

A Cross-Cultural Design Study of a Railway App for Bangladeshi International Students in China

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Abstract— With the deepening of the Belt and Road Initiative, cultural exchange between China and Bangladesh has intensified, and the number of Bangladeshi students in China continues to grow. China's high-speed rail network is the primary mode of transport for these students, yet the official ticketing platform, the 12306 app, exhibits clear shortcomings in cross-cultural usability. This study takes Bangladeshi international students as its research subject and, through in-depth interviews, literature review, and competitive analysis, systematically identifies five major pain points these users encounter with 12306: cumbersome registration and passport verification, incomplete English translation, restricted payment options, difficulty navigating stations, and excessive interface information density. Interviewees consistently reported that language barriers and uncertainty surrounding identity verification generated persistent use-related anxiety. Building on these findings, the study applies Hofstede's cultural dimensions theory to trace the cultural roots of these pain points across six dimensions and derives five design principles: step-by-step guidance, instant feedback, transparent trust, explicit expression, and multilingual support. An HTML interactive prototype comprising seven core screens was developed, alongside a conversational agent, "Railway Assistant," built on the Coze platform to deliver step-by-step guidance and Bengali greetings. Evaluation via 31 questionnaires showed that 93.5% of respondents endorsed the step-by-step registration flow, and the passport-login entry point and multilingual switching received highly positive ratings; unexpectedly, more than 70% of respondents regarded the AI assistant as a core requirement. This research systematically introduces Hofstede's cultural dimensions theory into railway app design, establishes a mapping framework linking cultural dimensions, user pain points, and design elements, and validates the effectiveness of the resulting cross-cultural design principles through the Coze-based agent.

I. INTRODUCTION

A. Background and Motivation

Driven by globalization and the Belt and Road Initiative, educational exchange between China and Bangladesh has grown steadily, and Bangladesh has become one of the leading South Asian sources of international students in China. During their studies, these students rely heavily on China's high-speed rail network to travel and experience the country. China's rail system is efficient, safe, and convenient, making it the preferred mode of transport for international students.

However, practical use of the official ticketing platform, 12306, reveals substantial cross-cultural friction. The app was designed primarily around the habits and cognitive expectations of domestic Chinese users; although some multilingual support has been introduced, deficiencies remain in cultural adaptation, user cognition, and payment integration. These barriers not only degrade the travel experience of international students but also constrain their broader integration into Chinese society.

As the core digital gateway to China's rail services, 12306's design philosophy, information architecture, and interaction logic are deeply rooted in the habits of domestic users. For users from different cultural backgrounds, this "default design" often becomes an invisible barrier, manifesting as cumbersome registration with no real-time feedback, incomplete and jargon-heavy English translation, restricted payment methods, difficulty wayfinding in large stations, and excessive interface information density.

These difficulties are not purely linguistic; they reflect deeper cognitive and cultural differences. Bangladeshi users are accustomed to the design style of local platforms such as Shohoz, which favor step-by-step guidance and visual simplicity, whereas 12306 relies on an information-dense layout. This divergence in design philosophy mirrors differences between China and Bangladesh along cultural dimensions such as uncertainty avoidance, long-term orientation, and communication context. Hofstede's model offers a useful analytical starting point for systematically identifying the cross-cultural barriers Bangladeshi students encounter when using 12306.

B. Research Questions and Objectives

This study addresses four core questions: (1) What specific cross-cultural usability barriers do Bangladeshi international students encounter when using China's railway app (represented by 12306)? (2) What cultural cognitive differences and mental models underlie these barriers, viewed through frameworks such as Hofstede's cultural dimensions theory? (3) How can targeted design optimization strategies be derived from cross-cultural

design theory? (4) How can these strategies be translated into concrete design solutions and validated through testing?

Correspondingly, the study pursues six objectives: systematically identifying core pain points and their causes through in-depth interviews; comparing the design of 12306 and the Bangladeshi platform Shohoz in terms of information architecture, interaction logic, and visual style; constructing a cross-cultural design framework grounded in Hofstede's theory and China–Bangladesh intercultural communication research; developing an HTML interactive prototype that embodies the proposed design strategies; building a Coze-based conversational agent as a validation tool; and distilling a reusable cross-cultural design guide for similar digital-service contexts.

