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Developing Informatics-Supported Culturally Responsive Service Capabilities in Tourism Service Systems: A Fuzzy Delphi Approach

Zhu Yating Zheng, Nurfaradilla Mohamad Nasri, Khairul Azhar Jamaludin*

Faculty of Education, Universiti Kebangsaan Malaysia
Ernesto@yeah.net

Abstract. From a service science and information systems perspective, tourism service systems increasingly rely on information-enabled infrastructures to support culturally responsive and personalized service delivery in diverse and digitally mediated contexts. Despite growing attention to experiential and culturally grounded service practices, systematic frameworks explaining how informatics structures support service capability development remain limited, particularly in information-intensive cultural tourism settings. This study develops and validates an informatics-supported, culturally responsive experiential framework for service capability development within tourism service systems. Drawing on service science principles, the study operationalizes key capability dimensions and employs the Fuzzy Delphi Method to achieve expert consensus. Twelve domain experts evaluated 78 initial indicators using threshold values, defuzzification scores, and consensus criteria, resulting in the retention of 62 validated indicators. These indicators emphasize the role of information infrastructures in structuring cultural knowledge, mediating experiential service engagement, and supporting performance-oriented capability formation. The validated indicators are synthesized into a five-stage service capability development cycle—culture activation, knowledge structuring, cultural service engagement, reflective integration, and performance articulation. This cycle offers a potential operational reference for the design of information-enabled service subsystems that may enhance service actor readiness, personalization, and service innovation in cultural tourism contexts.

Keywords: Service Science, Tourism Service Systems, Service Capability Development, Cultural Responsiveness, Information Infrastructure, Experiential Service Design, Service Innovation

1. Introduction

The rapid expansion of cultural tourism has fundamentally transformed the service capabilities required of frontline and managerial actors within tourism service systems. In increasingly diverse and digitally mediated service environments, employers in the tourism and hospitality sector expect service personnel to effectively manage culturally heterogeneous customer encounters, deliver authentic and personalized experiences, and adapt to fast-evolving digital platforms and market demands (Benaraba et al., 2022; Ruiz-Fernández et al., 2024; OECD, 2021). Recent research in the Journal of Logistics, Informatics and Service Science further emphasizes the need to recalibrate frontline service capabilities in hospitality post-pandemic (Arora et al., 2024) and highlights customer readiness for adopting technological innovations in the tourism sector (George, 2023).

However, persistent misalignment remains between the service capabilities actually developed and those demanded by the industry, particularly in cultural tourism contexts where cultural authenticity and intercultural competence constitute core value propositions (Stergiou & Airey, 2017; Viken et al., 2021).

Research indicates that high performance in tourism service systems depends not only on domain-specific knowledge but also on transferable service-oriented capabilities, including intercultural communication, adaptability, digital competence, critical judgment, and the ability to engage meaningfully with authentic service contexts (Piróg et al., 2021). When service capability formation mechanisms fail to integrate these elements within realistic cultural and digital service environments, service actors often demonstrate limited readiness for dynamic, real-world service delivery, which in turn constrains service quality, experience personalization, and innovation (Zins, 2025; Busulwa et al., 2024). This misalignment is echoed in studies on digital transformation in hospitality and tourism, where frontline employees' engagement with AI-driven tools and digital platforms remains a critical challenge (Hamid et al., 2024).

This challenge is especially pronounced in cultural tourism settings, where the interpretation and representation of local heritage, ethnic knowledge, and community-based experiences form the foundation of service value creation. In many regions, including multi-ethnic areas such as Inner Mongolia, service capability development frequently lacks sufficient integration of culturally grounded and experiential service logic, resulting in service personnel who possess conceptual understanding but struggle to design and deliver culturally meaningful and context-sensitive visitor experiences (Viken et al., 2021; Buhalis & Leung, 2018).

From a service science perspective, tourism services function as complex socio-technical systems in which service quality, personalization, and cultural authenticity are co-created by service actors and customers (Spohrer et al., 2007). Within such systems, effective service capability development requires mechanisms that systematically embed cultural responsiveness and experiential engagement, supported by digital infrastructures that enable simulation, reflection, and scalable practice in safe yet realistic environments. Culturally responsive approaches recognize the cultural identities, histories, and lived experiences of both service actors and customers as legitimate resources for capability formation, while experiential service engagement provides structured pathways for developing competence through situated practice, reflection, and application in digitally mediated contexts (Viken et al., 2021; Neuhofer et al., 2014).

Although digital tools—such as virtual reality (VR) simulations, blended digital platforms, and social media analytics—offer promising avenues to support experiential and culturally responsive service capability building, their integration into service capability development mechanisms remains inconsistent and under-theorized in tourism service systems (Deale et al., 2021; Goh & Sigala, 2020; Busulwa et al., 2024). Emerging work demonstrates how big data and deep learning can support innovative marketing models for tourism destinations (Peng et al., 2024), while gamified digital mechanisms encourage sustainable tourist behavior (Godbole et al., 2024). Practical constraints,

including scalability, accessibility, and alignment with industry-relevant outcomes, further highlight the need for validated, operational indicators that bridge cultural responsiveness, experiential service logic, and digital enablement. These tools function as informatics infrastructures by enabling data integration from cultural sources, real-time feedback loops during service simulations, and decision-support analytics for personalized service delivery.

From a logistics, informatics, and service science perspective aligned with JLISS, the limitations identified above are not merely issues of tool adoption, but reflect a deeper absence of systematic information infrastructure within tourism service systems, which hinders efficient information flows, coordination mechanisms across service actors, and decision-support processes essential for value co-creation in logistics-enabled tourism ecosystems. Existing studies largely treat digital technologies as supplementary delivery instruments, rather than as information architectures that shape how cultural knowledge is codified, how experiential data are generated and integrated, and how service-related decisions are supported across interconnected service subsystems (Buhalis & Leung, 2018).

In information-intensive service contexts such as cultural tourism, service capability development increasingly depends on the design and governance of informatics-enabled infrastructures that mediate human–system interaction, coordinate distributed service actors, and enable reflective learning and decision-making at scale. However, empirically grounded frameworks that explicate how informatics structures support the alignment of cultural responsiveness, experiential service logic, and service capability formation remain limited. This gap constrains both the theoretical understanding of information-enabled service systems and the practical design of digital service infrastructures capable of supporting culturally sensitive and adaptive service performance (OECD, 2021; Zhang et al., 2025).

This study contributes to JLISS by framing informatics-supported service capability development as a key subsystem in broader service systems, emphasizing how it enhances logistics coordination, informatics-driven personalization, and service innovation in cultural tourism contexts. Adopting an inductive approach informed by service science principles, this study aims to validate a set of culturally responsive experiential indicators for service capability development within tourism service systems, with particular emphasis on digitally supported mechanisms. Tourism consumer behavior is conceptualized here not as a standalone subject but as a critical service capability domain embedded within broader tourism service ecosystems. The study addresses the following research questions:

1) What service-oriented capability elements, supported by digital infrastructures, should be prioritized in culturally responsive experiential designs to enhance intercultural service performance and service innovation in tourism systems?

