readiness and operational stability showed relatively small gaps. This pattern indicates that the primary service-quality challenge was not the basic functionality of the IFP itself but the readiness of the supporting service system, particularly teacher capacity development and access to technical assistance.

The quantitative findings were reinforced by teachers' open-ended responses, which frequently highlighted internet connectivity, mastery of IFP features and applications, hands-on training, technical assistance, and equipment maintenance. Accordingly, improving IFP services in coastal primary schools requires more than expanding device availability. Priority should be given to strengthening service readiness through continuous practice-based professional development, competent support personnel, clear technical-response mechanisms, routine maintenance, and more reliable internet and supporting infrastructure.

The findings emphasize that sustainable educational digitalization requires a balance between functional technology, user competence, and the organizational capacity of schools to provide ongoing support. Future implementation of IFPs in coastal schools should therefore move beyond a device-provision approach toward a responsive, sustainable, and teacher-centered digital service system.

References

[1] I.M. Winayu, The Use of Digital Smart Boards as a Means of Supporting TPACK-Based Interactive Learning, Pijed 3 (2024) 367–381. https://doi.org/10.59175/pijed.v3i2.316.

[2] Z. Luo, X. Tan, M. He, X. Wu, The Seewo Interactive Whiteboard (IWB) for ESL Teaching: How Useful It Is?, Heliyon 9 (2023) e20424. https://doi.org/10.1016/j.heliyon.2023.e20424.

[3] Y. Zhang, D. Adams, K.S.L. Cheah, The relationship between technology leadership and teacher ICT competency in higher education, Education and Information Technologies 27 (2022) 10285–10307. https://doi.org/10.1007/s10639-022-11037-0.

[4] D. Adams, P. Thompson, Transforming School Leadership with Artificial Intelligence: Applications, Implications, and Future Directions, Leadership and

Policy in Schools 24 (2025) 77–89. https://doi.org/10.1080/15700763.2024.2411295.
[5] N. Ghamrawi, T. Shal, N.A. Ghamrawi, Exploring the impact of AI on teacher leadership: Regressing or expanding?, Education and Information Technologies 29 (2024) 8415–8433. https://doi.org/10.1007/s10639-023-12174-w.
[6] M.M. Tyson, N.J. Sauers, School leaders' adoption and implementation of artificial intelligence, Journal of Educational Administration 59 (2021) 271–285. https://doi.org/10.1108/JEA-10-2020-0221.
[7] M. Fullan, C. Azorin, A. Harris, M. Jones, Artificial intelligence and school leadership: Challenges, opportunities and implications, School Leadership & Management 44 (2023) 339–346. https://doi.org/10.1080/13632434.2023.2246856.
[8] S. Izadpanah, Evaluating the Impact of Smart Technology on Academic Eagerness, Academic Seriousness, and Academic Performance in Elementary English Language Learners as a Foreign Language, Plos One 19 (2024) e0300147. https://doi.org/10.1371/journal.pone.0300147.
[9] D.S.A. Obaid, The Effect of Smart Board on Students' Engagement in English, International Journal of Research in Social Sciences and Humanities 12 (2022) 52–64. https://doi.org/10.37648/ijrssh.v12i03.004.
[10] J.E. Imoke, B.C. Ushe, B.E. Ofem, Interactive/Smart Whiteboard and Student-Teachers Academic Performance in Educational Technology at the University of Calabar, Nigeria, Ejceel 2 (2024) 170–176. https://doi.org/10.59324/ejceel.2024.2(1).14.
[11] S. Orhani, The Contribution of the Smart Board to the Improvement of Learning Results in the Subject of Mathematics, Ijasse 1 (2023) 237–252. https://doi.org/10.59890/ijasse.v1i4.1040.
[12] W.L. Wong, M.M. Muhammad, M.S.Y. SHAK, M.A. Rahman, M.C. Lee, V. Pandian, Employing the Smart Interactive Whiteboard to Teach Guided Writing Vocabulary, Issues in Language Studies 13 (2024) 112–130. https://doi.org/10.33736/ils.5643.2024.
[13] O. Rogulska, O. Tarasova, Using Interactive Whiteboards to Enhance English Language Instruction and Learning, Збірник Наукових Праць Національної Академії Державної Прикордонної Служби України Серія Педагогічні Науки 16 (2021) 342–353. https://doi.org/10.32453/pedzbirnyk.v16i1.709.
[14] S.B. Tosuntas, Z. Cubukcu, G. Beauchamp, A new model for the factors that affect interactive whiteboard usage of teachers and its effect on performance, Education and Information Technologies 26 (2021) 3575–3592. https://doi.org/10.1007/s10639-021-10428-z.
[15] A. Parasuraman, V.A. Zeithaml, L.L. Berry, SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality, Journal of Retailing 64 (1988) 12–40.
[16] B.C. Delgado, A.C. Farrapo Junior, R.C. Mergulhao, D.A.L. Silva, Assessment of the quality of digital services provided by an e-learning platform focused on sustainability issues, Production 32 (2022) e20210110. https://doi.org/10.1590/0103-6513.20210110.
[17] Theresiawati, H.B. Seta, A. Arista, Implementing quality function deployment using service quality and Kano model to the quality of e-learning, International Journal of Evaluation and Research in Education 12 (2023) 1560–1571. https://doi.org/10.11591/ijere.v12i3.25511.
[18] Kementerian Pendidikan Dasar dan Menengah Republik Indonesia, Digitalisasi Pembelajaran Jenjang SD Dorong Pembelajaran Lebih Interaktif di Daerah 3T, (2026). https://www.kemendikdasmen.go.id/.