Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 5 Issue 2 (2025)

Developing A Scale to Measure Passengers' Perception of Technology Enabled Service Quality in Public Transportation

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Abstract: This research focuses on developing a scale to measure passenger perceptions of technology-enabled service quality (TESQ) in public transportation, specifically focusing on Andhra Pradesh State Road Transport Corporation (APSRTC) bus services. Based on established scale development procedures and insights from service quality and technology adoption literature, this study employs confirmatory factor analysis (CFA) to validate the factor structure of TESQ as perceived by passengers. Data from focus group interviews were used to inform the design of the survey instrument, which was then administered to a sample of 446 APSRTC passengers. The CFA validated a six-factor structure of TESQ: Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Technology-Enabled Service. The study provides model fit indices, construct reliability, and validity tests. The findings emphasize the importance of both traditional and technology-specific aspects of service quality in public transport and contribute to the knowledge related to service quality in technology-integrated settings. This work provides an empirically grounded and validated measurement scale for future research. It provides a practical tool for public transport providers to use when assessing service quality.

Keywords: technology-enabled service quality, Bus Services, Public transport, service quality

1. Introduction

Public transportation plays a key role in the socio-economic landscape of any region, providing essential mobility for individuals and communities (Eboli & Mazzulla, 2007; Wall & McDonald, 2007). Indian State Road Transport Corporations (SRTCs) such as the Andhra Pradesh State Road Transport Corporation (APSRTC) provide vital and affordable transportation services. However, with rapidly increasing technology adoption, SRTCs need to adapt and integrate digital solutions to enhance service quality and meet the ever-changing needs of passengers (Bakar et al., 2022; Redman et al., 2013). This includes providing online ticketing, mobile applications, and real-time tracking systems to improve the overall passenger experience (Currie, 2005; Nelson & Mulley, 2013).

While traditional dimensions of service quality such as tangibility, reliability, and responsiveness continue to be important (Parasuraman et al., 1988; Prioni & Hensher, 2000), the wide adoption of technology has introduced new dimensions that impact how passengers perceive the service. Public transport providers need to understand these new dimensions, and also the way that these new elements of service interact with the more established service attributes. This study aims to develop a scale to measure technology-enabled service quality (TESQ) in the context of APSRTC bus services, and to validate the factor structure of this construct, using a confirmatory factor analysis (CFA) methodology.

This study focuses on the development of a measurement instrument for the assessment of technology-enabled service quality, and will do so by:

1. **Identifying Key Dimensions:** Using both established theory and also by using data gathered from focus group interviews.
2. **Developing a Measurement Instrument**: Using a multi-dimensional scale to measure service quality in the context of technology-driven public transport (Churchill, 1979; Gilbert and Churchill, 1979; Nunnally, 1970; Hinkin et al., 1997; Llusar & Zornoza, 2002).
3. **Validating the Measurement Model:** This study will utilize confirmatory factor analysis (CFA) to validate the underlying factor structure of the developed scale, and will provide the necessary statistical justification for the use of the measurement instrument.

4. **Practical Implications**: This study contributes a tool that can be used by public transport organizations to assess their current performance and also make informed decisions about technology adoption.

This study will contribute to the academic literature by providing a validated measurement instrument that can be used to further the study of technology-enabled service quality in public transport, and will also contribute to the practical understanding of service delivery in this dynamic and important sector. This study does not include any exploratory factor analysis (EFA) and focuses on validating the proposed dimensions.

2. Literature Review

It focuses on the theoretical foundations of service quality, the role of technology in service delivery, and the application of these concepts within the public transportation sector. The review specifically highlights the key concepts and empirical studies that underpin the development and validation of a measurement model using confirmatory factor analysis (CFA) and also focuses on the area of technology-enabled services.

2.1. Theoretical Foundations of Service Quality and Measurement

Extensive research on Service quality with early models emphasizing the gap between customer expectations and perceptions (Parasuraman et al., 1985, 1988). The SERVQUAL Model proposed by Parasuraman, Zeithaml, and Berry (1988) identified five core dimensions of service quality: responsiveness, assurance, tangibility, empathy, and reliability. *Tangibility* refers to the physical environment of service (Parasuraman et al., 1988), while *reliability* focuses on the consistency and dependability of the service (Prioni & Hensher, 2000). *Responsiveness* is the willingness of staff to help customers, while *assurance* relates to the competence and courtesy of the staff (Parasuraman et al., 1988). *Empathy* reflects the care and individualized attention given to customers (Parasuraman et al., 1988).