C. Related Work

Hofstede's cultural dimensions theory remains one of the most influential frameworks in cross-cultural design research. Originally derived from a survey of IBM employees across more than seventy countries, the model initially comprised four dimensions—power distance, individualism versus collectivism, masculinity versus femininity, and uncertainty avoidance—later extended to include long-term versus short-term orientation and indulgence versus restraint. Marcus and Gould applied the framework to global web-interface design and found systematic differences in color, layout, navigation, and interaction preferences across cultures, with high-uncertainty-avoidance users favoring structured, predictable interfaces. Clemmensen and Roesse's decade-long review of cross-cultural human–computer interaction research confirmed Hofstede's model as the dominant explanatory framework while noting that most studies have concentrated on Euro-American and East Asian comparisons, leaving South Asian users comparatively under-examined.

Research specific to China–Bangladesh intercultural communication is limited but instructive. Yang examined the two countries' cultural differences using Hofstede's five dimensions through questionnaires and interviews, while Ye focused on the adaptation challenges of Bangladeshi students in China, highlighting unfamiliarity with local rules, distrust of authority, and reliance on immediate feedback as factors shaping their experience of Chinese digital services. Shen et al. surveyed Chinese and Bangladeshi executives and found that Bangladeshi managers favor a more competitive negotiation style while Chinese counterparts tend toward accommodation and avoidance, providing further quantitative support for the cultural-dimension comparison used in this study.

Within China, researchers have examined railway-app usability, hierarchical models of user experience,

multilingual ticketing architectures, and design for specific domestic user groups such as elderly passengers or women traveling alone; however, few studies use nationality or cultural background as a design variable, and dedicated attention to international-student cohorts is rare. Internationally, researchers have examined usability and ergonomics of public-transport apps, mental-model-based user journeys, sentiment analysis of trip-planning apps, and acceptance models such as UTAUT combined with the System Usability Scale; Husnina et al.'s study of a Bangladeshi bus app specifically highlighted the roles of facilitating conditions, system fit, and cultural familiarity, noting that Bangladeshi users favor local mobile-finance tools such as bKash and Nagad over international credit cards.

Conversational agents have also emerged as a promising tool for culturally adaptive user service. Xu et al.'s AgentTOD framework demonstrates that large-language-model-driven task-oriented agents can flexibly invoke external APIs to manage multi-turn interactions beyond the

rigid structures of traditional dialogue systems. Domain examples include MyRailGuide, an Android application integrating an AI chatbot for train-status queries, and JR East's Travel Concierge pilot, which uses generative AI to assist international tourists in Japan. Naidoo and Chadha's CRAIF-C framework argues that AI systems failing to recognize cultural difference erode user trust, and that embedding cultural sensitivity throughout a chatbot's design lifecycle substantially improves cross-cultural user experience—an insight that directly informs the agent-based validation approach adopted in this study.

II. METHOD

This study follows a mixed-methods design combining qualitative user research with iterative design practice, structured around six stages: problem exploration, cultural analysis, design strategy formulation, prototype implementation, evaluation, and synthesis, as illustrated in Fig. 1. Table 1 summarizes the methods used, their purpose, and their outputs.

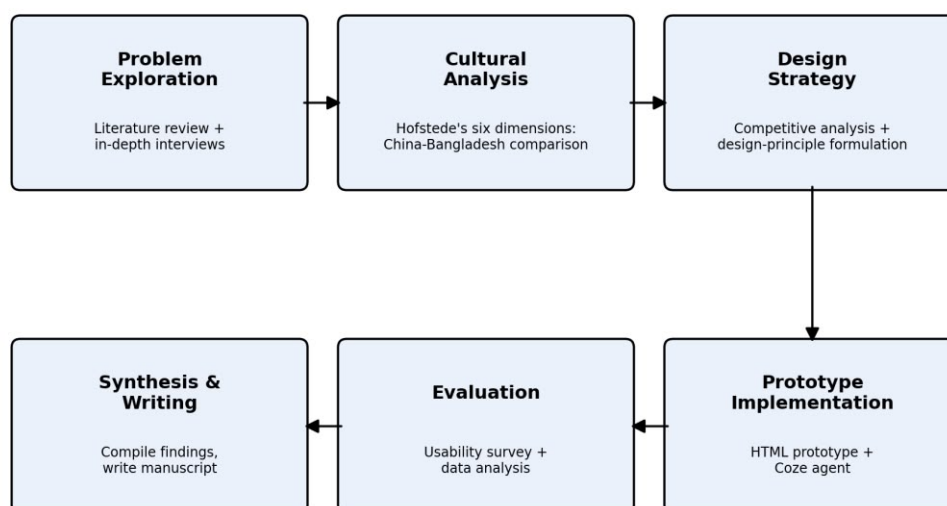


Fig. 1: Six-stage research workflow, from problem exploration through cultural analysis and design strategy to prototype implementation, evaluation, and synthesis.