2) How can validated indicators be synthesized into an operational service capability development cycle that integrates cultural responsiveness, experiential engagement, and digital support to better align service capability management subsystems with tourism industry requirements, focusing on system-level outcomes like operational efficiency and service innovation?

Key concepts are defined as follows: Cultural responsiveness refers to integrating cultural identities and experiences into service design (Viken et al., 2021). Experiential service logic emphasizes situated practice and reflection (Neuhofer et al., 2014). Service capability denotes transferable competencies for service delivery. Informatics support involves digital infrastructures enabling information flows and decision-making. A conceptual diagram (Figure 1) illustrates their relationships, showing how informatics mediates cultural responsiveness and experiential logic to form service capabilities in tourism systems.

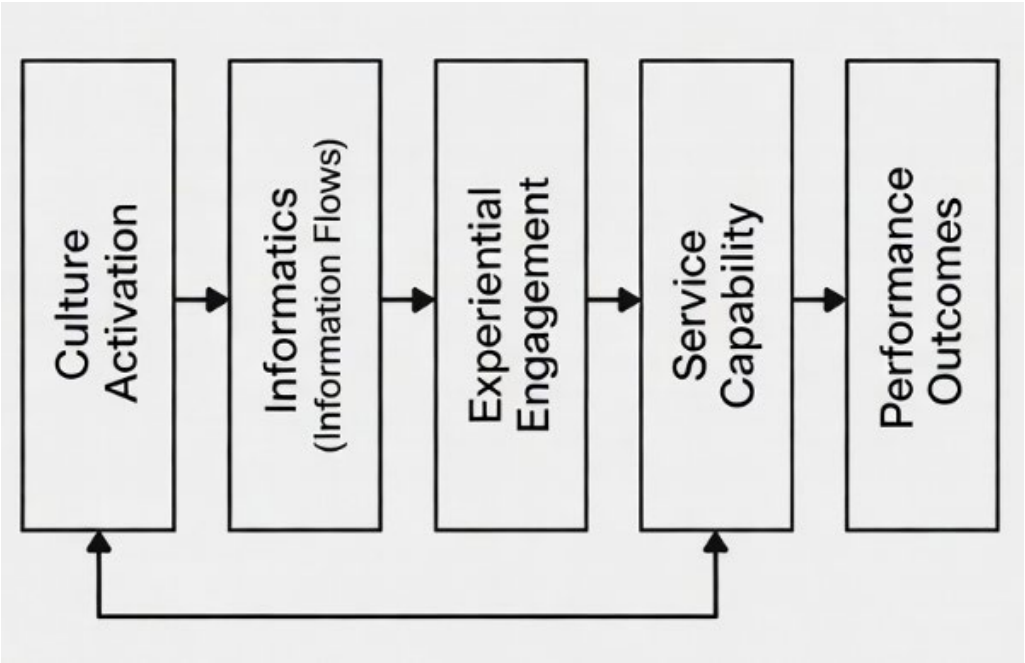

Fig.1: Conceptual Framework

2. Research Method

This study employed the Fuzzy Delphi Method (FDM) to develop and validate a set of culturally responsive experiential indicators for service capability development within tourism service systems. The focus was placed on tourism consumer behavior conceptualized as a core service capability domain embedded within broader tourism service ecosystems, with particular emphasis on informatics-supported mechanisms that enable culturally grounded and experiential service delivery in digital environments. While FDM is suitable for achieving expert consensus under ambiguity, it does not establish causal relationships or empirical performance outcomes, which are acknowledged as limitations addressed in future research.

FDM extends the traditional Delphi te chnique by integrating fuzzy set theory to handle uncertainty and achieve structured expert consensus (Cheng & Lin, 2002; Hsu & Sandford, 2007). It has been widely applied in service-related fields, including tourism management, smart tourism ecosystems, sustainable tourism indicator development, and service innovation under conditions of ambiguity (Syaifullah et al., 2025; Lin et al., 2019; Romero-García et al., 2023). In this research, FDM was utilized to refine and prioritize indicators across key dimensions of service capability formation, including conceptual orientation, capability objectives, content structuring, experiential engagement, performance evaluation, and digital service support infrastructures. The Fuzzy Delphi Method has proven effective in tourism-related decision-making contexts, such as assessing technological adoption readiness (George, 2023) and evaluating digital service models in hospitality and tourism ecosystems (Godbole et al., 2024; Peng et al., 2024).

2.1. Expert Panel

Experts were selected based on the following criteria: (i) at least a bachelor's degree in a relevant field (e.g., tourism management, service science, information systems, or hospitality), and (ii) a minimum of five years' professional experience in tourism service management, service operations, ethnic/cultural tourism, digital tourism applications, or service capability development (Baker et al., 2006; Syaifullah

et al., 2025). A panel of 12 experts participated (from an initial invitation of 18, yielding a 66% response rate), which aligns with recommended sizes for Delphi and FDM studies to ensure diversity and manageability (Hsu & Sandford, 2007). While this panel ensures balanced perspectives within a specific regional and cultural context, the findings may reflect institutional biases, limiting generalizability to diverse tourism service systems.

The panel comprised professionals with expertise in tourism service training systems, hotel and catering management, ethnic tourism, tourism consumer behavior, service operations, and digital service applications (as detailed in Table 1). This composition ensured balanced perspectives on informatics-enabled service mechanisms and culturally responsive practices in tourism service systems.

Table 1. Profiles of Domain Experts Participating in the Fuzzy Delphi Assessment

No.	Institution	Years of Experience	Field of Expertise	Degree/ Title
E1	Inner Mongolia Normal University	21	Catering Management, Food Culture	PhD. Professor
E2	Chengde Hebei Tourism College	5	Tourism Management	Master lecturer
E3	Inner Mongolia Normal University	18	Tourism Service Training Systems, Tourism Reception Operations	PhD. Professor
E4	Inner Mongolia Normal University	18	Ethnic Tourism, Tourism Psychology, Tourism Consumer Behavior	PhD. Lecturer
E5	Chengdu University, Aviation School	10	Service Training System Design, Civil Aviation Service Management	PhD. Lecturer
E6	Inner Mongolia Normal University	22	Hotel Service Management, Tourism Service Training Systems	PhD. Associate Professor
E7	Inner Mongolia Normal University	20	Tourism Management	Master Professor
E8	Inner Mongolia Normal University	5	Inner Mongolian Folk Culture, Scenic Area Management	Master Lecturer
E9	Gannan Normal University	10	Service Capability Development and Instructional Systems	PhD. Associate Professor
E10	Inner Mongolia Agricultural University (Vocational College)	6	Tourism Management	Master Lecturer
E11	Inner Mongolia Normal University	14	Corporate Culture, Tourism Studies, Tourism Planning & Development	PhD. Lecturer
E12	Inner Mongolia Normal University	12	Tourism Geography	PhD. Lecturer

Note. Panel members were drawn from institutions with strong engagement in tourism service systems, service operations, and service-related capability development.