Criticisms of the SERVQUAL model have led to alternative approaches such as the SERVPERF model, which focuses on performance-based measures of service quality (Cronin & Taylor, 1992, 1994). Despite these criticisms, the SERVQUAL model still acts as the basis for the development of a measurement scale for use in a technology-driven setting. It is also recognized that service quality has a direct impact on customer perceptions and overall customer satisfaction (Zeithaml et al., 2018).

2.2. Technology and Service Quality in Transportation and Technology Integration

The integration of technology into service delivery has transformed the landscape of a wide range of industries and has changed the way that customers experience different types of services (Bitner et al., 2000). Specifically in the public transportation sector, technology has been adopted in a variety of ways, including mobile ticketing systems, real-time information and other technology-driven aspects of the customer experience (Currie, 2005; Watters et al., 2013; Cheng & Huang, 2013).

The Technology Acceptance Model (TAM) (Davis, 1989) is used to understand how technology is adopted and suggests that perceived usefulness and perceived ease of use are key determinants for the successful implementation of any new technology in a service setting. Studies in e-service quality have emphasized the importance of user-friendly designs, reliability and also the security of digital platforms (Parasuraman et al., 2005). This suggests that technology needs to be well-designed and also needs to enhance the service, to have a positive effect on the customer experience (Collier & Sherrell, 2010). This highlights that the technology itself should not be seen as being independent of the service, but should be understood as a part of the overall service delivery process.

2.3. Measurement of Service Quality using Confirmatory Factor Analysis (CFA)

The development of reliable and valid measurement scales is essential for assessing service quality (Churchill, 1979), and in recent years, confirmatory factor analysis (CFA) has become an important tool for testing the psychometric properties of service quality models, and for validating the structure of a proposed measurement instrument (Hair et al., 2019). CFA is a statistical method that is used to examine the relationships between observed variables (e.g., survey items) and latent constructs, which are underlying concepts that cannot be directly measured, such as service quality or customer satisfaction (Anderson & Gerbing, 1988). This method of statistical analysis allows researchers to assess a variety of factors, including construct validity and construct reliability.

2.4. Research Gaps and the Need for This Study
While there is an extensive body of literature on service quality and technology adoption, research focused specifically on the development of a measurement scale for technology-enabled service quality in public bus transportation using confirmatory factor analysis (CFA) is limited. This study seeks to fill this gap by providing an empirically tested measurement model which has been validated using CFA and can be adopted by public transport organizations. There is a need for a psychometrically sound instrument for this sector to be used both by researchers and by public transport providers. The results of this study can help guide public transport providers as they implement new technologies into their service delivery process.

Table 2.1: Dimensions of Service Quality in Public Transportation and Related Sectors

S.No.	Author(s) & Year	Key Dimensions Identified
1	Bakar et al. (2022)	Service quality dimensions in public transport
2	Deb & Ahmed (2018)	Passenger perceptions and expectations of service quality in public transport
3	Parasuraman et al. (1988)	Tangibles, Reliability, Responsiveness, Assurance, Empathy
4	Bitner et al. (2000)	Efficiency, Accessibility, Convenience, and Responsiveness (related to Self Service Technologies)
5	Eboli & Mazzulla (2007)	Service Quality, Customer Satisfaction, Loyalty, Perceived Value (in public transport)
6	Prioni & Hensher (2000)	Service quality dimensions in bus services
7	Currie (2005)	Convenience, Efficiency, Accessibility, Cost Savings (Specifically about Smart Ticketing)
8	Watters et al. (2013)	Accuracy, Reliability, Usefulness, Accessibility (Specifically about Real-Time Information)
9	Collier & Sherrell (2010)	Control, Convenience, Ease of Use, Perceived Usefulness (related to Self Service Technologies)
10	Bhatnagar & Teo (2011)	Perceived Usefulness, Perceived Ease of Use, Security, Convenience (related to mobile payments)
11	Okazaki (2008)	Convenience, Personalization, Accessibility (related to mobile advertising)

3. Theoretical Framework
This section guides the development of a measurement scale for technology-enabled service quality (TESQ) in public bus transportation. It integrates concepts from service quality and technology adoption literature to propose a multi-dimensional model of TESQ, which is then subjected to empirical testing using confirmatory factor analysis (CFA).