Table 1: Research methods, purposes, and outputs

Method	Purpose	Output
Literature review	Synthesize cross-cultural design theory (Hofstede), China–Bangladesh intercultural research, and UX design principles	Theoretical basis and research framework
In-depth interviews	Semi-structured interviews with Bangladeshi students at Beijing Jiaotong University to surface authentic pain points	Pain-point inventory and interview transcripts
Competitive analysis	Compare 12306 and the Bangladeshi Shohoz app in information architecture, interaction logic, and visual style	Comparative analysis table

Cross-cultural analysis	Apply Hofstede's six dimensions to explain behavioral differences between Chinese and Bangladeshi users	Cultural-dimension comparison; culture–design mapping
Prototype design	Develop an interactive HTML prototype covering registration, search, and multilingual screens	Interactive HTML prototype
Agent construction	Build the "Railway Assistant" agent on the Coze platform for step-by-step guidance and Bengali greetings	Conversational Coze agent
Usability survey	Recruit Bangladeshi students to evaluate acceptance and satisfaction	User feedback report

A. User Interviews

Four Bangladeshi international students at Beijing Jiaotong University were interviewed semi-structurally, with sessions lasting 30–45 minutes. Eligibility required Bangladeshi nationality, at least one experience traveling by train or high-speed rail in China, and prior attempted or actual use of 12306. Interviews continued until responses reached thematic saturation. The interview guide covered eight areas without requiring strict sequencing: background and travel frequency, first impressions of the app, language and information comprehension, identity-verification

difficulties, payment adaptation, station wayfinding, comparison with local Bangladeshi travel apps such as Shohoz, and improvement expectations. Interviews were conducted primarily in Chinese, with English permitted for clarification, reflecting the reality that code-switching itself is a normal feature of intercultural communication.

Thematic analysis of the interview transcripts yielded five recurring problem dimensions: registration and authentication, language comprehension, payment methods, spatial navigation, and design preference. Table 2 summarizes representative feedback for each dimension.

Table.2: Summary of interview themes

Dimension	Main manifestations	Representative feedback
Registration & authentication	Cumbersome passport verification, long review waits, failed verification requiring in-person handling at the station	"Passport registration is troublesome"; "I tried many times"; "Had to go to the station to sort it out"
Language comprehension	Incomplete English translation, difficult professional terminology, fear of misreading information	"The English interface is incomplete"; "I don't understand '2nd class seat'"; "Afraid of misunderstanding and missing the train"
Payment methods	Requires a Chinese bank account, unstable international card payments, demand for local payment tools	"Need a Chinese bank card"; "International cards sometimes don't work"; "Wish it supported bKash"
Spatial navigation	Difficulty finding the way in large stations, no station maps, no real-time guidance	"Can't find the waiting area"; "The station is too big"; "Want walking-route guidance"
Design preference	Dense interface information, complex operation logic, preference for simple, step-by-step design	"Too many options"; "Shohoz is simpler"; "Fewer steps would be better"



Fig. 2: Home screen of the Bangladeshi platform Shohoz, showing its shallow information hierarchy, prominent core-function entry points, and bilingual (English/Bengali) labeling.

