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Regional Adaptation Mechanisms of AI-Empowered International Chinese Language Education in Malaysia: A Qualitative Study of Technology–Culture–Pedagogy Integration

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Abstract

Artificial intelligence (AI) has reshaped language education globally, yet its impact on international Chinese language education remains uneven across cultural contexts. In multilingual Malaysia, AI-supported Chinese language teaching cannot rely on direct technological transfer but requires regional adaptation that aligns AI affordances with local linguistic ecology, cultural norms, and pedagogical practices. This study explores the regional adaptation mechanisms of AI-empowered international Chinese language education in Malaysia, focusing on how teachers and institutions localize AI tools such as speech recognition, automated feedback, intelligent assessment, and generative learning platforms.Using a qualitative design, the study triangulates policy documents, classroom observations, and semi-structured interviews with teachers, learners, and educational stakeholders. Thematic analysis identifies three interconnected mechanisms: (1) institutional-policy alignment, shaping adoption through governance, resource allocation, and localized evaluation standards; (2) pedagogical orchestration, emphasizing teachers' mediation in task redesign, feedback calibration, and human–AI role negotiation; and (3) cultural-linguistic calibration, addressing code-switching practices, identity sensitivities, and culturally responsive content. Building on these findings, this study proposes a staged model (introduction–alignment–integration–optimization) to explain how AI achieves legitimacy and sustainability in Malaysia's Chinese language education ecosystem. It offers an ASEAN-oriented account of AI localization and provides practical implications for teacher training, platform development, and China–Malaysia educational cooperation.

Keywords: AI-Empowered Education, International Chinese Education, Regional Adaptation, Malaysia, Technology–Culture–Pedagogy Integration, Ai Localization, Qualitative Research

Introduction

AI has quickly transformed educational practices in the world, especially in language learning and teaching (Zhai & Chen, 2025). As the technologies of speech recognition, natural language

processing (NLP), intelligent assessment, and generative AI have advanced, language education has entered a period of personalisation based on data, automatic feedback, and interactive collaboration between a human and a machine (Zhai & Li, 2025). The tools made with the use of AI are becoming more integrated into classroom teaching, online education, and institutional evaluation systems, and they provide new opportunities for learning to enhance student engagement, improve the efficiency of teaching, and facilitate personalised learning paths (Zhai et al., 2023). In that regard, AI has been seen as a disruptive technology that can potentially revolutionise the pedagogical outlook of language teaching and speed up the pace of educational change (Wang et al., 2026).

Artificial intelligence in education should not be understood merely as a technological enhancement, but as a broader sociotechnical transformation embedded within institutional, cultural, and policy structures (Zhai et al., 2023). The integration of AI into language classrooms is shaped not only by algorithmic capabilities, but also by governance frameworks, curricular traditions, linguistic ecologies, and local value systems (Zhai & Li, 2025). In multilingual and culturally layered societies, educational technologies interact with issues of identity, cultural continuity, and social legitimacy, raising questions about how innovations are negotiated, adapted, and institutionalized (Wang et al., 2026). Therefore, examining AI integration in language education requires situating it within wider debates on technological diffusion, educational equity, and cultural reproduction. This broader perspective frames the present study, which explores how AI becomes pedagogically workable and socially sustainable through region-specific adaptation mechanisms.

Nonetheless, although the growing number of studies on the use of AI in language learning have been published, the application and performance of AI in foreign nation-specific language education are not uniform in diverse socio-cultural and geographical settings (Wang & Coleman, 2009). The current literature has concentrated mainly on the technological affordances of the AI tools and their effects on the language performance, including vocabulary learning, pronunciation instruction, writing feedback, and motivation in learners (Wankhade et al., 2022). However, most of such studies are carried out in relatively homogenous educational environments or presuppose the applicability of AI-based instruction models in different contexts (Sua, 2012). These assumptions are also restrictive; the implementation of AI in language education is not a purely technological procedure but a complicated socio-pedagogical change due to local linguistic ecology, cultural norms, institutional control, and teacher agency (Zhai & Pan, 2025). Thus, deciphering the problem of cultural specificity of AI localisation and adaptation in cultural areas has turned out to be a burning question of educational technology and Chinese education studies abroad.