3.1. A Multi-Dimensional Conceptualization of Technology-Enabled Service Quality (TESQ)
TESQ is a multi-faceted construct that encompasses both established service quality dimensions and also technology-specific attributes (Parasuraman et al., 1988; Bitner et al., 2000). This approach recognizes that while technology has changed service delivery, core elements of service quality remain highly relevant (Gronroos, 1984). The proposed dimensions of TESQ are:

- **Tangibility:** This refers to the physical aspects of the service, such as the condition of buses, cleanliness of facilities, and the comfort of seating, and also incorporates the user interface of technology platforms (Parasuraman et al., 1988; Leksono et al., 2019). This dimension ensures that the service is seen as being more than simply technology, but that all elements of the service are well-designed and maintained.
- **Reliability:** This reflects the consistency and dependability of the service (Prioni & Hensher, 2000), including the accuracy of timetables, the availability of services, and the reliability of technology platforms to deliver a dependable service.
- **Responsiveness:** This relates to the willingness of service providers to assist passengers and adapt to their needs (Parasuraman et al., 1988; Eboli & Mazzulla, 2007), and includes responding to complaints promptly, and also quickly adapting to changing situations when they arise. The responsiveness of technology platforms to provide reliable information to passengers also contributes to this dimension.
- **Assurance**: This dimension captures the feelings of safety, security, and confidence that passengers have in the service and the competence of staff (Parasuraman et al., 1988). It also covers the perceived security of online platforms, as well as the safety of the physical aspects of the service.
- **Empathy:** This refers to the caring and individualized attention that service providers give to passengers, and emphasizes the importance of human interaction even when technology is adopted for service delivery (Parasuraman et al., 1988).
- **Technology-Enabled Service:** This dimension is concerned specifically with the quality of the technology used to deliver the service, including the user-friendliness of mobile apps, the convenience of online booking, and the accuracy of real-time tracking (Bhatnagar & Teo, 2011; Collier & Sherrell, 2010). This dimension highlights the need to ensure that any technology adoption enhances the experience of the customer, rather than acting as a barrier to a smooth and efficient service.

This multi-dimensional framework posits that TESQ is not a single concept but is instead made up of different dimensions, all of which contribute to the passenger's overall perception of the quality of the service.

3.2. Application of Technology Acceptance Model (TAM)

This framework draws on the Technology Acceptance Model (TAM) (Davis, 1989) to understand how users adopt and interact with technology. TAM posits that the user's acceptance of technology is determined by two key constructs:

- **Perceived Usefulness:** The extent to which passengers believe that using technology-enabled features will enhance their experience by making the service easier, faster, and more convenient.
- **Perceived Ease of Use:** The degree to which passengers find the technology platforms to be easy to use and free from unnecessary effort.

It is proposed that a greater perception of both usefulness and ease of use will improve the overall technology-enabled service quality, and therefore these elements should be considered when designing and implementing technology solutions for public transport.

3.3. Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is used to validate the hypothesized factor structure of TESQ and also to confirm the proposed relationships of the dimensions. The CFA allows researchers to assess the psychometric properties of the instrument, and also to determine whether the data support the theoretical model. This process will use a range of fit indices and will also focus on construct reliability and validity. By using this technique, the study will be able to develop a robust and validated measurement scale for assessing technology-enabled service quality in the context of public bus transportation. The CFA technique will be used to confirm that each of the dimensions is distinct and that they combine to represent a single higher-order construct.

This theoretical framework offers a clear structure for understanding and measuring technology-enabled service quality. The framework will guide the data analysis and provide a clear basis for the interpretation of the findings. This framework emphasizes the need to consider both the traditional and technology-driven elements of service quality and also provides a theoretical basis for the development of a validated measurement instrument.

4. Methodology

This section outlines the research methodology used to develop and validate a measurement scale for technology-enabled service quality (TESQ) in public bus transportation. This study employs a sequential mixed-methods approach, using qualitative data to inform the development of the quantitative instrument, which is then validated using confirmatory factor analysis (CFA).