2.2. Data collection

The initial pool of 78 indicators was developed through: (a) a design-oriented synthesis of literature on tourism service innovation, culturally responsive service approaches, experiential service logic, blended service training, and digital enablement in service systems (see Appendix A), and (b) semi-structured interviews with selected experts in tourism service management and service capability development.

These indicators were organized into seven dimensions reflecting the conceptual, structural, and operational components of a culturally responsive experiential service capability framework. A structured FDM questionnaire was then distributed via WeChat for independent expert rating. To contextualize feasibility within tourism service contexts, four experts from the panel also participated in individual face-to-face interviews. All interviews were audio-recorded, transcribed, and member-checked. Questionnaire responses were submitted anonymously to preserve Delphi principles and minimize group influence.

2.3. Data analysis

Interview data were analysed using reflexive thematic analysis (Braun & Clarke, 2006), following the phases of familiarisation, coding, theme development, review, definition, and reporting. Emergent themes from the interviews were used to refine the conceptual constructs and wording of the FDM indicators.

For the Fuzzy Delphi Method component, the 12 experts rated the 78 indicators on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) across seven dimensions.

Each expert's rating was modelled as a triangular fuzzy number (TFN). The 12 experts' TFNs for each indicator were aggregated to produce a composite TFN (m_1, m_2, m_3). Three criteria were then applied to determine consensus and retention:

1. Threshold value (d)

The d-value reflects the degree of disagreement among expert judgements. For each indicator, the fuzzy distance between every expert's individual TFN and the group composite TFN was computed following Cheng and Lin's (2002) distance formula. The item-level d-value was then obtained by averaging these distances across all 12 experts.

Indicators with d ⩽ 0.20 were considered to have achieved acceptable convergence; items with d > 0.20 indicated higher dispersion of views.

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}[(m,-n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

2. Defuzzification score (A)

This score was calculated using the formula: $A = (1/3) \times (m_1 + m_2 + m_3)$

A defuzzification score (A) of 0.50 or greater indicated that the indicator was acceptable, while scores below 0.50 led to rejection. Among retained items, those with the highest defuzzification scores were ranked higher in priority.

3. Consensus percentage

The proportion of experts whose individual d-value was ⩽ 0.20 was calculated. Indicators required ⩾ 75% expert agreement for retention.Fuzzy computations were conducted using an Excel-based template (Fuzzy Delphi Analysis v2.0; Syamsul Nor Azlan Mohamad). For reproducibility and verification, a subset of indicators was manually recalculated in Excel, and the results matched the template outputs.

Indicators meeting all three thresholds (d ⩽ 0.20, A ⩾ 0.50, consensus ⩾ 75%) were retained. The retained indicators were synthesised into a structured service-oriented framework. Items were clustered according to their functions in service capability development and mapped onto a five-step service capability development cycle. This cycle ensures traceability across the seven dimensions and

supports applicability to service training subsystems within tourism service systems, including digitally supported experiential mechanisms.

3. Results

The Fuzzy Delphi questionnaire comprised 78 indicators distributed across seven interrelated dimensions. These dimensions represent the conceptual, structural, and operational components of a culturally responsive experiential service capability framework for tourism service systems. They include service-oriented conceptual orientation, capability objectives, content structuring, interaction environment, experiential engagement mechanisms, performance assessment, and digital platform support. To reduce redundancy, the initially proposed "Teaching Methods" category was integrated into other dimensions, resulting in seven finalized indicator groups labelled A, B, C, E, F, G, and H.

Based on the established FDM decision criteria ($d \leqslant 0.20$, $A \geqslant 0.50$, and expert consensus $\geqslant$ 75%), 62 indicators were retained and 16 were rejected (see Table 2). The retained indicators collectively form a validated framework prototype that demonstrates how culturally responsive and experiential principles can be operationalized to strengthen service capability development within tourism service contexts. The following sections summarize expert consensus patterns across dimensions and detail the indicators integrated into the framework, with particular emphasis on their relevance for tourism service systems, digital support infrastructures, and service innovation-oriented applications.

3.1. Expert Consensus on Part A: Service-Oriented Conceptual Orientation

For Part A, experts showed consistently high agreement across all six proposed indicators (see Appendix A for details). Item-level d-values ranged from 0.093 to 0.178, all consensus levels met or exceeded the 75% threshold, and defuzzification values were well above 0.50. Accordingly, all six indicators (A1–A6) were retained, reflecting strong convergence on the foundational conceptual orientation of the framework.

Collectively, the retained indicators articulate a service-oriented orientation in which service capability development activities are structured around facilitation, inquiry, and experiential engagement rather than unidirectional knowledge transmission. This orientation emphasizes active involvement of service actors, integration of prior professional and cultural experiences, and the use of locally grounded references as resources for sense-making and capability building. Within the service capability framework, these principles support the development of service-relevant competencies, including culturally responsive interaction, reflective judgement, and context-sensitive problem-solving in tourism service systems. No indicators in this dimension were rejected.

3.2. Expert consensus on Part B: Service-Oriented Capability Objectives

A similarly strong and stable consensus pattern was observed for Part B (see Appendix A for details). All eight proposed objective items (B1–B8) satisfied the FDM acceptance criteria, with individual d-values below 0.20 and a construct-level d of 0.0133, indicating a high degree of judgement stability. Expert agreement ranged from 83.3% to 100%, and all defuzzification values exceeded the 0.50 threshold. Accordingly, all proposed objectives were retained.

Collectively, the retained objectives define the intended functional orientation of the service capability development framework. Experts agreed that the framework should support adaptive engagement with blended, mobile, and digitally mediated service environments, strengthen intercultural service competence, promote critical and ethical judgement in tourism service contexts, enhance industry-oriented problem-solving readiness, and develop practical marketing and media-related capabilities applicable to culturally diverse tourism service systems.

3.3. Expert Consensus on Part C: Service-Oriented Content Structure

This section reports expert consensus on the 21 proposed content elements constituting the culturally responsive experiential service capability framework. These elements were developed to embed culturally responsive and experiential principles into tourism consumer behavior as a core service capability domain within tourism service systems, rather than as a standalone instructional domain. Seventeen items satisfied all FDM acceptance criteria and were retained, while four were excluded based on expert judgement (see Appendix A for details).

