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# Sustainable Audience Loyalty in Digital Public Broadcasting: An Integrated Analysis Using SEM and Two Fuzzy-Set Delphi Approach in Thailand

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## Abstract

*This study examines the key factors driving sustainable audience loyalty for Public Broadcasting Services in Thailand (Thai PBS) through an innovative Two Fuzzy Set Delphi Technique and Structural Equation Model (SEM), filling a crucial research gap by offering a new perspective on audience loyalty that extends beyond the Technology Acceptance Model (TAM) in digital broadcasting. Using a mixed-methods approach, qualitative data were gathered from 21 experts through in-depth interviews using the two fuzzy set Delphi techniques, while quantitative data were collected via an online survey of 818 Thai PBS audiences. The findings demonstrate that the proposed model has a good fit with empirical data, identifying eight factors that affect sustainable audience loyalty: trust, attitude, social media use, perceived ease of use, perceived usefulness, intention to view, social media engagement, and sustainable loyalty. This study suggests that Thai PBS should focus on increasing audience engagement, building trust through reliable content, and providing user-friendly features to help maintain audience loyalty. This framework will be a roadmap for the THAI PBS to gain sustainable audience loyalty while fulfilling its public service mission.*

**Keywords:** Public Broadcasting Service, Sustainable Loyalty; Social Media Engagement, Trust, Two Fuzzy Set Delphi, Technology Acceptance Model.

## Introduction

Public broadcasting services (PBS) symbolize a developed nation and a functioning democracy, reflecting a commitment to media independence and active citizenship (Smejkal and Urbániková, 2024), as they provide equal access to education, reliable news, and cultural content. However, digital disruption and the rapid adoption of digital platforms have transformed audience behavior and expectations. PBS worldwide now faces major challenges in maintaining its audience and contending with competition from global streaming platforms such as Netflix and Disney+, Over-the-Top TV (OTT) services such as Amazon Prime and Spotify, and Social TV platforms such as Facebook and TikTok (Chen, 2024). These converging trends reshape the dynamics of media consumption and audience engagement. Therefore, a changing competitive environment requires PBS to innovate while maintaining their public service goals, particularly by protecting organizational independence and encouraging democratic values (Donders, 2019).

In Thailand, this transformation aligns with the country's 20-Year National Strategic Plan (2023-2027), which emphasizes the significant role of media in shaping national development (Office

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of the National Economic and Social Development Council, 2023-2027). Specifically, Strategy 2 focuses on enhancing human resources, whereas Strategy 3 aims to promote social equality. The plan identifies media as an important tool for building social values and strengthening cultural unity by incorporating essential elements, such as family, community, religion, and education.

Thai public broadcasting services (Thai PBS) play an important role in supporting these national goals (Thai Public Broadcasting Service Act, 2008). As Thailand's first Public Broadcasting Service, established in 2008, Thai PBS has focused on providing unbiased news and meaningful content that aligns with the country's values (Tangkitvanich, 2008). Through its commitment to fairness and political independence, Thai PBS has earned the public's trust as a reliable source of responsible media (Christofolletti, 2024).

Digital disruption has fundamentally transformed traditional media landscapes (Yeasmin, 2024). The convergence of television broadcasting with online platforms has led to the emergence of Social Television—a hybrid model that blends traditional content delivery with interactive digital engagement, according to Yoedtadi (2024), for public broadcasters like Thai PBS. Adapting to this new paradigm is essential for remaining relevant in an increasingly digital-first society (Ibrahim et al., 2024).

Research data reveals substantial modifications in how Thai citizens use the media during recent years. Kemp (2024) detailed in the Digital 2024 Thailand report that viewers use online platforms along with mobile applications to obtain television content, and this behavior includes 95.4% of all viewers. Statistics demonstrate that Thais spend more than 8 hours and 39 minutes daily online and exceed 5 hours on mobile devices each day. Social media platforms in the country have experienced rapid growth because 56.6 million Thai residents use them. The social media landscape of Thailand places Facebook at the top position because it reaches nearly 49.80 million users (Kemp, 2024). The rapid growth of digital media requires Thai PBS to develop new strategies that preserve audience devotion throughout this technological period.

Existing research addresses digital media effects on conventional broadcasting but leaves unknown how PBS on online platforms can develop lasting audience relationships specifically in Thailand according to Garganas (2024). Extended studies about technology adoption and media consumption habits (Alzubi, 2023) neglect to analyze the distinctive problems faced by public broadcasting platforms (Martin, 2021) within the digital environment evolution. The research gap requires attention because it enables Thai PBS to achieve its public service mandate and national identity promotion and democratic participation enhancement through programming content. Public broadcasting networks pursue goals that surpass audiences' entertainment needs since their core objective involves fostering an educated nation that develops critical thinking while boosting citizen engagement throughout modern media offerings. This study addresses the current knowledge gap by analyzing the elements that support long-term audience commitment to Thai PBS during the digital age alongside operational methods for similar broadcasters in Asia to deal with digital challenges.

This investigation examined the variables that shape PBS audience loyalty sustainability when viewers access content from online platforms in Thailand. The research extends existing theoretical frameworks such as TAM by Davis (1989) and TRA by Ajzen and Fishbein (1980) by developing a new SEM for sustainable loyalty in digital media through the implementation of the Two Fuzzy Set Delphi Technique (Habibi et al., 2015). Through this combination of

research methods, scholars have established successful validations in their studies of public broadcasting audience conduct during recent digital media research.

Understanding key elements that boost durable digital loyalty in Thailand will enable Thai PBS to develop better strategies to retain and acquire audiences while performing basic cultural and educational responsibilities and enabling democratic processes. Public broadcasters throughout Asia face this same systematic problem, although Thailand specifically experiences it. Organizations such as Japan's NHK, South Korea's KBS, and Taiwan's PTS are working to shift from traditional TV to digital platforms while staying true to their public service mission (Dragomir et al., 2024). While researchers have studied how Western broadcasters such as the BBC and the USA's PBS handle digital changes, Asian public media operates in very different cultural settings, under different rules, and serves audiences with different expectations—issues that deserve closer study (Sharabati et al., 2024) the results and recommendations of this study will be highly beneficial for policymakers, media executives, and academics specializing in digital transformation within public service media, particularly in developing nations grappling with comparable challenges in adapting to rapidly evolving media environments.

This study aims to provide essential knowledge about public broadcasting development across different Asian media ecosystems, which will serve as a basis for additional research on public service broadcasting's digital adaptation and audience retention strategies.

## **Literature Review and Research Hypotheses**

### **Theoretical Background**

In the following section, we establish theoretical foundations for understanding sustainable audience loyalty in Public Broadcasting Service viewing. This review examines two essential areas: the changing landscape of public broadcasting services in the digital age and the methodological approach of the two fuzzy-set Delphi techniques. Public broadcasting services worldwide face significant challenges as digital transformation reshapes viewer habits and expectations. People no longer primarily watch scheduled programming but instead use streaming and social media platforms, disrupting traditional viewing patterns. Meanwhile, the two fuzzy set Delphi techniques provide a reliable methodological framework for capturing expert consensus on complex factors influencing audience loyalty. Together, these theoretical components create a comprehensive context for exploring how Thai PBS can cultivate and maintain sustainable audience loyalty in an increasingly competitive online media environment.

### **Public Broadcasting Service**

Public broadcasting services are non-commercial broadcasting systems that provide programs and content as public services, operating independently of commercial and state influence. Its primary purpose is to deliver diverse programming programs that promote cultural enrichment, education, and citizen participation for all audiences (Chivers & Allan, 2022). Globally, successful public broadcasters, such as BBC, NHK, and ABC, have demonstrated that strong public service values combined with audience-focused strategies help maintain audience loyalty in the digital age (Karadimitriou & Papathanassopoulos, 2024).

In Thailand, public broadcasting services play a vital role in serving the public interest by providing trustworthy programs. Thai PBS, established in 2008 through the Thai Public Broadcasting Service Act, represents Thailand's first public broadcasting service, operating

under an independent structure. Research shows that Thai public broadcasting faces unique challenges in maintaining audience loyalty during digital transformation, when viewers have increasing content choices. Studies indicate that understanding audience loyalty in Thai PBS becomes crucial, as it directly impacts the service's sustainability and effectiveness in fulfilling its public service mission (Intaratat, 2023).

### **The Two Fuzzy Set Delphi Technique**

The two-fuzzy-set Delphi method represents a structured research method that integrates two fuzzy-set theories alongside the traditional Delphi technique to handle expert opinion uncertainty. The process differs from standard Delphi methods through its capability to let experts make judgments on a scale rather than restricting them to exact binary responses (Tsai et al., 2021). Professional assessment interpretation in this technique uses two individual fuzzy membership functions to ascertain consensus through a multi-dimensional evaluation of expert opinions that reflect practitioner judgment diversity (Agyemang et al., 2023). The analysis of complex viewer behaviors within public broadcasting research becomes more effective because this approach enables researchers to study behavior patterns that defy basic categorization methods. Researcher expertise becomes more effective in detecting vital yet often overlooked audience retention factors using expert-level certainty expressions (Paweehirunkrai & Pankham, 2025). The technique serves PBS sustainability loyalty research by integrating multiple audience-broadcaster components with an understanding of uncertain behavioral predictions (Arias et al., 2024). Researchers can create stronger systems for understanding digital public broadcasting audience loyalty by refining their methods.

### **Empirical Studies Related to Research Framework**

A review of empirical studies connected to our eight model constructs follows the theoretical discussion. Sustainable loyalty in public broadcasting service viewing through online platforms in Thailand operates under the influence of the constructs found in Figure 1. This assessment analyzes step-by-step how the elements of social media usage, trust, attitude, perceived ease of use, social media participation, intention to view, and perceived usefulness link to sustainable loyalty. The hypothesized relationships between constructs receive empirical evidence through multiple studies across different contexts, with data collected from Thai PBS Facebook viewers. Researchers have created a framework that combines technology acceptance principles with social media engagement theories to study public broadcasting challenges in digital platforms.