The case of Malaysia is handy when exploring the localisation and adaptation of AI-assisted international Chinese education (Wankhade et al., 2022). Being a multilingual and multicultural society, Malaysia can be described as the coexistence of Malay, Chinese, English, and other minority languages and is a dynamic linguistic ecology in which code-switching is a prominent communicative phenomenon (Zhai & Chen, 2025). In the meantime, Chinese education in Malaysia is not only a long-standing practice in the country but also well-rooted in institutional terms, such as Chinese-based primary schools, independent Chinese secondary schools, and higher education in the Chinese language (Zhai et al., 2023). Chinese language learning in Malaysia is consequently not only an educational practice but also tightly

linked with the notions of cultural identity, ethnic community formation, and cross-cultural communication (Zhai et al., 2023). These attributes precondition the importance of Malaysia as a location to analyse the ways AI technologies can interplay with the local cultural and linguistic realities, as well as how the Chinese education that is supported by AI can be maintained in a regionally specific setting (Zhai et al., 2023).

It is impossible to realise AI-aided Chinese education in such an environment by means of direct technological transfer and mere imitation of ready-made AI systems, which are intended to be used in monolingual or culturally homogenous classrooms (Zhai et al., 2023). Instead, the implementation of AI demands a systematic adaptation of the region to match AI features with the specifics of local educational regulations, pedagogy, cultural considerations, and identity of learners (Yalun, 2019). As an example, speech recognition can be poor at dealing with accent differences and multilingual interference, automated feedback systems can be ineffective at interpreting code-switching expressions, and generative AI output can be insensitive to culturally relevant discourse conventions (Starr, 2009). The following difficulties imply that AI localisation is not a more technical adaptation process but a more comprehensive process of adaptation, which is conditioned by the institutional government, the mediation of teachers, and the cultural-linguistic tuning (Sua, 2012). However, although AI localisation is an issue that gathers more and more interest, there is a lack of research offering an integrated theoretical framework of the processes according to which AI can be made legitimate, effective, and sustainable in the ecosystem of international Chinese education in ASEAN settings (Wankhade et al., 2022).

In order to fill these gaps, this paper suggests that AI-enhanced international Chinese education should be reviewed on the basis of a mechanism-based approach that focuses on the dynamics of technology, pedagogy, and culture. Specifically, this study incorporates the notion of regional adaptation mechanisms to develop the concept of localisation of AI tools in the Malaysian education system based on Chinese. The regional adaptation mechanisms are defined as the institutional, pedagogical, and cultural-linguistic procedures when AI technologies are re-configured, negotiated, and integrated into the local environment of teaching in order to be able to perform meaningfully and sustainably. Turning to the case of Malaysia, this research would add to the ASEAN-centric description of AI localisation in the international Chinese education and promote theoretical debates about context-sensitive educational technology integration.

In order to address these goals, this paper will examine the localisation of AI-assisted international Chinese education in the Malaysian multilingual and multicultural education context. In particular, the following research questions will guide this study:
RQ1: How is AI currently adopted and localized in international Chinese education settings in Malaysia?
RQ2: What key regional adaptation mechanisms (institutional-policy, pedagogical, and cultural-linguistic) enable effective AI integration in Malaysia's Chinese education ecosystem?
RQ3: How can a staged regional adaptation model (introduction–alignment–integration–optimization) explain the legitimation and sustainability of AI-supported Chinese education in Malaysia?
The central research problem of this study is not simply whether AI improves language learning outcomes, but how AI becomes institutionally legitimate, pedagogically workable,

and culturally sustainable within a multilingual educational ecosystem. While existing studies predominantly focus on technological affordances and performance effects, they pay limited attention to the sociocultural and institutional mechanisms that shape technology adoption in diverse regional contexts. This gap is particularly significant in light of ongoing debates within the social sciences concerning technological diffusion, institutional legitimacy, educational equity, and cultural reproduction. By examining how AI integration is mediated through policy alignment, pedagogical orchestration, and cultural-linguistic calibration in Malaysia, this study contributes to a deeper understanding of how global technological innovations are locally negotiated and structurally embedded in education systems.