4.1. Research Design

This study uses a mixed-methods approach, combining qualitative and quantitative research techniques, which are used to enhance the understanding of service quality in public transport (Creswell & Creswell, 2018). This process began with exploratory focus groups and then progressed to a quantitative survey, which was then followed by confirmatory factor analysis (CFA). This design ensures that the quantitative data is both relevant and empirically robust. The goal of this study is to develop a scale that can be used to measure passengers' perceptions of technology-enabled service quality and also to validate this scale for future research.

4.2. Qualitative Data Collection

To gain a deep understanding of how passengers perceived technology-enabled service quality in public transport, exploratory focus group discussions were undertaken. Participants were selected using purposive sampling to ensure a diverse range of opinions (Creswell & Creswell, 2018). These focus groups helped to identify the dimensions that were most important for passengers and also allowed the researchers to understand their specific needs and expectations. The data gathered in the focus groups was then used to inform the design of the survey instrument and helped to ensure that the questions were contextually relevant.

4.3. Instrument Development and Pilot Study

Based on the literature review (Parasuraman et al., 1988) and the findings from the qualitative data, a survey instrument was developed. This instrument was designed to measure several constructs, including technology-enabled service quality, and also to capture passenger demographic information and suggestions for service improvements.

The survey instrument was divided into two parts:
Part A: This comprised 124 items designed to measure the various facets of technology-enabled service quality, and also to assess passenger satisfaction and loyalty. These items were measured using a 7-point Likert scale. Part B: This section collected demographic data using 14 items, and also invited respondents to offer suggestions and provide comments. Before the main data collection, a pilot study was conducted with 250 long-distance travellers across 25 strategically selected public transport depots to ensure that the survey instrument was both reliable and valid for use in the main study (Malhotra & Dash, 2010). The feedback from this pilot study was used to refine the survey instrument and to make some adjustments to improve the clarity and overall quality of responses (Nunnally, 1970).

4.4. Quantitative Data Collection

The main study collected data from 446 passengers using APSRTC bus services across the state of Andhra Pradesh. Data was collected at various bus depots across the region, using a convenience sampling method (Hair et al., 2015). This sampling method was chosen for logistical reasons, but also to ensure representation across a range of different regions and contexts. A sample size of 446 was deemed appropriate for use in confirmatory factor analysis (CFA). The responses were obtained using a self-administered questionnaire, where the researchers were present to answer any questions and to provide clarifications where necessary.

4.5. Data Analysis Techniques

The data analysis was conducted using AMOS software, and primarily utilized confirmatory factor analysis (CFA). The analysis process included:

Preliminary Data Analysis: Data was assessed to determine if it met the assumptions for CFA, including an examination of normality, linearity, and outliers (Hair et al., 2019; Aggarwal, 2017).

Confirmatory Factor Analysis (CFA): A first-order confirmatory factor analysis (CFA) model was used to assess the measurement properties of each of the six dimensions (Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Technology-Enabled Service) that were to be included in the model. A second-order

CFA model was then used to test the relationship between the six first-order factors and the higher-order construct of technology-enabled service quality. The model fit indices, factor loadings, average variance extracted (AVE), and construct reliability (CR) were evaluated (Hair et al., 2019).

Assessment of Validity and Reliability: Face validity, convergent validity, discriminant validity, and nomological validity were assessed for both the first and second-order measurement models (Churchill, 1979; Hair et al., 2019).