### **Social Media Use (SMU)**

Social media use represents the frequency with which people use social networking platforms to consume content while sharing or engaging with others (Payasi & Jain, 2025). Social media serves as a crucial platform for digital public broadcasting organizations to connect with their audience and share content among users. Users actively participate by searching for content, sharing information, monitoring broadcast updates, and engaging in discussions about broadcast programs (Stollfuß, 2019). Through social media, public broadcasting achieves enhanced communication capabilities, enabling broadcasters to directly interact with their audience. The technology allows audiences to provide real-time feedback, collaborate on creating broadcast content, and enables communities to engage with broadcast materials. Scientific research indicates that increased social media engagement leads to higher levels of audience involvement and commitment (Setiawan & Saefudin, 2024). In this study, social media use positively affects social media engagement because active social media users are more likely to participate in

discussions, share content, and form communities around broadcast programs, leading to stronger audience-broadcaster relationships and enhanced viewer loyalty. Therefore, our first hypothesis is as follows.

**Hypothesis 1 (H1).** *Social media use has a positive effect on social media engagement*

### ***Trust (TRU)***

Trust represents a psychological state that demonstrates people's acceptance of others, based on positive expectations of their intentions or behavior. Trust in public broadcasting refers to the audience's confidence in the reliability, credibility, and integrity of programs and services provided by public broadcasters (Sehl, 2024). In the context of public broadcasting, trust encompasses multiple dimensions: overall trust in the broadcaster, transparency of information, accuracy of content, quality of programs, and quality of program presentation (Paliszkievicz & Gołuchowski, 2025). The significance of trust in public broadcasting lies in its role as a key feature that distinguishes it from other media channels. Research indicates that higher levels of trust, particularly in content accuracy and transparency, contribute to stronger viewer connections and regular watching habits. Public broadcasters that maintain strong trust relationships through consistent quality standards attract loyal viewers and receive better feedback about their programs (Sudarmawan et al., 2024). In this study, trust positively influences sustainable loyalty because viewers who trust a public broadcaster are more likely to maintain long-term relationships and demonstrate consistent viewing patterns. Meanwhile, audiences are more likely to choose content from sources that are considered reliable and credible. Higher levels of trust in the platform or in content creators are likely to increase users' willingness to consume content. Therefore, our second hypothesis is as follows.

**Hypothesis 2 (H2).** *Trust has a positive effect on sustainable loyalty*

### ***Attitude (ATT)***

Attitude represents an individual's overall evaluation and ongoing response to a specific object or behavior, comprising both cognitive and affective components. Media consumption reflects users' favorable or unfavorable evaluations of specific media services (Johnson et al., 2022). Attitudes toward public broadcasting capture how viewers emotionally bond with and value their viewing experiences (Ramírez et al., 2021). In the public broadcasting landscape, viewer attitudes develop through several key elements: the joy of watching programs, feeling good about their viewing choices, experiencing satisfaction with the content, having a sense of pride, and feeling a personal connection to the broadcaster (Lingnau, 2012). How viewers feel about public broadcasting shapes their interactions with media content. Drawing from the Theory of Reasoned Action (TRA), attitudes are fundamental predictors of behavioral intentions. Studies show that when people develop warm feelings toward programs and find personal meaning in them, they become more dedicated viewers and active supporters (Kim & Kim, 2022). PBS creates content that connects viewers' emotions and values and attracts and maintains a stronger viewer base. According to the TRA theory, viewer attitudes guide watching decisions, where positive attitudes toward a behavior (viewing) strongly influence the intention to perform that behavior (Hoewe, & Sherrick, 2015). Therefore, our third hypothesis is as follows.

**Hypothesis 3 (H3).** *Attitude has a positive effect on intention to view*

## Perceived ease of use (PEU)

Perceived ease of use refers to how effortless someone expects a system to be when using it. It captures users' assessments of how easily they can learn and use a technology or service (Ff, 2023). In a public broadcasting environment, perceived ease of use includes several dimensions: simple viewing access, uncomplicated usage steps, easy content discovery, a straightforward learning process, and minimal effort required to watch programs (Purwanto et al., 2024). How easily viewers can access and use public broadcasting services influences viewing behavior. Referring to the Technology Acceptance Model (TAM), we see something interesting: it is not just about whether people will use something because it is easy—their perceived ease of use shapes how useful they think it is. Previous research has shown that when viewers find and watch content without frustration, they start seeing more value in what they are watching. Public Broadcasting services that provide user-friendly viewing experiences enhance both audience engagement and the perceived benefits of their content (Koponen et al., 2021). Therefore, our fourth and fifth hypotheses are as follows.

**Hypothesis 4 (H4).** *Perceived ease of use has a positive effect on intention to view*

**Hypothesis 5 (H5).** *Perceived ease of use has a positive effect on perceived usefulness*

## Social Media Engagement (SEG)

Social media engagement represents users' active participation and interaction with content and other users on social media platforms, including activities such as sharing, commenting, discussing, and participating in online communities (Salam, 2024). In the public broadcasting context, social media engagement encompasses viewers' active interaction with broadcast content through likes, shares, comments, and participation in online discussions. Research has indicated that higher levels of engagement on social platforms strengthen the relationship between audiences and content providers, potentially leading to more consistent viewing habits. When viewers actively engage with PBS content on social media, they develop stronger connections with the broadcaster and its program. Leiwakabessy et al. (2023) showed that engaged social media users are more likely to develop viewing intentions and demonstrate loyalty to media sources they interact with regularly (Sasono et al., 2024). As viewers participate in discussions, share content, and form communities around broadcast programs, they become more invested in content and broadcasters. Therefore, our sixth and seventh hypotheses are as follows.

**Hypothesis 6 (H6).** *Social media engagement has a positive effect on intention to view*

**Hypothesis 7 (H7).** *Social media engagement has a positive effect on sustainable loyalty*

## Intention to View (ITV)

Intention to view represents an individual's planned commitment to watch or consume specific media content in the future, directly indicating actual viewing behavior and reflecting the strength of their motivation to engage with content (Wang, 2023). In public broadcasting, viewing intention manifests in multiple aspects: immediate viewing plans, future watching commitments, continuous viewing dedication, upcoming content interest, and long-term watching intentions. Drawing from the Technology Acceptance Model (TAM) and Theory of Reasoned Action (TRA), the intention to view functions as a vital link between viewer attitudes and sustainable loyalty, fundamentally shaping how people engage with programs (Silalahi et al., 2024). Research has demonstrated that when viewers establish clear program-watching

plans, they develop more consistent viewing habits and regular engagement. PBS, which successfully fosters viewing intentions through engaging content, finds that viewers transform their planned behaviors into reliable watching routines (Trenz & Keith, 2024). Based on these theoretical foundations, intention to view positively affects sustainable loyalty (H8), as supported by both TAM and TRA frameworks, where planned viewing behavior translates into actual sustained watching, enabling viewers to maintain lasting connections with the broadcaster. Therefore, our eighth hypothesis is as follows.

**Hypothesis 8 (H8).** *The Intention to view has a positive effect on sustainable loyalty*

#### **Perceived Usefulness: (PUF)**

Perceived usefulness refers to the degree to which a person believes that using a particular system would enhance their performance or benefit their goals. In the media context, it reflects the extent to which users find value in the content and services provided (Galatsopoulou et al., 2022). In public broadcasting, perceived usefulness manifests through multiple aspects: time efficiency in accessing information, ease of receiving news and programs, convenient access to content, knowledge enhancement, and simplicity in following broadcast content (Rubiyanti et al., 2023). According to the Technology Acceptance Model (TAM), perceived usefulness serves as a key determinant of user acceptance and usage behavior, significantly influencing how viewers assess and engage with public broadcasting content. Research demonstrates that when audiences identify the practical value and clear benefits of programming, they develop consistent viewing patterns and stronger content engagement. PBS, which delivers content enabling viewers to save time, learn effectively, and access information, readily creates a more engaged and satisfied audience base (Rubiyanti et al., 2023). These theoretical foundations support two key hypotheses: perceived usefulness positively influences sustainable loyalty (H10), as viewers who recognize practical benefits in broader content are more likely to maintain long-term viewing relationships, and perceived usefulness positively influences intention to view (H9), as established in TAM theory, where users are more likely to adopt and use media platforms they perceive as beneficial to their needs. Therefore, our ninth and tenth hypotheses are as follows.

**Hypothesis 9 (H9).** *Perceived usefulness has a positive effect on intention to view*

**Hypothesis 10 (H10).** *Perceived usefulness has a positive effect on sustainable loyalty*

#### **Sustainable Loyalty (STL)**

Sustainable loyalty represents a deep commitment to consistently support and remain with a preferred service provider despite situational influences and marketing efforts that might cause switching behavior. It combines the behavioral and attitudinal dimensions of long-term consumer relationships (Bhat et al., 2024). Sustainable loyalty in PBS shows how deeply viewers commit to and stay connected to their chosen channel. Public broadcasting loyalty develops when audience members promote the channel to their acquaintances, distribute positive program feedback, and choose public broadcasting as their primary news source while supporting its social visibility. Sustainable loyalty is established by delivering integrated viewing experiences to viewers. Research indicates that viewers form lasting bonds with broadcasters after developing trust, actively engaging with content, and finding programs valuable (Gajardo & Meijer, 2023). PBS effectively maintains its viewership through its service loyalty program, creating dedicated watchers and channel advocates who support community growth (Donders, 2019). A research model demonstrates that loyalty sustainability occurs through three distinct paths: social media engagement (H7), intention to view (H8), and perceived usefulness (H10).