This research contributes to achieving three significant items by answering these questions. To begin with, it contributes to the current body of AI-related language education research, as it places more emphasis on the technological results of AI-assisted language education instead of the socio-pedagogical processes that guide AI localisation in culturally varied contexts. Second, it adds value to the research of international Chinese education by offering an empirically based account of the process of adapting AI tools in the context of the Malaysian language and culture ecology. Third, it presents a staged adaptation model (introduction- alignment- integration- optimisation) as the conceptualisation of how AI can be made legitimate and sustainable within the Chinese education ecosystem in Malaysia, which has practical implications in terms of teacher training, developing local platforms, and China-Malaysia educational collaboration. In general, this paper offers theoretical and practical implications for the development of AI-powered international Chinese education in the ASEAN region.

Literature Review

AI in Language Education: Affordances and Emerging Pedagogical Shifts

The use of artificial intelligence (AI) has become a very powerful player in the field of language education by altering how learners learn linguistic knowledge and how educators structure learning activities (Wang & Coleman, 2009). As speech recognition, natural language processing, machine learning based recommendation systems and generative AI models evolved, the language learning environment has progressively shifted from the traditional computer-assisted language learning (CALL) to the more adaptive and data-driven system (Yalun, 2019). The AI-assisted systems have become popular in pronunciation training, automated writing feedback, intelligent tutoring, conversational practice, and learning analytics (Zhai et al., 2023). The tools have enabled new opportunities for personalisation of learning, real-time formative assessment, and interactive learning experiences that are no longer limited to the classroom (Zhai et al., 2023).

Another critical theory that is often used to justify the educational usefulness of AI tools is the concept of affordance, which describes the action options of a technology to users in a given learning scenario (Zhai & Li, 2025). The functions that represent AI affordances in language education are sometimes automated detection of errors, adaptive learning suggestions, real-time pronunciation assessment and generation of instant feedback (Zhai & Chen, 2025). It is projected that these affordances will boost the level of autonomy and involvement of learners in addition to increasing the efficiency of instruction (Zhai & Pan, 2025). Specifically, intelligent assessment systems enable learners to get immediate diagnostic feedback and, therefore, they can also monitor their progress and change learning

strategies (Wang & Coleman, 2009). Meanwhile, the generative AI has extended these affordances even more by offering an interactive dialogue, contextualised language input and speedy content creation to write and practice speaking.

Although AI usage in language education has such possible advantages, it is still followed by significant pedagogical issues (Zhai & Li, 2025). First of all, the quality and dependability of AI-generated feedback can be subject to different interpretations based on the linguistic backgrounds of learners, peculiarities of their pronunciation, and the interference of multiple languages (Zhai et al., 2023). Second, AI-related software can offer technically accurate feedback that is not pedagogically understandable, which can weaken the effectiveness of the learners in decoding and integrating corrections (Zhai et al., 2023). Third, the growing popularity of generative AI is a cause of issues related to dependency, academic integrity, and potential jeopardy to reduce language acquisition to superficial correction instead of meaningful communicative growth in learners (Zhai et al., 2023). As a result, researchers have claimed that language learning supported by AI should not be perceived as a technological improvement but a complicated change in the pedagogy where mediation by the teacher and the contextual adjustment are critical factors.