5. Results/Analysis

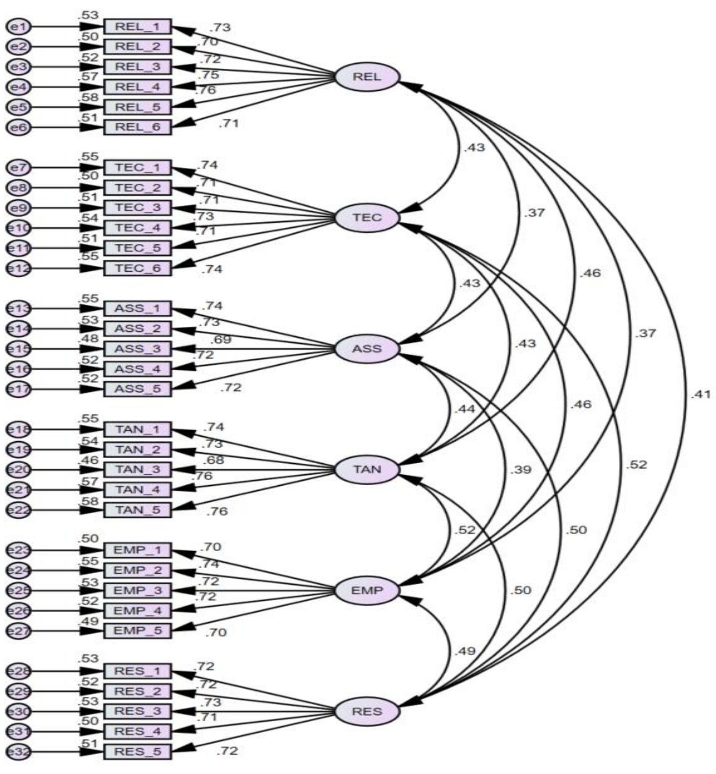
This section presents the findings of the data analysis, which include the results of the preliminary analysis, the first and second-order confirmatory factor analysis (CFA), and an analysis of the reliability and validity of the measurement model. The primary focus of the analysis is to validate the measurement scale for technology-enabled service quality (TESQ) in public bus transportation.

5.1. Preliminary Data Analysis

Before conducting the confirmatory factor analysis (CFA), preliminary data analysis was undertaken. This process included examining the data to determine whether it met the assumptions of normality and linearity, which are required for using Structural Equation Modelling (SEM). Tests of skewness and kurtosis, as well as scatter plots to examine linearity, were used to verify that the data was suitable for CFA, and also that there were no issues with outliers (Aggarwal, 2017; Hair et al., 2019). The results of these tests indicated that the data met the required assumptions, and there were no significant issues relating to outliers.

5.2. First-Order Confirmatory Factor Analysis (CFA)

The first-order CFA was performed for each of the six dimensions to assess their measurement properties, using AMOS software. The six dimensions that were tested include: Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Technology-Enabled Service. The factor loadings, average variance extracted (AVE), and construct reliability (CR) were calculated and evaluated.



Results of First-Order Confirmatory Factor Analysis (CFA)

Table Results of First order model of six-factor structure

χ^2	Df	GFI	AGFI	CFI	TLI	NFI	IFI	RMR	SRMR	RMSEA	PCLOSE
462.933	449	.940	.930	.998	.997	.929	.998	.075	.032	.008	1.000

Regression Weights: (Group number 1 - Default model)

			Estimate	C.R.	P	AVE	CR
REL_1	<---	REL	.727			.533	.872
REL_2	<---	REL	.704	13.979	0.000		
REL_3	<---	REL	.722	14.319	0.000		
REL_4	<---	REL	.752	14.912	0.000		
REL_5	<---	REL	.759	15.034	0.000		
REL_6	<---	REL	.715	14.184	0.000		
TEC_1	<---	TEC	.744			.526	.869
TEC_2	<---	TEC	.710	14.372	0.000		
TEC_3	<---	TEC	.711	14.409	0.000		
TEC_4	<---	TEC	.732	14.839	0.000		
TEC_5	<---	TEC	.713	14.441	0.000		
TEC_6	<---	TEC	.740	14.998	0.000		
ASS_1	<---	ASS	.739			.519	.844
ASS_2	<---	ASS	.728	14.209	0.000		
ASS_3	<---	ASS	.694	13.582	0.000		
ASS_4	<---	ASS	.723	14.118	0.000		
ASS_5	<---	ASS	.718	14.026	0.000		
TAN_1	<---	TAN	.741			.538	.853
TAN_2	<---	TAN	.733	14.601	0.000		