Table.3: Core design differences between 12306 and Shohoz

Dimension	12306 App	Shohoz App
Positioning	One-stop platform focused on rail ticketing and derivative services	Aggregated platform spanning multiple transport modes and local-life services
Info. architecture	High information density on the home page; many, deeply nested entry points	Simple home page; core functions are prominent with shallow, clear entry points
Booking flow	Information entered on a single, dense page before unified submission	Step-by-step flow, each step focused on a single task
Filtering	Multiple parallel filter conditions, dense option sets	Progressive filtering: origin/destination first, then date and service
Language support	Primarily Chinese; limited internationalization	English–Bengali bilingual switching with fairly complete coverage
Visual style	Rich color, dense information, function-oriented	Clean interface, clear contrast, generous white space

This comparison indicates that 12306 pursues functional completeness and operational efficiency by aggregating information within limited space, which raises interface density and lengthens the learning curve for first-time users, whereas Shohoz decomposes complex tasks into manageable steps and adopts a more restrained visual style

B. Competitive Analysis: 12306 vs. Shohoz

To move beyond attributing usage barriers to language alone, a competitive analysis compared 12306 with Bangladesh's leading multimodal travel platform, Shohoz, which supports bus, train, and ferry ticketing as well as food delivery and ride-hailing, with full English–Bengali bilingual support (Fig. 2). Biman Bangladesh Airlines and US-Bangla Airlines were consulted as secondary references. Shohoz was selected as the primary comparator because it is directly comparable to 12306 in rail-ticketing function, was familiar to all interviewees, and reflects prevailing Bangladeshi user habits.

The analysis focused on three dimensions—information architecture, interaction logic, and visual style—selected because they map most directly onto the difficulties interviewees reported ("interface too complex," "can't find functions," "too many steps"). Payment differences, although frequently mentioned, were treated as a contextual factor rather than an independent analytical dimension, since they depend on third-party payment integration and financial regulation outside the scope of interface design. Table 3 summarizes the core differences identified.

to reduce cognitive load. These design orientations correspond closely to interviewees' stated preferences: Bangladeshi students acknowledged 12306's functional completeness but preferred Shohoz's "fewer steps, more intuitive" operation, suggesting that a controllable, predictable process may matter more to these users than the

breadth of available functions, particularly in an unfamiliar linguistic and transport environment.

C. Cultural Analysis Framework

To connect observed behavioral preferences with cultural cognition, this study adopted Hofstede's cultural dimensions theory as its central analytical framework, using scores published by Hofstede Insights for China and Bangladesh (Table 4).

Table 4: Hofstede cultural-dimension scores for China and Bangladesh

Cultural dimension	China	Bangladesh	Interpretation
Power distance	80	80	Similar; both high-power-distance cultures
Individualism vs. collectivism	20	20	Similar; both strongly collectivist
Masculinity vs. femininity	66	55	China somewhat higher; more achievement-oriented
Uncertainty avoidance	30	60	Markedly different; Bangladesh notably higher
Long-term orientation	87	47	Markedly different; China notably higher
Indulgence vs. restraint	24	20	Similar; both restraint-oriented

Bangladesh's markedly higher uncertainty-avoidance score (60 vs. 30) suggests that Bangladeshi users are more comfortable with step-by-step, predictable interfaces and less tolerant of the information-dense layout that 12306 presents. China's markedly higher long-term-orientation score (87 vs. 47) suggests Chinese users more readily accept deferred feedback in pursuit of eventual efficiency, whereas Bangladeshi users place greater weight on visible progress at each step, consistent with interviewees' anxiety over unexplained verification delays. Although China and Bangladesh score identically on individualism–collectivism (20) and power distance (80), qualitative interview evidence

still revealed behavioral divergence: Chinese collectivism is paired with comparatively high institutional trust, while Bangladeshi collectivism centers on family and personal networks with more limited trust in formal institutions; and while both cultures nominally accept hierarchical authority, Chinese users tend toward substantive rule compliance whereas Bangladeshi users may exhibit surface compliance paired with informal, flexible workarounds. These qualitative distinctions, not captured by the numerical scores alone, informed a mapping from user pain points through cultural roots to design implications, shown in Fig.3

