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Policy

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Editor's Note

Dear Sir / Madam,

The JCAS journal has previously encountered certain setbacks; however, these challenges shall not diminish our resolve. Rather, all constructive feedback received will only serve to galvanize our efforts in disseminating superior knowledge to a broader audience. It remains our earnest aspiration to ascend to greater heights within two years, achieving renewed recognition. We persist steadfastly in our commitment to the pursuit of research characterized by exceptional quality and enduring scholarly value promise inherent to JCAS's academic mission. We warmly invite all colleagues to collaborate diligently towards this common objective.

We are delighted to announce the publication of the fifth volume, first issue of the Journal of China-ASEAN Studies (JCAS). This latest edition marks significant advancement towards securing Tier 2 accreditation from the Thai Citation Index (TCI), reflecting promising outcomes derived from our concerted academic endeavors. The international environment is currently experiencing substantial transformation, notably with ASEAN economies gaining prominence globally. Moreover, emerging considerations related to sustainability, Sustainable Development Goals (SDGs), and artificial intelligence (AI) necessitate rigorous analysis of evolving global environmental contexts (SDGs, AI).

Included in this issue are meticulously peer-reviewed articles expected to yield groundbreaking insights. Our strict adherence to peer-review protocols demonstrates our ongoing dedication to positioning JCAS as a reputable academic journal dedicated to China and ASEAN-related studies, with an ultimate goal of recognition by esteemed academic indices, including TCI 1, TCI 2, and Scopus. We anticipate continued scholarly contributions from researchers and academics, thus significantly furthering our collective academic goals.

JCAS distinguishes itself through an expansive interdisciplinary scope, addressing contemporary issues ranging from workforce dynamics and Sino-Thai relationships to business management, wellness paradigms, tourism, hospitality management, leisure studies, information technology, finance, accounting, communication arts, economics, education, humanities, arts and design, linguistics, applied sciences, and engineering. The journal's primary objective is to serve as a prestigious platform for academics, industry professionals, and students to disseminate both conceptual and empirical research of exceptional caliber. Manuscripts are invited in both Chinese and English to promote multilingual scholarly dialogue. JCAS is thus dedicated to publishing intellectually significant contributions and providing a platform for the rigorous discussion of advanced research methodologies and exemplary practices.

Yours sincerely

Editor-in-Chief
Asst. Prof. Dr. Chun-Shuo Chen
Journal of China-ASEAN Studies

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Cultural Intelligence and Fertility Decision-Making: Exploring Mediating Pathways in Sino-Thai Cross-Cultural Marriages

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Abstract

This study critically examines the mediating influence of cultural intelligence on the relationship between marital satisfaction and fertility intentions among Sino-Thai cross-cultural couples. Employing a methodologically rigorous approach, we surveyed 196 Chinese nationals married to Thai partners using validated instruments: The General Attitudes towards Intercultural Marriage Scale, the Cultural Intelligence Scale, and the Fertility Desire Scale. Correlational analyses revealed significant positive associations among marital satisfaction, cultural intelligence, and fertility intentions. Furthermore, mediation analysis demonstrated that cultural intelligence partially mediates the impact of marital satisfaction on fertility intentions. These findings underscore the pivotal role of cultural intelligence in navigating intercultural marital dynamics and fertility decision-making. The study contributes to the scholarly discourse by elucidating the complex interplay of cultural factors in cross-cultural marriages, particularly within the Sino-Thai context. Implications suggest that enhancing cultural intelligence may foster greater marital satisfaction and promote positive fertility intentions, thereby informing interventions and policies aimed at supporting intercultural couples.

Keywords: Cross-Cultural Marriage; Cultural Intelligence; Fertility Intentions; Sino-Thai Intercultural Relationship, Mediating Effects

1. Introduction

1.1 Research Background and Problem Statement

Globalization has unequivocally catalyzed the proliferation of cross-cultural marriages (Gaidukova, 2022; Piller, 2010). Facilitated by advancements in mobility, communication technologies, and economic interconnectedness, it has engendered an environment conducive to cross-cultural interactions and unions (Denoux & Simou, 2022; Safronova & Michshenko, 2023). This trend is exemplified by individuals from disparate cultural backgrounds forming relationships characterized by mutual understanding and shared experiences (Khatib-Chahidi et al., 2021; Machette & Cionea, 2023). In the Sino-Thai context, the historical continuum of Chinese migration to Thailand since the 19th century has established a robust foundation for contemporary cross-cultural marriages (Yao & Nie, 2024). Chinese immigrants have significantly influenced Thai society, embedding themselves in its socio-cultural and economic

fabric (Yao & Nie, 2024). Presently, these marriages manifest in Thai individuals marrying Chinese in China and Chinese individuals relocating to Thailand to marry Thais. While enriched by shared historical ties and cultural exchanges, they navigate complexities such as language barriers, cultural expectations, and familial dynamics (Barker, 2015; Koc, 2020). Thus, the intersection of globalization and historical Sino-Thai relations provides a compelling framework for examining the multifaceted nature of contemporary cross-cultural marriages, underscoring both challenges and opportunities inherent in these unions (Piller, 2010; Skuybedina & Khimich, 2021).

Cross-cultural marriages between spouses from distinct cultural milieus have proliferated due to heightened globalization and mobility (Gaidukova, 2022; Safronova & Michshenko, 2023). These unions blend diverse customs, traditions, and worldviews, engendering enriching experiences alongside formidable challenges (Barker, 2015; Koc, 2020). The crux of the problem lies in the interplay of cultural intelligence as a mediating factor between cross-cultural marriage and fertility intentions (Gonçalves & Sousa, 2022; Inkson & Thomas, 2011). Such marriages can enhance personal growth, foster greater tolerance, and deepen relational bonds through shared navigation of cultural disparities (Barker, 2015; Inkson & Thomas, 2011). However, they confront significant obstacles like communication barriers, conflicting cultural norms, familial and societal pressures, and the arduous task of identity negotiation (Denoux & Simou, 2022; Piller, 2010). Research underscores these challenges, highlighting issues like family conflicts, communication problems, and the emotional toll on marital satisfaction (Khatib-Chahidi et al., 2021; Machette & Cionea, 2023). Moreover, diverse values toward life and fertility further complicate these relationships (Berrington, 2021; Ji, 2021). Core value clashes regarding religious beliefs, gender roles, and individualism versus collectivism can engender discord in decision-making and conflict resolution (Barker, 2015; Denoux & Simou, 2022). In summation, the nexus between Sino-Thai cross-cultural marriage and fertility intentions is profoundly mediated by cultural intelligence (Gonçalves & Sousa, 2022; Koc, 2020). Addressing this necessitates a nuanced understanding of the multifaceted cultural dynamics at play, thereby contributing to the broader discourse on intercultural relationships and their socio-demographic implications (Barker, 2015; Koc, 2020).

1.2 Gap and Values of Research

Despite burgeoning interest in cross-cultural marriage studies, a notable research gap persists in understanding how cultural intelligence mediates the relationship between intercultural marital dynamics and fertility intentions (Gonçalves & Sousa, 2022; Inkson & Thomas, 2011). The extant literature predominantly addresses superficial elements such as communication barriers and cultural conflicts, neglecting the profound influence of underlying value systems on fertility decisions (Berrington, 2021; Tan, 2023). Focusing on the Sino-Thai cross-cultural marriage context, this study addresses this lacuna by offering nuanced insights into how deeply ingrained cultural intelligence shapes reproductive intentions amid cultural confluence (Gonçalves & Sousa, 2022; Yao & Nie, 2024). The research's value lies in its potential to significantly contribute to academic discourse on intercultural relationships and their socio-demographic implications (Barker, 2015; Denoux & Simou, 2022). It provides a robust framework for policymakers and social scientists to comprehend the complexities of

cultural intelligence in cross-cultural marriages, thereby fostering informed strategies to support these unions (Gonçalves & Sousa, 2022; Inkson & Thomas, 2011). This study not only advances theoretical understanding but also has practical implications for enhancing marital satisfaction and fertility outcomes in intercultural contexts, bridging crucial gaps in cross-cultural, demographic, and sociological research (Ji, 2021; Tan, 2023).

1.3 Research Questions

This study aims to elucidate the complex interplay between Sino-Thai cross-cultural marriages, cultural intelligence, and fertility intentions. To this end, given the complex interplay of cultural dynamics and personal values in Sino-Thai cross-cultural marriages, this study seeks to address the following research questions

1) What are the significant relationships among marital satisfaction, cultural intelligence, and fertility intentions in Sino-Thai intercultural unions?

2) To what extent do cultural intelligence mediate the relationship between intercultural marital dynamics and fertility intentions in Sino-Thai marriages?

2. Literature Review

2.1 Definition of Cross-Cultural Marriage, Cultural Intelligence and Fertility Intentions

Cross-cultural marriages, uniting individuals from disparate cultural backgrounds, necessitate complex negotiations of identity and communication strategies (Breger and Hill, 2021; Hsu, 2017). Influenced by factors such as linguistic proficiency, cultural fluency, and legal frameworks (Jackson, 2019; 2023; Semafumu, 2021), these relationships require cultural sensitivity, mutual understanding, and adaptive communication for success (SAGE Encyclopedia, 2017; Wiruchnipawan & Chua, 2018). Their formation and maintenance are shaped by socio-cultural contexts, individual choices, and global migration patterns (Khatib-Chahidi et al., 2021; Tremayne, 2001). Moreover, offspring experiences from such unions provide valuable insights into cultural integration and identity formation processes (Maxwell, 2021). This multifaceted phenomenon demands continuous adaptation and the development of intercultural competence to achieve relational harmony.

Cultural Intelligence (CI) denotes an individual's proficiency in functioning effectively within culturally diverse environments. This study conceptualizes CI as an integrative construct encompassing cognitive, motivational, and behavioral dimensions that facilitate cross-cultural interactions. Anchored by Ang and Dyne's (2015) definition—"a person's capability to adapt effectively to new cultural contexts"—this conceptualization aligns with perspectives emphasizing components enhancing intercultural adaptability (Thomas & Liao, 2023; Thomas & Inkson, 2017). Initially introduced by Smith (1954), CI's scope has been expanded by scholars like Gavriel (2020), who incorporated ethnographic intelligence, Caligiuri (2023), who highlighted cultural agility, and Anne-Crowne and Lo (2023), who differentiated CI from social and emotional intelligence. Berry (2022) positions CI as integral to intelligence aligned with ecological and cultural adaptation. The evolving nature of CI necessitates ongoing scholarly examination and refinement.

Fertility intentions, individuals' childbearing plans, are influenced by various factors. Recent studies underscore the complex interplay of environmental, socioeconomic, and cultural determinants shaping reproductive decisions. Bastianelli (2024) examines climate

change's impact on European fertility choices; Parra-Pérez (2020) investigates fertility dynamics in China's tourism-driven economy. Sobotka and Beaujouan (2017, 2021) analyze consequences of delayed motherhood in low-fertility nations. Gender inequality emerges as significant, evidenced by Yoon's (2016) research in South Korea and Wu et al.'s (2024) study on East Asian childcare systems. Comparative analyses of Asian fertility trends are provided by Gietel-Basten et al. (2018) and Tsuya (2019). Shreffler (2024) adopts a global public health perspective, while Brünig (2023) examines fertility intentions among European migrants and minorities.

2.2 Relationships between Cross-Cultural Marriage and Cultural Intelligence

Cross-cultural marriages serve as a profound domain for the development of cultural intelligence, as these unions inherently necessitate the continuous negotiation of diverse cultural identities and practices (Breger & Hill, 2021; Schick; 2017). The scholarly discourse posits that cultural intelligence, defined as the capability to function effectively in culturally diverse settings, is significantly enhanced through prolonged cultural exposure, such as that experienced in cross-cultural marriages (Anne-Crowne & Lo, 2023; Breger & Hill, 2021). Moreover, Maxwell (2021) contend that cross-cultural marriages provide an immersive environment that fosters the acquisition of cultural intelligence by compelling individuals to engage deeply with another culture on both cognitive and emotional levels. This continuous engagement contributes to the development of a more nuanced understanding and appreciation of cultural differences, thereby augmenting cultural intelligence (Breger & Hill, 2021; Weisfeld et al., 2017). The theoretical framework advanced by Crowne (2013) further suggests that the emotional intelligence developed within such marriages is instrumental in enhancing one's cultural intelligence, as emotional intelligence facilitates more effective interpersonal interactions across cultural boundaries. Given the empirical and theoretical evidence, it is plausible to hypothesize below:

H1a: There is a positive and significant relationship between cross-cultural marriage and cultural intelligence

This hypothesis is supported by the argument that the unique intercultural experiences inherent in cross-cultural marriages act as catalysts for the development of cultural intelligence, thereby underscoring the integral role of cross-cultural marriages in promoting intercultural understanding and competence (Maxwell, 2021; Yamani, 2021;). The potential implications of this relationship extend beyond the individual level, influencing broader sociocultural dynamics and contributing to the global discourse on cross-cultural adaptation and integration.

2.3 Relationships between Cross-Cultural Marriage and Fertility Intentions

The literature reveals that unique socio-cultural dynamics in cross-cultural marriages influence fertility intentions through the interplay of cultural convergence and divergent reproductive strategies (Cheng & Hsu, 2020; Kohlmann, 2002). Tremayne (2001) argues these marriages necessitate renegotiation of gender roles and family planning, recalibrating fertility intentions based on educational attainment and household labor division (Cross-cultural marriage and family, 2017; Kohlmann, 2002). Family policies significantly shape these intentions, particularly via gender-role preferences (Cheng & Hsu, 2020). Hewitt and Churchill (2020) describe a hybrid family planning model incorporating both cultures, complicated by individual agency and choices inherent in cross-cultural marriages (Breger & Hill, 2021). Understanding the cross-cultural value of children is essential for grasping the

fertility intentions of couples navigating conflicting expectations (Hewitt & Churchill, 2020; Kohlmann, 2002). Intercultural couples negotiate cultural values and expectations around parenthood, influencing fertility intentions as they reconcile divergent norms (Breger & Hill, 2021; Kohlmann, 2002). Globalization necessitates nuanced study of these intentions, considering the interplay between individual preferences, cultural backgrounds, and societal influences (Hewitt & Churchill, 2020). The literature underscores the intricate relationship between cross-cultural marriage and fertility intentions, shaped by cultural, educational, and policy factors. Future research should explore these dynamics to better understand intercultural couples' reproductive decisions (Cheng & Hsu, 2020; Kohlmann, 2002; Refsing, 2021), contributing to demographic trends and social change. Given the significant role of cultural adaptation in cross-cultural marriages, the research proposes the following hypothesis 1b:

H1b: Cross-cultural intelligence is positively correlated with fertility intentions

2.4 Relationships between Cross-Cultural Marriage and Fertility Intentions

The academic discourse elucidates how cross-cultural marriages influence fertility intentio ns. Dewangan et al. (2022) argue that cultural intelligence fosters harmony and stability in cro ss-cultural unions, essential for family and fertility decisions. Wawrosz and Jurásek (2022) su ggest it preserves distinct cultural identities, easing discussions about starting a family, and le ads to better cross-cultural adjustment linked to higher fertility intentions. Malay et al. (2024) find that cultural intelligence reduces perceived cultural distance, improving relational outcom es and facilitating long-term commitments, including childbearing decisions. Lower ethnocen trism combined with higher cultural intelligence enhances intercultural interactions (Young, H affejee, & Corsun, 2017). Partners embracing each other's cultural norms, including family pl anning attitudes, enable open discussions on desired family size. Çelik et al. (2021) highlight a positive correlation between cultural intelligence and relationship satisfaction, a critical fact or in deciding to have children. Baldwin et al. (2023) demonstrate that cultural intelligence fa cilitates effective intercultural communication, increasing positive fertility intentions by helpi ng couples navigate challenges. Tremayne (2001) emphasizes the necessity of cultural intellig ence in transnational cross-cultural marriages, leading to relational stability that positively inf luences fertility intentions. Ng (2013) underscores its role across intercultural contexts in relat ional satisfaction and life decisions, including fertility. Koc (2020) notes that intercultural com petence ensures the sustainability of cross-cultural marriages; couples with strong competence have enduring relationships, correlating with higher fertility intentions as they navigate cultur al differences to reach mutually satisfying decisions. Collectively, literature supports that cros s-cultural marriage positively correlates with fertility intentions, with cultural intelligence as a central factor. It enables partners to navigate intercultural complexities, fostering stability and facilitating discussions about family formation. Therefore, based on these studies, the present research formulates the following hypothesis:

H1c: Cross-Cultural Marriage is positively correlated with fertility intentions.

This hypothesis is grounded in the extensive body of literature that underscores the role of cultural intelligence and intercultural competence in fostering successful cross-cultural marriages, which, in turn, positively influences partners' decisions regarding fertility (Baldwin et al., 2023; Dewangan et al. 2022; Koc, 2020; Malay et al., 2024; Su, 2022; Wawrosz & Jurásek, 2022; Young et al., 2017).

2.5 Cultural Intelligence as a Mediating Factor toward Cross-Cultural Perspective

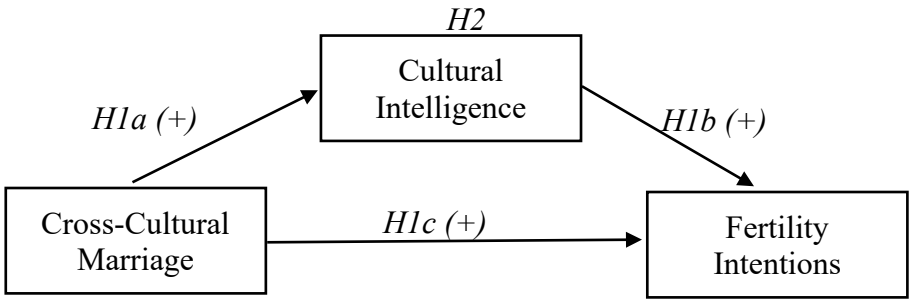
In the evolving field of cross-cultural psychology, contemporary research increasingly hig hlights the complexities of cross-cultural marriages, particularly in relation to fertility intentio ns. The concept of cultural intelligence (CI), defined as an individual's ability to navigate and adapt to diverse cultural contexts (Crowne, 2013), has emerged as a pivotal mediating variabl e in the dynamic between cross-cultural unions and reproductive decisions. Regarding researc h hypothesis 2:

H2 Cultural intelligence exerts a mediating effect in the relationship between cross-cultura l marriage and fertility intentions.

The hypothesis is substantiated by a substantial body of literature as illustrated below. Res earch indicates that higher levels of CI enable more effective communication, mutual understa nding, and conflict resolution among partners from different cultural backgrounds, thereby fos tering a more collaborative approach to family planning (Liao & Thomas, 2020; Thomas & Li ao, 2023). The confluence of diverse cultural norms, values, and practices inherent in cross-cu ltural marriages can often lead to misunderstandings or conflicts, particularly regarding fertilit y decisions (Hewitt & Churchill, 2020; Schick; 2017). In this context, CI emerges as a crucial competence that mitigates these challenges by enhancing the ability to interpret and respond t o cultural cues in a manner that promotes empathy, reduces ethnocentric biases, and fosters re lational harmony (Crowne, 2013; Liao & Thomas, 2020). Empirical studies further elucidate t he mediating role of CI, demonstrating that culturally intelligent individuals are more adept at negotiating cultural norms and societal expectations, thereby influencing fertility intentions i n cross-cultural marriages (Khatib-Chahidi et al., 2021). For instance, Bisin and Tura (2019) f ound that couples with higher cultural integration and understanding are more likely to align t heir fertility intentions, underscoring the importance of CI in harmonizing divergent cultural e xpectations. Moreover, CI not only mediates the relationship between cross-cultural marriage and fertility intentions but also moderates the impact of external stressors on marital stability, as couples with high CI are better equipped to handle cultural conflicts and adapt to changing circumstances (Liao & Thomas, 2020). This perspective is echoed by Thomas and Liao (202 3), who assert that CI enhances relational dynamics by fostering a conducive environment for discussing and aligning fertility intentions. Additionally, research suggests that CI empowers i ndividuals to resist societal pressures and make autonomous decisions regarding family plann ing, further highlighting its significance in cross-cultural contexts (Hewitt & Churchill, 2020; Liao & Thomas, 2020). In conclusion, the hypothesis that CI generates a mediating effect in t he relationship between cross-cultural marriage and fertility intentions is robustly supported b y empirical evidence. Enhancing CI among cross-cultural couples could thus be a strategic int ervention to promote marital harmony and facilitate cohesive decision-making processes rega rding fertility, aligning with broader socio-cultural factors and fostering an environment cond ucive to informed and mutually agreeable reproductive decisions (Bisin & Tura, 2019; Khatib -Chahidi et al., 2021). This underscores the imperative of integrating CI development into pro grams aimed at supporting cross-cultural marriages, thereby enhancing both relational and rep roductive outcomes in an increasingly globalized society.

In summation, the prevailing hypotheses articulated within this study have been synthesiz ed into the accompanying theoretical framework as illustrated in Figure 1 below. This framew ork serves as a schematic representation, mapping the conjectured relationships and variables under investigation. It is constructed with the intention of guiding subsequent empirical inquir y and facilitating a deeper understanding of the phenomena at hand.

Figure 1
Theoretical Framework of the Current Research



3. Methodology

3.1 Sample Cohort Selection and Description

The research cohort comprised 196 Chinese nationals (N=196) residing or working in Thailand, all engaged in heterosexual marriages with Thai nationals. Participants were recruited via a meticulously designed survey disseminated through the "Chinese Working and Living in Thailand" social media platform. Geographically, the sample spanned Bangkok, Chiang Mai, and Chonburi, and was stratified by gender, age cohorts, and location to provide a multifaceted depiction of the population.

The gender composition exhibited a slight male majority, with 104 men (53.1%) married to Thai women and 92 women (46.9%) wedded to Thai men, enhancing the study's capacity to explore gender-specific variations in cross-cultural marital dynamics and fertility intentions. A pronounced urban concentration was evident, with Bangkok hosting the majority of participants (n=115, 58.7%), followed by Chonburi (n=44, 22.4%) and Chiang Mai (n=37, 18.9%), allowing for comparative analysis of urban, industrial, and cultural milieus on cross-cultural couples. Age stratification revealed a predominance of participants in middle adulthood, with the majority between 30 and 50 years: 76 participants (38.8%) aged 30–40 and 92 participants (46.9%) aged 41–50. A smaller proportion included those under 30 (n=11, 5.6%) and over 50 (n=17, 8.7%). This age distribution is particularly pertinent for investigating fertility intentions during prime reproductive years. As elucidated in Table 1, this demographic profile demonstrates a relatively balanced gender ratio and significant urban concentration, particularly in Bangkok. The emphasis on midlife participants provides a rich substrate for exploring the complex interplay between cultural background, age, and fertility intentions within cross-cultural marriages. This sets the stage for a nuanced examination of how cultural adaptation, socioeconomic status, and life stage intersect to shape the reproductive decisions and family-building aspirations of Chinese expatriates in Thailand.