			Estimate	C.R.	P	AVE	CR
TAN_3	<---	TAN	.676	13.461	0.000		
TAN_4	<---	TAN	.756	15.049	0.000		
TAN_5	<---	TAN	.759	15.103	0.000		
EMP_1	<---	EMP	.704			.515	
EMP_2	<---	EMP	.739	13.768	0.000		
EMP_3	<---	EMP	.725	13.543	0.000		.842
EMP_4	<---	EMP	.720	13.468	0.000		
EMP_5	<---	EMP	.700	13.124	0.000		
RES_1	<---	RES	.725			.519	
RES_2	<---	RES	.719	13.891	0.000		
RES_3	<---	RES	.731	14.109	0.000		.843
RES_4	<---	RES	.708	13.678	0.000		
RES_5	<---	RES	.717	13.851	0.000		

***Note**: *Probability level of 0.001; ** The critical ratio is not available, because the regression weights are fixed at 1; AVE= Average variance Extracted; CR=Construct Reliability.*

First-order Measurement Model Results: AVE and Squared Inter-Construct Correlations (SIC) for Discriminant validity

	TAN	REL	RES	ASS	EMP	TEC	AVE
TAN	*						.538
REL	0.21	*					.533
RES	.25	0.17	*				.519
ASS	0.20	0.14	0.25	*			.519
EMP	0.27	0.13	0.24	0.15	*		.515
TEC	0.19	0.18	0.27	0.19	0.22	*	.526
AVE	.538	.533	.519	.519	.515	.526	

5.4. Reliability and Validity of the Measurement Model

The reliability of each factor was assessed using the construct reliability (CR), and all the first-order factors were found to exhibit acceptable levels of internal consistency, as the CR values were above the recommended threshold of 0.70 (Hair et al., 2019).

The model was also evaluated using measures of validity:

- **Face Validity:** Face validity was addressed during the instrument development phase using literature review and expert feedback.
- **Convergent Validity**: The CFA results show that all factor loadings were statistically significant and that the AVE values for each construct were above 0.50, indicating that each of the constructs converged on a single factor.
- **Discriminant Validity:** The variance extracted (VE) estimates for each construct were compared with the squared inter-construct correlations (SIC), and the extracted variance estimates were greater than the squared inter-construct correlations, supporting discriminant validity.
- **Nomological Validity:** Pearson product-moment correlations showed positive and statistically significant correlations between the latent variables, which indicates that the variables performed as expected based on theory.

6. Discussion

This study aimed to develop and validate a measurement scale for assessing technology-enabled service quality (TESQ) in public bus transportation, specifically within the context of APSRTC. The results from confirmatory factor analysis (CFA) have provided empirical support for a six-factor structure of TESQ and also validated the measurement model. This section discusses the findings, their theoretical and practical implications, and the contribution of this study.

6.1. Interpretation of the Findings

The confirmatory factor analysis (CFA) supported a six-factor structure for TESQ, which is comprised of the dimensions of Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Technology-Enabled Service. This framework demonstrates the complex nature of service quality and the way that both technology and traditional aspects contribute to the overall customer experience.

- **Traditional Service Quality Dimensions**: The presence of the traditional service quality dimensions such as tangibility, reliability, responsiveness, assurance, and empathy within the framework confirms that these core aspects of service delivery are still important, even in a technology-driven environment (Parasuraman et al., 1988). These dimensions capture the more fundamental elements of service and highlight that these are just as relevant as any new technology that is implemented into the service.
- **Technology as a Key Dimension**: The validation of the Technology-Enabled Service dimension highlights that technology has come to be a distinct and important dimension of service quality (Collier & Sherrell, 2010; Bhatnagar & Teo, 2011; Parasuraman et al., 2005). This emphasizes the need for public transport providers to ensure that any new technology is reliable, secure, and user-friendly, as this will contribute to the overall customer experience.

The second-order CFA model also confirms that these six dimensions can be combined to represent an overall higher-order construct, which represents the overall customer perception of the service and is an indication that the framework is robust and reliable. This finding also validates the underlying assumption that service quality is a holistic concept and that the different dimensions are all interlinked and must be considered as part of the same overall customer experience.

6.2. Implications of the Findings

The findings of this research have several implications for both public transport providers and researchers in this area.

- **A Validated Measurement Scale**: The validation of the instrument through CFA provides a robust tool that can be used for measuring technology-enabled service quality. This tool will be a valuable resource for transport providers and also for academics working in this area.
- **Technology as a Core Component of Service Delivery**: This study emphasizes that technology is not just a supporting tool, but rather a core component of the service delivery process and must be treated accordingly. When adopting new technologies, it is important to consider all aspects, including their reliability, security, and user-friendliness.