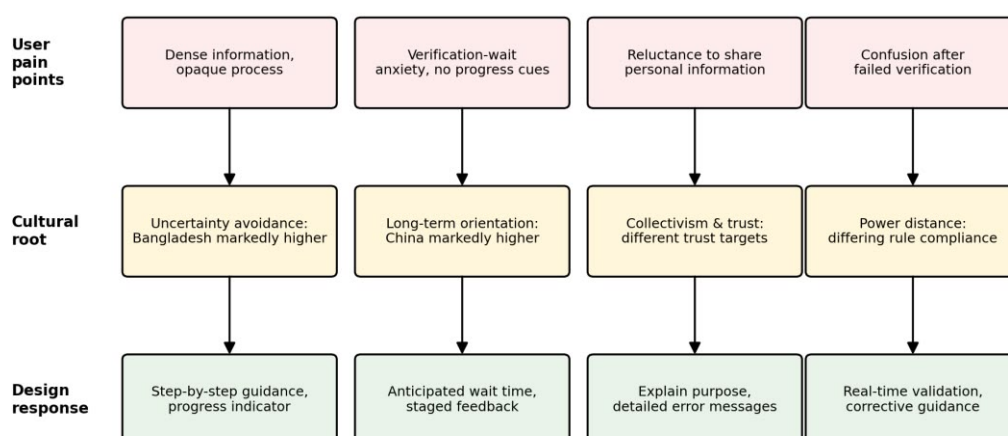


Fig. 3: Mapping from user pain points, through their underlying cultural roots, to the corresponding design responses.

Dimensions that did not yield a clear design correspondence in the interview and competitive-analysis material—masculinity–femininity and indulgence–restraint—were deliberately excluded from the mapping rather than forced into it, to preserve analytical focus.

III. RESULTS

A. Design Principles

Synthesizing the pain-point analysis and cultural mapping, five design principles were derived:

- Step-by-step guidance: complex flows such as registration and ticket purchase should be decomposed into a sequence of simple steps, each presenting limited information, reflecting Bangladesh's relatively high uncertainty-avoidance score (60).
- Instant feedback: every action should yield a clear status indication—success, failure, or in progress—reflecting Bangladeshi users' lower long-term-orientation score (47) and correspondingly greater emphasis on process controllability.
- Transparent trust: the purpose of every requested piece of information should be explained, and error messages should be specific, given Bangladeshi users' relatively cautious stance toward authority.
- Explicit expression: domain-specific terminology should be accompanied by explanation, and all interface text should be unambiguous, addressing a preference for direct, explicit communication.
- Multilingual support: Chinese, English, and Bengali interfaces, supplemented by a glossary, form the foundation on which the other principles depend, since language is the most immediate barrier reported by users.

B. Interface-Level Improvements

The redesigned home page reduces information density by moving the language-switch control to a prominent top position and adding a floating AI-assistant button in the lower-right corner, rather than embedding numerous function entries and an FAQ list on the landing screen, as shown in Fig. 4. The ticket-search page similarly simplifies the results list by deferring secondary information—such as seat-class detail—to the order-confirmation screen, and integrates filtering and sorting into the bottom navigation bar.

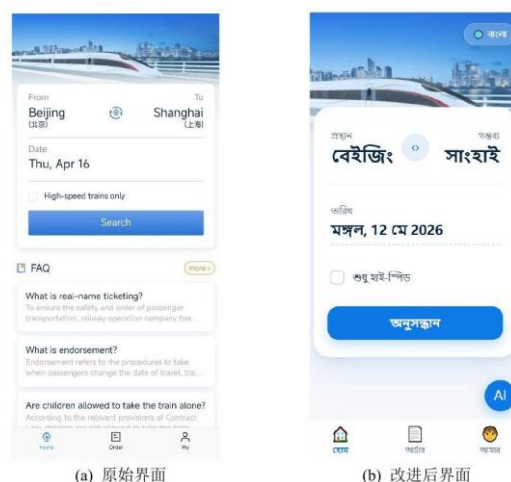


Fig. 4: Home-page comparison: (a) the original 12306 interface, dense with function entries and an FAQ list; (b) the redesigned interface, with a prominent language switch, a simplified search card, and a floating AI-assistant entry point.

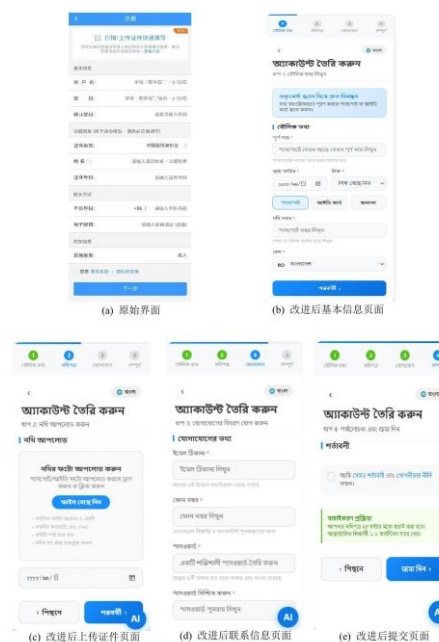


Fig. 5: Redesigned registration flow: (a) the original single-page form; (b)-(e) the four-step, progress-indicated flow with a fully localized Bengali interface and a persistent AI-assistant entry point.