Analysis of the retained items reveals three dominant expectations regarding content structuring. First, core content should be culturally grounded, drawing on service actors' and customers' lived cultural experiences and contextual tourism realities to support culturally responsive service understanding and interaction (C1, C2, C4, C6, C7). Second, service-related knowledge should be organized through a coherent modular structure encompassing psychological, sociocultural, decision-making, experiential, and cross-cultural perspectives, thereby enabling systematic interpretation of tourist behavior within service systems (C8–C14). Third, digital and multimedia resources—including VR-supported scenarios, infographics, and platform-based materials—should function as service simulation and knowledge support tools, enabling experiential sense-making and independent service analysis when meaningfully integrated into the service capability framework (C17, C18, C20, C21).

Meanwhile, the items rejected by experts are:

C3: Using ethically and culturally sensitive case studies promotes critical learning, which achieved a consensus value of 33.3% and recorded a threshold (d) value above the acceptable limit of 0.2;

C5: Service actors should practice problem-solving within cultural contexts, which achieved a consensus value of 41.6% and therefore did not meet the minimum expert agreement requirement.

C16: Include case analyses on ethnic and cultural tourism in Inner Mongolia, which achieved a consensus value of 8.3% and a threshold (d) value above 0.2;

C19: Online resources should replace traditional service training and extend knowledge, which achieved a consensus value of 33.3% and a threshold (d) value above 0.2.

These rejected items did not meet the Fuzzy Delphi Method acceptance criteria of consensus $\geqslant$ 75% and threshold d $\leqslant$ 0.2 and were therefore excluded from the final service content and experiential capability framework within the tourism service training system.

3.4. Expert Consensus on Part E: Service Training Environment

The Service Training Environment dimension comprised three items describing the characteristics of a culturally responsive and inclusive service training setting. All three indicators (E1–E3) met the acceptance criteria (see Appendix A for details). Experts agreed that tourism service capability development activities should be implemented within an environment that is welcoming, safe, inclusive,

and flexible, and that explicitly values cultural diversity and heritage. These items were therefore retained in full and define the contextual conditions under which culturally responsive experiential service capability development activities are expected to take place.

3.5. Experiential Service Interaction Activities

Nineteen xperiential service interaction activities were evaluated to determine their suitability for supporting culturally responsive and experiential service capability development within tourism service training contexts. Based on the combined defuzzification results and expert consensus criteria, 14 activities were accepted and 5 were rejected (see Appendix A for details). The accepted activities emphasize: structured interaction and role-based service simulation, including critical reflection tasks (F1, F6, F8); engagement with industry and cultural actors as well as service-related media, such as guest speakers, social media advertising analysis, and VR-based destination exploration (F2–F4); culturally grounded experiential tasks, including cultural ambassador storytelling, visits to local heritage sites, and the design of realistic tourism service solutions (F9, F10, F12); and analytical service activities focusing on SWOT analysis, customer journey mapping, destination image formation, and cross-cultural comparisons of motivation or satisfaction (F14–F17, F19).

Five activities did not satisfy one or more FDM criteria and were excluded from the prototype: Integrate service training with experiential field projects and require service actors to conduct reflective summaries at heritage sites (F5), rejected due to very low consensus (16.7%); Use role-play scenarios to simulate conflict resolution between tourists and local communities (F7), rejected due to consensus below 75% (66.7%); Require service actors to map the consumer decision-making process using textbook models (F13), rejected because it failed both the threshold condition ($d > 0.20$) and the consensus requirement; Encourage service actors to write reflective journals exploring bias, cultural dynamics, and ethical issues (F11), rejected due to both high d value and low consensus (16.7%); Guide service actors to conduct mini case studies linking tourist satisfaction to SERVQUAL or Experience Economy theory (F18), rejected because it exceeded the acceptable threshold value despite meeting the consensus level.

These rejected activities exhibited either low expert consensus, higher defuzzification values, or both, indicating concerns regarding feasibility, cognitive load, or operational suitability within a structured tourism service training context.

3.6. Expert Consensus on Part G: Service Capability Evaluation

The Service Capability Evaluation dimension included 12 items. Eight indicators were accepted, while four were rejected based on the Fuzzy Delphi criteria (see Appendix A for details). The accepted items reflect a clear preference for performance-based and authentic service capability evaluation approaches.

Experts emphasized holistic evaluation of service actors' knowledge, attitudes (e.g., openness and engagement), skills (e.g., communication and critical judgment), and behavioral performance in intercultural service contexts (G1). They also supported group-based service investigations, bilingual service communication design, projects focusing on culturally significant destinations, and the development of inclusive tourism service experiences (G4–G7). In addition, experts endorsed simulated cultural festivals, social media–based tourism marketing projects, and digital, scenario-based evaluation tasks designed to assess higher-order service-related judgment and decision-making (G8, G9, G12).

Four assessment items did not meet the acceptance criteria and were therefore excluded from the framework. These include: G2: process-based formative assessment structure (consensus 58.3%); G3: reflective assignments for adaptability and empathy development (41.6%); G10: business plan development for culturally sustainable tourism enterprises (41.6%); and G11: reflective portfolio evaluation, which, although reaching an acceptable consensus (83.3%), failed to meet the threshold criterion ($d = 0.208$).

These excluded items did not satisfy the Fuzzy Delphi acceptance criteria and reflect expert reservations regarding operational feasibility, workload intensity, or alignment with structured tourism service capability evaluation requirements.

3.7. Expert Consensus on Part H: Digital Service Training Platform Resources and Support

Experts demonstrated selective yet consistent support for the role of digital platforms (such as Chaoxing) as service training support infrastructures within the service capability framework. Of the nine proposed items (H1–H9), six satisfied all Fuzzy Delphi acceptance criteria and were retained (see Appendix A for details).

The accepted indicators emphasize that digital resources should be closely aligned with service capability development objectives (H1), be clearly structured and easily accessible for service actors (H3), and be supported by timely system notifications that facilitate service training process management (H5). Experts further endorsed the use of supplementary digital resources, such as curated article links and VR-based service simulations, to enrich service content and experiential understanding (H6), as well as opportunities for online interaction and collaboration through discussion forums and coordinated group tasks (H8). Finally, consensus was reached that digital resources should extend and complement structured service training activities rather than replicate them (H9).

In contrast, three items were rejected for failing to meet one or both of the FDM acceptance criteria: H2. Online activities (e.g., quizzes, discussion forums) should encourage service actors' active participation — rejected due to insufficient expert consensus; H4. Online quizzes and assessments should be provided to enhance service capability outcomes — failed to meet the threshold criterion, with an average d value of 0.204, exceeding the acceptable limit of 0.20; H7. Online task instructions should be clear and easy for service actors to understand and follow — rejected because it failed both criteria simultaneously (average d value of 0.204 and consensus level of only 33.3%), indicating substantial divergence in expert opinions.