Table 1

Overview of Research Participants' Demographic Characteristics (N=196)

Characteristic	Categories	N	Percentage (%)
Gender	Male	104	53.1
	Female	92	46.9
Age	<30	11	5.6
	30-40	76	38.8
	41-50	92	46.9
	>50	17	8.7
Residence Area	Bangkok	115	58.7
	Chiang Mai	37	18.9
	Chonburi	44	22.4

3.2 Research Instrumentations

3.2.1 General Attitudes towards Intercultural Marriage Scale (GAIMS)

The General Attitudes towards Intercultural Marriage Scale (GAIMS) was adapted from the General Attitudes towards Marriage Scale (GAMS) developed by Park and Rosén (2013). This scale, comprising 10 items, is designed to measure individuals' perceptions and attitudes toward marriage, including positive attitudes, negative attitudes, and associated fears. The scale operates on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), providing a quantitative means of measuring an individual's stance on marriage. The internal consistency of the GAMS, reported in its original validation, was robust with a Cronbach's alpha of .84, indicating high reliability. The construct validity of the scale was confirmed through various statistical tests, ensuring its applicability in cross-cultural contexts. In this study, the scale's adaptability allows for nuanced insights into how cultural factors may influence intercultural marriage attitudes.

3.2.2 Cultural Intelligence Scale (CQS)

The Cultural Intelligence Scale (CQS), initially developed by Ang et al. (2007), was employed in its adapted form as validated by Bücker, Furrer, and Peeters Weem (2016). The scale assesses individuals' cultural intelligence across four dimensions: cognitive, metacognitive, motivational, and behavioral, with a total of 20 items. To ensure cross-cultural applicability, confirmatory factor analysis (CFA) was utilized, revealing adequate model fit indices, including an RMSEA of .050 and .071 for Chinese and Dutch samples, respectively. Reliability was demonstrated through Cronbach's alphas ranging between .72 and .83, indicating strong internal consistency across cultural contexts. The scale's discriminant validity was partially supported, necessitating further examination of social desirability influences. Nevertheless, the two-dimensional adaptation of the CQS provided improved psychometric properties, supporting its use in cross-cultural studies, including the current investigation of Sino-Thai marriages.

3.2.3 Fertility Desire Scale (FDS)

The Fertility Desire Scale (FDS), as adapted from Naghibi et al., (2019), consists of 16 items grouped into three dimensions: Positive Childbearing Motivations, Childbearing Worries, and Social Beliefs. This newly modified version emphasizes positive statements and was validated using exploratory factor analysis (KMO = 0.761, $\chi^2(78) = 1966.558$, $p<0.05$), indicating suitable sampling adequacy for the analysis. Cronbach's alpha values, ranging from 0.718 to 0.781 across the dimensions, demonstrate the scale's good reliability, while test-retest Pearson correlations confirmed its stability over time. This instrument is vital for capturing individuals' fertility intentions within the specific context of cross-cultural marriage, where cultural intelligence may play a significant mediating role. All in all, Table 2 below detailed the summary

of research instruments provides a clear, organized presentation of the scales used in this stud y, ensuring methodological rigor and clarity.

Table 2
Breakthrough of Research Instruments

Scale	Author (Year)	Item	Dimensions	Reliability	Validity
General Attitudes towards Intercultural Marriage Scale (GAIMS)	Park & Rosén (2013)	10 items	Positive, Negative Attitudes; Fears	Cronbach's α =.84	Construct validity confirmed; adapted for intercultural marriage context
Cultural Intelligence Scale (CQS)	Bücker et al. (2016)	20 items (adapted)	Cognitive, Metacognitive, Motivational, Behavioral	Cronbach's α =.72-.83	CFA conducted, acceptable RMSEA and model fit indices; discriminant validity partially supported
Fertility Desire Scale (FDS)	Naghibi et al. (2019)	16 items (adapted)	Positive Childbearing Motivations, Childbearing Worries, Social Beliefs	Cronbach's α =.718-.781	KMO=]0.761, $\chi^2(78)=1966.558$, $p< 0.05$; Pearson correlations confirmed test-retest reliability

3.3 Procedure and Data Analysis

The study employed validated instruments, including the General Attitudes towards Inter cultural Marriage Scale (GAIMS), the Cultural Intelligence Scale (CQS), and the Fertility Des ire Scale (FDS). A comprehensive online principal survey questionnaire was developed, integ rating these scales to guarantee accurate measurement of the constructs under scrutiny. The su rvey was disseminated through a social media platform, specifically aimed at Chinese individ uals residing and working in Thailand. Data collection commenced on 16 January 2024 and c ontinued until 15 February 2024. Of the 208 questionnaires received, 12 were excluded due to invalidity, yielding a final sample of 196 valid responses. This equates to a valid response rat e of 94.2%, indicating robust participant engagement and high data reliability. The structured methodology employed in the design, distribution, and validation of responses ensures that th e data are both representative and methodologically sound, thus facilitating robust conclusion s regarding the interrelationship between cultural intelligence, attitudes towards intercultural marriage, and fertility intentions within Sino-Thai cross-cultural contexts.

Quantitative research design employed a rigorous data analysis protocol. Utilizing SPSS 25.0, a mediation analysis (Independent Variable-Mediating Variable-Dependent Variable) wa s conducted following Baron and Kenny's (1986) paradigm to elucidate indirect variable relat ionships. The model posited cross-cultural marriage as the independent variable, fertility inte ntions as the dependent variable, and cultural intelligence as the mediator. Linear regression a nalysis elucidated the mediator's influence on the IV-DV relationship. The four-step Baron an

d Kenny procedure was implemented to assess: (1) IV-DV effects, (2) IV-MV influence, (3) MV-DV impact, and (4) attenuation of IV-DV direct effects post-MV inclusion. This methodo logical approach illuminated Cultural Intelligence's pivotal mediating role in fertility decision -making within Sino-Thai unions.

4. Results

4.1 Positive Relationships Found among Three Research Variables

The correlation analysis, utilizing Pearson's correlation coefficients, identifies significant associations among the three variables under investigation. Specifically, cross-cultural marital satisfaction (IV) displays a strong positive correlation with cultural intelligence (MedV) (r=.615, $p < .001$), suggesting that higher levels of marital satisfaction correspond with greater cultural intelligence. Moreover, cross-cultural marital satisfaction demonstrates an even stronger correlation with fertility intentions (DV) (r =.693, $p < .001$), indicating that individuals reporting higher marital satisfaction are more likely to express positive fertility intentions. Cultural intelligence also exhibits a significant correlation with fertility intentions (r=.609, p <.001), reinforcing the notion that increased cultural intelligence is positively linked to heightened fertility intentions within these intercultural marriages. The descriptive statistics reveal relatively moderate mean values for cross-cultural marital satisfaction (M= 3.341, SD =.735), cultural intelligence (M=3.352, SD=.856), and fertility intentions (M=3.309, SD =.803), indicating variability within the sample. This underscores the presence of a spectrum of experiences within these marriages, thereby emphasizing the importance of cultural adaptation in promoting both marital satisfaction and fertility intentions. The correlations provide further support for the proposition that cultural intelligence functions as a mediator in shaping fertility intentions, particularly in the context of Sino-Thai marriages.

Table 3

Breakthrough of Research Instruments

	Mean	Std. Deviation		N
Cross-Cultural Marriage	3.410	.73502		196
Cultural Intelligence	3.3515	.85584		196
Fertility Intentions	3.3089	.80207		196
		CCM	CI	FI
CCM	Pearson Correlation		.615**	.693**
	Sig. (2-tailed)		.000	.000
	N	196	196	196
CI	Pearson Correlation	.615**		.609**
	Sig. (2-tailed)	.000		.000
	N	196	196	196
FI	Pearson Correlation	.693**	.609**	
	Sig. (2-tailed)	.000	.000	
	N	196	196	196

Note 1: CCM: Cross-Cultural Marriage; CI: Cultural Intelligence; FI: Fertility Intentions
*Note 2: **. Correlation is significant at the 0.01 level (2-tailed).*

4.2 Linear Regression Analysis (Mediation Analysis)

A mediation analysis was performed to investigate the extent to which Cultural Intelligence mediates the relationship between Cross-Cultural Marriage and Fertility Intentions

among Sino-Thai couples. Following the Baron and Kenny (1986) four-step approach, the analysis proceeded as follows:

Step 1: Effect of Cross-Cultural Marriage on Cultural Intelligence

The first step assessed whether cross-cultural marriage significantly predicts cultural intelligence, the proposed mediator. The regression analysis demonstrated a significant positive relationship between cross-cultural marriage and cultural intelligence (B=0.717, SE=0.066, β=0.615, t(194)=10.875, p<0.001). The model explained 37.9% of the variance in cultural intelligence (R^2=0.379). The 95% CI for B was between 0.587 and 0.847, and the VIF was 1.000, indicating acceptable levels of collinearity. These results fulfill the second mediation criterion, establishing that cross-cultural marriage is a significant predictor of cultural intelligence among Sino-Thai couples.

Step 2: Effect of Cultural Intelligence on Fertility Intentions

In the second step, the researcher evaluated the impact of cultural intelligence on fertility intentions. The regression analysis revealed that cultural intelligence significantly predicted fertility intentions (B=0.572, SE=0.053, β=0.609, t(194)=10.703, p<0.001). This model accounted for 37.1% of the variance in fertility intentions (R^2=0.371). The 95% CI for the unstandardized coefficient was between 0.466 and 0.677, with a VIF of 1.000, indicating no multicollinearity concerns. These findings satisfy the third condition for mediation, demonstrating that cultural intelligence is significantly associated with fertility intentions.

Step 3: Direct Effect of Cross-Cultural Marriage on Fertility Intentions

In the third step of the mediation analysis, we examined the direct relationship between cross-cultural marriage and fertility intentions among Sino-Thai couples. The linear regression analysis revealed a significant positive effect of cross-cultural marriage on fertility intentions (B=0.758, SE=0.057, β=0.693, t(194)=13.404, p<0.001). This model accounted for 48.1% of the variance in fertility intentions (R^2=0.481), indicating a substantial influence. The 95% confidence interval (CI) for the unstandardized coefficient ranged from 0.646 to 0.869. The Variance Inflation Factor (VIF) was 1.000, suggesting no multicollinearity issues. These findings satisfy the first condition of Baron and Kenny's (1986) mediation criteria, confirming that cross-cultural marriage significantly predicts fertility intentions.

Step 4: Mediation Effect of Cultural Intelligence

The final step involved testing the mediation effect by including both cross-cultural marriage and cultural intelligence in the regression model predicting fertility intentions. The combined model was significant (F(2, 193)=110.788, p<0.001) and accounted for 53.4% of the variance in fertility intentions (R^2=0.534), an increase of 5.4% over the model with only cross-cultural marriage (ΔR^2=0.054). In this model, both cross-cultural marriage (B=0.560, SE=0.068, β= 0.513, t(193)=8.225, p<0.001) and cultural intelligence (B=0.276, SE=0.058, β=0.294, t(193)=4.717, p<0.001) remained significant predictors of fertility intentions. The 95% CIs for B were 0.426 to 0.694 for cross-cultural marriage and 0.160 to 0.391 for cultural intelligence. The VIF values for both predictors were 1.610, indicating no issues with multicollinearity. The decrease in the standardized coefficient for cross-cultural marriage from β=0.693 (in Step 1) to β=0.513 suggests partial mediation. This attenuation confirms that cultural intelligence partially mediates the relationship between cross-cultural marriage and fertility intentions, highlighting its pivotal role in fertility decision-making within Sino-Thai unions. Table 4 below succinctly presents the key statistics from each step of the mediation analysis, reinforcing the conclusion that Cultural Intelligence plays a crucial mediating role in fertility decision-making within Sino-Thai cross-cultural marriages.

Table 4

Summary of Hierarchical Mediating Regression Analysis (N=194)

Variables	Linear Regression Path Analysis Model Dependent Variable (DV)							
	CI				FI			
	Model 1		Model 2		Model 3		Model 4	
	β	t	β	t	β	t	β	t
CCM	0.615	10.875			0.693	13.404	0.513	8.225
CI			0.609	10.703			0.294	4.717
F-value	118.266		114.554		179.655		110.788	
Sig.	<.0001		<.0001		<.0001		<.0001	
R^2	0.379		0.371		0.481		0.054	
ΔR^2	-		-		-		0.054	
VIF	1.000		1.000		1.000		1.610	
95% CI (lower, Upper)	(0.587, 0.847)		(0.466, 0.677)		(0.646, 0.869)		CCM: (0.426, 0.694) CI: (0.160, 0.391)	

Note 1: CCM: Cross-Cultural Marriage; CI: Cultural Intelligence; FI: Fertility Intentions; B: Unstandardized Coefficient; SE: Standard Error; β: Standardized Coefficient; R^2: Coefficient of Determination; ΔR^2: R^2 Change; t: t-value; CI: Confidence Interval; VIF: Variance Inflation Factor

*Note2: *p<0.05; **p<0.01; ***p<0.001*

4.3 Testing of Hypotheses

Correlation analysis confirms Hypotheses H1a, H1b, and H1c, revealing significant positive relationships among cross-cultural marital satisfaction, cultural intelligence, and fertility intentions. Specifically, cross-cultural marital satisfaction showed a strong positive correlation with cultural intelligence (r=.615, p<.001), confirming H1a and indicating that higher marital satisfaction associates with enhanced cultural intelligence. Additionally, cultural intelligence positively correlated with fertility intentions (r=.609, p<.001), supporting H1b and suggesting that individuals with higher cultural intelligence are more likely to have positive fertility intentions. Cross-cultural marital satisfaction exhibited an even stronger correlation with fertility intentions (r=.693, p<.001), affirming H1c and indicating that higher marital satisfaction significantly predicts fertility intentions.

Mediation analysis, employing Baron and Kenny's (1986) methodology, provided evidence for Hypothesis H2, proposing that cultural intelligence mediates the relationship between cross-cultural marriage and fertility intentions. Regression analyses demonstrated that cross-cultural marriage significantly predicts cultural intelligence (B=0.717, p<.001), which in turn significantly predicts fertility intentions (B=0.572, p<.001). Notably, when both variables were included in the regression predicting fertility intentions, the effect of cross-cultural marriage remained significant but diminished (β decreased from 0.693 to 0.513), indicating partial mediation. The combined model explained a substantial variance in fertility intentions (R^2=0.534), thus affirming H2 and emphasizing the pivotal role of cultural intelligence in fertility decisions among Sino-Thai cross-cultural marriages.

Overall, these findings underscore cultural intelligence's integral role in fostering positive fertility intentions among Sino-Thai couples, mediated through the quality of cross-cultural marital relationships. The significant associations and partial mediation effect highlight the complex interplay between marital satisfaction, cultural adaptation, and fertility intentions. These results suggest that enhancing cultural intelligence may improve marital satisfaction and

promote positive fertility intentions in cross-cultural unions. Thus, the study contributes to the literature by elucidating mechanisms through which cultural factors influence fertility decisions in intercultural marriages. Table 5 provides a comprehensive summary of the hypothesis testing.

Table 5

Summary of Research Hypotheses Testing

Hypo.	Statement	Result	Evidence
H1a	Cross-cultural marriage positively relates to cultural intelligence	Supported	Significant positive correlation (r=.615, p<.001); Regression analysis (B=0.717, SE=0.066, β=0.615, p<.001).
H1b	Cultural intelligence positively relates to fertility intentions	Supported	Significant positive correlation (r=.609, p<.001); Regression analysis (B=0.572, S=0.053, β=0.609, p<.001)
H1c	Cross-cultural marriage positively relates to fertility intentions	Supported	Significant positive correlation (r = .693, p<.001) Regression analysis (B=0.758, SE=0.057, β=0.693, p<.001)
H2	Cultural intelligence mediates the relationship between cross-cultural marriage and fertility intentions	Supported	Partial mediation demonstrated; attenuation of β from 0.693 to 0.513 when cultural intelligence included Significant indirect effect (p < .001)

5. Conclusion

This study endeavored to elucidate the intricate interplay between cultural intelligence, marital satisfaction, and fertility intentions within Sino-Thai cross-cultural marriages. By examining the mediating role of cultural intelligence, we sought to deepen the understanding of how intercultural competence influences reproductive decision-making in these unique marital contexts (Ng, Ang, & Rockstuhl, 2022; Kim, 2017). The findings revealed significant positive relationships among the three variables under investigation. Cross-cultural marital satisfaction was strongly correlated with both cultural intelligence and fertility intentions, underscoring the pivotal role of marital harmony in shaping reproductive goals (Scelza, 2023; Ramlan, 2020). Furthermore, cultural intelligence emerged as a crucial mediator, partially mediating the relationship between cross-cultural marriage and fertility intentions. This suggests that individuals with higher cultural intelligence are better equipped to navigate cultural differences, thereby fostering marital satisfaction and aligning fertility intentions (Varela, 2019; Young, Haffejee, & Corsun, 2017).

Additionally, the results affirm the initial hypotheses, demonstrating that cultural intelligence not only enhances marital satisfaction but also positively influences fertility intentions. These findings contribute to the existing body of knowledge by highlighting the importance of cultural intelligence in cross-cultural marital dynamics, particularly in the context of Sino-Thai unions (Robinson, 2024). Implications of this research extend to both theoretical and practical realms. Theoretically, the study enriches the discourse on cross-cultural marriages by integrating cultural intelligence as a mediating construct, offering a nuanced understanding of how intercultural competence impacts marital and reproductive

outcomes (Kim, 2017). Practically, the findings suggest that interventions aimed at enhancing cultural intelligence may promote marital satisfaction and facilitate positive fertility intentions among cross-cultural couples (Ng, Ang, & Rockstuhl, 2022). Future research should consider exploring this phenomenon in different cultural contexts to further generalize the findings. Additionally, longitudinal studies could provide deeper insights into how cultural intelligence and fertility intentions evolve over time within cross-cultural marriages (Ramlan, 2020).

6. Discussion

The results highlight the pivotal role of cultural intelligence in fostering positive marital and reproductive outcomes within Sino-Thai cross-cultural marriages. Significant positive relationships among marital satisfaction, cultural intelligence, and fertility intentions corroborate prior research emphasizing intercultural competence in marital dynamics (Kim, 2017; Varela, 2019). The strong correlation suggests that spouses with higher cultural intelligence adeptly navigate intercultural complexities, aligning with Ng, Ang, and Rockstuhl's (2022) assertion that cultural intelligence enhances adaptation to diverse cultural contexts, thereby promoting marital harmony. Furthermore, the positive association between cultural intelligence and fertility intentions implies that culturally intelligent individuals are more likely to align on reproductive goals, attributable to their ability to reconcile differing cultural norms regarding family planning (Young, Haffejee, & Corsun, 2017). The mediating role of cultural intelligence underscores its critical function in bridging cultural gaps and influencing fertility decisions. These findings extend Robinson's (2024) exploration of intercultural family formation and provide empirical support to Scelza's (2023) theoretical frameworks on marriage and monogamy, suggesting cultural intelligence as a key factor in successful intercultural unions. Moreover, the study aligns with Ramlan's (2020) examination of cross-cultural marriage issues, emphasizing the necessity of cultural intelligence in addressing globalization's impact on marital dynamics. The influence of cultural intelligence on fertility intentions also resonates with Kim's (2017) model of cross-cultural adaptation, underscoring the importance of intercultural competence in navigating life transitions. Notably, while the mediating role of cultural intelligence was anticipated, its influence was more substantial than initially hypothesized, suggesting it plays a more critical role in fertility decision-making than previously understood, warranting further investigation.

7. Recommendations

In light of the study's findings, several recommendations emerge for practitioners, policymakers, and future research. Practitioners working with cross-cultural couples should prioritize the development of cultural intelligence as a core component of marital counseling and family planning services. Tailored programs that enhance intercultural sensitivity and competence can facilitate better communication and understanding between partners, thereby promoting marital satisfaction and positive fertility intentions (Kim, 2017; Varela, 2019). Educational institutions and organizations can also play a role by incorporating cultural intelligence training into curricula and professional development programs. As Ng, Ang, and Rockstuhl (2022) suggest, fostering cultural intelligence in individuals contributes to more harmonious intercultural interactions across various domains. For policymakers, considering the impact of cultural intelligence on family formation can inform the development of support systems for cross-cultural marriages. Policies that encourage cultural exchange and provide resources for intercultural couples can enhance marital stability and reproductive decision-

making (Ramlan, 2020). Future research should expand on this study by exploring the longitudinal effects of cultural intelligence on marital satisfaction and fertility intentions. Investigating diverse cross-cultural contexts will also enhance the generalizability of the findings. Additionally, examining the role of other mediating factors, such as communication styles and conflict resolution strategies, could provide a more comprehensive understanding of the dynamics at play in cross-cultural marriages (Robinson, 2024).

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Building Trust in a Matrix of Distrust: Chinese International Students' Experiences in the UK

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Abstract

This study investigates how trust is constructed among Chinese international students in the UK during the COVID-19 pandemic. Although much research addresses trust and migration, trust among international students remains underexplored. To address this gap, we propose a new theoretical approach of building trust within a matrix of distrust. Drawing on in-depth interviews with 70 Chinese international students who studied in the UK during the COVID-19 lockdowns from 2020 to 2021, we identify four main trust-relevant situations: performing public health rituals, learning during the pandemic, managing emotional well-being, and making sense of COVID policies. Our findings reveal that trust construction involved complex interactions with various trustees, challenging existing binary categorisations between generalised and particularised trust and in-group/out-group dynamics. We observed trust-building across ethnic boundaries and trust-contesting within in-groups, as well as shifts in political trust when exposed to alternative approaches. These findings demonstrate the limitations of existing trust categorizations and emphasize the need to consider trust as an evolving, context-dependent process. By focusing on building trust, this new theoretical approach not only allows us to uncover the sites and processes of trust construction but also to systematically map out how trustors and trustees interact in the matrix of trust-relevant situations.