The research framework illustrates how different aspects of the viewer experience contribute to building strong bonds of dependability between public broadcasts and their audiences.

The research model was developed to validate sustainable loyalty pathways (Figure 1) based on the proposed hypotheses mentioned above.

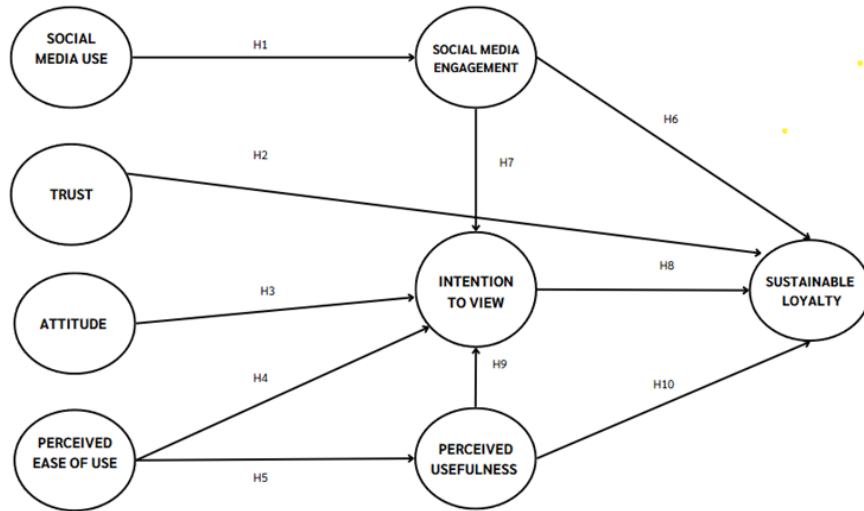


Figure 1. Conceptual Model

## Research Method

This study employs a mixed methodology including qualitative and quantitative (QUAL → QUAN) to construct and validate a comprehensive Structural Equation Model (SEM). The methodological framework, designed to understand the determinants of sustainable audience loyalty in Thailand through the digital public broadcasting ecosystem, followed a distinctive two-phase sequential design. This innovative approach enhances methodological depth in digital broadcasting research by combining expert insights with audience behavioural data and examining the multifaceted relationships between content, technology, and audience engagement in digital broadcasting, a groundbreaking framework in public service media studies. This study was approved by the Ethics Review Board of Rangsit University (COA.NO.RSUERB2024-081). In Phase I (Qualitative), we employ the two fuzzy set Delphi techniques with an expert panel of 21 participants equally divided among academics, government officials, and broadcasting executives. The first fuzzy set evaluates construct appropriateness, whereas the second assesses implementation feasibility, a dual validation approach that strengthens the theoretical foundation. Data collection involved in-depth interviews and online questionnaires using a 7-point Likert scale. This process manages uncertainty in expert judgments and identifies consensus, producing expert agreement on key constructs and an initial model framework. In Phase II (quantitative), we validated this framework through structural equation modelling (SEM) with a sample of 818 respondents from the Thai PBS Audience Council obtained through convenience sampling via online questionnaires. The statistical approach begins with descriptive statistics, Confirmatory Factor Analysis (CFA) and structural equation Modelling (SEM). Model fit was evaluated using multiple indices including CMIN/DF, GFI, AGFI, RMSEA, SRMR, CFI, and TLI. This



methodological design combines qualitative depth with quantitative validation, allowing expert knowledge to inform empirical testing, while accounting for uncertainty in the digital broadcasting context, as illustrated in Figure 2.

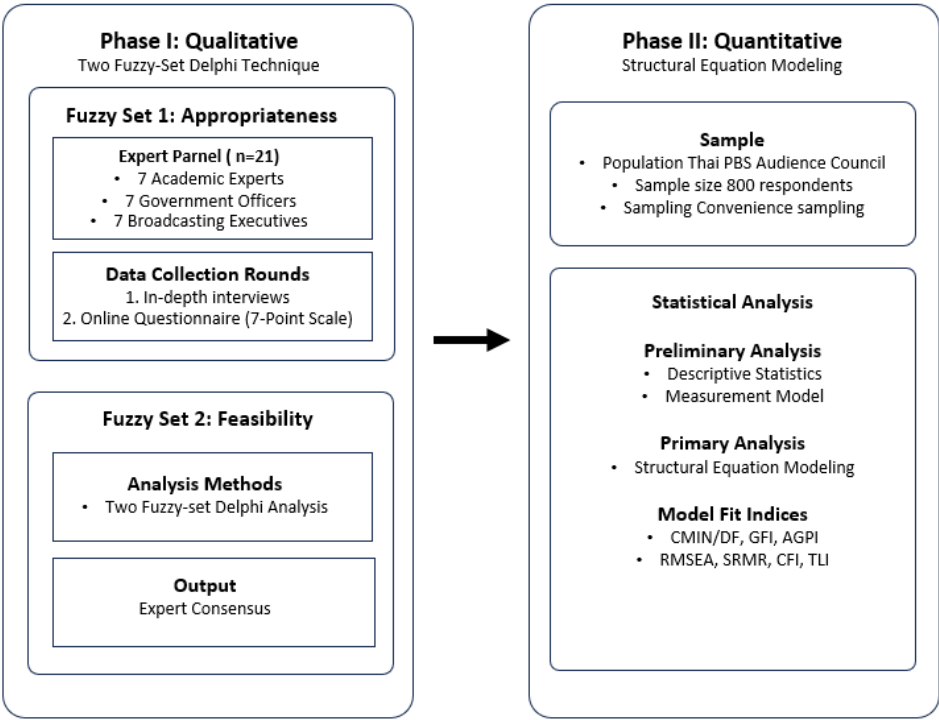


Figure 2. Mixed Method Research Design

Qualitative Research

The qualitative phase of this study employs the two fuzzy set Delphi techniques (Saelee & Pankham (2024) and establishes a solid conceptual framework. This approach systematically gathers expert knowledge to manage uncertainties in human judgment processes. The first fuzzy set focused on appropriateness assessment through an expert panel of 21 participants balanced across three stakeholder groups: academic experts providing theoretical foundations, government officials offering policy perspectives, and broadcasting executives contributing industry insights. Data collection followed a consecutive three-round process beginning with in-depth interviews for contextual understanding, followed by structured online questionnaires using 7-point Likert scales for systematic quantification and consensus validation (Lipovetsky & Conklin, 2018). The second Fuzzy Set evaluates feasibility through two fuzzy set Delphi analyses, which accommodates uncertainty in expert judgments to identify consensus and divergence. This methodological process produces an expert consensus on key constructs and an initial model framework, forming the foundation for later quantitative testing.

Population and Sampling

Purposive sampling was employed to select an expert panel for the qualitative phase. Following Macmillan's theoretical framework, which suggests that 17-20 participants provide optimal saturation in expert panel studies and avoid an error rate of less than 0.02, 21 experts were

selected for comprehensive coverage. The selection process ensured equal representation by academic institutions, government regulatory bodies, and broadcasting organizations (n=7 from each category) to capture complementary perspectives.

### Research Tool and Data Collection

This study employs an innovative comprehensive three-round methodological framework using Two Fuzzy Set Delphi techniques to systematically develop a validated conceptual model and transform qualitative insights into measurable constructs. Round 1 began with in-depth interviews with 21 experts (seven from each stakeholder group), generating qualitative data that underwent thematic analysis. In Round 2, these qualitative insights are transformed into a 7-point Likert-scale questionnaire for appropriateness assessment, with initial Fuzzy Set calculations identifying preliminary consensus patterns. Round 3 refines this approach by implementing a revised questionnaire with histogram visualizations and feasibility assessments and applying second Fuzzy Set calculations to precisely determine consensus thresholds. This progressive methodology effectively bridges qualitative expert knowledge and measurable elements, resulting in a validated conceptual structure that serves as the foundation for subsequent qualitative questionnaire development. This represents a sophisticated approach that maintains complex expert perspectives while establishing measurable research parameters, as illustrated in Figure 3.