These rejected items suggest that, although certain operational features of digital platforms were perceived as moderately useful, experts did not regard them as core support mechanisms for culturally responsive experiential service capability development due to inconsistent relevance, feasibility concerns, or insufficient alignment with structured service training processes.

3.8. Summary of FDM Consensus and Expert Feedback on Service Capability Design

The Fuzzy Delphi Method (FDM) instrument was developed to validate the design of a culturally responsive experiential service capability framework within a structured tourism service training subsystem. The instrument comprised 78 items, of which 62 were accepted and 16 were rejected based on the predefined criteria ($d \leqslant 0.20$, $A \geqslant 0.50$, and consensus $\geqslant 75\%$). This distribution reflects a high degree of expert convergence regarding the core orientation of service capability development, accompanied by careful selectivity toward items perceived as operationally vague, structurally impractical, or misaligned with service training realities and institutional constraints.

Table 2. Overall Summary of Accepted and Rejected Service Capability Design Items

Section	Total Items	Accepted	Rejected
A. Service Facilitation Logic.	6	6	0
B. Service Capability Objectives.	8	8	0
C. Service Content and Capability Components.	21	17	4
E. Service Training Environment.	3	3	0
F. Experiential Service Interaction Activities.	19	14	5
G. Service Capability Evaluation.	12	8	4

Section	Total Items	Accepted	Rejected
H. Digital Service Training Platform Support	9	6	3
Total	78 items	62 accepted	16 rejected

The results indicate strong expert consensus on the epistemological orientation and operational logic of service capability design within tourism service systems. Experts endorsed facilitative service interaction, experiential ownership, cultural integration, and context-sensitive service practice, signaling a shift from transmission-oriented training toward service-centered and culturally grounded capability development.

Service content items received selective but substantial support, particularly those linking tourism consumer behavior theory with locally grounded service contexts, such as heritage interpretation, destination image formation, and experiential decision analysis. Items framed in abstract ethical or cultural terms without clear operationalization were rejected, reflecting a preference for culturally responsive service practice enacted through concrete service design mechanisms rather than symbolic statements.

Experiential service interaction activities were favored when they involved structured simulation, field engagement, cultural comparison, and industry-oriented problem solving. Activities relying heavily on unstructured reflection or complex theoretical abstraction were rejected due to concerns regarding feasibility, equity of participation, and operational clarity within service training contexts.

Overall, expert feedback emphasized contextual realism, operational traceability, and alignment with service system requirements. Experts were not resistant to innovation, such as the use of AI tools, VR applications, or digital platforms, but stressed the importance of integrating these elements into coherent service training architectures that balance cultural responsiveness, institutional capacity, and tourism service industry needs.

3.9. Synthesis of Retained Indicators into a Five-Step Service Capability Development Cycle

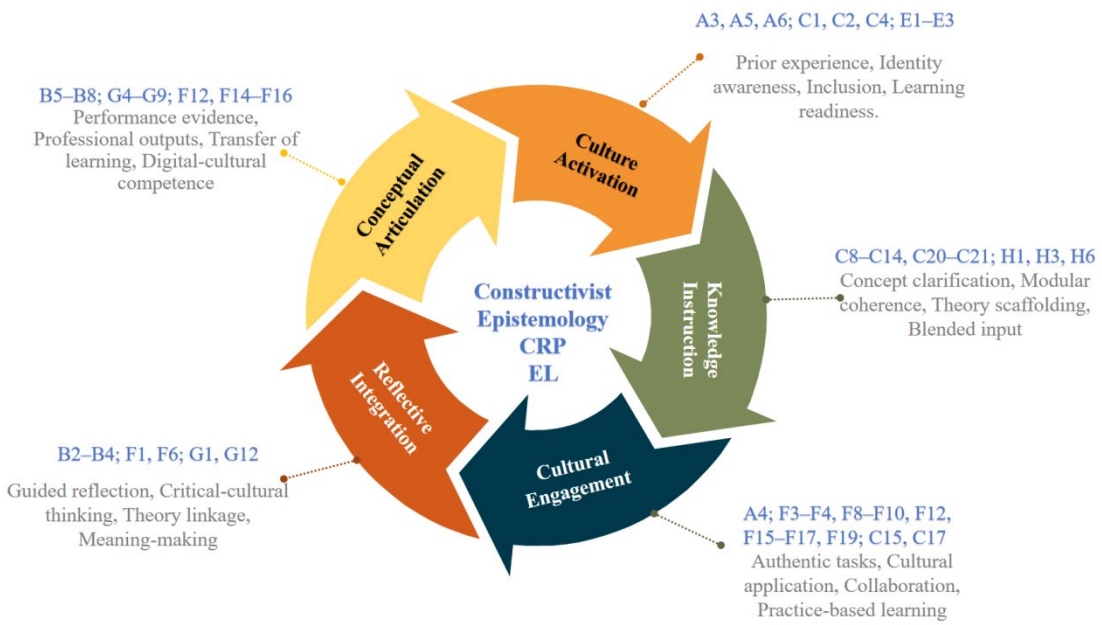

Fig.2: Five-Step Service Capability Development Cycle

To translate the retained indicators into an implementable and transferable service capability framework, the accepted items were systematically mapped onto a five-step service capability development cycle, which serves as a conceptual and design-oriented model rather than an empirically tested process. This cycle can be iteratively applied within service training subsystems and integrates culturally responsive principles (recognition of cultural identities, inclusion, cultural grounding, and context-sensitive facilitation) with experiential service routines (situated experience, guided sense-making, and applied problem-solving). The cycle maintains explicit traceability to the FDM consensus results and strong alignment with tourism service training contexts, digital support infrastructures, and service innovation requirements.

Step 1: Culture Activation

This initial stage focuses on activating service actors' prior tourism experiences and cultural identities to establish an inclusive and psychologically safe service training climate. It emphasizes readiness for intercultural service interaction through culturally grounded content and structured facilitation. Supported by retained indicators from conceptual orientation, content, and environment dimensions (A3, A5, A6; C1, C2, C4; E1–E3). Key functions: experience activation, cultural identity awareness, inclusion, and service interaction readiness. For instance, in an informatics-enabled tourism platform, culture activation could involve AI-curated cultural profiles to initiate personalized service interactions.

Step 2: Knowledge Structuring

This step provides structured conceptual input aligned with the five core service capability domains and supported by clearly organized digital platform resources. It ensures coherent knowledge pathways, multimodal access to essential tourism consumer behavior constructs, and conceptual scaffolding for subsequent service application. Supported by retained indicators from content structuring and digital support dimensions (C8–C14, C20–C21; H1, H3, H6). Key functions: concept clarification, modular coherence, theoretical structuring, and blended knowledge input. E.g., modular knowledge structuring via data dashboards integrating sociocultural analytics.