Keywords: Trust Construction; Social Practice; the Matrix of Distrust; Chinese International Students; Covid-19

1. Introduction

Since Donald Trump referred to COVID-19 as "the Chinese Virus" in a Tweet on March 17, 2020 (Hswen et al., 2021), Chinese international students have drawn significant media and academic attention, particularly regarding their experiences of stigma, their lessened presence in higher education institutions, and the impacts of that decline. One topic that has gotten short shrift in this context, however, is trust. This oversight reflects a broader pattern in which trust among international students has been largely neglected by scholars.

Media coverage has highlighted the rise in anti-Chinese hostility and hate crimes against Chinese international students rose in both the United States and in the United Kingdom (Huang et al., 2023; Murphy, 2020), while academic research has documented their experiences

of stigmatization, victimization, and alienation in these countries (Allen & Ye, 2021; Cao et al., 2021; Ji & Chen, 2023; Jin & Wang, 2023; Ma & Zhan, 2022). Scholars have also investigated how Trump's "Chinese Virus" language exacerbated geopolitical relations between China and global north countries allied with the United States and the implications of this for Chinese international students (Allen & Ye, 2021; Ma & Zhan, 2022). Some studies have assessed significant ruptures in U.S.- China research and innovation collaborations, knowledge exchange, and bilateral student exchange opportunities; others have investigated the declining number of Chinese international students and the ramifications for higher education sectors in both the U.S. and the UK (Allen & Ye, 2021).

While there is voluminous research on trust and migration, little attention has been given to trust among international students specifically. For instance, studies on the impact of cultural heritage on immigrants' and emigrants' trust (Bilodeau & White, 2016; Moschion & Tabasso, 2014) rarely consider international students as a distinct migrant category. Likewise, research exploring migration experiences on trust (Dinesen & Hooghe, 2010; Dinesen & Sønderskov, 2015; Wu & Wilkes, 2018) tends to focus on differences in trust levels between host and home countries without interrogating the migration experiences of international students. Meanwhile, research on international students (Brooks & Waters, 2010; Findlay et al., 2012; Tindal et al., 2015) often lack a systematic analysis how trust shapes their study and migration experiences. Scholarship on Chinese international students during the pandemic (Ma & Zhan, 2022; Ji & Chen, 2023; Jin & Wang, 2023) frequently portrays stigmatization and alienation as normalized lived experiences, without interrogating the agency of international students in bridging or contesting social connections. Even studies on social and political attitudes among Chinese international students (Jin & Wang, 2023) overlook their interactions with different trustees in specific trust-relevant situations.

Our limited understanding of trust in the context of Chinese international students highlights the need for a new theoretical approach—one that bridges research on trust with scholarship on international student experiences. In response, this article proposes a reconceptualization of trust. We define trust as a moral, normative, and functional mechanism embedded within interpersonal relationships, institutions, and broader social structures (Fukuyama, 1996; Putnam, 1995; Uslaner & Conley, 2003). However, rather than viewing trust as a static or abstract norm—such as generalised or particularised trust, or as social and political trust (Delhey et al., 2011; Fukuyama, 1996; Uslaner & Conley, 2003)—we reconceptualise it as an interactive social practice. This new approach centres on doing trust: the everyday, situated interactions between trustors and trustees, and the dynamic processes of trusting and demonstrating trustworthiness. By focusing on these interactions, our conceptualisation captures the contingent, relational, and context-specific nature of trust-building, particularly within the matrix of distrust experienced during the global pandemic. This framework allows us to analyse trust not as a fixed attribute, but as a practice negotiated across three distinct yet interconnected levels.

This article develops a new theoretical approach to building trust within a matrix of distrust, drawing on in-depth interviews with 70 Chinese international students who studied in the UK during the COVID-19 lockdowns from 2020 to 2021. This article seeks to answer three key

questions: 1) What were the main trust-relevant situations in Chinese international students' lived experiences during the global pandemic? 2) How did these students navigate trust relationships with various social groups—including family members, friends, immediate Chinese networks, strangers, non-Chinese communities, host universities, and local communities? 3) How did participants construct trust across different sites where trust became salient? We identify four primary trust-relevant situations as sites of trust construction, ranging from the micro-level of performing public health rituals and managing emotional well-being to the meso-level learning during the pandemic, and the macro-level process of making sense of UK's COVID-19- related policies. We find that trust construction occurred through interactions between Chinese international students and trustees at multiple levels. Further, these processes of trust-building or trust-contesting were imbedded in specific situations, in which trustors' act of trust responded to trustees' act of trustworthiness. This new theoretical approach of trust in action therefore offers an opportunity for scholars to assess the complexity of trust construction in different contexts and to analyse interactions between trustors and trustees in various trust-relevant situations.

2. "Doing Trust" in the Matrix of Distrust

Existing scholarship tends to conceptualise trust through binary opposition trust versus distrust, high versus low trust, or in-group versus out-group trust. This dichotomous framing is especially prevalent in macro-level comparative studies that link patterns of generalised and particularised trust to economic development, political participation, and social cohesion (Delhey et al., 2011, 2014; Dinesen, 2012; Uslaner & Conley, 2003; Wilkes, 2011). Particularised trust is typically associated with strong, face-to-face ties within families or close-knit communities, where social sanctions reinforce compliance and reciprocity (Fukuyama, 1995; Portes, 1998; Portes & Vickstrom, 2011). Generalised trust, by contrast, refers to trust in strangers and the broader public—seen as fostering tolerance, civic engagement, and shared values (Putnam, 1995, 2000; Newton, 2009).

Even foundational accounts often reify these categories to distinguish "high-trust" and "low-trust" societies. Banfield (1958), for instance, attributed persistent poverty in Southern Italy to excessive particularised trust and a deficit of generalised trust. Similarly, Fukuyama (1995) argued that economic prosperity depends on high generalised and low particularised trust, while underdevelopment stems from the reverse. These dichotomies have been reinforced through cross- national surveys—particularly the World Values Survey—leading to increasingly sophisticated yet reductive models of societal trust (Delhey et al., 2011; Delhey & Welzel, 2012; Frederiksen et al., 2016).

At the individual level, trust research follows two main trajectories: cultural and experiential. The cultural approach treats trust as a fixed trait, instilled early through socialisation and embedded in cultural value systems (Delhey et al., 2011; Uslaner & Conley, 2003). In contrast, the experiential approach examines how life experiences—such as education, social interaction, or political involvement—shape trust. While more dynamic, this perspective still tends to frame trust in binary terms: trust is either gained or lost based on individual exposure (Tao et al., 2014; Uslaner & Brown, 2005; Wu, 2020). Education offers a prime

example. Numerous studies link higher education to increased generalized trust across diverse contexts (Huang et al., 2011; Niedlich et al., 2021; Wu & Shi, 2020), reinforcing the assumption that trust operates in predictable, linear ways.

Increasingly, however, scholars have discovered complex overlaps between trust and distrust, high and low trust, or in-group and out-group (dis) trust particularly through studies of migration, which traces high-level generalized/trust patterns among migrants in low-trust societies or vice versa. Some of these studies highlight the impact of persistent cultural factors on trust, arguing that trust is transmitted as part of cultural reproduction across generations despite migration to different country contexts with different levels of generalized trust (Moschion & Tabasso, 2014). The second set of studies have argued that trust levels present in destination countries may affect generalized trust among migrants (Dinesen & Hooghe, 2010; Dinesen & Sønderskov, 2015; Wu & Wilkes, 2018). In this view, migrants may exhibit decreased trust levels when residing in countries where generalized trust is lower than their countries of origin, while they become more trusting in host countries where generalized trust is higher than in their home country. Yet even this emerging debate remains constrained by its focus on cultural versus experiential determinants of trust levels, rather than questioning the fundamental adequacy of binary trust frameworks themselves.

Emergent scholarship has become increasingly interested in how (mis)trust is produced or contested through interactions between trustors and trustees (Dodson et al., 2023; Ho, 2021; Kuwabara, 2015; Smith, 2005). This focus on locating trust-relevant situations (Smith, 2005) marks a shift away from the preoccupation of the dichotomous trust framing to understanding trust in action. For instance, Dodson and colleagues' (2023) further revealed the complexity of (mis)trust and (un)trustworthiness in research on responses to sexual misconduct in U.S. workplaces. They found that co-workers' moral values of loyalty towards and trust in organizations sometimes override their trust in victims and their experiences (Dodson et al., 2023). They attribute this to himpathy, that is, the support of alleged perpetrators rather than victims, which they describe as a result of the hierarchal structures in the workplace promoting authority and loyalty, which are further embedded in the individuals' processes of evaluating trustworthiness, thus disadvantaging women.

This growing body of literature demonstrates the importance of conceptualizing trust in action in specific trust-relevant situations. Building on this work, we advance two theoretical interventions, drawing inspiration from West and Zimmerman's "doing gender" (1987), Swidler's concept of "unsettled times" (1986), and Richie's "matrix of violence" (2012, 2022). First, we propose re-conceptualizing trust as an interactive social practice instead of as an abstract norm or a binary state. While this approach shares some conceptual ground with West and Zimmerman's "doing gender", trust differs crucially in that it is not merely a routine, methodical practice where individuals conform to established cultural norms. Instead, "doing trust" involves complex processes of interactions between trustors, trustees, acts of trust, and demonstrations of trustworthiness. These interactions are evolving and further mediated by culture, experiences, and life course transitions as well as external stressors such as the global pandemic.

Second, we introduce the concept of a "matrix of distrust" in "unsettled times" of the global pandemic. We build upon Swidler's theory of culture in action (1986), particularly her analysis of "unsettled times" when established cultural practices and social actions become misaligned during challenging socioeconomic and political circumstances. Our conceptualization of the matrix of distrust maps the interconnected cultural, social, political, and institutional circumstances that amplify distrust. This framework draws inspiration from Richie's matrix of violence (2012, 2022), which illuminates both specific sites of harm and the intersecting systems that perpetuate violence. The matrix of distrust operates across three distinct yet interconnected levels. At the micro level, individual socioeconomic, cultural, racial, and ethnic characteristics shape personal experiences of trust and distrust. The meso level includes networks, communities, and trust-relevant situations where the dynamics between trustors and trustees unfold. At the macro level, broader economic, political, and social circumstances create the overarching context within which trust relations develop or deteriorate. Crucially, these levels interact dynamically. Changes at the individual level can reshape interactions within communities and trust-relevant situations, while structural changes in formal and informal networks may equally influence individual behavior in trust-relevant contexts. To demonstrate the analytical utility of this framework, we apply it to examine trust-building processes among Chinese international students studying in the UK during the Covid-19 lockdowns.

3. The Research Context: Chinese International Students "Doing Trust" in the Matrix of Distrust During the Pandemic

The COVID-19 pandemic created unique circumstances which make Chinese international students' experiences particularly valuable for examining the matrix of distrust. The period represents "unsettled times", where political, economic, and cultural circumstances heighten distrust, offering unique opportunities for researching "doing trust". First, the geopolitical context was especially significant. Following Donald Trump's characterization of COVID-19 as the "China virus", Chinese international students faced escalating hostility and hate crimes in countries such as the US and UK (Hu et al., 2022; Ma & Zhan, 2022). This situation spawned two competing narratives: some scholars argue that Global North politicians scapegoated China—an emerging economic power—to deflect attention from their inadequate pandemic responses and internal political conflicts (Allen & Ye, 2021). Others focus on the practical implications, particularly how these tensions affect international student mobility, knowledge exchange, and the financial stability of higher education sectors that depend heavily on Chinese student tuition (Portes, 2024). The intensified geopolitical circumstances of 2020-2021 illuminated complex trust relationships between universities and national governments. These manifested in several key areas: competing interests in international student visa policies, public health communication strategies, coordination of pandemic responses, and responsibilities for international student safety (Adams et al., 2023). Moreover, this context provides valuable insights into how Chinese international students "do trust"-actively constructing and negotiating trust. Jin and Wang's (2022) research demonstrates how these students experienced "double stigmatization"—both in their host country and at home—leading them to reassess their political beliefs, civic values, and attitudes towards both governments.

Second, Chinese international students lived experiences during the pandemic provide a

unique case for investigating the sites and interactions between them and various trustees across the micro- level, meso-level and macro-level. At the micro level, individual characteristics such as gender, socioeconomic status, and prior educational experiences significantly influenced students' interactions with host communities and universities (Ma & Zhan, 2022). These personal factors shaped both their vulnerability to discrimination and their capacity to build trust in new environments. The meso level reveals how students navigated institutional relationships and community networks. Ma and Zhan's (2022) research documented how fear of racial abuse led students to develop protective strategies, including limiting their engagement with university and local communities. Zhu et al. (2024) extended this analysis, revealing how students experienced alienation from various institutional support systems, despite universities' efforts to provide communication channels and support services. At the macro level, Ji and Chen's (2022) work demonstrated how broader societal hostility in the United States created conditions of extreme vulnerability for Chinese international students. This vulnerability was compounded by the complex interplay between national policies, public health measures, and international relations. These multi-dimensional, trust-relevant situations provide rich opportunities to analyse trust-building processes between Chinese international students (as trustors) and various trustees—including host universities, formal and informal communities, and host/home governments—during unsettled times.

3.1 Data and Methods

3.1.1 The Sample

The data used in this study come from 70 in-depth individual interviews with Chinese international students who were studying in the UK during the COVID-19 pandemic. The interviews were conducted remotely between November 2020 and May 2021. Table 1 provides descriptive characteristics of our sample. Participants included self-identified male (n=29) and female (n=41) students aged between 21 and 37 who were pursuing undergraduate or postgraduate degrees at the time of the first lockdown in the UK, March 20, 2020. The sample included 32 respondents pursuing STEM-related fields of study and 38 enrolled in social sciences, arts and humanities, and the law studies courses. The recruitment of participants covered most regions in the UK except Northern Ireland.

Table 1
A Summary of Respondents' Demographic Details (n=70)

Demographic Details		No.
Age	20-30	59
	31-40	11
Gender	Female	41
	Male	29
Length of Migration	Less than 12 months	17
	More than 12 months	53
Level of Study	Undergraduate degree	2
	Postgraduate Taught degrees	46
	Postgraduate research degrees	22
Fields of Study	STEM	32
	Non-STEM	38
University location in the UK	England	49
	Scotland	17
	Wales	4

We started the research recruitment via our own networks of Chinese international students, most of whom were pursuing postgraduate study at the time. We circulated our recruitment advertisement titled: "新冠危机, 孤岛之历 " via these WeChat groups for potential participants. Circulating our project recruitment only in Chinese serves two purposes. First, leveraging linguistic familiarity was the first step of trust building with our potential research population. Prior research shows that the use of the native language and local dialects is not only helpful for obtaining in-depth and detailed qualitative data but also crucial for bridging social distance between researchers and the research participants (Van Nes et al., 2010). Second, the use of Chinese, specifically framing our solicitation in two four-word poetic phrases, conveys a concise message about the key objectives of this research project, namely lived experiences during the COVID-19 pandemic. We framed our inquiry as "experiences in the Covid" without priming participants about trust. Third, instead of referencing the UK, we called the place of study "孤岛 a lonely island" as a way to evoke shared sentiments about isolation and social distancing in the time of the pandemic. The strategy proved effective in that recruitment quickly snow-balled into wider networks through WeChat groups, covering Chinese international students across the UK. We received an overwhelming expression of interest in participating in the project and interviewing all would have exceeded the capacity of our small research team at the time.

3.2 Research Procedures

After obtaining approval for the project from the author A's university's Research Ethics Committee, we started a pilot study with two participants to test the validity of the interview questions. All interviews were conducted in Mandarin Chinese and transcribed in Chinese in full. All identifying information was deleted from the transcripts and pseudonyms were used from this point forward. Assessing our own positionality with respect to this project was an ongoing process. All three members of the research team are ethnic Chinese. Author A is a tenured academic and Authors B and C were postgraduate research students at the time of data collection. As we research trust, we were acutely aware of how the enactment of trust in hierarchical relationships complicates our project. In order to give agency and voice to our research participants, the team rearranged the fieldwork roles with Authors B and C conducting all the interviews and Author A responsible for the research design, the interview questions, and transcriptions.

3.3 Data Analysis Strategies

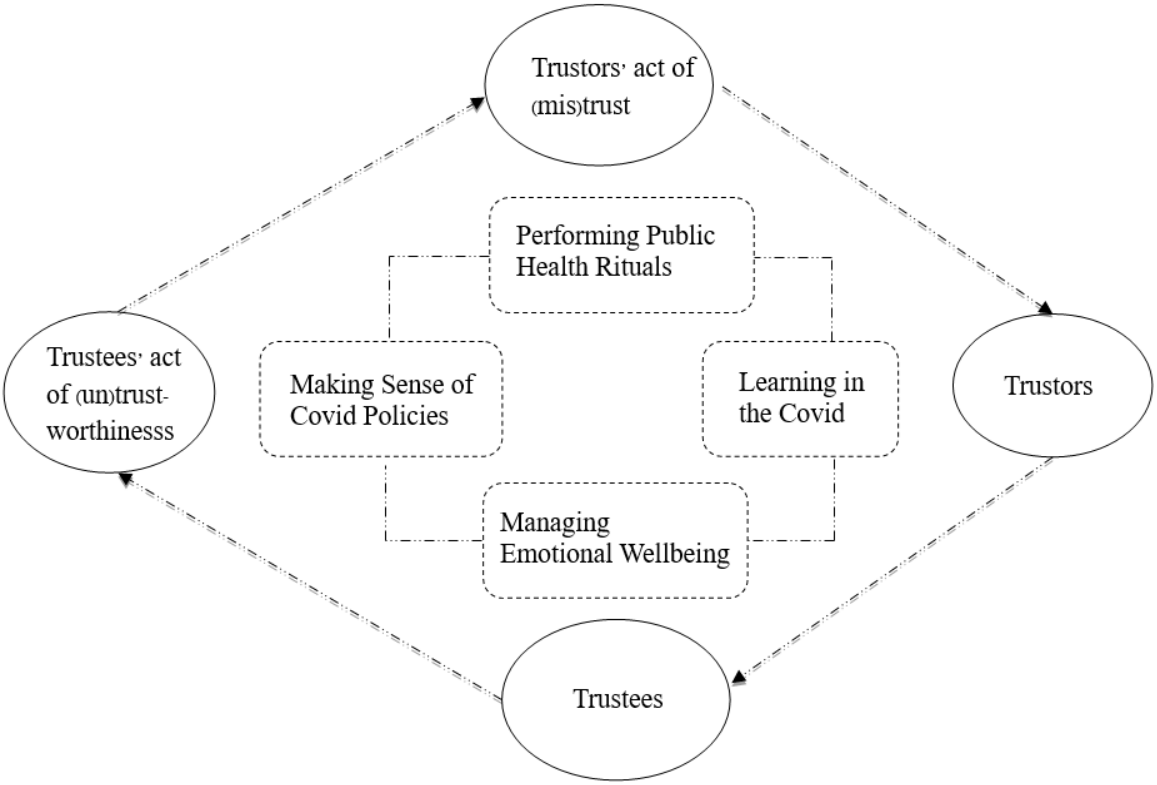
The final 70 interviews were used for data analysis. These 70 interviews allowed us to cover the main research inquiries, to add depth and additional themes, which satisfied criteria for data and thematic saturation (Hennink & Kaiser, 2022). Data saturation was reached after 37 interviews, but new thematic dimensions emerged between the 45th and 67th interviews. Regardless of the number of interviews in a study, the key to obtaining robust qualitative data lies in exposure (Small & Calarco, 2022), that is, the number of hours spent in fieldwork. The total exposure through individual interviews was 129.27 hours, reflecting interviews ranging from 1.08 to 2.27 hours. In total, we logged 134.87 fieldwork hours.

The main analytical strategies involved coding and mapping. Coding bridges the qualitative data and the conceptual framework of trust in action. The first round is open coding, which involves reading all transcripts and field notes, highlighting recurring themes, and reflecting on emergent issues in a series of memos. This process allowed us to generate a list of initial codes marking trust-relevant situations at different levels, which we entered in the Nvivo software for a review of all the data. The Nvivo coding was fed by the initial sets of codes, but coding proceeded iteratively in several rounds. During this process, we were able to reflect, expand, and modify the initial sets of codes and highlight deviant incidents. In the second round, we drew the codes together and then identified different trustees in different "situations" at the micro-, meso-, and macro-levels. In the final round, we drew the codes together and then map interactions between Chinese international students and trustees at micro-, meso- and macro-levels in different trust-relevant situations.

4. The Matrix of Distrust During the Pandemic

To contextualise the matrix of mistrust during the pandemic, we have identified four main sites of trust-relevant situations, ranging from micro-level of the performance of public health rituals and management of emotional well-being to meso-level of the management of learning experiences, to the macro-level of assessment the COVID policies. In each of these sites, Chinese international students interacted with multi-dimensional trustees from their close communities, to strangers, academics and to the policymakers. These interactions also occurred across all levels. Figure 1 provides a visual map of the matrix of distrust in the pandemic.

Figure 1
Doing Trust in the Matrix of Distrust



Note: This figure is generated by researchers

The first site is the daily performance of public health rituals among communities. These rituals, such as masking, disinfecting, social distancing, regulate behavior, focus on performance, and seeking connection (Hobson et al., 2018). Within this site, Chinese international students engaged with various trustees at different levels, including friends, classmates, professors, strangers, Chinese student networks, university communities, local communities while studying in the UK. The act of trustworthiness means strict compliance with and performance of these public health rituals, with non-compliance signaling untrustworthiness. The second trust-relevant site describes the management of emotional and mental well-being during the pandemic lockdowns. Trustees in this sites included family members, friends, classmates, Chinese student networks, university personal tutors, therapists, psychologists, and non-Chinese social networks. Trust was built and challenged through specific interactions with these trustees. The third trust-relevant site pertains to learning during the pandemic, primarily within the university setting. The trustees in this context included academics (professors, personal tutors, and Graduate Teaching Assistants) and university administration and management teams responsible for communicating about online learning technology, learning support, and COVID-19 guidelines. Trustworthy actions were specific to the roles of these trustees in supporting students' learning experiences during the pandemic.

The final trust-relevant site involves assessing specific policies implemented at the national level, which directly or indirectly affected our respondents during their time in the UK. The Covid-related public health and social policies considered included, but were not

limited to, the nation-wide lockdown, masking and social distancing rules, and vaccination rollout programs. In this site, trust was linked to the government's actions. Many respondents used China's COVID-related policies as a reference point, comparing them with their lived experiences in the UK to evaluate the trustworthiness of the UK's policies.