The registration flow received the most substantial redesign: a single, dense form was decomposed into four progressive steps—basic information, document upload, contact confirmation, and submission—each displayed with a progress indicator at the top of the screen (Fig. 5). A dedicated "verification process" notice at the submission

step informs users of the expected review time and explicitly discourages repeated submission, directly addressing the interview finding that uncertainty about wait duration was a major source of anxiety. An AI-assistant button is available at every step as a non-intrusive floating icon rather than an automatic pop-up, so that users who do not need assistance are not interrupted.

The login page was enhanced with a dedicated passport-login option alongside the existing account-based login, plus WeChat and Alipay quick-login entries for domestic-style users, together with full Bengali interface support. The order-confirmation page—identified as a low-tolerance-for-error step—received a top-right language switch and a floating AI-assistant entry, allowing users to verify trip and payment details in their native language immediately before payment. The language-selection page was expanded to include a full Bengali option alongside the existing standard and accessibility versions, directly extending Shohoz's well-received bilingual pattern to the redesigned 12306 prototype.

C. Interaction-Layer Improvement: The AI-Assistant Pop-up

Because interface changes alone cannot resolve every cross-cultural barrier—such as ambiguous terminology, mid-task confusion, or the need to explain complex rules—an AI-assistant pop-up, "Railway Assistant," was designed as a complementary interaction layer. Tapping the floating AI button opens a chat-style panel that greets the user, states explicitly that the assistant is designed specifically for Bangladeshi students using China's railway system, and offers three core entry points: explaining Chinese rail rules, resolving identity-verification problems, and general question answering. A footer notice—"Content is AI-generated; for reference only"—ensures appropriate use of AI-generated guidance.

D. Design Validation Survey

To evaluate the redesigned prototype, a questionnaire was distributed to Bangladeshi students, yielding 31 valid responses, all from Bangladeshi nationals either studying in China or residing in Bangladesh. Respondents varied in Chinese proficiency (45.2% fluent or near-fluent, 48.4% basic conversational, 6.5% none) and in train-travel frequency (16.1% weekly, 19.4% monthly, 48.4% a few times per semester, 16.1% rarely or never). Of the 31 respondents, 27 (87.1%) had previously used 12306, with

23 describing it as "acceptable," 4 as "very difficult to use," and 4 reporting no prior use.

Acceptance of individual design changes was strong. All 31 respondents rated the dedicated passport-login option positively (24 "very convenient," 7 "fairly convenient"). The four-step registration flow was endorsed by 29 respondents (93.5%), with virtually all citing the same reason: "easier, because every step is clear"—a result consistent with Bangladesh's higher uncertainty-avoidance score. Integrating filtering and sorting into the bottom navigation bar was rated positively by 28 respondents (90.3%). The order-confirmation language switch was described as reassuring by 25 respondents (80.6%), with the remaining 6 neutral and none negative.

Evaluation of the AI-assistant button was more mixed: 24 respondents (77.4%) found it "very noticeable," while 4 (12.9%) reported not noticing it at all, indicating room to increase its visual prominence. The clarity of the bottom navigation icons received the weakest rating among all elements tested, with only 16 respondents (51.6%) finding them intuitive.

Regarding the AI assistant specifically, 24 respondents (77.4%) rated its interface layout "very clear." Critically, 26 respondents (83.9%) considered the assistant "essential, a core requirement," 4 (12.9%) viewed it as "optional," and only 1 (3.2%) considered it unnecessary—an unexpectedly strong endorsement given that the assistant was originally conceived as a supplementary feature. The most frequently requested assistant capabilities—passport-verification troubleshooting, waitlist-ticket rules, refund/rebooking guidance, and step-by-step purchase instructions—closely mirror the core pain points identified in the interview phase.

Qualitative feedback reinforced these quantitative findings. One respondent noted that the fully Bengali interface was "very helpful for those of us who sometimes struggle with English, and especially Chinese, interfaces," while others praised the AI assistant as "very innovative." One notable comment concerned terminology localization: a respondent who preferred the English interface observed that Bengali translations of technical rail terms sometimes fail to convey their precise meaning, and suggested pairing Bengali labels with the original English term. Table 5 summarizes the resulting terminology-localization strategy.