Step 3: Cultural Service Engagement

This stage transitions service actors from conceptual understanding to culturally situated service application through project-based tasks, VR-supported simulations, field-linked activities, and cross-cultural problem-solving. Tourism consumer behavior concepts are applied within realistic tourism service scenarios, with emphasis on collaboration, cultural responsiveness, and experiential service practice. Supported by retained indicators from facilitation logic, experiential interaction, and content dimensions (A4; F3–F4, F8–F10, F12, F15–F17, F19; C15, C17). Key functions: authentic service tasks, cultural application, collaborative engagement, and practice-oriented capability building. E.g., VR simulations coordinating cross-cultural service engagements.

Step 4: Reflective Integration

This step strengthens the linkage between conceptual knowledge and service practice through guided critical reflection and culturally informed judgement. It consolidates experiential insights by aligning intercultural service objectives with structured reflective and situational evaluation mechanisms, supporting deeper meaning-making and ethical-cultural reasoning in service contexts. Supported by retained indicators from capability objectives, experiential interaction, and evaluation dimensions (B2–B4; F1, F6; G1, G12). Key functions: guided reflection, critical-cultural analysis, theory–practice integration, and interpretive consolidation. E.g., feedback loops using analytics for reflective integration.

Step 5: Performance Articulation and Output

This final stage requires service actors to demonstrate consolidated service capability through performance-based outputs that evidence culturally sensitive problem-solving, professional readiness,

and digital-cultural competence within tourism service systems. Outputs emphasize transferability, industry relevance, and demonstrable service competence. Supported by retained indicators from capability objectives, evaluation, and experiential interaction dimensions (B5–B8; G4–G9; F12, F14–F16). Key functions: performance evidence, professional articulation, transfer of learning, and digital-cultural service competence. E.g., performance dashboards articulating outcomes for operational alignment.

4. Discussion

The framework is reframed as a service capability management subsystem, emphasizing its role in logistics coordination and system-level performance within tourism service systems. The Fuzzy Delphi Method (FDM) results extend beyond item-level validation by revealing a coherent design logic for service capability development within tourism service systems. Across seven dimensions, the 62 retained indicators reflect expert consensus on the importance of culturally grounded capability objectives, structured experiential engagement, performance-oriented evaluation, and digitally enabled support mechanisms that are explicitly aligned with service system requirements. Rather than emphasizing isolated pedagogical practices, the findings point to the need for integrated service capability formation mechanisms that operate across interconnected service subsystems.

Selective retention patterns further clarify expert preferences for operational clarity and feasibility. Indicators associated with vague reflection, excessive cognitive or logistical demands, or limited observability were consistently deprioritized. This suggests that, in tourism service systems, service capability development mechanisms are more likely to be effective when they emphasize structured, assessable, and resource-conscious designs that support consistent service readiness and innovation, rather than relying on loosely defined or overly demanding activities.

4.1. Interpretation of the Validated Indicators from a Service Systems Perspective

From a service systems perspective, the validated indicators emphasize the role of service capability development as an institutionalized subsystem that supports value co-creation, personalization, and service innovation, extending service-dominant logic (Vargo & Lusch, 2014) by integrating informatics infrastructures to facilitate resource integration and operant resource activation in tourism ecosystems. The retained indicators highlight five interrelated priorities: (1) facilitators acting as guides who leverage service actors' cultural experiences as capability resources; (2) clearly articulated and assessable service capability objectives; (3) structured experiential service tasks rather than ad hoc activities; (4) performance-based and authentic evaluation mechanisms; and (5) digital support infrastructures that serve service capability goals rather than operating independently. This informatics-enabled approach aligns with recent findings in JLISS on digitalisation's role in service innovation and customer adoption in tourism (George, 2023; Peng et al., 2024), as well as the recalibration of frontline capabilities in post-pandemic hospitality settings (Arora et al., 2024).

Full acceptance within conceptual orientation, capability objectives, and service training environment dimensions indicates strong expert agreement that this direction is both necessary and feasible. In contrast, selective retention in content structuring, experiential interaction, capability evaluation, and digital support dimensions reflects expert caution toward approaches that are difficult to scale, evaluate, or align with service system constraints. These findings reinforce the view that effective service capability development depends not on the quantity of experiential activities, but on their alignment with observable service outcomes and system-level feasibility.

The synthesized five-stage service capability development cycle—culture activation, knowledge structuring, cultural service engagement, reflective integration, and performance articulation—translates the validated indicators into repeatable operational routines. The proposed cycle complements emerging models in JLISS, including gamification for sustainable urban tourism behavior (Godbole et al., 2024) and determinants of online hotel booking adoption through modified technology acceptance

frameworks (Al-Kateb & Alzyoud, 2024). Rather than prescribing specific instructional techniques, the cycle functions as a process model that clarifies how culturally responsive and experiential principles can be embedded within structured service capability formation mechanisms. By making the sequencing and functional relationships among stages explicit, the cycle addresses a common gap between abstract design principles and implementable service subsystem routines. This cycle refines existing service ecosystem models (e.g., Chandler & Lusch, 2015) by incorporating informatics-enabled feedback loops that explain how cultural responsiveness drives adaptive value co-creation in logistics-intensive service systems.

Expert caution toward unstructured or open-ended reflective practices further reinforces the importance of embedding cultural responsiveness within guided service tasks and evaluation mechanisms. Furthermore, the framework resonates with JLISS research on the interplay of resident support, government policies, and knowledge in shaping sport tourism development (Satrya et al., 2024), highlighting the need for culturally grounded mechanisms in tourism service systems. While reflective sense-making remains essential, the findings suggest that reflection is most effective when integrated into observable activities, feedback loops, and performance articulation processes. This approach supports capability development while maintaining transparency, scalability, and alignment with service system requirements.

4.2. Implications for Information Systems and Digital Service Infrastructure Design

Beyond service capability development logic, the findings carry direct implications for the design of information systems and digital service infrastructures within tourism service systems, specifying how informatics enables information flows (e.g., cultural data codification), data integration mechanisms (e.g., VR-enhanced experiential datasets), feedback loops (e.g., reflective analytics), and decision-support functions (e.g., AI-driven personalization) across service subsystems. The validated indicators conceptualize digital platforms not as neutral delivery channels, but as enabling infrastructures that structure how cultural knowledge is curated, experiential service data are generated, and decision-making processes are supported across simulated and real service contexts.

Across the five stages of the service capability development cycle, distinct infrastructural functions emerge. Culture activation and knowledge structuring rely on information systems capable of organizing culturally grounded content and making localized knowledge accessible and interpretable. Cultural service engagement and reflective integration require digitally mediated environments that support scenario-based simulation, structured interaction, and iterative feedback. Performance articulation highlights the role of information infrastructures in enabling assessable outputs aligned with service performance expectations. From an information systems perspective, these functions underscore the importance of information architecture, task sequencing, and feedback mechanisms in enabling scalable and service-relevant capability development.