5. Doing Trust Through Contesting Boundaries

In the first trust-relevant site of performing public health rituals, there was a perception among our respondents that "Asian students" were diligent with complying with public health rituals. Xiaoli Wei, a female MA student who were in the UK for 21 months, described an interaction that changed her perspective. Xiaoli noticed a bottle of disinfectant hanging on the keyring on Lea's backpack and she recalled the start of her friendship with Lea: "it's rare to see a non-Chinese so serious about being vigilant. We started sitting 'together' with distance, eating lunch outside. She was comfortable with me because I was careful too". Xiaoli and Lea's friendship developed through a shared understanding of and strict compliance of the rituals. Failure to adhere to public health rituals caused divisions within Asian student communities as well. Xiyin described her frustrations and sense of distrust because she observed some fellow Chinese students who were "hang[ing] out together, cooking, eating. Guess what. They got the COVID and spread it among us. I understand we were very lonely and emotionally challeng[ed]. But their negligence hurt innocent and rule-abiding friends like me." A shared understanding of the importance of performing public health rituals promoted trust and created social connections, including across racial and ethnic lines. Likewise, non-compliance with these rituals created divisions and mistrust, even within Chinese student communities. By examining the trust-relevant situation of performing public health rituals, this analysis advances our knowledge of the complexity of trust-building and trust-contesting through interactions between trustors and trustees in the pandemic context. It also extends beyond the narrow binary conceptualization of high -low particularized trust with in-groups and out-groups in the Chinese culture (Huhe, 2014; Pye, 1999).

In the trust-relevant site of managing emotional and mental wellbeing, some of our respondents could not rely on family members but successfully connected with non-familial networks for support. These networks included digital gym buddies, online music clubs, poetry-writing clubs, video game partners, and K-pop dance clubs. Xueran Wu, a 23-year-old Master's student, explained why she could not confide in her parents about her struggles with isolation and study: her father had a "severe disability," and her mother was "struggling to care for him back home." Instead, Xueran coped with her emotional challenges by "dancing it out" with her "people"—a community of amateur dancers who practiced K-pop routines in outdoor public spaces in London. This shared passion for K-pop brought her into a community of "strangers from many parts of the world," who became a reliable source of emotional support during the pandemic.

While some respondents dealt with mental health issues privately, others sought formal support through professional therapists or psychologists available at their universities or through the UK National Health Service (NHS). For some, like Xueran, this was due to their families' "difficult circumstances in China." Others, like Xiaojing Wu, a 23-year-old Master's student, reported that their parents lacked empathy for their mental health issues. Like many respondents, Xiaojing struggled with academic pressure and loneliness during the lockdown. She sought help from her university's mental health services and the NHS, though both required her to wait more than eight weeks for assessment. Despite the wait, she ultimately found the NHS therapist she accessed to be "very experienced and professional." Xiaojing

explained her decision to seek professional help:

There is only so much you can share with your family and friends. When I was in a dark place, I wanted to talk to someone without being judged. I was very lucky to be seen by the professional therapist here. I wish I had competent therapists and psychologists back in China.

Similarly, Xujuan Zhang, a 24-year-old Master's student who had a history of self-harm, saw her mental health deteriorate during the lockdown. Both Xiaojing and Xujuan emphasized that the treatment they received from NHS therapists was "life-saving". Reflecting on her prior experiences when her parents actively prevented her from seeking professional help, Xujuan, who had engaged in self-harm, emphasized the importance of dismantling the mental health taboo through the role of trained psychologists and therapists: "We should trust professionals and experts on mental health, not parents."

These findings on the trust-relevant situations of emotional well-being and mental health reveal multiple pathways through which Chinese international students build trust with a range of trustees, including parents, friends, strangers with shared interests, and professionals. We argue that studying in the UK created a distance from the traditional familyist trust radius, allowing our respondents to engage with "strangers" through shared hobbies, interests, and professional channels. The lived experiences during the COVID-19 pandemic further amplified the need to connect beyond the constraints of networks defined by family ties, racial, or ethnic boundaries. These interactions allowed our respondents to evaluate acts of (un)trustworthiness, respond accordingly with acts of (mis)trust and draft their own narratives of trust based on their personal experiences rather than solely adhering to cultural norms.

In the third site of learning during COVID-19, we observed a similar pattern of using a cultural toolkit to assess the trustworthiness of various trustees. For instance, academics earned students' trust through the effective delivery of courses, responsiveness to students' needs—especially those related to the transition to online learning—and providing academic support. The vast majority of our respondents appreciated their professors' efforts in delivering virtual courses, managing the technological challenges of online learning, and empathizing with students' academic struggles during the lockdowns.

Minglang Sun, a 23-year-old master's student, recalled the professionalism of his professors during the sudden switch to online learning during the first wave of the national lockdown:

It was really hard to switch to online learning. We [students] weren't as talkative as in person. There were many awkward moments. But my teachers were all very professional. They went out of their way to get us to talk and engaged in the course content. They used different apps and visuals to make teaching more fun and easier to understand.

The findings on our respondents' trust in university professors align with prior studies on trust patterns deeply rooted in Chinese culture, where there is high respect and trust in scholars (teachers and professors) (Delhey et al. 2011; Liu and Shen 2021; Pye 1999; Wu and Wilkes 2018). However, our findings diverge from prior scholarship by emphasizing the interactive processes—"acts of (un)trustworthiness"—between academics, management, and our respondents, rather than simply following a cultural script of trust.

6. Multi-Scalar Trust Constructing and Contesting

This section illustrates the process of trust building and contesting across multiple sites in the context of making sense of COVID policies. A key trust-relevant situation involved determining whether to trust the British government, its institutions and their COVID-related public health policies. These policies included the nation-wide lockdown, masking and social

distancing rules, and vaccine roll- out programs, all of which directly affected respondents during their studies in the UK. The majority of our respondents found the British government's COVID-related public health policies to be "appropriate to the cultural and demographic context of the UK." They recognized that differences between British and Chinese COVID rules were context-specific and thus deemed appropriate. As Yuqing Ma, a 24-year-old master's student, reflected:

The UK lockdowns were not strict as the Chinese ones. They could not implement the Chinese rules here. It's a small country without a high population density. In China, there are so many people living so close to each other. Strict lockdown policies made sense in China too. Plus, people [in the UK] are so used to freedom and individual liberty. It would not have worked here.

Respondents also highlighted the consistent presence and involvement of medical experts and scientists in policymaking, which boosted their confidence in governmental decisions. For Xusu Liu, a 25-year-old master's student, the constant visibility of a chief science adviser during the COVID era was a reassuring sign of trustworthiness: "I liked the way the scientists presented the daily data and the projections of the infections. The data were mathematically convincing. Politics is a game, but maths don't lie." Jiexu Wu, a 24-year-old master's student, also expressed trust in science and "scientific rationale." Jiexu dismissed the Chinese media's portrait of "the crazy idea of the herd immunity," which Jiexu said, "was laid out scientifically and calculated with the consideration of the capacity of the national health system. I think nothing could be more rational." The emphasis on and the trust in science over politics was echoed by many respondents.

Beyond accepting UK COVID policies, respondents began to appreciate the value of individual freedom and civic liberty based on their experience in the UK. As Wanjun Zhu, a 26-year-old PhD student, noted, this understanding was a part of the "eye-opening" experiences that would not have been possible it they had not studied in the UK. Xiaochun Su, a 22-year-old master's student, explained:

What I experienced in the lockdowns here was much more humane than that of my friends and family back in China. I started to appreciate the UK approach. For instance, I could go out for a run every day, which is not possible if I were in China. I realized how important it is to have freedom to run and enjoy nature during this dark time. Is liberty less important than being alive? What is the point of being alive without liberty?

Many respondents expressed similar feelings, reflecting on the relationship between individuals and the state. While some still understood China's COVID rules as appropriate to that context, others were less convinced. Huixian Xia, a 24-year-old master's student, contrasted her medical experience in the UK with that of her cousin in China during their respective lockdowns.

Huixian, who has a long-term medical condition requiring regular examinations and medication, found her treatment unaffected by UK lockdowns. Her cousin, however, faced a starkly different situation. With "a suspicious tumour on her neck," the cousin travelled from Henan to Shanghai for treatment but was quarantined "indefinitely" without any medical attention. Huixian described her cousin's ordeal as "a near-death experience" and questioned, "did this top-down uniform lockdown really have no room for accommodating a person's urgent surgery? Is a person's life so worthless?" For Huixian, China's rules had come to seem "inhumane".

Some respondents discussed the role of the state in providing social security, comparing China and the UK. Xujun Liu, a 27-year-old PhD student, described the UK government's

furlong scheme (the Coronavirus Job Retention Scheme) "socialism": "It's what socialism would look like. It's what we learned in the textbooks in China. The government actually steps up and pays workers who could not work during the pandemic. It's unimaginable in China. The government pays you not to work? No way." Similarly, Ziyi Wu, a 25-year-old master's student, was extremely enthusiastic about the UK government's policies on "rent and mortgage holidays" and questioned the education she received about Western capitalism in China:

In school, we were told about western capitalist countries and exploitation. But these policies are so humane and caring. it's unimaginable in China. Chinese banks would never collect a fen less. The [Chinese] government would never hel[p] to cover the rent or mortgage during the time of the crisis. We all asked our families for help, not the state.

For Xujun and Ziyi, their lived experiences in the UK provided space to reassess the role of state welfare, or lack of thereof in creating good lives for citizens. Exposure to different types of policy provisions in terms of welfare and social security prompted these respondents to question the Chinese approach of authoritarian control without adequate social support in the pandemic.

Moreover, some students demonstrated an "awakening sense of social justice" through comparing the mass unemployment particularly of youth and migrant workers in China, to the UK government's social programs. As Xujun put it:

China is supposed to be a socialist country, but the government does not care about people losing their jobs. I have some friends who are recent graduates from university. They all lost their jobs almost overnight because of the lockdowns. Did the government help them? No. They asked their parents for help and they are all lying flat. How many migrant workers lost their jobs because of the COVID? Did the government help them? No. They were all kicked out and left to fend for themselves. They were blamed for being low quality population. It's socialism with Chinese characters.

For other respondents, the sense of social injustice during the pandemic in China hit closer to home when their family members became unemployed and life chances became precarious. These findings diverge from previous research on the patterns of political trust among the Chinese. While prior scholarship consistently demonstrates a high level of political trust in the state and unquestioned support for the Chinese Community party (Dickson et al., 2017; Huhe, 2014; Pye, 1999), our findings shed light on the impact of migration experiences on international students during the unsettled times of the pandemic. Studying in the UK provided new opportunities and unique spaces for the Chinese students to reconsider their political trust in the state. The Chinese state' authoritarian approaches during the pandemic were contrasted to a range of policy alternatives they observed in the UK, from emphasizing individual liberty and freedom to providing for social security. The migration experiences led international students to reassess these alternatives and develop a sense of social justice, a sensibility they attributed to their experience of studying in the UK.

7. Discussion and Conclusions

Researching trust risks being extracted from the sites and processes of interactions between trustors and trustees if "doing trust" remains under-theorized. Furthermore, "doing trust" can be limited, especially when only one dimension of analysis—the micro, meso, or macro level, is applied. Instead, in this paper we seek to understand trust as an interactive social practice in the matrix of distrust. Drawing upon 70 in-depth individual interviews with Chinese international students who were pursuing postgraduate studies in the UK, we

analyzed the sites and processes of "doing trust" in the matrix of distrust during the COVID-19 pandemic. We have identified four main trust-relevant situations as sites of trust construction, ranging from micro-level of performing public health rituals and managing emotional well-being, to meso-level of learning during the pandemic, to the macro- level of making sense of COVID policies. Furthermore, we have unpacked the processes of trust construction through the interactions between trustors—Chinese international students—and trustees—those around them—at multidimensional levels. These processes of trust-building were embedded in the matrix of distrust in the pandemic.

This paper's findings have significant implications for the study of Chinese international students and trust more broadly. In particular, they underscore the need to theorize trust as an interactive social practice. Failure to do so could risk conceptualizing trust simply as an abstract act informed by one's value systems, obscuring the intricate interactions between trustors and specific trustees. This may lead to an overemphasis on the role of culture and values in influencing trust. Furthermore, failure to center trust in action in the conceptualization of trust may also risk generalizing experiences in shaping trust without contextualizing trust-relevant situations or specifying the sites and processes of trust construction. By recognizing trust as an interactive process, we can better capture the complex dynamics of trust building and contesting in diverse contexts.

How best to research trust remains an open question. Our findings on performing public health rituals resonate with prior research on mutual mistrust between Chinese international students and their host communities and destinations (Ji & Chen, 2023; Ma & Zhan, 2021). This study's findings also support scholarship on the role of trust in bridging and bonding social connections in ethnic diverse communities (Dinesen & Sønderskov, 2015; Wu & Shi, 2020). Moreover, our findings on learning and managing mental well-being in the context of the pandemic support existing studies researching characteristics of particularized and generalized trust among Chinese (Dickson et al., 2017; Fukuyama, 1996; Pye, 1999), that is, in line with past research we found Chinese respondents had a high level of trust in individual families as well as in experts such as professors and professionals.

However, our research reveals the limitations of binary oppositions—trust versus distrust, high versus low trust or in-group versus out-group (dis)trust. The binary conceptualization risks an oversimplification of how trustors and trustees interact in specific trust-relevant situations and how their interactions might build trust relationships in unsettled times. We find that some respondents built bridging relationship between Chinese international students and non-Chinese through shared understanding of the importance of performing public health rituals. Failure to comply with the public health rituals caused rifts among the Chinese community. Likewise, our respondents developed trusting relationships with strangers who shared their hobbies such as K-pop dancing. Another factor complicating in-group trust was the lack of shared understanding of mental health between our respondents and their parents. In other words, trust building can overcome the boundaries of in-groups and out-groups based on familistic or ethnic characteristics. Meanwhile, trust contesting can also occur among in-group members due to a lack of shared understanding or beliefs in specific trust- relevant situations. Our findings on political trust provide new evidence on how the absolute trust in the Chinese state might shift when exposed to alternative political approaches in "unsettled times" like the pandemic.

Our study addresses these conceptual inadequacies by theorizing trust as an interactive social practice. Centering trust in action not only allows us to uncover the sites and processes of trust construction but also to systematically map out how trustors and trustees interact in

the matrix of trust-relevant situations. By specifying the matrix of distrust as well as unpacking the interactions between trustors and trustees, we could better understand how trust is built and how an act of trust responds to an act of trustworthiness. Equally important, understanding trust as an interactive social practice also provides us an analytical tool to amplify trustors' agency in building or contesting trust with trustees at micro-, meso-, and macro-levels.

Building on the insights of the current study, future scholarship on trust should take up several additional questions. First, what constitutes a trust-relevant situation? Second, how can we embed a life-course lens when researching trust as an interactive social construct? A longitudinal research design could allow for tracking the research population across life course transitions to the labor market, marriage and parenthood. By addressing these questions and refining our methodological approach, we can further advance our understanding of trust as an interactive social construct in different social contexts.

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Generative AI and Creative Thinking in Art Education: A TPACK-Based Theoretical Framework

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Abstract

As a conceptual study, this paper proposes an integrated framework based on TPACK theory, aiming to integrate generative AI into the field of art education and help cultivate creative thinking of art teachers. Through interdisciplinary literature analysis, the study redefines generative AI as a technical knowledge form that dynamically interacts with teaching strategies and subject content. The framework advocates that educators regard AI tools as collaborative partners to enhance students' creative thinking ability. The conceptual model promotes the development of creative ability and the improvement of critical digital literacy by integrating AI-assisted teaching, subject content knowledge and ethical reflection (covering issues such as the definition of creative ownership and the examination of bias). The actual cases and empirical evidence in the article further confirm the applicability of the model in real classroom scenarios. This study not only lays a theoretical foundation for subsequent empirical exploration, but also provides operational practical inspiration for the curriculum design of art teacher education.

Keywords: Generative AI; TPACK; Creative Thinking; Art Education

1. Introduction

Artificial intelligence (AI) is advancing at an astonishing pace, especially breakthroughs in the field of generative technology, which has brought new opportunities and challenges to the educational scene. Today, tools such as ChatGPT, DALL.E, and Midjourney are no longer exclusive to a niche group; they have become widely popular and can generate text, images, and multimedia content by simulating human creativity. Zawacki-Richter et al., (2019) pointed out that in the post-epidemic era, education is continuing to evolve towards a more flexible and technologically integrated model, and these generative AI tools are increasingly seen as partners with both cognitive and creative functions in the teaching environment. It is particularly worth noting that the deep integration of generative AI and art education has opened up broad space for re-exploring the path to cultivate students' creative thinking, and the development of creative thinking is precisely the core goal of aesthetic learning.

Art education has long been closely linked to the cultivation of imagination, the improvement of expression skills, and the shaping of divergent thinking. However, as early as 2002, Eisner pointed out that traditional art classes, especially in vocational education or teacher training scenarios, often over-emphasize skill reproduction, standardized assessment,

and the pursuit of results-oriented, which may restrict true creative exploration. Today, the integration of generative AI has injected new possibilities into art education-it is expected to revolutionize the traditional teaching paradigm by providing learners with new tools for conceptualization, creative experimentation, and work criticism. As Madaan et al., (2024) proposed, students can use AI to achieve multiple creative practices: let AI generate multiple visual interpretations of a concept, analyse the composition rules of artistic styles, or deconstruct and reorganize existing works of art. In this way, learners can be exposed to creative processes that transcend their own technical limitations and style preferences. Although generative artificial intelligence has shown significant technological application potential in the field of art education, the theoretical guidance framework for its deep integration with teaching practice still needs to be systematically constructed.

In response to the shortcomings of this theoretical research, this paper takes the Technology Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006) as the theoretical basis and constructs a new conceptual analysis framework. The study aims to explore how art educators can cultivate students' creative thinking ability through the effective integration of generative artificial intelligence. The core of the TPACK framework proposed by Mishra and Koehler is to emphasize the interdependence of teachers' understanding of technology knowledge, teaching methods and subject content. When applied to the field of art education, it provides a structured perspective from which the educational functions of generative AI can be accurately matched with creative learning goals. This paper systematically analyzes the generative AI tools in the TPACK model and discusses in depth from a theoretical level how to use these technologies in a targeted manner to enhance students' creative thinking ability. According to the theory of Runco and Jaeger (2012), the creative thinking ability mentioned here not only covers the ability to create original works, but also includes the ability to establish novel connections, conceive multiple possibilities, and express aesthetic intentions.

As a conceptual study, this paper focuses on the interpretation of the potential value of generative artificial intelligence in the cultivation of creative thinking of reserve teachers in art education. Although the research belongs to the category of theoretical construction, the framework system proposed is formed by systematically integrating the interdisciplinary research results of artificial intelligence technology, creative thinking theory and art education and teaching knowledge. Different from the empirical research path, this study adopts a theory-driven methodology. First, it extracts common research topics, teaching practice difficulties and teaching design principles from existing academic achievements and then integrates the elements with the help of the analytical framework of the TPACK (Technology -Pedagogy - Content Knowledge) model, and finally constructs a set of theoretical systems that can guide artificial intelligence-assisted creative teaching. This conceptual research foundation aims to provide a theoretical reference for subsequent empirical research and curriculum development in the field of professional art teacher education.

2. Literature Review

In recent years, the integration of artificial intelligence and education has become the focus of widespread attention in the academic community. Zawacki-Richter et al., (2019) argued that as generative AI technology demonstrates increasingly complex capabilities in simulating

human output, its application in education is receiving increasing attention. In teaching and learning scenarios, artificial intelligence is no longer just seen as a tool for automation or evaluation, but as a co-creation partner for knowledge building, problem solving, and cognitive stimulation. Marrone and Hill (2022) believes that with the continuous emergence of models capable of generating text, images and soundscapes, educators are beginning to explore new teaching opportunities to help students think development, especially those involving creativity and imagination. process. In this broad research area, art education provides rich research soil for exploring how artificial intelligence supports high-level cognitive results. Creative thinking, as the core content of aesthetic and expressive learning, has traditionally attracted much attention, and now it is expected to achieve new breakthroughs with the help of artificial intelligence.

Creative thinking in art education has long been regarded as a multi-dimensional process that covers fluency, originality, flexibility and exposition. Guilford made this view as early as 1950, and Runco and Jaeger agreed in 2012. In 2005, Craft pointed out that in contemporary education concepts, creativity is no longer a talent unique to a few talents, but a set of skills and traits that can be cultivated through well-designed courses and reflective practice. However, Bequette and Brennan (2023) found through empirical research that in many classrooms, especially in vocational education and teacher education, the actual effect of creativity cultivation is often difficult to achieve expectations. These courses may focus more on technical transfer and compliance with stylistic norms, leaving students limited space for divergent thinking and personal experimentation. In this context, the emergence of generative AI has brought opportunities and challenges. Manu (2024) believes that on the one hand, it raises concerns about the authenticity, authorship and artistic judgment of art works; on the other hand, it also provides learners with powerful tools to reimagine, recombine and expand visual creativity in unprecedented ways.

At present, academic circles have discussed the application of generative AI in art classrooms from various perspectives. Ho et al., (2019) emphasize the motivational and exploratory benefits of these tools for students with limited technical drawing or rendering skills. With AI tools, students can bypass some mechanical creative barriers and explore art forms, styles and concepts more freely. There are also scholars who hold different views. Fisher, J. A. (2023) advocate that generative AI be regarded as a “creative provocateur”, that is, as an external force that stimulates new creative ideas, encourages the juxtaposition of visual elements, or guides students to critically reflect on aesthetic decisions. Although generative AI has shown much potential in art classrooms, there is still a lack of a structured teaching model to guide how to effectively integrate it into teaching practice, especially how to align it with clear creative learning goals.

Mishra and Koehler developed the Technological Pedagogical Content Knowledge (TPACK) framework in 2006, which argues that one possible way to address this gap is to apply the TPACK framework. TPACK proposes that effective technology integration in education requires an in-depth and detailed understanding of the dynamic relationships between content knowledge (CK), teaching knowledge (PK), and technological knowledge (TK). TPACK does not regard technology as a simple add-on, but emphasizes the need for careful cross-integration between various knowledge areas so that these three knowledge areas can together provide the basis for teaching decisions. In the field of art education, using the TPACK framework means that when selecting digital tools, we cannot just focus on the novelty of the tool, but also consider its support for expression skills, whether it can deepen conceptual understanding, and whether it can stimulate students’ creativity.