Table.5: Terminology-localization strategy examples

Chinese term	Translation issue	Proposed solution
Waitlist ticket (候补购票)	Direct Bengali translation fails to convey "queue for a refunded ticket"	Retain English "Waitlist Ticket" with a brief Bengali explanation
Rebooking (改签)	No direct Bengali equivalent exists	Use English "Reschedule / Change Ticket" as a transitional term
Real-name system (实名制)	Direct translation is long and hard to remember	Use the English abbreviation "Real-name System" with Bengali clarification

Overall, respondents strongly endorsed the registration redesign, passport login, and order-confirmation language switch, and rated the AI assistant as a near-essential feature; however, the survey's scope was limited primarily to interface layout, registration flow, multilingual support, and the AI assistant, leaving payment preferences and station navigation—both identified in interviews—insufficiently validated through quantitative data.

E. Conversational Agent Implementation and Testing

The "Railway Assistant" agent was built on the Coze platform, chosen for its no-code prompt configuration, knowledge-base support, and multilingual interaction capability. The agent's design targets four goals: step-by-step guidance, multilingual support (Chinese, English, and Bengali, with proactive Bengali greetings), cross-cultural explanation of design differences between the original and redesigned interfaces, and instant help on demand.

The prompt was structured around a role definition, a user-persona description, a defined capability set (registration and passport-verification guidance, ticket search/purchase/rebooking/refund instruction, explanation of special rules, boarding and station reminders, and cross-cultural explanation), a small set of Bengali greeting phrases, and response templates for six recurring scenarios. A knowledge base was populated with a roughly 50-term Chinese–English–Bengali glossary, screenshots comparing the original and redesigned registration screens, and documentation of the rationale behind each design change. Fig. 6 illustrates the resulting interaction flow.

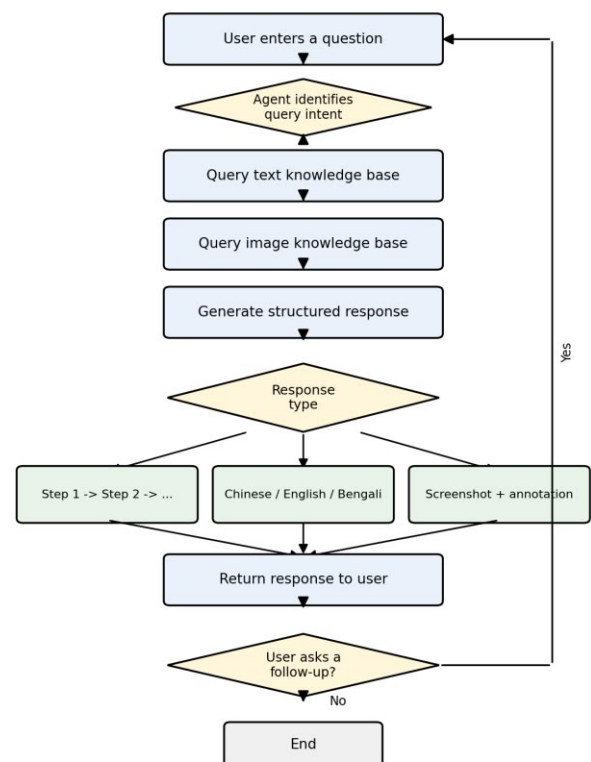


Fig. 6: Interaction flow of the Railway Assistant agent, from intent recognition through knowledge-base retrieval to structured, multilingual response generation.

Four test scenarios validated the agent's behavior. In a function-overview test, the agent listed its five core capabilities in a clearly itemized response and invited follow-up questions. In a registration-guidance test, the agent decomposed the process into four steps with English glosses for each term and proactively noted that "verification may take a few hours; do not resubmit," directly addressing a documented pain point (Fig. 7). In an image-explanation test, the agent displayed a screenshot of the Bengali order-confirmation screen and annotated its key elements with numbered labels. In a Bengali-language test, the agent correctly parsed a fully Bengali query about how

to purchase a 12306 ticket and replied in Bengali using a clarifying, step-by-step strategy—first asking for origin, destination, and travel date before offering guidance—confirming that the assistant could operate entirely within the user's native language.