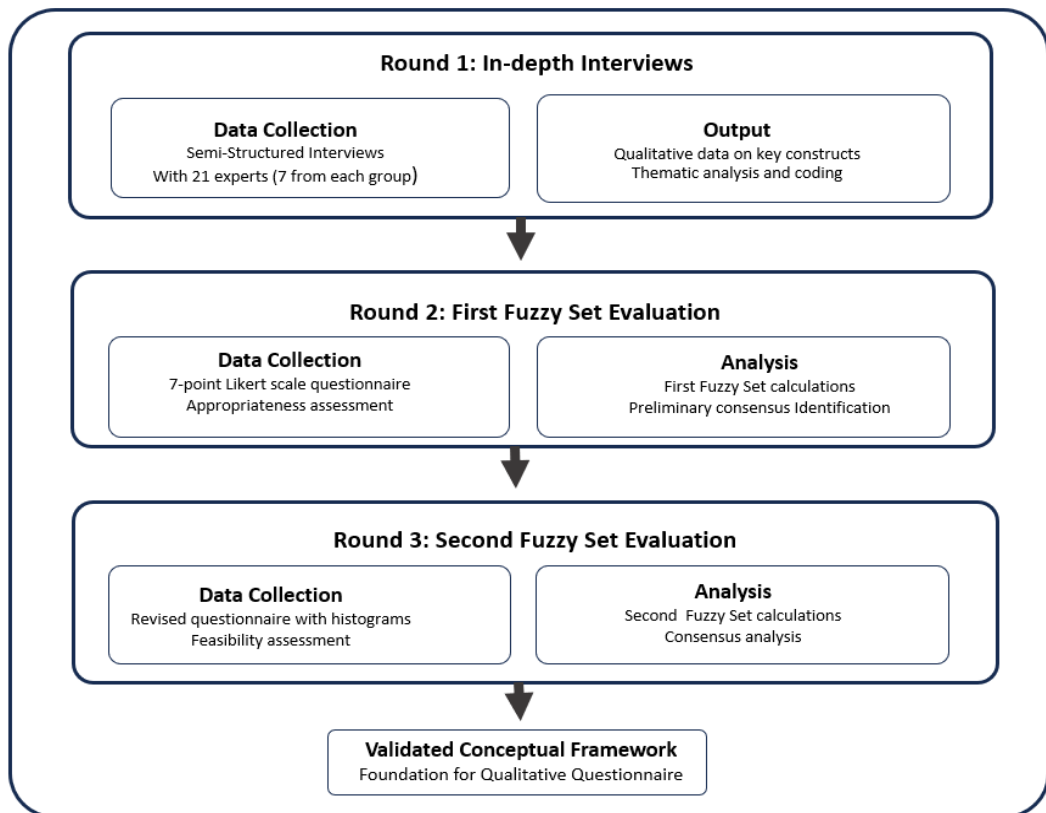


Figure 3. Three-Round Research Conceptual Framework

## Data Analysis

The researchers implemented two fuzzy Delphi methods to generate consensus regarding proposed indicators from 21 expert participants through their evaluation on a 7-point Likert scale in two separate data collection rounds. The experts converted their answers to triangular fuzzy numbers for analysis, and a consensus evaluation was reached when the threshold was  $> 0.8$  based on crisp values. Experts assessed indicators in each round by comparing them to the established threshold value, accepting indicators above a crisp value of 0.8 and rejecting those below it. A multi-step evaluation method allowed experts to test and verify their opinions twice, enabling researchers to accept indicators with values higher than 0.8. The systematic approach required experts to compare results from round to round, leading to the final acceptance of indicators that met the defined threshold criteria.

The secondary phase utilizes fuzzy logic, which enhances the traditional Delphi method by incorporating two fuzzy set theories to address uncertainty in expert judgments. This approach uses triangular membership functions, as illustrated and calculated in Figure 4.

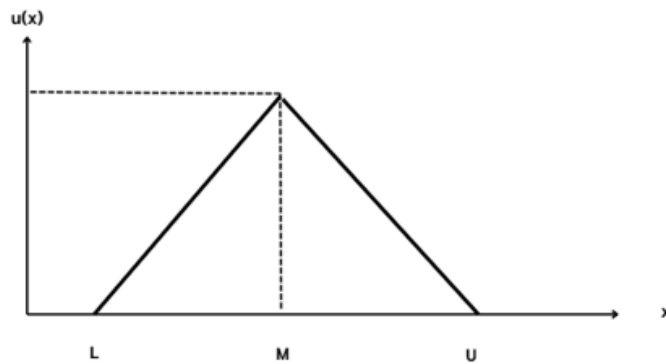


Figure 4. Triangular Fuzzy Number Membership Function (Source Author)

$$F = (L, M, U)$$

L (Lower Bound): The smallest numerical value of a member in the fuzzy set.

M (Middle Value): The most representative or typical value of the fuzzy set.

often considered the peak of the membership function.

U (Upper Bound): The largest numerical value of a member in the fuzzy set.

Triangular fuzzy numbers are highly computationally efficient Mashadi et al. (2023), states that due to their uncomplicated mathematical structure. The operations between fuzzy numbers  $F_1$  and  $F_2$  can be executed through basic formulas, significantly simplifying the calculation process as formula below

$F_1$  is the consensus from experts obtained in the second round.

$F_2$  is the consensus from experts obtained in the third round.

$$F_1 = (l_1, m_1, u_1)$$

$$F_2 = (l_2, m_2, u_2)$$

$$F_1 \oplus F_2 = (l_1 \oplus l_2, m_1 \oplus m_2, u_1 \oplus u_2)$$

This process converted the rough set binary outputs from the 7-point Likert scale shown in the figure into Triangular Fuzzy Numbers (TFN). The conversion used the parameters listed in Fig. 5 and Table 1. shows the breakdown of how each point on the 7-point Likert scale corresponds to its respective triangular fuzzy number.

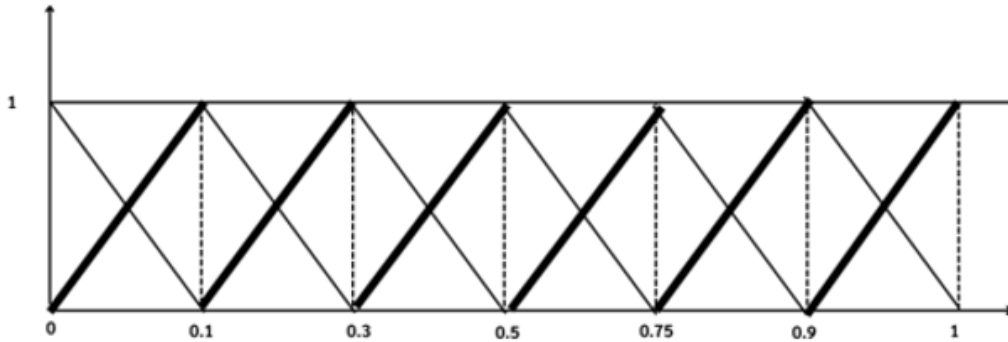


Figure 5. Selection of Factors in Fuzzy Theory (Source: Author)

Very Important	Important	Above Moderate	Moderate	Below Moderate	Low Importance	Very Low Importance
- VI	- I	- AM	- M	- BM	- LI	- VLI
(0.9,1.0, 1.0)	(0.7,0.85,1.0)	(0.5,0.7, 0.9)	(0.3,0.5,0.7)	(0.1,0.3, 0.5)	(0, 0.15,0.3)	(0, 0, 0.1)

Table 1. Triangular fuzzy numbers of 7-point Likert scale

Using Table 1's triangular fuzzy numbers for the 7-point Likert scale, calculate the averages of L, M, and U from both rounds. Given the expert feedback results from Round 1 and Round 2, calculate the averages of L, M, and U as follows:

$$L_{avg} = \frac{L_{round1} + L_{round2}}{2}$$

$$M_{avg} = \frac{M_{round1} + M_{round2}}{2}$$

$$U_{avg} = \frac{U_{round1} + U_{round2}}{2}$$

Then the researchers calculate the crisp value using the formula

$$Crisp = \frac{L_{avg} + M_{avg} + U_{avg}}{3}$$

This formula yields a single crisp value that represents the consensus among experts based on the fuzzy set parameters. The results are presented in Table 3, where a threshold of 0.80 is used as the criterion for acceptance; any value below this threshold is considered unacceptable and thus rejected.

## **Quantitative Research**

This study developed a comprehensive research design to investigate sustainable audience loyalty in Thailand's digital public broadcasting sector. The researchers selected a large sample of 818 users from Thai PBS Facebook pages using strategic convenience sampling from the Audience Council of Thai PBS. The instrument comprised eight valid constructs assessed through 24 variables on a 7-point Likert rating scale. The research analysis involved descriptive statistics and correlation analysis to assess construct relationships, followed by Confirmatory Factor Analysis (CFA) for model verification and structural relationship evaluation. The two-step analysis enhanced construct validity across all measurements before hypothesis testing, improving the statistical power and reliability of the study. The analysis yielded a statistically significant empirical validation for the integrated theoretical model of sustainable audience loyalty in digital public broadcasting, providing substantive contributions to contemporary discourse on digital media sustainability. These findings offer valuable theoretical extensions and practical applications for researchers and media practitioners navigating Thailand's rapidly transforming media landscape, thus addressing a critical research gap in non-Western digital public broadcasting contexts.

## **Population and Sampling**

This study employed a convenience sampling approach to investigate sustainable audience loyalty among Thai PBS Facebook page users. We distributed online questionnaires to a population of approximately 5,000 members of the Thai PBS audience council and received 818 responses. The sample achieved balanced gender representation (female:  $n = 416$ , 50.9%; male:  $n = 402$ , 49.1%) across the six geographical regions of Thailand. The Northern (30.4%) and central (30.3%) regions represent the largest segments, followed by the northeastern (12.6%), eastern (9.8%), western (9.8%), and southern (7.1%) regions, providing comprehensive national coverage.

The age distribution centered primarily on the 38-47 years (34.6%) and 28-37 years (28.9%) brackets, with additional representation from respondents aged 48-57 years (19.2%), 58 years and above (9.7%), and 18-27 years (7.6%), reflecting the demographic diversity of Thai PBS's digital audience.

Educational attainment data revealed that a substantial majority (78.6%) of participants held bachelor's degrees, 13.8% held master's degrees, 2.2% held doctoral degrees, and 5.4% reported education below bachelor's level. Occupationally, the sample comprised employees (39.2%), government officers (28.4%), business owners (17.5%), self-employed individuals (14.6%), and students (0.3%), providing diverse representations of professional backgrounds within the Thai context.

Content preference analysis indicated strong engagement with news programming (67.4%), followed by drama series (14.2%), documentaries (9.2%), and a variety of programs (9.2%). Regarding viewing frequency, most participants (64.8%) accessed platform content 1-3 times weekly, with 24.9% viewing 4-6 times per week, 9.6% viewing daily, and only 0.7% accessed content less than once a month, demonstrating consistent audience engagement.

The sample size of 818 substantially exceeded the minimum threshold recommended for structural equation modeling. According to Wagner and Grimm (2023), a sample size of at least 200 is considered adequate for most SEM applications, with a preferred ratio of ten respondents per observed variable. With 24 observed variables in our model, a sample size of 818 yielded a

ratio of approximately 33:1, well above the recommended threshold, ensuring sufficient statistical power for hypothesis testing and model validation. This approach aligns with best practices for sample adequacy in media research involving complex structural models (Jiang et al., 2024). The respondents' demographic profiles are summarized in Table 2.