The findings also highlight the need for adaptable digital infrastructure design. Strong expert support for integrating local cultural resources suggests that rigid or standardized content prescriptions are less effective than flexible system architectures that allow contextual localization while preserving consistent capability development logic. These insights extend to broader digitalisation trends in service-oriented SMEs, where business model innovation and internationalization processes are mediated by digital capabilities (Batuparan et al., 2025). At the same time, the rejection of generic calls for increased online participation or platform usage indicates that digital infrastructures deliver value only when tightly aligned with service capability objectives and operational task flows. This balance between structural coherence and contextual adaptability is central to the effective deployment of information systems within complex tourism service ecosystems.

Managerially, the framework guides decision-making by enabling system designers to select informatics platforms (e.g., those with robust data integration for cultural responsiveness), redesign service processes (e.g., incorporating feedback loops for performance articulation), and benchmark

capabilities (e.g., using the cycle to assess operational readiness in tourism subsystems). Policymakers can apply it to invest in digital infrastructures that align with logistics efficiency and service innovation goals.

5. Conclusion

This study contributes to service science and information systems research by articulating how informatics-supported infrastructures could potentially be designed to enable culturally responsive and experiential service capability development within tourism service systems. Rather than treating digital technologies as supplementary tools, the study conceptualizes information infrastructures as structural mechanisms that shape the codification of cultural knowledge, the mediation of experiential data, and the alignment of service-related decision-making processes.

Using the Fuzzy Delphi Method, the study established expert consensus on 62 validated indicators spanning conceptual orientation, capability objectives, content structuring, service environments, experiential interaction, capability evaluation, and digital support. Synthesized into a five-stage service capability development cycle—culture activation, knowledge structuring, cultural service engagement, reflective integration, and performance articulation—the framework provides an operational reference for designing information-enabled service subsystems that support service readiness, personalization, and innovation in culturally diverse tourism contexts.

By integrating culturally responsive principles with structured experiential logic and information infrastructure design, the study advances understanding of how service capability formation can be supported through coordinated information architectures and decision-support processes. The findings highlight the importance of aligning information flows, task sequencing, and feedback mechanisms with service capability objectives, offering practical insights for the development of scalable and context-sensitive digital service infrastructures within tourism service ecosystems.

Several limitations should be acknowledged. The expert panel was relatively small and regionally concentrated, reflecting a specific socio-cultural and institutional context. In addition, while the Fuzzy Delphi Method effectively identifies the importance and feasibility of indicators, it does not capture causal relationships or relative weights among capability elements. Future research could extend this work by engaging more diverse expert panels, applying weighting or modeling techniques (e.g., structural equation modeling), and examining the effects of informatics-supported service capability development on service performance, decision quality, and experiential outcomes across different tourism contexts through empirical case studies or quantitative validation in real service systems. Future research directions should be expanded to include cross-regional or international expert panels and stakeholders from logistics and information system design roles to enhance transferability.

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Appendix A: Detailed Fuzzy Delphi Indicators and Consensus Results

1. Summary of Defuzzification Values and Rankings for Service-Oriented Facilitation Logic

Item	Service Facilitation Logic Statement	(d) Values	Experts' Consensus	Defuzzification Val	Ranking
A1	Service facilitators should function as experiential guides and interaction coordinators rather than mere transmitters of standardized service scripts.	0.153	91.7%	0.733	1
A2	Service facilitators should enable service actors to explore, reflect, and construct experiential service knowledge through active participation in service processes.	0.093	75%	0.583	5
A3	Customers' and service actors' cultural experiences, perspectives, and interpretations should be actively integrated into service design and delivery processes.	0.178	91.7%	0.683	3
A4	Service actors should develop ownership of service performance through hands-on experiential engagement and practice-based service activities.	0.170	91.7%	0.717	2
A5	Service facilitators should scaffold experiential service processes that activate service actors' prior professional and cultural knowledge.	0.178	91.7%	0.683	3
A6	Service facilitators should incorporate local cultural references to support service identity formation and customer engagement.	0.093	75%	0.583	5

Note. The statements reflect service-oriented facilitation logic and capability development principles rather than pedagogical or instructional philosophies.

2. Summary of Accepted Items for Tourism Service Capability Objectives

Item	Service Capability Objective	Threshold (d) Values	Experts' Consensus	Defuzzification	Ranking
B1	Cultivate service actors' adaptability to blended, mobile, and digitally mediated service environments.	0.115	100%	0.650	7
B2	Develop service actors' intercultural competence for cross-cultural service interaction.	0.126	100%	0.656	6
B3	Foster service actors' critical judgment, self-awareness, and ethical responsibility in service encounters.	0.170	91.7%	0.717	1
B4	Enhance service capability development by integrating service principles with practice through authentic situational inquiry.	0.191	83.3%	0.650	7
B5	Develop service actors' ability to design inclusive and culturally sensitive marketing and	0.178	91.7%	0.700	3

Item	Service Capability Objective	Threshold (d) Values	Experts' Consensus	Defuzzification	Ranking
	service strategies.				
B6	Strengthen service actors' professional awareness and industry readiness within tourism service systems.	0.149	100%	0.717	1
B7	Strengthen service actors' adaptability and real-world service problem-solving capabilities.	0.178	91.7%	0.700	3
B8	Cultivate service actors' practical marketing capabilities, critical media literacy, and cultural sensitivity for application in digital tourism promotion services.	0.170	91.7%	0.667	5

Note. The objectives represent prioritized tourism service capability development goals rather than pedagogical or instructional outcomes.

3. Summary of Accepted Items for Tourism Service Content and Experiential Capability Components

Item	Service Content and Capability Components	Threshold(d) Values	Experts' Consensus	Defuzzification	Ranking
C1	Service content should reflect service actors' and customers' cultural backgrounds and lived experiences.	0.153	91.7%	0.650	5
C2	Service content design should respect and represent customer and service actor diversity.	0.193	83.3%	0.678	4
C4	Integrating local cuisine, crafts, and customs enriches tourism service content.	0.153	91.7%	0.650	5
C6	Emphasis should be placed on analyzing and understanding tourism service experiences.	0.178	91.7%	0.683	3
C7	Combining practical service skills with cultural knowledge enhances service actor competence.	0.170	91.7%	0.717	1
C8	Service content structure should follow a coherent modular logic across the service training system.	0.178	91.7%	0.683	3
C9	Service content should encompass five core service capability domains: psychological, sociocultural, decision-making, experiential, and cross-cultural.and cross-cultural.	0.191	100%	0.550	7
C10	Service Domain 1: Understanding tourism consumers by linking service experience with conceptual service models.	0.179	91.7%	0.694	2
C11	Service Domain 2: Psychological perspectives on motivation, perception, attitude, and cultural influences in service encounters.	0.093	75%	0.617	6