- **The balance between Traditional and Digital Service Delivery**: The study shows that public transport organizations need to maintain a balance between traditional service quality elements and the new technology-driven aspects of service. A holistic view of service delivery is needed that does not focus on one element to the detriment of the other.
- **Actionable Insights**: The study also provides specific insights into what contributes to the technology-enabled service quality. The various items that have been validated as part of this study can be used to create actionable steps for service delivery improvement.
- **Implications for Resource Allocation**: This study highlights that resources need to be allocated in a way that supports all dimensions of service quality, and this includes both technology-related and more traditional aspects of service delivery.

6.3. Theoretical Contributions

This study contributes to the existing literature in the area of technology-enabled service quality by:

- **Developing a Context-Specific Measurement Scale:** The study provides a measurement scale that has been specifically designed for the context of public bus transportation. The scale has been thoroughly validated and can be adopted in similar settings.
- **Providing Empirical Evidence:** This study offers empirical evidence for a six-factor model of TESQ, supported by CFA, which will inform future research in this area. This allows for a greater understanding of the dimensionality of technology-enabled service quality.
- **Highlights the Importance of Technology**: By identifying technology as an independent construct within service delivery, this study has highlighted the importance of this dimension. This can be used to encourage further exploration of this important aspect of modern service delivery.

6.4. Limitations

The findings of the study need to be considered in light of the following limitations:

- **Context Specificity**: Although the framework and instrument can be adopted by other organizations globally, the findings are specific to the context of APSRTC.
- **Cross-Sectional Design:** The study employed a cross-sectional design, meaning that it is not able to establish causal relationships between variables.
- **Purposive Sampling:** The use of a purposive sample for the qualitative phase, and a convenience sample for the main quantitative study, limits the generalizability of the findings to all populations.

7. Conclusion

This study focused on developing a measurement scale for technology-enabled service quality (TESQ) in public bus transportation, specifically within the context of Andhra Pradesh State Road Transport Corporation (APSRTC) bus services. By using established scale development procedures and drawing upon insights from both service quality and technology adoption literature, a multi-dimensional model of TESQ was developed and tested using confirmatory factor analysis (CFA). The findings provide a valuable contribution to the academic literature and also offer practical implications for service delivery.

The key conclusions of this research are:

- **Validated Six-Factor Model of TESQ:** The CFA supported a six-factor model of TESQ, comprising Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Technology-Enabled Service. This confirms that TESQ is a complex construct that combines both traditional service quality dimensions and technology-specific attributes (Parasuraman et al., 1988; Bitner et al., 2000). This study provides support for the conceptualization of technology as a separate factor of service quality.
- **Empirically Validated Scale**: This study has developed a scale that has been validated using rigorous statistical procedures, and this tool is now available for use by public transport organizations and also researchers in this area. This study will help to improve the measurement of service quality in the technology-driven public transport setting.
- **Practical Guidance for Transport Providers:** The findings offer actionable insights for public transport organizations to enhance their services by focusing on key dimensions that impact customer perceptions and loyalty. This includes the continued delivery of high levels of service across all aspects of the service encounter, as well as ensuring that technology is easy to use, reliable, and secure.

Recommendations for Future Research

Future research should address the limitations of this study, and also focus on:

- **Exploring the Causal Relationships:** Future research should focus on understanding the causal relationships between the identified dimensions of TESQ and also their influence on outcomes such as customer satisfaction and loyalty, which has not been investigated in this study.
- **Testing the Generalizability of the Model:** Future research should also focus on testing the generalizability of the measurement instrument in different geographical locations, and also in different transport sectors.
- **Longitudinal Studies:** Longitudinal studies can be conducted to explore how these dimensions change over time, and to track the impact of new technology adoptions.
- **Explore the influence of other variables**: Further research should explore the way that other mediating or moderating variables influence the relationship between technology-enabled service quality and customer loyalty.

In conclusion, this research has provided a validated measurement scale for technology-enabled service quality (TESQ) in public bus transportation. The findings offer a framework for understanding and measuring the complex relationship between service quality and technology in the public transport sector and provide a robust tool that can be used for future studies.

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