Demographics	Details	No. Respondents	Percentage
Gender	Female	416	50.9
	Male	402	49.1
Age	18-27 years	62	7.6
	28-37 years	236	28.9
	38-47 years	283	34.6
	48-57 years	157	19.2
	58 years and above	80	9.7
Education	Below Bachelor's	44	5.4
	Bachelor's Degree	643	78.6
	Master's Degree	113	13.8
	Doctoral Degree	18	2.2
Occupation	Employee	312	39.2
	Government officer	231	28.4
	Business Owner	143	17.5
	Self-employed	120	14.6
	Student	12	0.3
Residence	Northern Region	249	30.4
	Central Region	248	30.3
	Eastern Region	80	9.8
	Northeastern Region	103	12.6
	Western Region	80	9.8
	Southern Region	58	7.1
Program Type	News Programs	546	67.4
	Drama Series	118	14.2
	Documentary	77	9.2
	Variety Program	77	9.2
Viewing Frequency	Less than once a month	9	0.7
	1-3 times per week	525	64.8
	4-6 times per week	204	24.9
	Daily viewing	80	9.6

Table 2. Descriptive Statistic of Demographic

## Research Tool

The research instrument involved an online questionnaire based on expert consensus findings from the qualitative phase, which included 8 tested constructs measured through 24 variables. The measurement instrument relies on eight established factors: trust (TRU), attitude (ATT), perceived usefulness (PUF), perceived ease of use (PEU), intention to view (ITV), social media engagement (SEG), social media use (SMU), and sustainable loyalty (STL). The validity of the measurements increased using three items for each construct. All measurement items were

assessed using a 7-point Likert scale, with "Strongly Disagree" as option 1 and "Strongly Agree" as option 7. A sample of 200 participants conducted pilot testing for the instrument to check its clarity, length, and internal consistency, which led to some minor wording changes. The reliability of the main study instrument was supported by pilot study Cronbach's alpha scores greater than 0.80, as recommended by Sarstedt (2019).

### Data Collection

The quantitative phase data collection proceeded with a methodology that aimed to gather reliable and complete participant responses. Thai PBS audience council members participated in the structured online questionnaire through a secure Thai PBS survey platform during November 2023 and January 2024. All participants accessed survey links through Line to see an introduction that described research objectives, privacy assurances, and an estimated duration of 10 minutes to complete the questions. The survey mentioned how researchers would use data, along with privacy measures and permissions, to choose survey completion. Data security on the online platform is established through encryption methods combined with access authorization protocols. This approach yielded 818 responses, as shown in Figure 6.

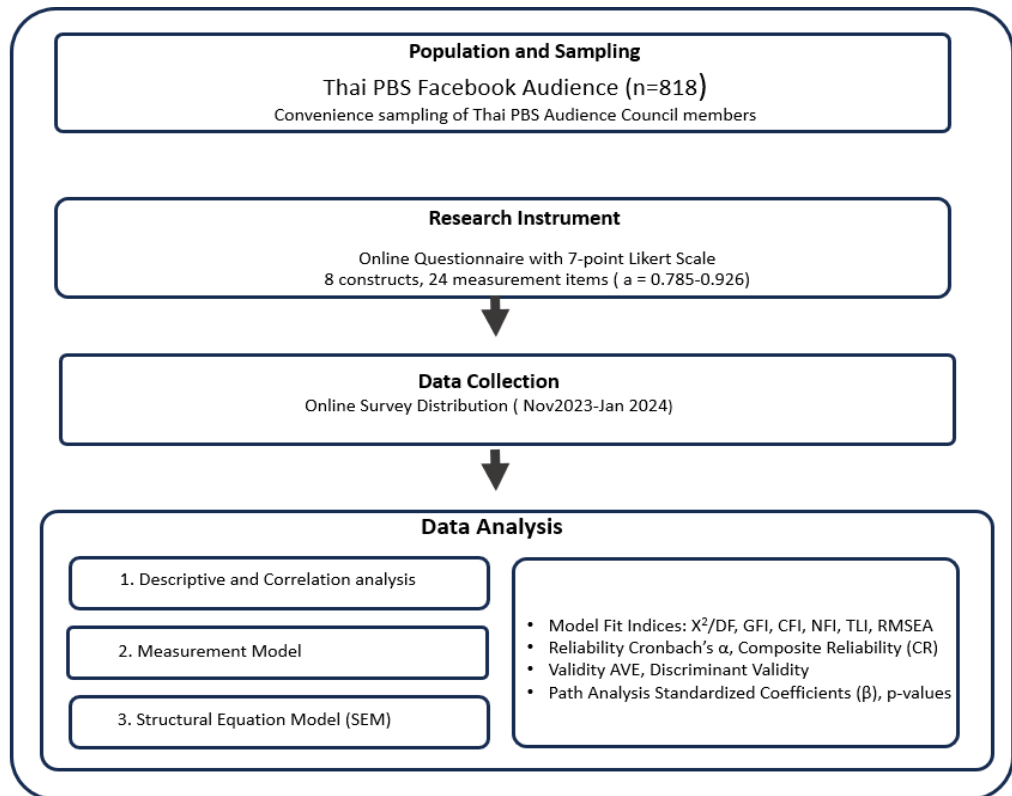


Figure 6. Qualitative Research Conceptual Framework

### Data Analysis

Data analysis procedures in this study included multiple analytical methods for complete validation of our proposed model design. The research began with constructing correlations to



determine important relationships before measuring reliability through Cronbach's alpha assessment, which met or exceeded the 0.80 threshold identified by Chuang & Chen (2023). Our study evaluated the measurement model's goodness of fit through CFA by running multiple indices per Byrne and Kline's recommendations, which included the  $\chi^2$  ratio ( $\text{CMIN}/\text{df} \leq 3.0$ ), RMSEA ( $\leq .08$ ), CFI ( $\geq .90$ ), TLI ( $\geq .90$ ), and SRMR ( $\leq .08$ ). Construct validity was achieved through composite reliability ( $\text{CR} > .70$ ) and average variance extracted ( $\text{AVE} > .50$ ), while discriminant validity was demonstrated when the square root of AVE values exceeded inter-construct correlations. Researchers applied SEM with maximum likelihood estimation to examine our conceptual framework by validating the hypothesized relationships after completing the measurement model assessment. The structural model was evaluated using equivalent fit indices from the measurement model assessment, while path coefficients ( $\beta$ ) with p-values identified the significant relationships. A multigroup analysis enabled investigators to review potential demographic factors that may moderate the studied interactions between variables. The research focused on age group comparisons and viewer patterns. The analytics used in this paper follow contemporary research approaches for studying media audiences while assessing all proposed direct and indirect relationships within the theoretical construct.

## Results

The research design used a sequential mixed-methods approach to construct a comprehensive evaluation of sustainable audience loyalty practices among Thai PBS Facebook page subscribers. The research initiated its qualitative stage by employing two fuzzy set Delphi analyses to systematize expert information for validating the content validity of the measurement tools. The two fuzzy set Delphi methods transformed expert opinions into numerical data to address the unpredictability of human assessments. Experts confirmed the research findings, leading to a quantitative stage that involved 818 respondents for confirmatory factor analysis (CFA) to assess the reliability and validity of the measurement model. The relationships between TRU, ATT, PUF, PEU, ITV, SEG, SMU, and STL were tested using SEM. By integrating these research methods, researchers gained valuable insights into digital public broadcasting audience loyalty patterns that could not be obtained through independent methods. The research findings began with expert validation results before delving into a detailed examination of measurement and structural models derived from quantitative analysis. The results are as follows.

### Qualitative Result

The consensus analysis of this research confirms all indicators across eight dimensions: trust (TRU), attitude (ATT), Perceived Usefulness (PUF), Perceived Ease of Use (PEU), Intention to View (ITV), Social Media Engagement (SEG), Social Media Use (SMU), and Sustainable Loyalty (STL). In the two fuzzy set Delphi methods, expert opinions are captured as triangular fuzzy numbers with lower (L), middle (M), and upper (U) values, acknowledging the inherent ambiguity in human judgment. The final 'Crisp' column transforms these ranges into single values between 0 and 1 using the defuzzification formula, with higher values indicating stronger expert agreement. All indicators exceeded the acceptance threshold of 0.80, with consensus scores ranging from 0.84–0.94. Trust-related items (TRU1-TRU3) received the highest scores (0.93–0.94), suggesting that experts particularly valued these elements in understanding audience loyalty. Even the lowest-scoring item (SEG3 = 0.84) received substantial expert endorsements. These consistent results across both evaluation rounds validate not only our measurement approach, but also confirm strong expert agreement on the quality and

effectiveness of the Thai PBS Facebook platform, providing a solid foundation for our subsequent quantitative analysis with 818 respondents, as illustrated in Figure 3.