Recently, many literature has begun to explore how to better adapt TPACK to creative disciplines. Kara, S. proposed in 2021 that in the art teacher education process, the TPACK model can help prospective teachers develop the confidence and flexibility to try new technologies, while also ensuring that the integrity of art is not affected. In 2023, Tusiime et al., also emphasized that TPACK-based teaching has the potential to narrow the gap between digital literacy and creative expression, allowing students to use technology as a medium of conception rather than just for creative output. However, most of this kind of research is currently abstract, and there is still a lack of specific frameworks when applying TPACK to the specific background of generative AI. Therefore, there is an urgent need for a theory to illustrate the connection between generative AI tools, TPACK-based instructional design, and the cultivation of creative thinking in art education.

3. Conceptual Framework

To conceptually explore the potential of generative AI to foster creative thinking in art education, this paper uses the TPACK framework as a theoretical foundation. The TPACK model proposed by Mishra and Koehler in 2006 points out that the key to achieving effective integration of technology in teaching lies in the teacher's deep understanding and simultaneous mastery of CK, PK and TK. These three core areas intersect to form a knowledge base that enables educators to design and conduct meaningful learning activities. This cross-fertilization is particularly important in the field of art education, because teaching the creative process requires not only solid subject expertise and sound instructional strategies, but also the ability to select and apply relevant technologies to support students open-ended exploration and expression. In this study, the integration of generative AI was clearly classified as TK in the TPACK framework. TK refers to the knowledge system required to select, understand and use digital tools to effectively support learning activities. Generative AI tools that can generate images, texts or multimodal works based on user instructions fit the definition of this knowledge category.

However, the potential of generative AI tools in education is not determined solely by their technical performance, but also by whether they can be closely integrated with teaching strategies and content knowledge designed to promote students' creative engagement, thereby linking these strategies with subject characteristics. For example, in a digital illustration course, if teachers want to explore surrealist aesthetics with the help of image generation models, they must not only be familiar with the stylistic characteristics of surrealism but also understand the algorithmic logic that affects the results of AI generation. More importantly, the application of generative AI in art education and teaching must be guided by the fundamental principle of cultivating creative thinking habits. This requires that the teaching tasks designed cannot remain at the level of passive acceptance or pursuit of superficial novelty, but should guide students to criticize, reconstruct and expand the content generated by AI.

From this theoretical perspective, the TPACK framework not only constitutes the theoretical framework of teachers' knowledge structure but also becomes an important basis for the design of learning scenarios. In such a teaching environment, artificial intelligence technology should be positioned as a tool to empower human creativity, rather than a replacement. Specifically, the teaching knowledge dimension plays a key role in guiding students to interact with AI tools - students can regard AI as a creative collaboration partner, a source of inspiration, or an extension of their own imagination. In addition, the content knowledge elements in the TPACK framework can ensure that the application of generative artificial intelligence in art education does not deviate from the essence of the subject and avoid

falling into the misunderstanding of technology supremacy. In the context of art education, in addition to technical skills and historical knowledge, the teaching content also includes the cultivation of aesthetic judgment ability, the formation of personal artistic style, and the improvement of cultural literacy.

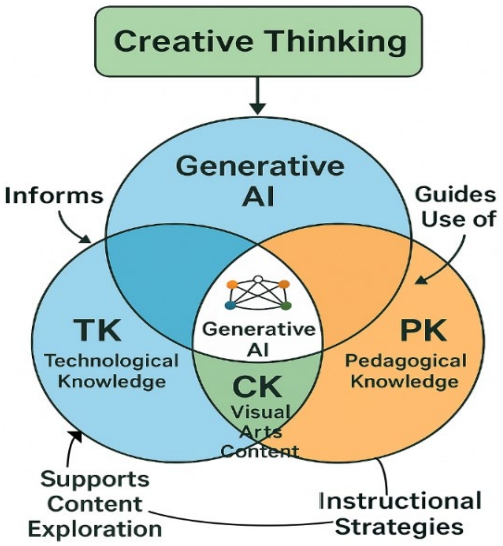
The TPACK framework is often seen as the intersection of three areas: content, pedagogy, and technology. However, its value lies not only in defining these knowledge areas, but also in its insight into the dynamic interactions between them. Koehler and Mishra pointed out in 2009 that to achieve effective technology integration, teachers must make decisions based on the actual teaching environment, in which technology tools, teaching intentions, and subject goals always influence each other. This interaction is not a simple superposition, but a process of mutual stimulation - teaching strategies often change due to the new possibilities brought by technology, and conversely, teaching needs will also drive the adaptive adjustment of technology.

In the field of art education, this dynamic dependency is particularly evident. Art creation itself is a process of repeated adjustment and mutual feedback between conception, technical practice, and teaching guidance. Therefore, we should not regard the TPACK framework as a fixed knowledge system, but as a flexible ecosystem that can generate new knowledge. This system is essentially a heuristic teaching design method, with which educators can continuously optimize AI-assisted teaching to promote learner-centered, real-world artistic exploration.

To integrate the above theoretical research results, this study proposes a conceptual model that integrates generative AI into the TPACK framework for intuitive presentation. As can be seen from Figure 1, generative AI belongs to the category of TK, however, its teaching value is reflected in the visual arts education scenario through dynamic interaction with PK and CK.

Figure 1

TPACK-Based Conceptual Model for Integrating Generative AI into Art Education.



This model highlights the role of generative AI in building a bridge between teaching strategies and teaching content in specific fields, ultimately helping to cultivate students creative thinking. This visual framework educators with a practical perspective to aligner

chaological advantages with teaching goals and subject depth.

Therefore, teachers need to be able to guide students to understand the ethical, cultural, and conceptual implications of using artificial intelligence in creative work. This Figure 1 TPACK-based conceptual model for integrating generative AI into art education includes exploring topics such as authorship, originality, and the boundaries between human-created and machine-generated artworks, which are, as Manu pointed out in 2024, core points in contemporary discussions of digital aesthetics. This framework conceptualizes generative AI as a form of TK that interacts dynamically with PK and CK in visual arts education. Through their integration, instructional strategies can be developed to enhance students' creative thinking.

To strengthen the conceptual framing with empirical grounding, the procedural steps underpinning the AI-enhanced TPACK model must be explicitly articulated and validated through classroom-based evidence. For instance, Kong, Yang, and Yeung (2024) described iterative design cycles in which STEM teachers trialed AI components and refined pedagogical strategies based on structured feedback. Chen (2022) used mixed methods analysis of teacher reflection diaries to verify the core structure of the model. Similarly, Ruthmann and Mantie (2017) explained the interactive relationship between technology, content, and teaching methods through case-based music education research, while Wijaya (2020) used observation records to evaluate digital teaching practices. These empirical studies provide specific verification cases and rich support for theoretical propositions.

By organically combining the application of generative AI with the three interrelated dimensions of the TPACK framework, this conceptual framework provides a new perspective for evaluating and designing teaching strategies that promote creative thinking in art classrooms. Rather than being limited to specific tools or preset outcomes, the model guides educators to think deeply about the inherent connection between the potential of technology, teaching goals, and art subject content. In the process, it constructs an implementation path that is both flexible and principled, organically integrating emerging artificial intelligence technologies into the complex practice of cultivating creativity for future art educators.

4. Proposed TPACK-Based Approach

Based on the TPACK framework, this section proposes a flexible teaching strategy to help art educators integrate generative AI into the cultivation of creative thinking. This strategy abandons the mechanical application of fixed teaching models and instead emphasizes the dynamic coordination of technical knowledge (TK), pedagogical knowledge (PK) and subject content knowledge (CK). In this design, generative AI is not used as a terminal tool, but as a creative collaborator to support exploration, experimentation and iteration in the process of artistic development.

The close fit between pedagogical knowledge (PK) and creative teaching strategies is crucial. Referring to the theoretical model of Runco and Jaeger (2012), creative thinking is regarded as a multidimensional ability covering fluency, originality and flexibility - these dimensions of ability naturally match the functional characteristics of AI tools. Taking the mixed media painting workshop as an example, after students generate a variety of composition schemes with the help of AI tools, they screen and refine elements to construct personalized visual narratives. By designing such structured and open tasks, educators can guide students to criticize, reconstruct and expand AI-generated content, so that the generation system can be transformed into an effective tool to support the development of higher-order thinking.

Content knowledge (CK) is the foundation of discipline, ensuring the coherence of concepts and techniques. In the field of art education, CK covers the understanding of aesthetic theory,

historical context, symbolic system and media dimension. Generative AI is not intended to replace these knowledge systems, but to provide a new path for exploring and expanding the boundaries of knowledge. For example, students can use generative AI to generate visual elements that fit the conceptual theme and then deconstruct and reconstruct them through traditional and digital means. As shown in the fashion design project of Lee and Suh (2023), this fusion effectively optimizes the entire process from creative conception to material landing. In addition, the studies of Sang et al. (2018) and Syukri et al. (2023) have confirmed that embedding AI tools into collaborative critical cycles can cultivate students' deeper artistic perception and iterative learning ability.

Crucially, this teaching model deeply integrates moral reflection with the cultivation of critical digital literacy. Teachers need to guide students to clarify the boundaries between human and machine creation, analyze the implicit bias of algorithms, and examine the social impact of AI-generated visual content. Modular criticism models or real-time formative feedback mechanisms such as those proposed by DeWitt and Alias (2021) can not only promote responsible technological exploration but also avoid shallow application or improper use of AI. These ethical considerations are by no means subsidiary content but are the core of cultivating educators who have the ability to master the AI era and have both vision and creativity.

This model organically integrates TK, PK and CK into teaching design, transforming teachers into designers of transformative learning experiences. It not only enables prospective teachers of professional art education to creatively use generative AI, but also encourages them to examine, reconstruct and expand the possibilities of technology applications from both teaching and artistic dimensions.

5. Conclusion

This paper constructs a conceptual framework based on the TPACK model, aiming to integrate generative AI into the field of art education. By integrating technical knowledge, pedagogical knowledge and subject content knowledge, the framework advocates the use of AI as a catalytic tool to stimulate students' fluency, originality and flexibility in expression, rather than a means to replace human creativity. The framework also emphasizes ethical considerations, including the definition of creative ownership, cultural bias and the rational use of technology, so as to promote digital literacy while promoting creativity. In order to promote the in-depth integration of theory and practice, subsequent research can examine the application effect of the framework in real teaching scenarios through empirical methods such as classroom case analysis, teacher reflection records or experimental design. Specifically, it can focus on the impact mechanism of AI-assisted tasks on creative achievements, the strategic path for educators to cope with ethical challenges, and the model's support model for curriculum innovation. Such research will provide a basis for the effectiveness verification of the framework and help its promotion and application in the field of art teacher education.

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Fostering Sustainable Learning through AI-Supported Flipped Classrooms: A Conceptual Framework for Enhancing Self-Regulated Learning in Chinese College English Listening Instruction

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Abstract

This study constructs a conceptual framework to integrate AI-supported flipped classrooms with self-regulated learning (SRL) in English listening teaching in Chinese universities. Referring to Zimmerman's (2000) SRL cycle theory, the framework integrates AI tools and flipped teaching to solve the problems of passive learning. AI customizes pre-class content and provides real-time feedback to help students plan and monitor their learning independently. Classroom activities promote collaborative reflection and connect individual and social learning. By cultivating self-regulated learning habits and long-term motivation, the framework meets the needs of post-epidemic education resilience. Although this integration can increase participation and relieve anxiety, its effectiveness depends on the fairness of technology access and the balance between teachers. In order to overcome infrastructure differences and avoid indicator dependence, this study advocates a mixed implementation of high- and low-tech strategies to achieve fair promotion. This study regards AI as a boost to SRL cultivation, reshapes the concept of language education, and highlights the synergy between technology, teaching methods, and learner autonomy.

Keywords: AI-supported Flipped Classrooms；Self-Regulated Learning；Sustainable Learning；College English Listening Instruction；Post-Pandemic Education

1. Introduction

English listening teaching in Chinese higher education has long faced a series of challenges, which are not only due to the inherent drawbacks of the traditional teaching model, but also closely related to the changing educational needs. At present, the conventional teaching method is teacher-centred and adopts a standardized assessment system. Under such a model, students' learning behaviour is passive and foreign language listening anxiety (FLLA) is aggravated (Liu & Yuan, 2021; Zhou & Thompson, 2023). Moreover, this type of teaching method over-emphasizes listening comprehension checks, but ignores the cultivation of students' metacognitive strategies and self-regulated learning (SRL) abilities, making it difficult for learners to cope with real-time cognitive challenges in the listening process (Xu & Luo, 2022). In addition, the promotion of English-medium instruction (EMI) requires students to decode language information and understand subject content, which further increases the cognitive

burden (Zhou & Rose, 2021). Students' English proficiency varies, and a unified curriculum cannot take into account the needs of everyone. Students with poor English foundation are easily marginalized in teaching (Chen, 2024). These systemic problems indicate an urgent need to restructure the teaching framework and break through the emotional, cognitive and teaching system barriers in the process of listening skill development.

In response to the challenges mentioned above, the flipped classroom (FC) model has become a revolutionary teaching alternative. Qiu and Luo (2022) and Cevikbas and Kaiser (2022) have shown that this model cultivates learners' autonomy and reduces their learning anxiety by replanning the learning sequence, moving content delivery before the class, and focusing on collaborative practice in the classroom. A large number of empirical studies have shown that, especially when flipped classrooms are combined with digital tools, they are effective in improving learners' listening skills and promoting the use of metacognitive strategies (Fan, 2022). However, in China, the promotion and application of flipped classrooms are subject to certain constraints due to inadequate infrastructure and insufficient teacher preparation. This phenomenon reflects the contradiction and conflict between teaching innovation and the traditional education system (Feng, 2020; Miao et al., 2024). At the same time, artificial intelligence (AI) technology is booming, and adaptive learning platforms, speech recognition systems, etc. have opened up a new path for personalized teaching. Research by Crompton et al. (2024) and Alrasheedi (2025) showed that AI can provide real-time feedback and accurately diagnose students' listening problems, which is very consistent with the requirements of differentiated teaching in classrooms with varying levels of language proficiency. However, Tsang (2019) pointed out that current academic research often treats AI and flipped classrooms as independent teaching methods, ignoring the synergistic value of the two in dealing with the complex and immediate teaching needs of listening comprehension.

In the post-epidemic era, the field of education has undergone profound changes, and it has become increasingly urgent to build a sustainable learning model. This model is not a stopgap measure but focuses on long-term development. The Organization for Economic Cooperation and Development (OECD, 2021) proposed the concept of "sustainable learning", which aims to cultivate learners who can continue to improve in a changing environment and have adaptability and self-regulation. This concept is very consistent with China's Education Power Construction Plan (MOE, 2024). In this context, the AI-supported flipped classroom (AI-supported FC) model provides a feasible solution for enhancing students' learning resilience. With the help of this model, learners can effectively overcome cognitive and emotional challenges through repeated practice and timely feedback and better adapt to complex and changing learning environments.

This study builds a conceptual framework that integrates artificial intelligence and flipped classroom (FC), aiming to overcome the key theoretical and practical difficulties in English listening teaching in Chinese universities and improve students' self-regulated learning (SRL) ability. The framework is based on the self-determination theory proposed by Ryan and Deci (2020) and the SRL model of Zimmerman (2002). In the framework, artificial intelligence is positioned as a tool to promote metacognition development. With the help of adaptive algorithms, pre-class and classroom learning content is tailored according to the actual level of

learners. The research conducted by Chen (2024) and Zhou and Rose (2024) focuses on the regulatory role of language ability in learning. They oppose the homogeneous use of educational technology and advocate narrowing the achievement gap between different students through tiered support. The results of this study provide a set of scalable strategies for sustainable teaching methods, which are in line with the policy requirements of China's digital transformation and the actual situation of Chinese education. Through in-depth exploration from multiple dimensions, this study incorporates discussions on global fair artificial intelligence integration and educational resilience in the post-epidemic era, and innovatively proposes a new learner-centred dynamic listening teaching model.

The nature of this study should be clarified: this paper is a conceptual exploration, not an empirical study. This paper proposes a theoretical framework that combines AI-supported flipped teaching with autonomous learning principles, aiming to provide guidance for teaching innovation. It is recommended that future research empirically validate this framework by using a longitudinal mixed-method design in real educational settings.

2. Theoretical Foundations

2.1 Self-Regulated Learning (SRL) and Zimmerman's Three-Phase Model

The conceptual framework of this study is based on the self-regulated learning model (SRL) proposed by Zimmerman, (2000). The model divides the learning process into three stages, involving forethought, performance control, and self-reflection. In the forethought phase, learners set learning goals and develop learning strategies based on their self-efficacy and analysis of learning tasks. Pintrich (2000) pointed out that this process is extremely critical to language acquisition, among which metacognitive planning directly affects the choice of listening comprehension strategies. During performance control, learners use self-observation and flexibly use adaptive strategies to monitor their learning progress. For example, when encountering unfamiliar accents or fast speaking speed, learners will adjust their listening skills. However, Boekaerts (1999) believes that in the traditional teacher-centered teaching model, learners' abilities in this area are often not fully developed. Entering the self-reflection stage, learners analyze the causes of learning outcomes through self-evaluation, thereby optimizing subsequent learning strategies. Although Zimmerman's model provides important theoretical support for understanding self-regulated learning, it has also been criticized. Winne and Perry (2000) and Zhou and Thompson (2023) pointed out that the model pays relatively little attention to emotion regulation. In the process of language learning, anxiety often interferes with learners' cognitive engagement and is an important factor that cannot be ignored.

2.2 Sustainable Learning: Bridging SRL and Lifelong Adaptability

As an extension of self-regulated learning (SRL), sustainable learning emphasizes the cultivation of adaptive lifelong learning capabilities that go beyond short-term academic goals (OECD, 2021). Rooted in the educational priorities of the post-pandemic era, sustainable learning focuses on cultivating learners' resilience and autonomy to help them cope with the ever-changing language and technology environment (Adam, n.d.). This concept advocates process-oriented development, prompting learners to internalize strategies for autonomous knowledge construction rather than simply pursuing established standards, thus challenging the traditional result-oriented model. However, in an environment dominated by standardized tests, there is still controversy about the implementation of curriculum sustainability, and

institutional accountability often obscures personalized learning paths (Caspersen, 2005). Integrating SRL principles into the sustainable learning framework requires teaching innovation and balancing structured guidance with learners' subjective initiative - this is also the core contradiction in the process of technology-enabled language education.

2.3 AI-Supported Flipped Classrooms: A Synergistic Model for SRL Activation

There is a synergistic effect between the flipped classroom supported by artificial intelligence and the activation of self-regulated learning (SRL), and the two complement each other in terms of personalized learning path design and metacognitive development support. Although both artificial intelligence and flipped classrooms aim to enhance learners' autonomy, their core functions are different: artificial intelligence provides personalized scaffolding and real-time feedback through data-driven algorithms, while flipped teaching shifts the focus of the classroom to active strategy training by restructuring the teaching sequence. The synergistic value of the two lies in integrating the adaptability of artificial intelligence with the collaborative reflection mechanism of flipped classrooms. Cevikbas and Kaiser (2022) pointed out that flipped classrooms use carefully selected digital resources to pre-stage knowledge absorption, freeing up time for interactive high-level tasks in class, which naturally fits the pre-thinking and executive control stages of SRL. On this basis, Alrasheedi (2025) and Crompton et al. (2024) believe that AI uses adaptive algorithms to diagnose individual listening challenges, recommend personalized practice materials, and provide real-time feedback on speech accuracy to meet the needs of learners at different levels. For example, AI-driven speech recognition systems help learners improve their pronunciation before class, and classroom collaborative activities promote reflective communication among peers, which is consistent with the self-reflection stage of SRL proposed by Zimmerman (Saks & Leijen, 2014). Qiu and Luo (2022) proposed that this integrated model provides a low-risk, self-paced practice environment, thereby effectively reducing learners' cognitive burden and alleviating foreign language listening anxiety.

It should be emphasized that the effectiveness of the AI-flipped classroom does not rely solely on the surface form of technology application. Rovers et al. (2019) believe that although artificial intelligence relies on fine-grained data analysis to better measure student behavioral participation, such as task completion time, error types, etc., it often ignores the emotional and motivational aspects., there is a risk of over-reliance on quantitative indicators. Moreover, the model assumes that students have equal access to digital infrastructure and are familiar with the autonomous learning process. However, research by Miao et al. (2024) shows that this assumption is difficult to hold in rural colleges in China due to resource gaps. In addition, Ardasheva et al. (2017) and Cheng and Chau (2013) warned through empirical research that without clear metacognitive strategy training, students are likely to rely solely on artificial intelligence tools to improve the efficiency of the learning process and find it difficult to achieve deep learning. This highlights the importance of teachers playing a guiding role, which is the only way to ensure that technological applications are consistent with self-regulated learning (SRL) goals. Overall, the AI flipped framework has been able to achieve results thanks to its dual functions of both technical support and teaching concept guidance. With this framework, listening teaching is redefined as a dynamic interactive process between learner autonomy, adaptive support, and sustainable skill transfer.

3. Proposed Framework

Building on Zimmerman’s SRL model and sustainable learning principles, this framework

operationalizes the synergy between AI and flipped pedagogy through three phases: input, process, and output (see Figure 1 for details). The goal is to promote students' self-Regulated learning (SRL) and cultivate their sustainable learning ability. Alrasheedi (2025) and Cevikbas and Kaiser (2022) found that in the input stage, intelligent listening platforms, such as speech recognition systems, adaptive diagnostic modules, and flipped classroom resources, such as pre-class video lectures, interactive tasks and other artificial intelligence-driven tools, play a key role. These technologies can provide personalized learning content and give real-time feedback based on the actual situation of students to meet the needs of students at different levels, as shown by Han et al. (2025), mobile AI chatbots can provide self-regulated learning (SRL) scaffolding for goal setting and reflection. At the same time, by building a learning preparation link, students' cognitive pressure can be reduced. pointed out that this function plays an extremely important role in alleviating students' anxiety when learning foreign language listening. Furthermore, flipped videos that incorporate metacognitive prompts (such as guided note templates and reflection questions) guide students to participate in classroom activities with strategic thinking, which is consistent with the SRL pre-thinking stage proposed by Zimmerman (2000).