Fig. 7: Railway Assistant test transcripts: (left) function-overview response listing the agent's five core capabilities; (right) registration-guidance response decomposing the process into four steps with English glosses.

Across all four scenarios, the assistant produced accurate, appropriately structured, and linguistically correct responses, with no observed language confusion when switching between Chinese, English, and Bengali input. Two limitations emerged: when a single message contained multiple distinct questions, the assistant tended to address only the final one; and the image-display feature required network connectivity. Recommended refinements include prompt templates for multi-question handling, voice-input support for noisy station environments, and an expanded knowledge base incorporating additional cross-cultural case examples.

IV. DISCUSSION

The findings indicate that Bangladeshi students' difficulties with 12306 arise from a systematic mismatch between two cultural profiles instantiated in a single digital interface. The app's design assumptions—tolerance for high information density, a preference for eventual efficiency over step-by-step transparency, default institutional trust, and an expectation that users will precisely follow formal rules—align with Chinese users' relatively low uncertainty avoidance, strong long-term orientation, and high institutional trust. Bangladeshi users, by contrast, bring a stronger need for process visibility, a preference for

structured guidance, and a more flexible, informally negotiated relationship with formal rules. Cross-cultural design improvement, in this light, is not simply translation or cosmetic polish; it requires identifying which specific design assumptions are culturally contingent and deliberately adjusting them.

The unexpectedly strong endorsement of the AI assistant—regarded as "essential" by over 80% of survey respondents despite its originally supplementary role—suggests that conversational, culturally adaptive support may address needs that static interface redesign alone cannot fully satisfy, particularly around rule explanation and real-time troubleshooting. This finding is consistent with Naidoo and Chadha's argument that culturally sensitive AI design measurably improves cross-cultural user trust and engagement.

The study nonetheless has several limitations. The interview sample ($n = 4$) and survey sample ($n = 31$) are small and geographically concentrated in Beijing, limiting generalizability to Bangladeshi students elsewhere in China or to other South Asian nationalities. No formal usability testing—System Usability Scale scoring, task completion time, or error-rate measurement under controlled conditions—was conducted; user endorsement instead reflects reactions to prototype demonstrations rather than sustained real-world use. Moreover, the survey concentrated on registration, language support, and the AI assistant, leaving payment-method adaptation and station-navigation support without dedicated quantitative validation. Finally, reliance on a single cultural framework cannot capture every dimension of cross-cultural difference relevant to interface design; complementary frameworks such as Hall's high-/low-context theory or Schwartz's value model may usefully extend the analysis in future work.

V. CONCLUSION

This study systematically examined the cross-cultural usability barriers Bangladeshi international students face when using China's 12306 railway app, and translated cultural-dimension analysis into concrete, testable design interventions. Five recurring pain points—registration and authentication, language comprehension, payment methods, spatial navigation, and interface design preference—were identified through in-depth interviews and interpreted through Hofstede's cultural dimensions theory, revealing that Bangladesh's higher uncertainty avoidance and lower long-term orientation, relative to China, largely explain user anxiety around process transparency and verification delay, while more subtle differences in trust mechanisms and rule-compliance behavior help explain users' hesitancy in

providing personal information and their difficulty completing rule-based verification steps.

Five design principles—step-by-step guidance, instant feedback, transparent trust, explicit expression, and multilingual support—were derived from this analysis and implemented in an interactive HTML prototype spanning seven core screens, complemented by a Coze-based conversational agent offering step-by-step guidance and Bengali-language interaction. Validation through 31 user questionnaires showed strong acceptance of the redesigned registration flow (93.5%), universal endorsement of the dedicated passport-login option, and an unexpectedly strong preference for the AI assistant as a core rather than supplementary feature (83.9% considering it essential; 96.8% willing to recommend it to peers).

This research contributes a systematic application of Hofstede's cultural dimensions theory to railway app design, establishing a reusable mapping between cultural dimensions, user pain points, and design elements, and demonstrates a practical, agent-based approach to validating cross-cultural design principles. Future work should expand the interview and survey samples across multiple cities and additional South Asian nationalities, conduct formal usability testing with standardized metrics such as the System Usability Scale, develop dedicated solutions for payment-method integration and in-station navigation, and explore complementary cultural frameworks to further refine the design-mapping approach introduced here.

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