Item	Round 1 (F1)			Round 2 (F2)			Average (F3 = F1 $\oplus$ F2)			Threshold	Result
	L	M	U	L	M	U	L	M	U	0.80 Crisp	
TRU1	0.83	0.95	0.98	0.85	0.96	0.99	0.84	0.96	0.99	0.93	Acceptable
TRU2	0.84	0.95	0.98	0.86	0.97	0.99	0.85	0.96	0.99	0.93	Acceptable
TRU3	0.85	0.97	1.00	0.86	0.97	1.00	0.86	0.97	1.00	0.94	Acceptable
ATT1	0.80	0.93	0.98	0.83	0.95	0.99	0.81	0.94	0.98	0.91	Acceptable
ATT2	0.81	0.95	0.99	0.83	0.96	0.99	0.82	0.95	0.99	0.92	Acceptable
ATT3	0.81	0.94	0.99	0.81	0.95	0.99	0.81	0.94	0.99	0.91	Acceptable
PUF1	0.80	0.92	0.95	0.81	0.92	0.95	0.81	0.92	0.95	0.89	Acceptable
PUF2	0.77	0.89	0.94	0.79	0.90	0.95	0.78	0.90	0.94	0.88	Acceptable
PUF3	0.78	0.89	0.93	0.80	0.90	0.93	0.79	0.90	0.93	0.87	Acceptable
PEU1	0.79	0.90	0.95	0.80	0.91	0.95	0.80	0.91	0.95	0.88	Acceptable
PEU2	0.80	0.91	0.95	0.81	0.91	0.95	0.80	0.91	0.95	0.89	Acceptable
PEU3	0.81	0.91	0.95	0.81	0.92	0.95	0.81	0.92	0.95	0.89	Acceptable
ITV1	0.79	0.90	0.95	0.81	0.93	0.97	0.80	0.92	0.96	0.89	Acceptable
ITV2	0.80	0.92	0.96	0.83	0.95	0.98	0.82	0.94	0.97	0.91	Acceptable
ITV3	0.81	0.93	0.97	0.83	0.94	0.98	0.82	0.94	0.97	0.91	Acceptable
SEG1	0.76	0.89	0.96	0.79	0.92	0.97	0.77	0.90	0.97	0.88	Acceptable
SEG2	0.73	0.87	0.94	0.76	0.89	0.95	0.75	0.88	0.95	0.86	Acceptable
SEG3	0.72	0.84	0.91	0.76	0.89	0.94	0.74	0.86	0.93	0.84	Acceptable
SMU1	0.78	0.90	0.96	0.81	0.93	0.98	0.79	0.92	0.97	0.89	Acceptable
SMU2	0.76	0.89	0.94	0.79	0.91	0.95	0.77	0.90	0.95	0.87	Acceptable
SMU3	0.78	0.91	0.96	0.80	0.92	0.96	0.79	0.91	0.96	0.89	Acceptable
STL1	0.80	0.93	0.97	0.82	0.94	0.98	0.81	0.93	0.97	0.91	Acceptable
STL2	0.79	0.92	0.96	0.81	0.93	0.96	0.80	0.92	0.96	0.90	Acceptable
STL3	0.77	0.90	0.96	0.80	0.92	0.98	0.79	0.91	0.97	0.89	Acceptable

Table 3. Expert Consensus Result by Using Two Fuzzy-Set Delphi Techniques

### Quantitative Result

The quantitative analysis of Sustainable Audience Loyalty revealed valuable insights through statistical testing methods. We used both confirmatory factor analysis and structural equation modeling to verify our measurement tools and test the relationships between key factors. Our model showed a good fit with the data, with favorable technical indicators across the board ( $\chi^2 = 671.41$ ,  $df = 228$ ; GFI = 0.94; CFI = 0.97; RMSEA = 0.05). The results confirmed meaningful links among trust, attitudes, usefulness, ease of use, viewing intentions, social engagement, and long-term loyalty. All ten relationships in our theoretical model proved to be statistically significant. We found particularly strong connections between social media use and engagement ( $\beta = 0.95$ ), and between engagement and intention to view content ( $\beta = 0.65$ ).

These findings support our proposed framework for understanding loyalty in digital public broadcasting, and highlight the critical role of social engagement in building sustainable audience relationships on social media platforms.

The correlation analysis presented in Table 4 reveals moderate-to-strong positive relationships among all constructs. PEU exhibited the highest mean value (6.531, SD = 0.634), whereas ITV exhibited the lowest (5.839, SD = 0.744). The correlation coefficients ranged from 0.443 (between ATT and PUF) to 0.701 (between ITV and SCG), indicating substantial interconnection between the variables. Notably, SMU demonstrated consistently robust correlations with other constructs, particularly with TRU (0.617) and ITV (0.675), suggesting its central role in the model. The relationship between ITV and SCG (0.701) represented the strongest correlation in the matrix, indicating a particularly significant ( $p < 0.001$ ) association between these constructs. All correlations are statistically significant and positive, confirming that the constructs in the structural model are meaningfully related, while remaining sufficiently distinct to represent separate concepts, thus supporting the discriminant validity of the measurement model.

Constru ct	Mean	SD	Correlation							
			1	2	3	4	5	6	7	8
TRU	5.965	0.44								
ATT	6.057	0.63	.564*							
PUF	6.164	0.61	.512*	.443*						
PEU	6.531	0.63	.541*	.487*	.530*					
ITV	5.839	0.74	.538*	.554*	.546*	.575*				
SCG	5.706	0.81	.494*	.528*	.508*	.527*	.701*			
SMU	5.772	0.75	.617*	.582*	.540*	.537*	.675*	.660*		
STL	6.011	0.71	.595*	.551*	.583*	.583*	.690*	.677*	.721*	

Table 4. Correlation Result

The Measurement model of this study demonstrated strong construct validity across all dimensions. The Trust construct (mean =5.965, SD=0.446) showed good reliability (CR=0.853, Cronbach's  $\alpha$ =0.852) with AVE=0.659, while its indicators exhibited strong outer loadings (TRU1=0.81, TRU2=0.78, TRU3=0.84). The Attitude construct (Mean=6.057, SD=0.632) performed exceptionally (CR=0.931,  $\alpha$ =0.926, AVE=0.818) with robust indicator loadings (ATT1=0.85, ATT2=0.97, ATT3=0.89). Perceived Usefulness (Mean=6.164, SD=0.616) demonstrated excellent metrics (CR=0.918,  $\alpha$ =0.911, AVE=0.788) and strong loadings (PUF1=0.89, PUF2=0.82, PUF3=0.94). The perceived Ease of Use (mean =6.531, SD=0.634)

showed solid results ( $CR=0.871$ ,  $\alpha=0.867$ ,  $AVE=0.694$ ) with good loadings ( $PEU1=0.85$ ,  $PEU2=0.90$ ,  $PEU3=0.74$ ). The intention to view (mean =5.839,  $SD=0.744$ ) demonstrated acceptable metrics ( $CR=0.806$ ,  $\alpha=0.803$ ,  $AVE=0.581$ ) with adequate loadings ( $ITV1=0.79$ ,  $ITV2=0.77$ ,  $ITV3=0.72$ ). Social Engagement (mean =5.706,  $SD=0.811$ ) showed acceptable values ( $CR=0.796$ ,  $\alpha=0.795$ ,  $AVE=0.566$ ), with satisfactory loadings ( $SEG1=0.77$ ,  $SEG2=0.83$ ,  $SEG3=0.79$ ). Social Media Use (mean =5.772,  $SD=0.759$ ) maintained adequate metrics ( $CR=0.786$ ,  $\alpha=0.785$ ,  $AVE=0.551$ ) with varying loadings ( $SMU1=0.89$ ,  $SMU2=0.83$ , and  $SMU3=0.67$ ). Finally, Sustainable Loyalty (mean =6.011,  $SD=0.713$ ) exhibited good results ( $CR=0.844$ ,  $\alpha=0.833$ ,  $AVE=0.646$ ), with mixed loadings ( $STL1=0.89$ ,  $STL2=0.83$ ,  $STL3=0.67$ ). All constructs demonstrated perfect model fit indices ( $GFI=1.0$  across all dimensions), with RMSEA values ranging from 0.958 to 0.995,  $p$ -values=0, and CMIN/df values from 0 to 0.095, confirming the statistical soundness of the measurement model for evaluating user perceptions of the Thai PBS Facebook page, as illustrated in Table 6.

Items	Cronbach's alpha	CR	AVE	Construct Validity			
				CMIN/df	RMSEA	p	GFI
Trust (TRU)	0.852	0.853	0.659	.000	.000	.989	1.000
(TRU1) You trust Thai PBS FB page.					Outer Loading = 0.81		
(TRU2) You trust the transparency of Thai PBS.					Outer Loading = 0.78		
(TRU3) You trust the honesty of Thai PBS.					Outer Loading = 0.84		
Attitude (ATT)	0.926	0.931	0.818	.003	.000	.958	1.000
(ATT1) You enjoy using Thai PBS FB page to watch news or programs.					Outer Loading = 0.85		
(ATT2) You like using Thai PBS FB page to watch news or programs.					Outer Loading = 0.97		
(ATT3) You feel proud to use Thai PBS FB page to watch news or programs.					Outer Loading = 0.89		
Perceived Usefulness (PUF)	0.911	0.918	0.788	.003	.000	.958	1.000
(PUF1) You think Thai PBS FB page helps you save time in consuming news.					Outer Loading = 0.89		
(PUF2) You think Thai PBS FB page helps you receive news quickly.					Outer Loading = 0.82		
(PUF3) You think Thai PBS FB page helps you receive news anywhere, anytime					Outer Loading = 0.94		
Perceived Ease of Use (PEU)	0.867	0.871	0.694	.095	.000	.977	1.000
(PEU1) You think Thai PBS FB page 's features are easy to use.					Outer Loading = 0.85		
(PEU2) You think Thai PBS FB page has simple step to use					Outer Loading = 0.90		
(PEU3) You think using Thai PBS FB page doesn't require much effort.					Outer Loading = 0.74		
Intention to View (ITV)	0.803	0.806	0.581	.000	.000	.994	1.000
(ITV1) You intend to use Thai PBS FB page to watch various programs.					Outer Loading = 0.79		
(ITV2) You intend to use Thai PBS FB page to watch various programs continuously.					Outer Loading = 0.77		
(ITV3) You definitely intend to use Thai PBS FB page to watch various.					Outer Loading = 0.72		
Social Engagement (SEG)	0.795	0.796	0.566	.000	.000	.995	1.000
(SCG1) You always watch news or various Programs on Thai PBS FB page.					Outer Loading = 0.77		
(SCG2) You always like watching news or various programs on Thai PBS FB page.					Outer Loading = 0.83		
(SCG3) You always share news or various programs from Thai PBS FB page.					Outer Loading = 0.79		
Social Media Use (SMU)	0.785	0.786	0.551	.000	.000	.992	1.000
(SMU1) You always use Thai PBS FB page to search for news					Outer Loading = 0.89		
(SMU2) You use Thai PBS FB page to increase your knowledge					Outer Loading = 0.83		
(SMU3) You use Thai PBS FB page as a source of entertainment					Outer Loading = 0.67		
Sustainable Loyalty (STL)	0.833	0.844	0.646	.000	.000	.990	1.000
(STL1) You are willing to recommend Thai PBS FB page to other					Outer Loading = 0.89		
(STL2) You always share good experiences with other about Thai PBS FB page					Outer Loading = 0.83		
(STL3) You will return to watch Thai PBS FB page					Outer Loading = 0.67		