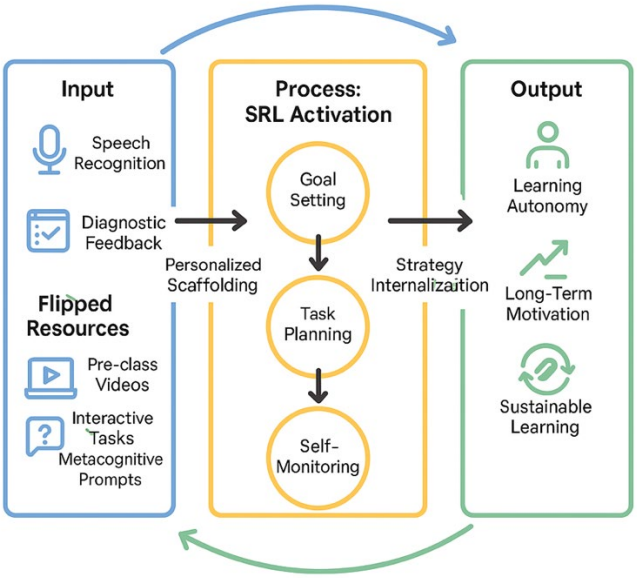
The process stage activates self-regulated learning (SRL) strategies through orderly interactions between learners, technology, and instructional design. Ardasheva et al. (2017) pointed out that in the pre-class interaction, AI tools can diagnose individual listening shortcomings, recommend targeted exercises, and help learners set goals; while flipped tasks can closely link pre-class preparation content with class goals by building an outline, stimulating learners to plan tasks. This is consistent with the conclusions of related studies: trajectory analysis based on natural language processing (NLP) has objectively reflected learners' autonomous learning strategies when watching video lectures (such as self-questioning, Winne, 2017), and the prompt words generated by ChatGPT provide scaffolding support for learning plan formulation and process monitoring in pre-class activities (Li, 2023). In the classroom, peer-led discussions, problem-solving simulations, and other activities are carried out to encourage learners to explain the use of strategies and adjust their learning methods based on feedback from peers and teachers. Pintrich (2000) believes that this interactive process fully reflects the performance control stage proposed by Zimmerman. However, studies by Rovers et al. (2019) and Saks and Leijen (2014) also pointed out that this model has potential problems. If learners rely too much on the algorithmic suggestions of artificial intelligence, they may unconsciously narrow their own strategy selection range; a phenomenon observed when high-SRL students exhibited decreased autonomy after over-relying on chatbot guidance (Han et al., 2025). Similarly, if there is a lack of guidance in flipped tasks, learners may only participate superficially. Therefore, the framework emphasizes the guiding value of teachers, and while carrying out strategy training, it also makes reasonable use of the autonomous assistance function of artificial intelligence. This is to ensure that learners can truly understand and practice the principles of self-regulated learning (SRL) and avoid simply learning mechanically according to tool prompts.

The output level covers key elements such as improving learning autonomy, maintaining learning motivation, and cultivating sustainable learning ability. Cheng and Chau (2013) pointed out that learners can gradually develop the habit of autonomous listening practice by continuously participating in artificial intelligence feedback activities and completing collaborative flipped tasks, such as independently selecting appropriate learning resources according to their own level, or reflecting on the types of errors. Such habits were fostered through AI-driven reflection prompts that help promote strategy transfer and emotional self-

regulation. (Li, 2023; Yılmaz et al., 2017). When students have a stronger sense of control over their learning process, they will reduce their dependence on external rewards such as test scores. More importantly, Prøitz (2010) emphasized that the framework integrates transferable self-regulated learning (SRL) strategies such as adaptive goal adjustment and emotional self-regulation into daily learning, focusing on cultivating learners' sustainable learning ability and helping them cope with various challenges in future language learning after the end of formal teaching. However, Miao et al. (2024) and Chen (2024) point out that there are still systemic challenges. Rural colleges may not be able to fully utilize advanced AI tools due to relatively weak infrastructure; at the same time, the exam-oriented education culture often focuses more on students' short-term performance and neglects the cultivation of sustainable skills. Therefore, to ensure that the framework can be widely and equitably implemented, a hybrid implementation approach is recommended, combining AI-driven personalized teaching with low-tech SRL support methods such as reflection journals and peer guidance.

Figure 1

Visual Representation of the Framework via a Linear Flow



**Noted: This figure is generated by researchers*

4. Implications for English Listening Instruction

4.1 Pedagogical Implications: Task Design and AI Integration

For educators, the framework requires a paradigm shift: from content imparters to strategic coordinators of multiple roles that mediate between technology, pedagogy, and equity. Teachers need to act as designers of pre-class self-regulated learning (SRL) by embedding metacognitive prompts in pre-class materials and strategically integrating AI tools and flipped learning resources to scaffold learners' pre-thinking phase and relieve anxiety (Liu & Yuan, 2021). When selecting pre-class materials, teachers should consider both language difficulty and metacognitive guidance (Cevikbas & Kaiser, 2022), such as incorporating reflective questions into flipped videos to help students anticipate listening challenges or assess comprehension gaps. In addition, as facilitators of self-regulated learning in the classroom, teachers need to prioritize the design of collaborative activities (such as peer discussions) to encourage students

to express and adjust strategies based on feedback, ensuring that they go beyond algorithmic suggestions to achieve deep cognitive engagement (Ardasheva et al., 2017; Pintrich, 2000). In this process, AI platforms are not only diagnostic tools, but also adaptive partners that generate personalized exercises through real-time error analysis, allowing teachers to focus on high-impact interventions such as collaborative problem solving (Alrasheedi, 2024). However, we need to be wary of over-reliance on AI automation, which may weaken teachers' teaching guidance role - algorithms often prioritize efficiency rather than deep cognitive engagement (Rovers et al., 2019). To this end, teachers also need to act as hybrid designers with fairness at the core, combining the personalized advantages of AI with low-tech strategies (such as reflective journals) to bridge infrastructure differences and test-taking bias (Chen, 2024; Miao et al., 2024). Therefore, professional development should empower teachers to critically interpret AI analysis data and design hybrid tasks (such as using AI error reports to conduct strategy workshops) to balance technical feedback with humanistic guidance (Wang, 2023). Finally, as a catalyst for autonomous learning transfer, teachers need to design targeted activities (such as peer analysis of AI-identified errors) to extend adaptive skills beyond the curriculum and cultivate sustainable learning capabilities that are consistent with the goal of resilience in the post-epidemic era (Cheng & Chau, 2013; OECD, 2021).

4.2 Student Implications: Cultivating Self-Regulated Learners

Students need to receive systematic tool literacy and metacognitive awareness training w hen transitioning to the AI flipped classroom model. Saks and Leijen (2014) suggested that in the initial guidance stage, students should be made aware of the unfamiliarity of AI functions, such as showing how the speech recognition system can give constructive feedback on pronu nciation, and at the same time make it clear to students that AI is only an auxiliary tool and ca nnot replace critical thinking. To help students develop the habit of self-regulated learning (S RL), Cheng and Chau, (2013) suggested that teachers can introduce reflection logs, allowing s tudents to record goal setting, such as "This week, I will focus on identifying key words in rap id speech", and use AI-generated indicators to evaluate learning progress. However, there are still challenges in practice. Chen (2024) and Zhou & Rose (2024) found that learners with poo r English foundation may over-rely on AI correction and neglect the cultivation of comprehen sive strategies, while students with excellent grades may find automatic feedback lacking valu e. Ardasheva et al. (2017) pointed out that this problem can be solved by constructing “strateg y transfer” activities, such as discussing problems identified by AI in peer teaching sessions, t o ensure that students’ learning skills can be transferred to different scenarios.

4.3 Educational Sustainability: Aligning with Post-Pandemic Innovation

The Organization for Economic Cooperation and Development (OECD, 2021) pointed out that in the post-epidemic era, it is crucial to build a resilient lifelong learning ecosystem, and this framework just meets this need. Through AI-based flipped hybrid teaching, teaching activities are no longer overly dependent on physical classrooms. This model is not only an important measure to deal with the crisis, but also effectively cultivates learners' autonomy and helps them continue to learn beyond the scope of formal education. Prøitz (2010) proposed that when students internalize self-regulated learning (SRL) strategies into habits, they can achieve sustainable learning results. For example, they can use AI tools to conduct independent learning in informal scenarios such as work or daily life long after the course ends. However, the research of and Feng (2020) warns that systemic inequality poses a challenge to the promotion of this framework. There is a gap in technology use between urban and rural areas, which may prevent learners in remote areas from benefiting from AI; at the

same time, the exam-oriented education culture may reduce flipped classrooms to "digital cramming" and fail to truly promote deep learning. Therefore, to resolve this problem, policymakers should proactively promote inclusive hybrid teaching models, combining low-bandwidth artificial intelligence tools such as offline voice applications with community-based peer-to-peer networks to promote the widespread dissemination of sustainable education concepts and ensure that more learners can benefit from this teaching model.

More broadly, the framework supports the cutting-edge discussion on sustainable learnin g by linking self-regulated learning (SRL) with long-term learner adaptability and national di gital transformation policies (OECD, 2021). It challenges the teaching model centred on short -term test-taking by emphasizing metacognitive development, learner agency and emotional r esilience. These teaching transformations are particularly critical in the post-pandemic recove ry phase, in which technology-enabled flexible teaching needs to coexist with fair and people -centered learning environments.

5. Conclusion

Integrating AI-supported flipped classroom into English listening teaching is a revolutionary teaching practice. This teaching method promotes students to achieve sustainable learning by activating self-regulated learning (SRL) strategies through the system. In this model, the adaptive nature of AI and the flipped teaching method's emphasis on students' active participation work together to successfully overcome the long-standing problems of passive learning, cognitive overload, and foreign language learning anxiety in the field of language education. At the same time, this model can effectively cultivate learners' autonomous learning ability and help them master lifelong skills. This study constructs a corresponding conceptual framework based on the three-stage theory of self-regulated learning proposed by Zimmerman (2000), namely, pre-thinking, executive control, and self-reflection. The framework shows that when AI tools are strategically integrated with flipped classroom resources, a virtuous cycle will be formed. In the cycle, students' learning motivation and autonomous learning ability continue to improve, which in turn encourages them to participate more deeply in teaching activities. The Organization for Economic Cooperation and Development (OECD, 2021) pointed out that this synergistic effect can not only improve students' current listening skills, but also help students master metacognitive strategies, which can be transferred to different language learning and academic scenarios, in line with the needs of cultivating learners with resilience and autonomous learning ability in the post-epidemic era.

Wang (2023) pointed out that this framework provides important theoretical support for future teaching innovation in balancing technology integration and people-centered teaching methods. It prompts educators and policymakers to rethink AI and regard it as a catalyst for the development of self-regulated learning (SRL) rather than a substitute for traditional teaching, while highlighting the irreplaceable role of teachers in cultivating students' reflection and critical thinking. However, the framework is still theoretical and needs to be validated through empirical research to quantify its impact in different educational scenarios. It should be noted that there are several potential limitations: First, the premise of implementation is the availability of standardized digital infrastructure, which may be difficult to meet in resource-poor environments (Miao et al., 2024). Therefore, a hybrid approach combining high-tech and low-tech tools is needed to ensure equitable access. Second, if not properly regulated, the integration of AI tools may weaken teachers' subjective initiative (Rovers et al., 2019). Educators need to receive targeted training to interpret AI feedback and maintain teaching dominance (Wang, 2023). Third, learners with low self-regulated learning ability (SRL) may

over-rely on automated suggestions and even deviate from the reflective learning process. These risks highlight the importance of teacher-led strategy scaffolding and differentiated instructional design.

Future research should give priority to conducting longitudinal mixed-method surveys to evaluate the effectiveness of the framework in actual teaching environments. In particular, it is necessary to explore the interaction between AI's personalized functions and factors such as culture and infrastructure, for example, whether students in rural areas with limited technological resources can benefit from a combination of low-tech and high-tech teaching models. In addition, comparative studies across English course types, such as academic listening and conversational English, will help to clarify the contextual adaptation strategies needed to optimize the generalizability of the framework. Finally, it is critical for AI developers and educators to engage in interdisciplinary collaboration to improve tool design so that it prioritizes teaching goals rather than simply pursuing algorithmic efficiency, ensuring that AI-enhanced instruction not only improves immediate learning outcomes but also contributes to a more sustainable, inclusive, and learner-centered educational ecosystem.

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Navigation Safety and Risk Management Verification Mechanism for Maritime Autonomous Surface Ship (MASS)

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Abstract

The development of Maritime Autonomous Surface Ships (MASS) has attracted the attention of the maritime industry. However, people hope to reduce the risk of human error through relevant technologies, but the process of technological verification will give rise to other related problems. This study hopes to effectively curb the spread of risks through a set of management mechanisms and effectively assess and improve the problems derived from risks. Through the mechanism to ensure the impact of the verification process of the relevant functions of MASS on the current actual maritime operating environment (including autonomous and remote-control navigation). This study, through this iterative verification mechanism, controls risk within an acceptable range and collaborates with cross-disciplinary experts and scholars to examine the potential risk issues that the innovation process poses to both internal and external environments. As these issues are collected, the relevant supervisory authorities can evaluate and modify the current operational norms and legal and regulatory requirements through these empirical experiences. The research results provide an effective and systematic empirical verification mechanism for introducing innovative technology in the future society.

Keywords: Maritime Autonomous Surface Ship (MASS); Navigation safety; Risk management; Verification mechanism

1. Introduction

Maintaining the safety of life and property at sea and protecting the marine environment are the primary goals in the maritime field. Through the power of technological innovation, we continue to update the technologies required for operations in the maritime field. "Global Marine Technology Trends 2030" has confirmed that "Smart Ship" is a key technology for the development of the maritime field, especially autonomous navigation and control as the core of the technology (Shenoi et al., 2015). Countries have also begun to invest huge resources in formulating related plans, including the world's first "FALCO" fully autonomous sailing test completed by Rolls-Royce Marine in 2018 (Rolls-Royce, 2018), Japan and South Korea are also working hard for the upcoming era of autonomous sailing ships (Enevoldsen et al., 2023;

Nguyen et al., 2022). The International Maritime Organization (IMO) officially proposed the concept of Maritime Autonomous Surface Ship (MASS) at the 99th meeting of the Maritime Safety Committee (MSC). At the 101st meeting, MSC issued the "Interim Guidelines for Testing of Autonomous Maritime Surface Navigation Ships" and approved MASS to conduct actual testing in actual sea areas under restricted conditions (IMO, 2018). However, the guidelines retain details such as flexibility and technical specifications required in the test execution process in accordance with the maritime culture, climate environment, technical capabilities and other factors of each country.

Taiwan established the "Unmanned Vehicle Technology Innovation Ordinance" in 2018 to use the innovative spirit of sandbox supervision to encourage industry, government, academia and research to invest in the research and development and application of unmanned vehicles through loosening regulations to promote industrial technology development and innovation. In 2019, the Kaohsiung City Steamship Company cooperated with the Ship and Marine Industry Research and Development Center (hereinafter referred to as the Ship Center) to transform the original electric ferry (Love Boat) into Taiwan's first and stern intelligent surface unmanned vehicle in Love River Bay (Figure 1). Through the empirical research of the above-mentioned plans, relevant R&D units will be able to think about the regulations and standards, technological innovation trends, safety and risk management and other issues that they will face in the future development of MASS.

Figure 1

Taiwan's Autonomous Surface Navigation Fleet Piloted in 2019 - Results of the Love Boat Research Project

**Source: https://kcs.kcg.gov.tw/Content_List.aspx?n=38E3F0AC78634C4C*

2. Literature Review

This study divides the past efforts of experts and scholars from various countries on the development of MASS into three parts: (1) regulations and guidelines (2) development and innovation of ship autonomous navigation and remote-control technology (3) empirical research on MASS.

2.1 Regulations and Guidelines

IMO organized the MSC 108 meeting to develop the "Management Charter for Maritime Autonomous Navigation Ships on the Surface" (MASS Code) during the adjournment. The main functions of the development are divided into an introduction (Introduction), operating environment, and functional requirements (Main Principles for MASS and MASS Functions). and three main charter structures: Goals, Functional Requirements, and Provisions. In the third charter, the main functions of MASS are distinguished, including 17 main development functions such as navigation and remote operations. At the same time, it also confirms the International Convention for the Safety of Life at Sea (SOLAS), the International Regulations for Preventing Collisions at Sea (COLREG), and the International Seafarer's Watch. Norms such as the Standards for Training and Certification of Watchkeepers (STCW) are applicable to MASS. IMO member countries will review the scope of national regulations and take into account the definition of regulatory scope (Regulatory Scoping Exercise, RSE) (International maritime organization, 2018a, 2018b). Countries have also conducted in-depth assessments of future practical application scenarios in the maritime environment for these 17 functions. This research mainly focuses on the functional development and verification of two main functions, including navigation and remote control (Report of the Intersessional MASS Working Group, 2023).

The American Bureau of Shipping (ABS) revised the "Autonomous and Remote-Control Functional Requirements" from the original design guide (Guide) to specification requirements (Requirements) in 2022, which not only provides the industry with testing and verification of ship-related functions, but also It also represents changing the original non-mandatory recommendations into mandatory verification requirements (ABS, 2022). China Classification Society (CCS) will publish the "Guidelines for the Inspection of Class Notations for Autonomous Navigation of Ships" in 2023 (CCS, 2023). The guidelines set out the performance requirements for autonomous navigation functions and propose verifiable and followable processes for the development, design and management of the system. Architecture. Japan and South Korea also put forward relevant project plans and specification requirements (Class NK, 2024; KR, 2024). From the process of project planning and specification development in various countries, we can know how each country identifies autonomous navigation systems. However, when examining the current entry and exit procedures of various countries, the question that arises is how to integrate MASS into the current maritime operating environment, including the entry and exit procedures of ocean-going ships and the impact of other operating vessels in the environment on the premise of considering navigation safety. influence and meet the trend needs of intelligence and automation.

2.2 Development and Innovation of Ship Autonomous Navigation and Remote-Control Technology

The European Maritime Safety Agency (EMSA) investigated accidents between 2014 and 2022. Nearly 59.1% of accidents involved human factors, of which 50.1% were related to human behavior. A comprehensive analysis of human behavior and influencing factors shows

that the proportion of human factors in these accidents is as high as 80.7% (Annual Overview of Marine Casualties and Incidents 2023, 2023). In addition, the development of autonomous navigation technology can help solve the following four problems: (1) respond to the harsh maritime environment and alleviate the future shortage of seafarers, (2) reduce overall transportation operating costs, (3) reduce carbon emissions in response to global environmental changes platoon needs, (4) the need to improve navigation safety (Porathe et al., 2014). Therefore, it is crucial to use autonomous navigation and increase decision-making assistance through remote control technology as a solution to reduce maritime accidents and improve related operational issues. The following describes the research related to ship autonomous navigation and remote control:

2.2.1 Autonomous Navigation

According to the ABS "Autonomous and Remote-Control Functional Requirements", an intelligent assisted navigation stage (intelligentization) must be passed before fully autonomous navigation (ABS, 2022). The use of information and communication equipment to assist navigation ships increases their awareness of the environment, such as the impact of bridge piers on water flow during navigation, which may increase the possibility of ship collisions and affect the safety of ship navigation (Geng et al., 2023); in inland shallow waters, reduce the risk of stranding of sailing ships due to tides (Picado et al., 2022). Although the development of MASS-related technologies is expected to reduce potential risks caused by human factors and bring many benefits (Norris, 2018), there are also many operational-related challenges, such as the large demand for ship sensors. The data processed (Wahlström et al., 2015), or in the future, the MASS operator may remotely control the ship without being on the ship, so there is a risk of delays or limitations in the ship's situational awareness, which will affect the Ship maneuverability (MacKinnon et al., 2015).

The autonomous navigation of ships in the maritime environment and the autonomous driving of vehicles on the road have completely different navigation safety factors to consider. Autonomous sailing ships need to consider the encounter situations with other autonomous sailing ships or traditional ships. How to evaluate the possibility of avoiding collision or stranding at sea through complex power propulsion systems without a visible channel. The process needs to combine the real-time ship situation and the maritime environment. A feasible short-term proposal is to use personnel to assist autonomous navigation ships and establish an information exchange mechanism between ships (Kim et al., 2023; Maidana et al., 2023; Rødseth et al., 2023; Zheng et al., 2024). However, for fully autonomous navigation, complex system evaluation methods must still be adopted, combining the three basic technologies of situation awareness, collision risk detection and intelligent assisted decision-making (Chen et al., 2020; Wang et al., 2024).

2.2.2 Remote Control

The description of the remote-control function defined by IMO in the "Regulations on the Management of Autonomous Ships Navigating Maritime Surface Navigations" believes that MASS or automation functions should be able to be controlled from a safe remote operating center (the Remote Operating Center, ROC). During the process, there should be a verified and verifiable system operation interface between ROC and MASS to ensure that MASS can maintain safe, reliable, and effective operation when used.

IMO highlighted the gaps in regulatory experience regarding the role of remote operators during the current development stage of the MASS program. It is believed that the role of the ROC operator and its related operational management issues are listed as the most high-priority

issues that need to be resolved at this stage (IMO, 2021). At the same time, people are also worried that although humans hope to use artificial intelligence to enhance the decision-making capabilities of crew members and remote operators, highly complex decision support systems are difficult to understand and opaque for crew members and remote operators, which may cause difficulty in decision-making during human-computer interaction (MacKinnon et al., 2015).

2.3 MASS-Related Empirical Research

Among the previous documents, most of them are the results of the completed MASS project. This section mainly introduces the current international MASS projects that are being developed in various countries. Compared with the period from 2020 to 2023, most countries have invested in the development of autonomous navigation and remote-control functions. The current development directions of major projects in various countries are slightly different, which also means that various countries have more imaginable possibilities for their future expectations for MASS. The U.S. ABS will release the "Guide for Smart Functions for Marine Vessels and Offshore Units" and the "Guide for Smart Technologies for Shipyards" in 2023, integrating the application of artificial intelligence technology into Extending from ships to offshore facilities and shipyards. Through artificial intelligence, the relevant production and maintenance work processes of offshore facilities and shipyards are combined, and augmented reality technology is combined to assist maintenance personnel in equipment maintenance (ABS, 2023a, 2023b). The Maritime and Port Authority of Singapore (MPA) will release the Just in Time Planning and Coordination Platform (JIT Platform) combined with smart ports in 2023. It is hoped that through automated planning and operation processes, the waiting time for ships to enter and exit the port will be reduced, thereby reducing the problem of carbon emissions during the waiting process. At the same time, it also reduces the risk of personal injury caused by crew members traveling between the ship and the port due to the operation process (MPA, 2023). The EU hopes to effectively alleviate land traffic congestion through autonomous navigation of inland waterways and reduce air and noise pollution problems.