Item	Service Content and Capability Components	Threshold(d) Values	Experts' Consensus	Defuzzification	Ranking
C12	Service Domain 3: Sociocultural and economic factors shaping service behavior, including groups, norms, subcultures, and class effects.	0.191	83.3%	0.650	5
C13	Service Domain 4: Service decision journeys, including decision-making, satisfaction, and loyalty processes.	0.153	91.7%	0.650	5
C14	Service Domain 5: Cross-cultural service analysis and inclusive service marketing strategies.	0.153	91.7%	0.650	5
C15	Integrating heritage interpretation and community-based tourism enhances contextualized service understanding.	0.178	91.7%	0.500	8
C17	Introduce VR-based tourism applications and emerging technologies to support experiential service simulation.	0.149	100%	0.683	3
C18	Digital service platforms should integrate ethnic and cultural tourism content with online service resources.	0.115	100%	0.650	5
C20	Service content should integrate infographics, VR exhibits, and multimedia service tools.	0.178	91.7%	0.683	3
C21	Online service resources should support independent exploration and continuous service capability refinement.	0.115	100%	0.650	5

Note. The accepted items represent prioritized tourism service content and experiential capability components rather than course-based teaching materials.

4. Expert consensus on the Service Training Environment

Item	Service Training Environment (E)	Threshold (d) Values	Experts' Consensus	Defuzzification (A)	Ranking
E2	The service training space should be safe, inclusive, and flexible to support active participation in service capability development.	0.170	91.7%	0.667	2
E1	The service training environment should foster a welcoming atmosphere that respects diverse cultural perspectives.	0.153	91.7%	0.650	3
E3	The service training community should value and actively respect cultural diversity and heritage.	0.178	91.7%	0.683	1

Note. The environmental indicators describe contextual conditions for culturally responsive service capability development rather than classroom-based instructional settings.

5. Summary of Accepted Experiential Service Interaction Activities

Item	Experiential Service Interaction Activities	Threshold (d) Values	Experts' Consensus	Defuzzification (A)	Ranking
F1	Enhance service actor engagement through group discussions, role-based service simulation, and structured critical reflection activities.	0.191	83.3%	0.650	3
F2	Invite practitioners from the tourism industry and cultural sectors to enrich experiential service understanding.	0.145	91.7%	0.556	7
F3	Use online VR-based tours to facilitate virtual exploration of tourism service environments.	0.115	75%	0.650	3
F4	Encourage service actors to collect and analyse tourism-related advertisements on social media platforms.	0.191	75%	0.650	3
F6	Cultivate service actors' critical judgment regarding tourism service issues through immersive experiential activities.	0.153	91.7%	0.600	6
F8	Discuss and address cases involving cultural misunderstandings and cross-cultural challenges in tourism service encounters.	0.153	83.3%	0.650	3
F9	Engage service actors in cultural ambassador activities by narrating culturally grounded stories from their local contexts.	0.191	91.7%	0.650	3
F10	Organize experiential field engagement and visits to local cultural heritage service sites.	0.191	91.7%	0.650	3
F12	Guide service actors to design realistic tourism service solutions, such as itineraries, visitor codes of conduct, and cultural event designs.	0.170	91.7%	0.667	2
F14	Have service actors conduct a SWOT analysis of a tourism destination as a service system.	0.115	91.7%	0.650	3
F15	Require service actors to design customer experience journeys for tourist groups from different cultural backgrounds.	0.170	91.7%	0.633	4
F16	Have service actors analyze destination image formation using authentic tourism marketing materials.	0.178	91.7%	0.683	1
F17	Encourage service actors to share personal experiential insights related to cultural tourism services.	0.178	83.3%	0.616	5
F19	Require service actors to compare motivation or satisfaction differences among tourists from different cultural groups.	0.178	91.7%	0.683	1

Note. The accepted activities represent experiential service interaction mechanisms designed to support culturally responsive service capability development rather than classroom-based learning tasks.

6. Summary of Accepted Items for Service Capability Evaluation

Item	Service Capability Evaluation Items	Threshold (d) Values	Experts' Consensus Values	Defuzzification (A)	Ranking
G1	Evaluate service actors' performance holistically, including knowledge, attitudes (e.g., openness and engagement), skills (e.g., communication and critical judgment), and behavioral performance in intercultural service contexts.	0.178	91.7%	0.683	2
G4	Require group-based investigations comparing travel habits across social classes or subcultures, followed by service-oriented analytical presentations.	0.115	100%	0.650	4
G5	Assign bilingual (Chinese–English) tourism service brochure design tasks integrating the cognitive and affective components of destination image theory.	0.178	91.7%	0.700	1
G6	Organize group projects analyzing culturally significant destinations from a service system perspective, including heritage, authenticity, inclusion, exploitation, and protection.	0.178	91.7%	0.683	2
G7	Require service actors to design multicultural or inclusive tourism service experiences based on authentic stakeholder needs.	0.178	91.7%	0.700	1
G8	Ask service actors to plan simulated cultural festivals (e.g., Naadam), applying motivation and perception theories to service design, logistics, and promotion.	0.149	100%	0.683	3
G9	Conduct TikTok-based group tourism marketing projects targeting specific visitor segments, applying push–pull motivation and destination image theories.	0.136	100%	0.667	3
G12	Require digital-based evaluation tasks and authentic situational assessments (e.g., case analyses and VR-based field observations) to assess higher-order service judgment and decision-making capabilities.	0.149	91.7%	0.683	2

Note. The evaluation items represent mechanisms for assessing tourism service capability performance rather than classroom-based academic assessment.

7. Summary of Accepted Items for Digital Service Training Platform Resources and Support

Item	Aspect of Digital Service Training Platform Resources and Support	Threshold (d) Values	Experts' Consensus Values	Defuzzification (A)	Ranking
H1	Uploaded digital resources (e.g., readings, videos, assignments) should be closely aligned with service capability development objectives.	0.191	83.3%	0.650	5
H3	Uploaded digital resources should be well organized and easily accessible for service actors.	0.191	83.3%	0.717	1
H5	System notifications or reminders should be provided promptly to support service training process management.	0.153	100%	0.500	6
H6	Supplementary digital resources (e.g., article links or VR-based experiences) should be provided to enrich service content and experiential understanding.	0.178	91.7%	0.700	2
H8	Opportunities should be provided for online interaction and collaboration to support coordinated service capability development.	0.178	91.7%	0.700	2
H9	Digital resources should complement and extend structured service training activities rather than duplicate them.	0.178	91.7%	0.700	2