Table 6. Measurement Index Result

Note: CR = Composite Reliability; AVE = Average Variance Extracted; CMIN/df = Chi-square/degrees of freedom;

RMSEA = Root Mean Square Error of Approximation; p = p-value; GFI = Goodness of Fit Index

The Structural Equation Model (SEM) presented in Figure 7 demonstrates a complex in-Ter relationship among multiple constructs with satisfactory model fit indices ( $\chi^2 = 671.410$ ,  $df = 228$ ; GFI = 0.936; CFI = 0.968; NFI = 0.952; TLI = 0.961; RMSEA = 0.049; RMR = 0.023). The path coefficients reveal several significant relationships: Social media use (SMU) strongly influences social engagement (SCG) with a substantial path coefficient of 0.89. Trust (TRU) demonstrated moderate relationships with both social (0.73) and attitude (0.73), while Perceived Ease of Use (PEU) showed significant paths to ITV (0.70) and PUF (0.68). The model indicates that content generation (SCG) has a strong direct effect on intention to view (ITV), with a coefficient of 0.82, which in turn influences long-term use intention (STL), with a coefficient of 0.23. Additionally, SCG directly affects STL with a coefficient of 0.47. Perceived usefulness (PUF) mostly affects STL (0.18). The measurement components displayed adequate factor loadings across all latent variables, with most indicators loading above the recommended threshold of 0.70, confirming sound construct validity within the structural model.

The structural equation modeling results provide comprehensive empirical support for the hypothesized relationships within the sustainable audience loyalty framework. The analysis revealed strong path coefficients between the key constructs, with particularly robust relationships between perceived ease of use and perceived usefulness ( $\beta = 0.689$ ,  $p < 0.001$ ), social media use and social engagement ( $\beta = 0.946$ ,  $p < 0.001$ ), and social engagement and intention to view ( $\beta = 0.647$ ,  $p < 0.001$ ). All hypothesized paths demonstrated statistical significance, with attitude showing the weakest, though still significant, influence on intention to view ( $\beta = 0.077$ ,  $p < 0.05$ ). The measurement model demonstrated excellent construct validity, with most factor loadings exceeding 0.90, indicating high statistical significance ( $p < 0.001$ ). Notable loading values included SMU1 (1.159), STL4 (1.194), PUF1 (1.055), and PEU1 (1.018), indicating strong indicator reliability. The high critical ratios (C.R.) across all relationships further confirm the robustness of both the measurement and structural aspects of the model, with values ranging from 17.398 to 40.068 for the strongest relationships, providing strong statistical evidence for the pro-proposed theoretical framework of sustainable audience loyalty in digital public broadcasting, as shown in Figure 7.

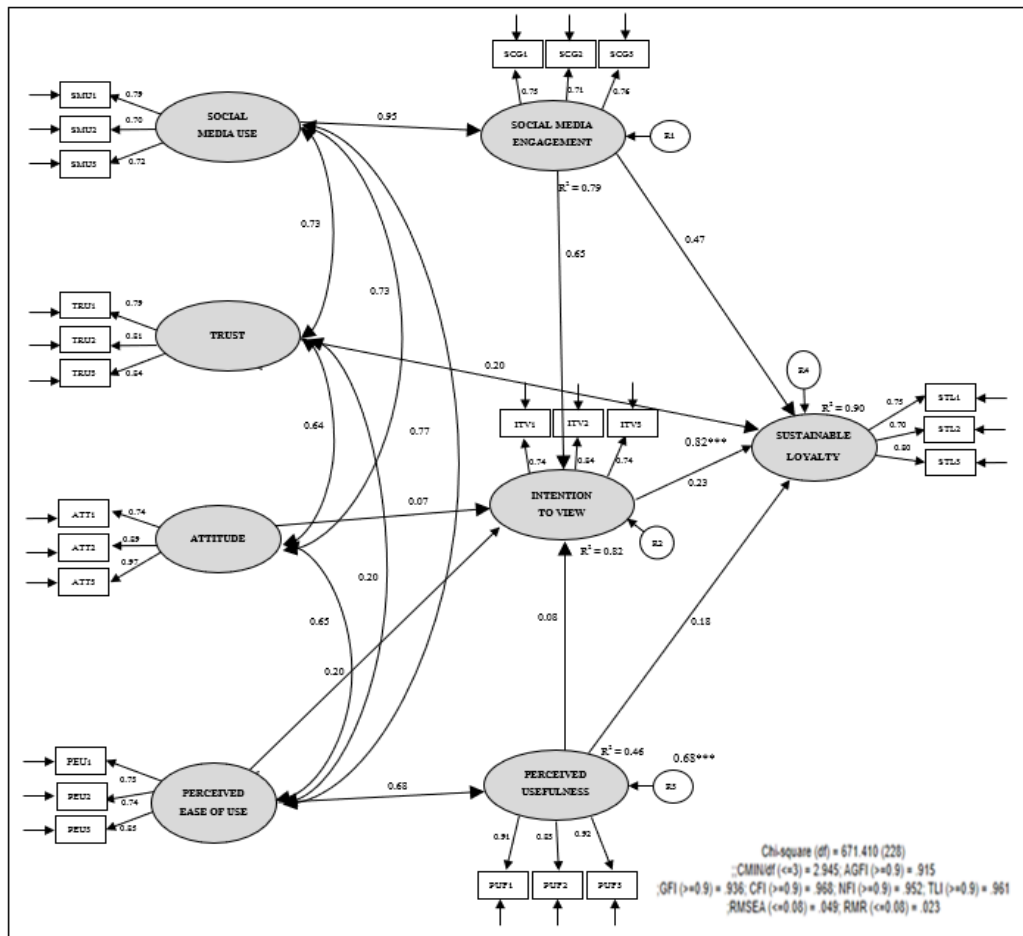


Figure 7. Structural Equation Model

The structural equation modeling results fully supported all ten hypothesized relationships in the conceptual framework, with varying strengths of effect. Social media use demonstrated the strongest influence on social engagement (H1:  $\beta = 0.946$ ,  $p < 0.001$ ), followed by perceived ease of use on perceived usefulness (H5:  $\beta = 0.689$ ,  $p < 0.001$ ), and social engagement on intention to view (H6:  $\beta = 0.647$ ,  $p < 0.001$ ), indicating that these relationships form the core pathways in the model. Moderate effects were observed for social engagement on sustainable loyalty (H8:  $\beta = 0.412$ ,  $p < 0.001$ ) and trust in sustainable loyalty (H2:  $\beta = 0.262$ ,  $p < 0.001$ ). Perceived ease of use had a notable effect on intention to view (H4:  $\beta = 0.252$ ,  $p < 0.001$ ), whereas intention to view (H9:  $\beta = 0.202$ ,  $p < 0.05$ ) and perceived usefulness (H10:  $\beta = 0.193$ ,  $p < 0.001$ ) demonstrated significant but smaller effects on sustainable loyalty. The weakest significant relationships were perceived usefulness on intention to view (H7:  $\beta = 0.102$ ,  $p < 0.05$ ) and attitude on intention to view (H3:  $\beta = 0.077$ ,  $p < 0.05$ ), with the latter being marginally significant. These findings validate the integrated theoretical framework, confirming that sustainable audience loyalty in digital public broadcasting develops through multiple



complementary pathways involving trust, technology acceptance factors, and social media engagement dynamics, as illustrated in Table 8.

Table 8. Hypotheses Result

	hypotheses	$\beta$	S.E.	t-Value	p- Value	Findings
H1: SMU	→ SCG	0.946	0.052	18.183	***	Supported
H2: TRU	→ STL	0.262	0.053	4.944	***	Supported
H3: ATT	→ ITV	0.077	0.039	1.963	*	Supported
H4: PEU	→ ITV	0.252	0.068	3.691	***	Supported
H5: PEU	→ PUF	0.689	0.04	17.398	***	Supported
H6: SCG	→ ITV	0.647	0.057	11.421	***	Supported
H7: PUF	→ ITV	0.102	0.044	2.301	*	Supported
H8: SCG	→ STL	0.412	0.085	4.875	***	Supported
H9: ITV	→ STL	0.202	0.083	2.427	*	Supported
H10: PUF	→ STL	0.193	0.038	5.141	***	Supported

## Discussion

The Structural Equation Modeling results provide strong empirical support for all hypothesized relationships in our conceptual framework of sustainable audience loyalty in digital public broadcasting. These findings offer valuable insights into how Thai PBS can maintain viewer relationships within an increasingly competitive digital landscape.

Hypothesis 1, which proposed that social media use positively affects social engagement, was strongly supported ( $\beta = 0.946$ ,  $p < 0.001$ ), indicating that active social media usage significantly drives user engagement with Thai PBS Facebook content. This substantial path coefficient underscores the critical role of social media as an entry point for audience interactions. This finding demonstrates that regular social media use creates deeper engagement opportunities through commenting, sharing, and community participation (Stollfuß, 2019). Regular social media use creates opportunities for deeper engagement through commenting, sharing, and community participation. Social media has transformed passive viewers into active participants in public broadcasting ecosystems.