In addition to the research project reports of the above-mentioned countries, in international academic research, attention is also paid to the development of MASS-related technologies. Research from Chinese scholars assesses the complexity of navigation missions through the TOPSIS method (Tao et al., 2025). Also from China, the research conducts navigation collision avoidance decisions through quantitative analysis of the ship's attitude and autonomous navigation environment detection (Shi et al., 2025). Since the immediate changes in the Marine environment during navigation are closely related to the ship's navigation decisions, the decision on the ship's draft is controlled by detecting the changes in navigation and environmental conditions in real time through an adaptive approach (Yan et al., 2024). Research from South Korea uses the detection of ship trajectories to make ship navigation decisions for collision avoidance (Lee & Kim, 2025). Scholars have clearly pointed out that there are many potential risk issues during the autonomous navigation of ships, including cyber-attacks, human errors, and equipment malfunctions, among other navigation risk problems that cannot be ignored (Chang et al., 2021). By integrating the project results and academic research achievements of the above-mentioned countries, although it can be known that the development of autonomous navigation technology and the importance of risk management in navigation decision-making are significant, there are few studies discussing the integration of technology development and actual Marine environment verification mechanisms to assist management units in conducting risk assessment and verification.

Compiling the above-mentioned research results of autonomous maritime navigation ships and smart ship projects in various international countries, we can understand that various countries have invested huge resources in the development of related technologies. It is hoped that artificial intelligence-related applications will be integrated into the maritime environment to solve existing problems in the maritime operating environment. However, the risk management issues hidden in current operations due to the introduction of innovative technologies cannot be ignored. Therefore, this study proposes the navigation safety and risk management verification mechanism for autonomous water navigation ships and functions in the next section, hoping to reduce the impact on the existing operating environment caused by the introduction of innovative technologies.

3. Navigation Safety and Risk Management Mechanism for Autonomous Maritime Navigation Ships and Functions

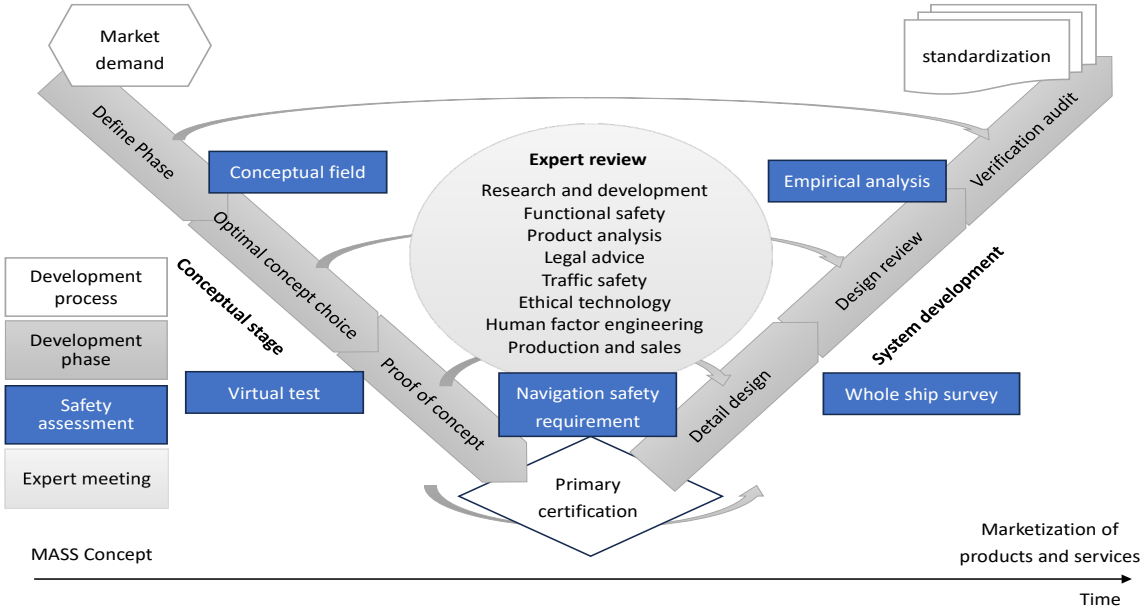
3.1 The Verification and Validation Testing of Systems Engineering

The verification mechanism proposed in this study originates from the project management concept of systems engineering (Forsberg & Mooz, 1991). Such a concept is widely applied in the development of autonomous driving technology for automobiles (ISO 26262) (Dawson & Garikapati, 2021), and Model Based Systems Engineering (MBSE) (Henderson & Salado, 2021). The core technologies of systems engineering in automotive autonomous driving technology have not changed much over the past few years, but the complexity will grow and increase exponentially with the scale of the system. Meanwhile, the autonomous navigation technology of ships is significantly different from that of self-driving cars. During the navigation of a ship at sea, it cannot obtain immediate feedback and stop the ship through the friction of the road surface like a car's braking system. It must have a longer reaction time to avoid the occurrence of sea collision accidents. The navigation decisions of MASS in the port area require support from multiple parties, including the assistance of the crew, the maritime pilot and the control tower, in order to navigate and dock safely. How to verify the results of system integration will be a verification issue for complex systems (Tang et al., 2025). Therefore, it is necessary to re-examine the risks that autonomous navigation technology may bring during the field measurement process and establish a verification mechanism for risk control. It is hoped that through the management of the mechanism and continuous iterative testing, the losses and impacts caused by risks can be improved and reduced.

This study suggests that relevant R&D projects can be divided into two main stages: the concept stage and the system development stage. The concept stage mainly focuses on MASS and related functional hazard risk analysis through market demand analysis. The development process can be subdivided into the definition stage, the best concept selection stage and the concept verification stage; the system development stage mainly focuses on security verification, and it is expected to standardize future products and services through the development process. The development process can be subdivided into detailed design time, design review stage and verification sign-off nuclear stage. During the process, a cross-field expert team needs to jointly confirm the navigation safety requirements in the maritime operating environment. The cross-domain expert team includes internal experts on navigation safety, system functions, human factors engineering, product services and regulatory compliance analysis, as well as navigation safety, market competition analysis, cognitive psychology, laws and regulations outside the project, ethics and other external experts to jointly review the development results of relevant functional requirements (Figure 2).

Figure 2

Risk Management Verification Mechanism for Autonomous Navigation and Remote-Control Functions



**Noted: generated by researchers*

This verification mechanism not only ensures the risk management issues caused by innovative technology development in the actual field-testing process but also hopes to connect internal and external experts through the development process to jointly examine the impact of relevant technologies on the internal and external environment. For the internal environment, the main assessment is to examine compliance with overall project requirements. As for the external environment, it mainly examines the impact of innovative technologies on the future market environment, while confirming compliance with laws and regulations. If necessary, amendments to relevant bills need to be proposed (such as regulations and requirements related to entry and exit application notification procedures). In addition, as MASS technology matures, the relevant personnel operating environment on the ship needs to be adjusted in response to operational needs. In addition, internal and external experts are also alert to the navigation safety risks that network information security may pose to MASS.

3.2 The Experience and Feedback Obtained Through Empirical Research

This study divides the feedback obtained during the testing process into the external environment and the internal operating system for separate description, hoping to provide the necessary experience and information for future related research.

3.2.1 Reduce the Complexity of Management Through Iterative Environment Testing

In the part of the external environment, this study conducts an empirical review in combination with an expert team and holds that the construction of infrastructure will affect the development of autonomous navigation systems. The so-called construction of infrastructure includes issues related to network communication and network security. The decision-making process for ship navigation requires multi-party communication and coordination among crew members, navigators and port control towers. Therefore, a smooth network communication connection is highly necessary. In the empirical process, our research

team adopted 5G technology for network communication connection. During the testing process, a network latency issue occurred (though it lasted for a short period of time, about a few seconds). The crew members reported that especially during the process of the vessel docking, this delay of just a few seconds could very likely lead to incorrect operation and pose a risk of vessel collision. Although, this problem is expected to be improved in the future through satellite communication and 6G network technology. But at this stage, it remains an important issue of concern for the research team.

3.2.2 Reduce the Complexity of Systems Engineering Through Iterative System Testing

In the part of internal system construction, most project teams divide the autonomous navigation system into multiple subsystems such as environmental sensing, navigation decision-making and navigation control for development. And each subsystem will have distinct system differences due to the different technologies adopted. With environmental sensing technology, traditional ships rely on the AIS system to detect the ship's navigation trajectory. However, the AIS system has a time difference problem. Therefore, environmental sensing technology needs to integrate perception technologies of the real environment, such as radar and machine vision. However, when considering the complexity of system engineering, independent verification is required before conducting system integration testing. Enable system developers to obtain actual information from the actual testing process to confirm and verify whether the system development conforms to the expected Settings.

3.2.3 Human-Machine Collaboration and Personnel Training Issues

The long-term goal of setting up the autonomous navigation system is to reduce the potential human errors that may occur during the operation of the ship crew during navigation. However, according to the current regulatory requirements, during the operation process of the autonomous navigation system, the crew members still have to obtain relevant information about the system decision-making process through the display and be responsible for the navigation safety decision-making. Such navigation operation tasks require a high degree of human-machine collaboration. However, this is significantly different from the traditional navigation operation environment of maritime personnel. Therefore, before the introduction of the autonomous navigation system, there must be a meticulous personnel training mechanism. Through various navigation mission training operations, the crew members can become familiar with how to carry out collaborative cooperation. The expert team suggests that the relevant management units establish corresponding personnel training institutions to combine with the actual navigation mission operations, which will be conducive to the collaborative cooperation of multiple parties.

4. Conclusion

The commissioning of autonomous sea navigation ships and the development of related functions provide more possibilities and choices for the current harsh maritime operating environment. This means that many systems will be jointly developed to perform operations that humans have performed in the maritime environment through automation (autonomous functions). At the same time, it will also face the integration of functional systems such as navigation systems, communication systems, passenger and cargo transportation systems, and shore-side traffic control centers. This study proposes a systematic verification mechanism through empirical research to establish internal and external experts and scholars who can collaborate across fields to reduce the impact of the introduction of innovative technologies on the current operating environment.

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A Study on the Purchase Intention of Electric Vehicles in Taiwan: Starting from Sustainable Development

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Abstract

In Taiwan, a specific policy is to achieve 'Net-Zero' by 2050; thus, the Taiwanese government has announced a ban on the sale of gasoline-powered cars by 2030 and gasoline-powered motorcycles by 2040 to achieve this goal. With the rise of environmental awareness, the driver of governmental policy, and the introduction of the value of green consumption, we expect consumers' consumption habits to be gradually reshaped. To fill this gap, we propose a sustainability research model to assess consumers' EV purchase intention in this study. We apply the Theory of Planned Behavior (TPB) as the research framework with external cues(stimuli), such as green advertising exposure, government incentive policies, environmental concern, knowledge of electric vehicles, and perceived value. This study collected 341 valid questionnaires, and SPSS 25 software was used to analyze and confirm the validity of all hypotheses. Our findings show that governmental incentive policy is the most critical factor, following environmental concerns, on EV purchase intentions. We also examined the controlled variables of socioeconomic and demographic influences on purchase intention. Our results corresponded with previous studies in which socioeconomic status, life stages, and age show different purchase intentions. The final section proposes valuable insights for EV marketing management and a practical, sustainable policymaking reference.

Keywords: Electric Vehicle; Theory of Planned Behaviour; Cue-Utilization Theory; Sustainability

1. Introduction

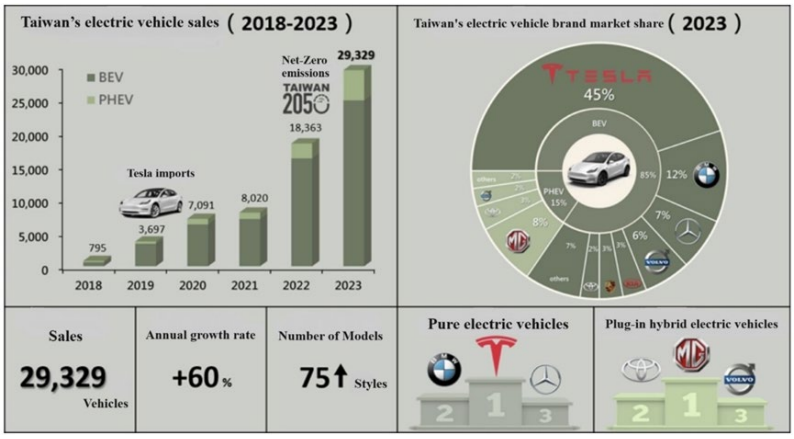
Due to the global effects of the ecological environment, no individual, enterprise, government, or nation can remain unaffected. The numerous phenomena and challenges associated with global climate change and environmental protection inevitably compel people to reconsider how to coexist with the natural environment and pursue sustainable development. Among these issues, the exhaust emissions from automobile engines significantly contribute to the global greenhouse effect. Additionally, the smog from automobile exhaust causes annual agricultural losses amounting to billions of dollars worldwide. Consequently, the adoption of electric vehicles and electric scooters has emerged as a crucial and global trend.

Different manufacturers are producing various types of EVs, such as battery electric vehicles (BEVs), hybrid electric vehicles (HEVs), Plug-in Hybrid Electric Vehicles (PHEVs), Range-Extended Electric Vehicles (REEVs), and Hydrogen Fuel Cell Vehicles (HFCVs), also known as Fuel Cell Vehicles (FCVs). The EV market has been expanding rapidly over the past decade. The global sales volume of EVs in 2023 has also approached nearly 15 million units, reflecting a significant and growing market demand for environmentally friendly transportation solutions. A recent report from the International Energy Agency (IEA) shows that the global number of EVs is projected to reach 10 million, marking a substantial 43% surge compared to figures from 2019(Zheng et al.,2023). To a peak of 6.75 million units in 2021 (Aljarash et al., 2022). In 2020, one in every 25 cars sold was electric; by 2023, this proportion had reached one in five (IEA, 2023).

Taiwan's net-zero policy locks in electric vehicles as the first wave. Various data show that the sales volume and number of licenses of electric vehicles in Taiwan show very positive growth figures, with an increase of 60% in 2023 compared with the previous year, and the number of licenses issued by countries around the world has also grown very positively during the same period (FedEx, 2024; China Economic News Service [CENS], 2024). This remarkable achievement highlights an impressive annual growth rate of 16.4%, setting a new high record since 2011 (CENS, 2024). This upward trend indicates that EVs' popularity and market potential in Taiwan are continuously strengthening. It demonstrates that Taiwan has made significant progress in promoting the development of EVs, and the market demand for EVs is gradually increasing. (see Figure 1)

Figure 1

Overview of Taiwan's electric vehicles market in 2023 (sales volume and market share)



**Source: Statistical Inquiry Network of the Ministry of Communications, Chunghwa Telecom Data Communication Branch, Vehicle Center*

Policy incentives and environmental concerns stimulate consumer interest in electric vehicles. Therefore, this study aims to support the goal of achieving net-zero transformation by focusing on consumer acceptance of electric cars and electric motorcycles. It analyzes the purchase intentions of first-time buyers, vehicle switchers, and commercial vehicle users, ensuring alignment with global sustainable development objectives.

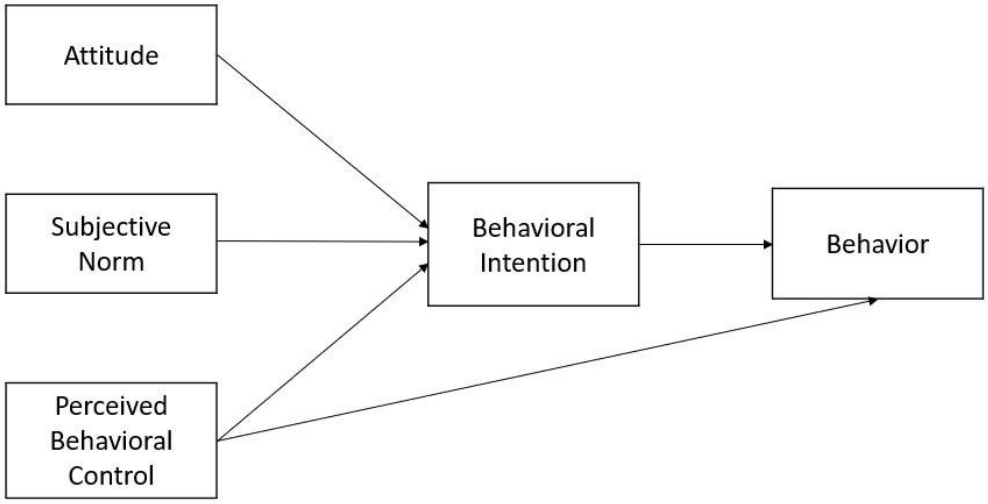
2. Literature Review

2.1 Theory of Planned Behaviour

The Theory of Planned Behavior (TPB) was proposed by Icek Ajzen in 1991(see Figure 2), building upon and extending the Theory of Reasoned Action (TRA) to predict and explain human decision-making processes. According to the foundational principles of TRA, individuals are influenced by their behavioral intentions, which are shaped by their attitudes toward the behavior (ATT) and subjective norms (SN) (Fishbein & Ajzen, 1975). However, the assumption of complete voluntary control over behavior in TRA overlooks situations where individual decision-making is insufficient when control over the behavioral goal is not fully autonomous and depends entirely on internal beliefs (Ajzen & Madden, 1986). To address this limitation, Ajzen introduced perceived behavioral control (PBC) as a third component, leading to the development of the current TPB.

Figure 2

Framework of the Theory of Planned Behavior (Ajzen, 1991)



Source: generated from Ajzen (1991)

As shown in Table 1, previous studies have applied the Theory of Planned Behavior (TPB) in the context of electric vehicles, particularly in investigating consumers' purchase intentions in the electric vehicle markets of different countries. Scholars and researchers widely use it to gain deeper insights into consumers' preferences, attitudes toward electric vehicles, and the motivations influencing their purchasing decisions. These insights are crucial for formulating effective marketing strategies and policies, thereby promoting the growth and acceptance of the electric vehicle market. This highlights the global trend of studying the impact of the TPB model on market intentions in the electric vehicle sector and emphasizes its importance in both academic and practical fields.

Table 1:
Previous Studies Using the Theory of Planned Behavior (TPB) in the EV Market

Scholar	Country	Subject	Application variables
Mohamed, H., Ferguson, Kanaroglou (2016)	Canada	Intention to adopt EVs.	Attitude, subjective norm, perceived behavioral control, personal moral norm, environmental concern
Eccarius & Lu (2020).	Taiwan	Tertiary students' intention to use electric scooter sharing.	Attitude, subjective norm, perceived behavioral control, environmental values, perceived compatibility, awareness knowledge
Mamun, Zainol, Hayat (2020)	Malaysian	Youth willingness to purchase electric scooters.	Attitude, subjective norm, perceived behavioral control, environmental concern, knowledge, attributes of interest, monetary benefit
Murtiningrum, Darmawan, Wong (2022)	Indonesia	Intention to adopt electric motorcycles.	Attitude, subjective norm, perceived behavioral control, knowledge, environmental concern, economic benefit, perceived environmental benefit, perceived risk, perceived cost, perceived incentive policies.
Shakeel (2022)	Pakistan	Intention to buy EVs.	Attitude, subjective norm, perceived behavioral control, cognitive status, product perception, non-monetary incentive policy, monetary incentive policy
Ackaah, Kanton, Osei (2022)	Ghana	Intention to buy EVs.	Attitude, subjective norm, perceived behavioral control, transport sector
Deka, Dutta, Yazdanpanah, Komendantova (2023)	India	Intention to buy an EV.	Attitude, subjective norm, perceived behavioral control, herd behavior, incentives policy
Chang (2023)	Taiwan	EV purchase behavior and the types of personal chargers used in communities.	Attitude, subjective norm, perceived behavioral control, perceived usefulness, moral norm, government subsidies policy, green product information, environmental consciousness

Table 1:
Previous Studies Using the Theory of Planned Behavior (TPB) in the EV Market (Continue)

Scholar	Country	Subject	Application variables
Nguyen -Phuoc, Truong, Nguyen, Pham, Li, Oviedo-Trespalacios (2024)	Vietnam	Intention to use electric motorcycles.	Attitude, subjective norm, perceived behavioral control, perceived risk, knowledge
Rehman, Rehman, Bresciani, Yahiaoui, Kliestik (2024)	China	Determine adoption intention for BEVs.	Social norms, environmental concerns, price and battery cost, range confidence, financial incentives

2.2 Cue-Utilization Theory

Since its emergence, the cue-utilization theory has gradually attracted attention in academic circles and accumulated valuable research literature (Cox, 1962; Li et al., 2020). This theory explains how consumers process information and make decisions based on environmental cues or stimuli, selecting cues they consider helpful as criteria for judging quality and making purchasing decisions. It distinguishes between internal and external cues (Olson & Jacoby, 1972), where internal cues refer to fixed product characteristics, such as size, shape, and taste, that are unaffected by external factors. On the other hand, external cues relate to variable attributes associated with the product, such as price, brand name, and labeling.

Considering the inherent difficulty in modifying internal cues, this paper will primarily focus on the impact of external cues on the consumer evaluation process, emphasizing green advertising exposure and incentive policies. Additionally, three personal factors—environmental concern, knowledge about electric vehicles, and perceived value—will be incorporated to observe their roles within the Theory of Planned Behavior (TPB) and purchase intentions.

2.2.1 Green Advertising Exposure

With the rise in environmental awareness, the advertising industry has undergone significant changes, reflecting society's concern for sustainable development. This shift has led to the emergence of green advertising, which aims to satisfy the needs and desires of environmentally conscious consumers by providing information related to nature and conservation (Zinkhan & Carlson, 1995). This transformation highlights the importance of the audience in green advertising, stimulates interest in consumer culture, and influences purchasing behavior. Furthermore, it has sparked a keen interest in innovative marketing strategies (Batool, 2016). In the current ecological context, advertising and communication are valuable tools for raising awareness and encouraging sustainable behavior (Lima et al., 2024).

Previous research indicates that despite the industry's significant focus on sustainability, there is limited exploration of the application of Cue Utilization Theory in the electric vehicle market. Therefore, this study aims to integrate environmental information with electric vehicles by utilizing green cues provided by companies. This integration enables consumers to evaluate product quality, reducing uncertainty in their decision-making process.

2.2.2 Incentive Policy

Considering EVs' multiple social and environmental benefits in promoting renewable energy use, governments worldwide have implemented incentives, subsidies, and regulatory

measures to encourage the widespread adoption of EVs (Graham-Rowe et al., 2012). In Ireland, EVs receive government support through the Sustainable Energy Authority of Ireland (SEAI) subsidy program, which includes exemptions from purchase taxes, vehicle registration tax reductions, and approximately €15,000 toll fee exemptions per vehicle (IGEES, 2019; Caulfield et al., 2022). Additionally, EVs registered since 2018 are eligible for grants of up to €600 for installing home charging stations (ACEA, 2020).

Governments worldwide are committed to encouraging and promoting the widespread use of electric vehicles, reflecting their support for renewable energy use and their commitment to carbon reduction targets. These initiatives drive the growth of the electric vehicle market and foster the development of related infrastructure, pushing the entire automotive industry toward a more environmentally friendly and sustainable direction. Taiwan is also on the path to achieving net-zero carbon emissions by 2050, with "electrification and decarbonization of transportation" being one of the government's 12 critical strategies for net-zero transformation. The ultimate goal is to ban the sale of all internal combustion engine vehicles by 2040 (Chen et al., 2023).

2.2.3 Environment Concern

Environmental concern refers to an individual's awareness and consciousness of environmental issues, playing a crucial indirect role in specific environmental behaviors by influencing the generation of cognition (Bamberg, 2003). Studies have shown that environmental concern influences consumers' attitudes and is pivotal in encouraging individuals and society to adopt more environmentally friendly behaviors (Diamantopoulos et al., 2003; Kilbourne & Beckmann, 1998; Shanmugavel et al., 2022). This concern is one of the driving forces behind environmental protection and sustainable development, making it critically important for shaping the future of society.

2.2.4 Knowledge

Product knowledge is considered a key influencing factor in consumer purchasing behavior. This knowledge not only helps determine the value and purchase risks of products (Wang, Hazen 2016). On the other hand, environmental knowledge has a positive and significant effect on green purchase intention (Nita & Rina, 2024). However, also plays a crucial role in consumers' understanding of products, particularly in the EV domain (Burgess et al., 2013; Degirmenci & Breitner, 2017).

Consumer understanding of EVs is crucial for driving the development of this sector. When consumers have a higher level of awareness and understand the advantages and benefits of EVs, they are more inclined to hold positive attitudes and increase their willingness to adopt EVs (Wang et al., 2018).

2.2.5 Perceived Value

Monroe and Krishnan (1985) introduced the perceived value model to investigate the relationships among price, perceived quality, and perceived value. This model defines value as the overall evaluation by consumers of a product or service, considering the perceived benefits and their contributions (Zeithaml, 1988; Sirdeshmukh et al., 2002; Hu et al., 2023).

Previous studies have indicated that perceived value is conceptualized as a single-dimensional structure (Sánchez-Fernández et al., 2007), defined primarily based on consumers' subjective assessments of value rather than the company's operational efforts. Therefore, within market research and marketing domains, a thorough comprehension of this model is paramount for capturing consumers' perceptions of value concerning products or services, given its direct

influence on purchase intentions and brand loyalty (Lv et al., 2024).

2.2.6 Hypothesis

Numerous studies have employed the TPB to explore consumers' intentions regarding EV purchases (as depicted in Table 1). The findings of these studies reveal that three variables, attitude, subjective norm, and perceived behavioral control, significantly and positively influence consumers' inclination to purchase EVs (Mohamed et al., 2016; Mamun et al., 2020; Shakeel, 2022). Thus, within the realm of investigating EV purchase intentions, TPB provides a solid theoretical underpinning that aids in comprehending consumers' preferences and decision-making processes concerning EVs. On this basis, the following hypotheses were formulated:

H1: Attitude has a positive effect on electric vehicle purchase intention

H2: Subjective Norm has a positive effect on electric vehicle purchase intention

H3: Perceived behavioral control has a positive effect on electric vehicle purchase intention

Previous studies focused on the correlation between advertising exposure and vehicles, primarily centered on road safety warning advertisements, which differs from the commercial advertising exposure studied in this research. Based on past research, advertising exposure on online media platforms is positively correlated with consumer attitudes (Wardhani & Alif, 2019), with brand attitudes formed under high-advertising message conditions being more susceptible to influence (Kokkinaki & Lunt, 1999). Hence, it can be inferred that advertising exposure is an effective promotional tool for enterprises. Innovations in advertising and advertising media enable appropriate targeting of the intended consumer audience. Thus, based on the above literature, the following hypotheses are expected:

H4: Green advertising exposure has a positive effect on attitude

Governments have made significant efforts to encourage consumers to buy and use EVs. They have offered subsidies for purchasing them, promoted the expansion of charging infrastructure, and accelerated their commercialization (Wang et al., 2016). These broad policy measures aim to stimulate consumer adoption and purchases, thereby fueling the growth of the EV market (Coad et al., 2009; Huang & Ge, 2019; Wang et al., 2017). This illustrates the close relationship between the thriving EV market and the implementation of diverse incentive policies (Zhou et al., 2015). Additionally, these incentive policies are designed to enhance the user experience for drivers (Kumar & Alok, 2020; Wang et al., 2021), leading to improved attitudes and increased willingness to make a purchase. Thus, based on the above literature, the following hypothesis is expected:

H5a: Incentive policy has a positive effect on attitude

H5b: Incentive policy has a positive effect on electric vehicle purchase intention

In the automotive sector, relevant research also emphasizes a significant positive correlation and impact between consumers' environmental concern and their willingness to use new energy vehicles (Sang & Bekhet, 2015; Si et al., 2024). This implies that consumers' preference for environmentally friendly vehicles is closely linked to their environmental concerns, further motivating their adoption of eco-friendly vehicles. Thus, based on the above literature, the following hypothesis is expected:

H6a: Environmental concern has a positive effect on attitude

H6b: Environmental concern has a positive effect on electric vehicle purchase intention

When consumers deeply understand and are familiar with electric vehicle (EV) knowledge and information, their perception of the risks associated with EV adoption decreases, improving their attitudes and behavioral intentions toward adopting EVs (Jaiswal et al., 2022).

Previous studies in this area have also yielded positive results (Wang et al., 2018; Huang et al., 2021; Jaiswal et al., 2022), confirming the crucial role of knowledge in consumer cognition. Therefore, we can infer that the level of consumer understanding of EV knowledge directly impacts their views and willingness to adopt EVs. Based on the above literature, the following hypothesis is expected:

H7a: Knowledge has a positive effect on attitude

H7b: Knowledge has a positive effect on electric vehicle purchase intention

When consumers perceive multiple dimensions of value from EVs, including personal emotions, social environment, and vehicle performance (Salehzadeh & Pool, 2017), these values reflect consumers' value perception of EVs, positively influencing their purchase intention and attitude (Chen et al., 2012; Pai et al., 2023). Numerous studies have shown that when consumers perceive high value in a product or service, they are more inclined to purchase it (Ng et al., 2018; Hu et al., 2023; Pai et al., 2023). In the EV market, perceived value is often a key factor influencing consumer decisions, directly impacting their purchase intention and loyalty. Thus, based on the above literature, the following hypothesis is expected:

H8a: Perceived value has a positive effect on attitude

H8b: Perceived value has a positive effect on electric vehicle purchase intention

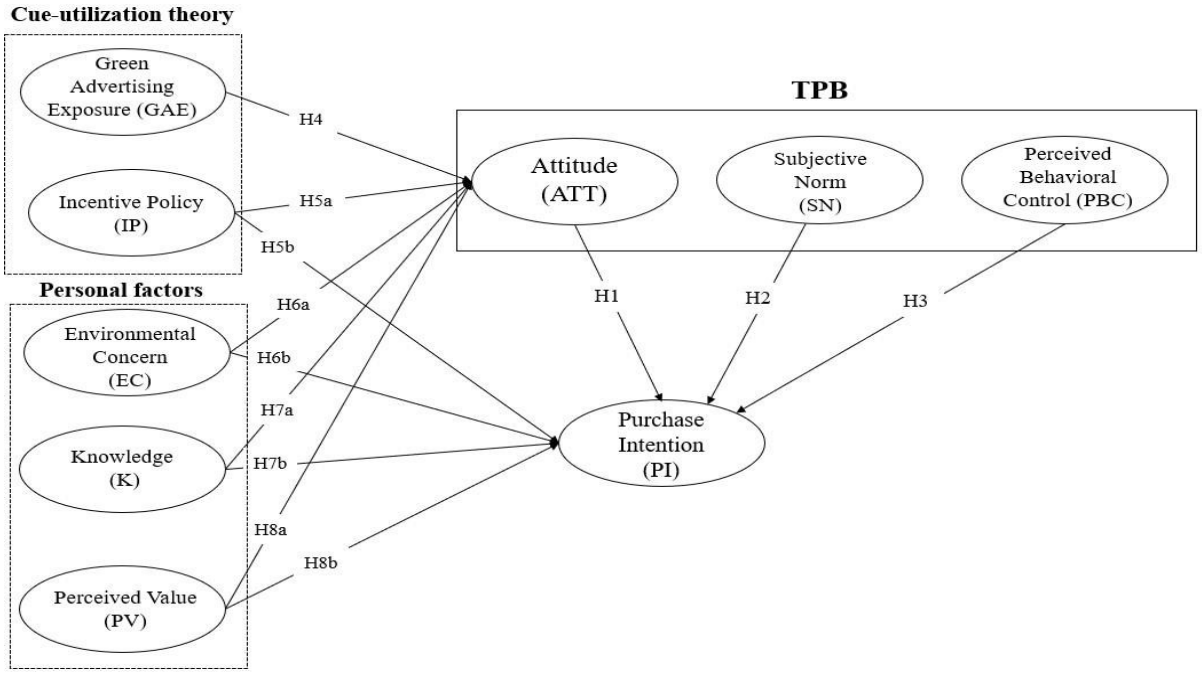
3. Methodology

3.1*Research Model*

Based on the TPB and the Cue-Utilization Theory, this study categorizes consumer issues into a structured classification, incorporating relevant literature on factors influencing the adoption of EV intentions. The independent variables in this model include attitude, subjective norm, perceived behavioral control, green advertising exposure, incentive policy, environmental concern, knowledge, and perceived value, with purchase intention as the dependent variable. The research model is depicted in Figure 3.

Figure 3

Research Model



3.2 Research Method

3.2.1 Measurement Development

According to the above research hypotheses, this study aims to comprehend various dimensions by creating a questionnaire to measure eight constructs. The questionnaire was developed by examining each item from various established measurement scales. The operational definition of this study is modified based on the original definition.

3.2.2 Questionnaire Design

The questionnaire is divided into three main parts. The first part consists of basic personal information, including seven demographic questions. The second part is an analysis of the willingness to purchase EVs, which includes nine questions related to the usage and purchase intentions. The results of this section will be used to compare purchase intentions among different demographics. The third part consists of scale questionnaire content, comprising 33 questions related to respondents' self-perceived behavior regarding EVs.

The demographic data in the first part of this questionnaire does not differ significantly from that used in other studies on EV purchase intentions, indicating its representativeness. Therefore, we can reasonably compare and analyze the results of this study with other relevant research to derive more comprehensive conclusions and insights.

3.2.3 Data Collection and Sample

The online questionnaire for this study was created via the SurveyCake cloud platform, with the survey period running from January 27, 2024, to April 10, 2024. The target respondents were individuals aged 18 and over 50 in Taiwan with experience with EVs (renting or owning). Most of the statements in the questionnaire were the same as those used in previous scales designed to measure the variables above. The questionnaire was distributed through Instagram, Facebook, and Line. Most of these platforms are forward, and the total number of questionnaires cannot be counted, but after review, there are 341 valid questionnaires, and the number of such samples is sufficient.

3.2.4 Data Analysis Method

The data analysis for this research primarily utilized SPSS version 25.0 as the primary analytical tool. An explanatory research method will be employed to address the issue of causal relationships between the dependent and independent variables. In addition, the contents of the questionnaire will be measured using a 5-point Likert scale, utilizing an interval scale to obtain participants' quick and sincere responses. The scale ranges from 5 = Totally agree, 4 = Mostly agree, 3 = Neutral, 2 = Mostly disagree, to 1 = disagree.

The pre-test was conducted with 30 samples and assessed the reliability of each item using Cronbach's α reliability coefficients, with all constructs exceeding the standard of 0.7, indicating high reliability (Devellis, Robert, 1991). This suggests that the questionnaire tools used in this study exhibit good reliability and validity.

4. Data Analysis and Results

4.1 Research Model

4.1.1 Descriptive Statistical Analysis

The first part of this study includes questions related to demographic statistics, encompassing gender, age, highest education level, profession, annual income, nationality, and residential area. The survey analysis reveals that males constitute 43.3%, while females represent 56.6% in the gender distribution. The age bracket of 18-29 years exhibits the highest

prevalence at 40.8%, followed by those aged 50 years and above at 35.9%. Individuals holding a bachelor's degree or equivalent constitute the majority at 54.3% regarding educational levels. The profession segment predominantly comprises students or other categories, comprising 66.3% of the respondents. In terms of annual income, the majority falls below 560,000 NT dollars, accounting for 51.3%. Taiwanese nationals constitute the overwhelming majority at 97.9%. Residentially, metropolitan living areas are the most represented, at 70.1%.

4.1.2 Reliability and Validity Analysis

4.1.2.1 Reliability Analysis

Reliability analysis determines measurement instruments' stability, consistency, and repeatability in assessing the concepts under research. It is typically assessed using Cronbach's α and Composite Reliability (CR), with CR being calculated based on the factor loading between observed variables and their corresponding constructs. A Cronbach's α value exceeding 0.7 indicates high reliability, and CR should exceed 0.6 (Devellis, Robert, 1991). Moreover, individual item factor loadings should surpass 0.45 (Hair et al., 2006). All constructions in this study met these criteria.

4.1.2.2 Validity Analysis

Validity analysis was conducted to assess the appropriateness of the measurement model in accurately capturing the underlying constructs. Convergent validity examines the degree of correlation between observed variables and their corresponding constructs to ensure the measurement tools adequately reflect the constructs. Average Variance Extracted (AVE) is a critical structural equation modeling indicator for convergent validity. It indicates the average proportion of variance explained by observed variables about the constructs. A value exceeding 0.5 signifies good validity, while a value above 0.36 is considered a minimally acceptable standard (Fornell & Larcker, 1981). All constructs in this study met or exceeded these validity criteria.

The discriminant validity assesses the differences between different constructs to ensure that the measurement tool can distinguish between various constructs. Fornell & Larcker (1981) indicated that the average variance extracted (AVE) of individual items should have square root values greater than those of other constructs in discriminant validity. The discriminant validity of each construct meets the standard, as shown in Table 2.

Table 2
Discriminate validity analysis of each construct

	ATT	SN	PBC	EC	IP	K	PV	GAE
ATT	0.67							
SN	0.51	0.67						
PBC	0.64	0.38	0.71					
EC	0.69	0.43	0.52	0.72				
IP	0.35	0.31	0.40	0.27	0.73			
K	0.48	0.46	0.46	0.49	0.47	0.76		
PV	0.53	0.31	0.56	0.65	0.36	0.50	0.62	
GAE	**0.50**	**0.42**	**0.42**	**0.42**	**0.48**	**0.51**	**0.35**	**0.8**

4.1.4 Hypothesis Testing Results

Based on the data analysis of respondents, all hypotheses in this study demonstrate significant effects, indicating that the hypotheses are supported and confirmed. Significance levels (two-tailed) are smaller than 0.05 are denoted by *, smaller than 0.01 by **, and smaller than 0.001 by ***, as shown in Table 3.

Table 3
The Results of All Hypothesis Testing

Hypothesis	Hypothesis Content	Significance	Decision
H1	Attitude has a positive effect on electric vehicle purchase intention	0.001***	Supported
H2	Subjective Norm has a positive effect on electric vehicle purchase intention	0.001***	Supported
H3	Perceived behavioral control has a positive effect on electric vehicle purchase intention	0.001***	Supported
H4	Green advertising exposure has a positive effect on attitude	0.001***	Supported
H5a	Incentive policy has a positive effect on attitude	0.001***	Supported

Table 3
The Results of All Hypothesis Testing (Continue)

Hypothesis	Hypothesis Content	Significance	Decision
H5b	Incentive policy has a positive effect on electric vehicle purchase intention	0.001***	Supported
H6a	Environmental concern has a positive effect on attitude	0.001***	Supported
H6b	Environmental concern has a positive effect on electric vehicle purchase intention	0.001***	Supported
H7a	Knowledge has a positive effect on attitude	0.001***	Supported
H7b	Knowledge has a positive effect on electric vehicle purchase intention	0.001***	Supported
H8a	Perceived value has a positive effect on attitude	0.001***	Supported
H8b	Perceived value has a positive effect on electric vehicle purchase intention	0.001***	Supported

**: P < 0.05 (significant), **: P < 0.01 (highly significant); ***: P < 0.001 (extremely significant)*

4.1.5 Cluster Analysis

This study conducts two clustering analyses to understand the factors of concern to respondents better. The first analysis divides respondents into two groups according to their willingness to purchase EVs, aiming to discern their varying degrees of emphasis on different factors. The second analysis focuses on the two age groups with the most respondents (18-29 years old and 50 years old and above) to explore differences in factors of concern and preferences between these two extreme groups.

4.2 Discussion

4.2.1 Hypothesis and Research Results

From the results in Table 3, it can be concluded that there are significant differences among all hypotheses. Further analysis shows that five constructs—green advertisement exposure, concern for sustainable environment, knowledge about EVs, incentive policies, and perceived value— positively impact individuals' attitudes towards EVs (H4, H5a, H6a, H7a, H8a). This indicates that consumers shape their attitudes towards EVs through these external factors, reflecting their concern for sustainability and environmental friendliness, advanced technology awareness, and policy promotion acceptance. These findings validate our research hypotheses and offer critical insights into understanding how individuals' attitudes toward EVs are formed. In addition, regarding the various dimensions of purchase intention, it is evident that the TPB variables - attitude, subjective norm, perceived behavioral control, and external factors -

environmental concern, incentive policy, knowledge, perceived value, and green advertising exposure - significantly influence purchase intention (H1, H2, H3, H5b, H6b, H7b, H8b), aligning with findings from the literature.

4.2.2 Cluster Analysis and Research Results

4.2.2.1 Correlation-Willingness Cluster Analysis Results

Based on the analysis, females comprise the majority, constituting 38.7% with willingness and 17.9% with unwillingness. Age-wise, two brackets stand out: 18-29 years and 50 years and above, with respective willingness rates of 27.9% and 21.7% and unwillingness rates of 12.9% and 13.5%. The highest educational level is commonly at the bachelor's or equivalent level, with willingness and unwillingness rates of 35.5% and 18.8%. Occupationally, students and other professionals outside the academic realm are prominent, showing willingness rates of 42.2% and unwillingness rates of 24%. Annual income distribution around two brackets: below $560,000 and between $560,001 and $1,260,000, with willingness rates of 32.3% and 28.2% and unwillingness rates of 19.1% and 11.1%. Taiwanese nationals constitute the primary sample, with willingness and unwillingness rates of 65.1% and 32.8%. Metropolitan living areas dominate, with willingness and unwillingness rates of 49.6% and 20.5%.

4.2.2.2 Correlation-Age Cluster Analysis Results

The analysis results for the 18-29 age group show that the majority are female, accounting for 36.3%. The highest level of education is generally a bachelor's degree or equivalent, accounting for 32.4%. Regarding occupation, students and other workers are the most prominent, reaching 40.5%. Annual income is distributed mainly across two ranges: below $560,000 and between $560,000 and $1,260,000, accounting for 43.2% and 10.4%, respectively.

The analysis results for the 50 and above age group show a nearly even gender distribution, with males at 25.5% and females at 20.9%. The highest level of education is generally a bachelor's degree or equivalent, accounting for 20.5%. Students and other workers are the most prominent in terms of occupation, reaching 29.7%, followed by military and civil servants at 12.4%. Annual income is also distributed across two ranges: below $560,000 and between $560,000 and $1,260,000, accounting for 13.9% and 24.3%, respectively.

Research findings indicate that compared to the 18-29 age group, the 50 and above age group has a relatively lower acceptance of electric vehicles.

5. Conclusion and Recommendations

5.1 Conclusion

This study contributes significantly to several theoretical aspects. Firstly, we utilized the widely adopted TPB to effectively understand and predict consumers' behavioral intentions toward purchasing EVs. Secondly, we applied the cue-utilization theory and incorporated external factors, which significantly influence consumers' purchase intentions. This research contributes to the academic understanding of how external stimuli, such as advertising and policy incentives, can shape consumer behavior and attitudes toward sustainable EV options. Thirdly, this study integrates the TPB and Cue-Utilization Theory, providing new insights into consumer behavior regarding EVs. Fourth, this research introduced three personal factors - environmental concerns, knowledge about EVs, and perceived value to delve deeper into consumers' adoption and purchase intentions. Lastly, we analyzed demographic variables, including gender, age, highest education level, profession, annual income, and residential area, to understand Taiwanese consumers' willingness to purchase.

To summarize, this study effectively explores the formation process of consumers' purchase intentions towards electric vehicles, enriching the understanding of the psychological mechanisms underlying purchasing behavior. Furthermore, we present a broader perspective on consumers' attitudes and purchase intentions regarding electric vehicles, which aligns with the United Nations Sustainable Development Goal (SDGs) 12, 'Ensure Sustainable Consumption and Production Patterns.' This alignment provides valuable reference points for industry stakeholders and policymakers.

5.2 Managerial Implications

The EV market is currently regarded as an essential area of development globally. Although many countries and regions have invested significant resources to promote the development and adoption of EVs, this market still faces a range of challenges and potential areas for development. Based on the results of this study, it is found that there are different values among the public regarding the adoption of EVs. However, incentive policies and environmental concern are their primary concerns.

Therefore, by adopting a comprehensive approach that combines regulatory measures, incentive policies, and various support integration, the government can effectively reduce carbon emissions, enhance environmental benefits, and contribute to the stable growth and sustainability of the electric vehicle market. Such collective efforts are crucial for achieving the ambitious goal of net-zero transformation by 2050. Furthermore, companies must pay special attention to sustainability, as they can meet the expectations of ESG investors and attract environmentally conscious consumers. This approach can enhance trust and recognition among both investors and consumers.

5.3 Research Limitations and Future Research Directions

In terms of limitations, the demographic data of the questionnaire sample (e.g., gender, age, education level, profession, annual income, and location of residence) does not comprehensively represent the entire Taiwanese population. Moreover, the focus of the study is on exploring the purchase intentions of Taiwanese consumers regarding EVs.

In terms of future research directions, it is crucial to delve deeper into the impact of government subsidies and related regulations and policies on consumers' purchase intentions, as prioritized by consumers in this study. These regulations and policies may encompass aspects such as the ease of EV registration procedures, the establishment of related insurance costs, and potential environmental taxes or exemptions. Through a more comprehensive analysis and investigation, we can better understand how these factors influence consumers' decision-making regarding EV purchases, providing more specific recommendations and policy directions.

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