Hypothesis 2 posits that trust directly influences sustainable loyalty ( $\beta = 0.262$ ,  $p < 0.001$ ). This result demonstrates that audience confidence in the reliability and credibility of Thai PBS is a significant factor in developing lasting viewer-relationships. Trust serves as a differentiating factor for public broadcasters in the era of misinformation stated by Day (2022), and credibility perceptions strongly predict audience retention rates in public media organizations. Interestingly,

this relationship was independent of other mediating variables, suggesting that trust creates a direct pathway to loyalty regardless of other engagement factors.

Hypothesis 3, suggesting a positive relationship between attitude and intention to view, was supported but with marginally significant results ( $\beta = 0.077$ ,  $p < 0.05$ ). This relatively weak coefficient suggests that, while positive attitudes contribute to viewing intentions, their effect is modest compared to other factors in the model. This aligns with prior research highlighting stronger attitude-intention linkages in commercial media environments, suggesting that public broadcasting audiences may prioritize factors such as content quality and societal relevance over emotional responses. These differences underscore how motivational frameworks in public broadcasting diverge from those in commercial settings (Chivers & Allan, 2022).

Hypothesis 4 proposed that perceived ease of use positively influences the intention to view content, which received strong empirical support ( $\beta = 0.252$ ,  $p < 0.001$ ). The strong effect proves that viewers prioritize interfaces that offer simplicity alongside effortless content access (Mohamed, 2025). The study results demonstrate that eliminating cognitive challenges in media consumption sharpens intentions to use these platforms. This discovery confirms the need to optimize user experiences because it provides essential benefits for gaining and maintaining an advantage in crowded digital media markets.

Research participants provided strong evidence to support hypothesis 5, which found that perceived ease of use directly affects perceived usefulness ( $\beta = 0.689$ ,  $p < 0.001$ ) while remaining one of the strongest relationships within the model. Researchers follow Tao (2008)'s Technology Acceptance Model base by confirming that public broadcasting platforms should provide simple interfaces because this improves viewers' perception of content worth and ease of use benefits for regular audiences. The strong relationship between technical accessibility confirmation establishes that convenient platform access is vital for experiencing content fully.

The research data confirmed that social engagement practices generate positive effects on the intention to view ( $\beta = 0.647$ ,  $p < 0.001$ ). Active user engagement methods of content interactions create substantial future viewing preferences based on the reported coefficient. The results indicate that when users interact with media content, they tend to consume it repetitively (Jiang et al., 2024). Similar to traditional attitudinal measures, social engagement proves itself as a better predictor of viewing intention within social media environments.

Studies show that perceived usefulness has a positive impact on the intention to view based on Hypothesis 7 ( $\beta = 0.102$ ,  $p < 0.05$ ). According to the hypothesis test results, the direct effect of content utility on viewing intentions remains limited in strength relative to other circulatory factors, including social engagement, although the relationship shows statistical significance. Such research evidence indicates that audience perceptions of utility primarily function by connecting to alternative pathways within public broadcasting scenarios according to Cha (2019). Platform viewership on socially oriented platforms depends on more than just practical value in content, although such utility remains essential.

The research data revealed that social engagement demonstrates a positive correlation with sustainable loyalty because its influence was statistically significant ( $\beta = 0.412$ ,  $p < 0.001$ ). Participation in content activities proves to be crucial for developing enduring relationships between audiences (Odunaiya et al., 2020). The involvement of active audiences who actively discuss and distribute media content establishes their increased psychological connection with media platforms according to Chuang & Chen (2023). Digital public broadcasting depends on

active audience participation because this pathway leads to substantial sustainable audience loyalty.

Sustainable loyalty shows a positive connection with the intention to view based on the findings ( $\beta=0.202$ ,  $p < 0.05$ ). The researchers validated the conceptual link between intentions to watch content and sustainable loyalty yet discovered that social engagement remained a stronger predictor of loyalty according to the study results reported by Redondo & Serrano (2025). User intentions to watch show a meaningful contribution to customer loyalty within social media platforms yet take place at a secondary level. This relationship supports the sequential nature of media consumption decisions, where behavioral intentions contribute incrementally to the process of loyalty formation.

Finally, Hypothesis 10, which posits that perceived usefulness positively influences sustainable loyalty, received strong support ( $\beta = 0.193$ ,  $p < 0.001$ ). This finding underscores that when audiences perceive practical value in content, they develop stronger loyalty independent of their immediate viewing intentions (Liu & Liang, 2025). This direct relationship aligns with the value-based loyalty framework, which identifies perceived benefits as the cornerstone of sustainable audience relationships. The results highlight the importance of Thai PBS, consistently demonstrating relevance and utility in fostering and maintaining loyalty in competitive digital environments (Mangunsong & Sobari, 2024).

A few limitations affect the study of sustainable audience loyalty for Thai PBS, and attention is needed to achieve a better balance in the findings. The qualitative findings, based on interviews with 21 experts, could be influenced by limited perspective diversity due to professional biases. Stratified sampling should replace the survey approach, as the distributions of Thai PBS audiences from the 818-participant online survey reveal important quantitative patterns but show limited demographic validity. The specialized nature of the research results makes them challenging to apply beyond specific cultural domains, so researchers should conduct cross-cultural research across different geographical locations. The results may be influenced by technological advancements in media distribution, dependent data responses that are prone to natural response errors, and audience members having different interpretations of program content. Research needs to incorporate various factors while utilizing mixed research approaches and long-term assessments to enhance the understanding of public broadcasting audience loyalty patterns.

Thai PBS should create interactive programming through social media design to build loyal audiences by providing social media-based feedback opportunities and audience engagement capabilities. Viewers need the capability to access interactive digital tools through companion mobile applications or web interfaces that allow them to participate in program events using social features and virtual polling systems. Local influencers and community organizations can partner with Thai PBS to increase audience reach and credibility while fostering viewer connections. Thai PBS should focus on making all digital platforms user-friendly with convenient interfaces to ensure a smooth experience for viewers engaging with content. Organizations should invest in data analytic solutions for audience preference research to improve content targeting and increase audience engagement. Future research should examine specific content types and their impact on audience loyalty across different demographics, as well as evaluate long-term engagement strategies in evolving media environments. Additionally, the analysis of emerging VR and AR technologies that enhance viewer experience and loyalty should be a key focus for future studies on public broadcasters.

## Conclusions

This study successfully developed and validated a comprehensive model to explain sustainable audience loyalty in Thailand's digital public broadcasting environment. By integrating Technology Acceptance Model (TAM) principles with social media engagement, we created a solid framework for understanding loyalty formation in modern media ecosystems. The findings reveal multiple significant pathways to sustainable loyalty, with social media use, social media engagement, trust, and perceived ease of use serving as foundational factors.

The exceptionally strong relationship between social media use and social engagement ( $\beta = 0.946$ ) demonstrates how interactive platforms transform passive audience members into active participants. Similarly, the substantial influence of perceived ease of use on perceived usefulness ( $\beta = 0.689$ ) confirmed that technical accessibility remains a prerequisite for content appreciation. Social engagement serves as a central mediating mechanism that directly affects both viewing intentions ( $\beta = 0.647$ ) and sustainable loyal ties ( $\beta = 0.412$ ). Trust's direct effect on loyalty ( $\beta = 0.262$ ) confirms that credibility and reliability remain essential competitive advantages for public broadcasters in today's cluttered media environment, in which factual reporting and balanced content serve as differentiating features.

A distinctive contribution of this research is our novel methodological approach combining the Two Fuzzy Set Delphi techniques with structural equation modeling, an integration rarely employed in media studies. This innovative methodology captures subtle expert judgments while accounting for natural uncertainty in human evaluation processes, preserving valuable insights that might be lost through traditional methods. This study extends the Technology Acceptance Model (TAM) to public broadcasting services (PBS) in emerging digital landscapes and empirically demonstrates the multidimensional nature of audience loyalty in the digital age, revealing complementary pathways through technology acceptance, social engagement, and trust building.

Despite these contributions, this study has several limitations. The cross-sectional design potentially misses dynamic changes in audience behavior, suggesting that future research should employ time-series approaches. While strategically focusing on Facebook as Thailand's most popular platform, where Thai PBS maintains its largest follower base, this approach did not capture behaviors across other platforms such as YouTube, Twitter, TikTok, and Instagram, each attracting different demographic segments. Future studies should include cross-platform analyses and incorporate content-specific variables for different program genres.

Additionally, the model can be strengthened by exploring how Thai cultural factors influence audience relationships, potentially revealing insights relevant to PBS in other emerging Asian markets. Media habits, regulatory frameworks, and cultural settings across Asia show marked differences from the Western approaches that currently fill academic journals. This opens up valuable research paths to explore how different organizational structures and media policies across countries influence viewers' development of long-term connections with public broadcasters. Despite the limitations, our research offers both theoretical understanding and practical guidance for building sustainable audience relationships in the digital public broadcasting sphere. The insights we have uncovered provide concrete direction for Thai PBS and comparable organizations, as they adapt to digital transformation while staying true to their public service commitments.

## Abbreviations

The following abbreviations are used in this manuscript:

PBS	Public Broadcasting Service
Thai PBS	Thai Public Broadcasting Service
SEM	Structural Equation Model
TRU	Trust
ATT	Attitude
PUF	Perceived Usefulness
PEU	Perceived Ease of Use
ITV	Intention to View
SCG	Social Media Engagement
SMU	Social Media Use
STL	Sustainable Loyalty
CFA	Confirmatory Factor Analysis
FB	Page Facebook Page
TAM	Technology Acceptance Model.

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