Thus, recent studies focus more and more on the idea that the achievement of AI integration is not only based on technological performance, but it also depends on the ways of integrating AI tools in the local teaching process, curriculum objectives, and socio-cultural learning systems. This change is an indicator of the necessity of a mechanism-based approach that describes how AI tools will become pedagogically significant and socially acceptable in various education settings.

International Chinese Education in ASEAN: Development and Contextual Complexity

International Chinese education has grown exponentially during the last decades because of the increasing need to master the Chinese language as an essential part of global communication, economic cooperation, and cultural exchange (Wankhade et al., 2022). The external and internal forces have influenced the development of Chinese education in ASEAN regions (Wankhade et al., 2022). On the one hand, the growing role of the Chinese economic activity has improved the instrumental power of learning the Chinese language (Zhai et al., 2023). Conversely, Chinese education has become a long-term cultural and identity-related practice due to the historical existence of Chinese communities in on-the-ground Southeast Asia (Zhai et al., 2023). This is the two-sidedness of Chinese education in ASEAN as compared to most of the West, where Chinese is mainly studied as a foreign language.

The ASEAN countries are also characterised by a high level of diversity in their language policies, ethnic makeup, and educational management (Zhai et al., 2023). The learning of the Chinese language can take place in mainstream public education systems, in the form of privatised institutions of learning, and heritage institutions of learning that are communal, or in international programs (Zhai & Li, 2025). The learners can be heritage speakers who do not lose cultural identity, non-Chinese learners who seek economic opportunities, and bilingual learners who have to navigate multilingual settings (Wankhade et al., 2022). This diversity creates intricate teaching conditions and establishes considerable differences in the motivation to learn, modes of classroom intercourse, and cultural anticipations.

Malaysia is one of the most unique examples of the development of Chinese education in the region (Wankhade et al., 2022). Malaysian Chinese education has good institutionalisation, such as using Chinese media in primary schools, independent Chinese secondary schools, and highly established Chinese programs in higher education (Zhai et al., 2023). Meanwhile, Malaysia is a multilingual society where there are Malay, Chinese, English and many different dialects. The everyday use of code-switching on a daily basis or in the educational process impacts the learning of the Chinese language by learners (Zhai et al., 2023). The education of the Chinese in Malaysia is not just a question of the language, and it is also closely related to the traditions of Chinese culture and ethnic identity negotiation, as well as to social integration into the multicultural national system (Zhai et al., 2023).

These situational attributes imply that Chinese education in Malaysia is situated in a complicated socio-cultural ecology (Zhai et al., 2023). Educators have to contend with the dilemma of curriculum goals and cultural responsiveness. In contrast, the language acquisition process in learners is informed by the multiple lingual repertoires and identity formation (Zhai & Li, 2025). Consequently, the introduction of AI in the Malaysian Chinese education cannot be presupposed to be integrated in the framework of the monolingual models. Instead, the AI tools need to address the linguistic ecology of Malaysia and its cultural standards to become accepted and maintain the educational effectiveness (Wankhade et al., 2022).

AI Localization and Contextual Adaptation: Institutional, Pedagogical, and Cultural Dimensions

Localisation of education technology has been one of the most debated topics in technology diffusion, adoption of innovation, and cross-cultural pedagogy studies. According to the classical theory of innovation diffusion, technological adoption does not take the form of a transfer but is a negotiation process where the local users and institutions reinterpret and change the innovations (Wankhade et al., 2022). Likewise, other models, including the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT), demonstrate that the perceptions of utility of the technology, ease of use, and social influence are the factors influencing technology adoption (Wankhade et al., 2022). Although the models are valuable in understanding the acceptances on the individual level, they neglect the existence of broader cultural, institutional, and pedagogical frameworks on how the integrations of technology can be long-term sustainable (Zhai & Li, 2025).

Socio-cultural and ecological approaches have been developed in language education research, with a greater number of authors utilising those approaches, aiming to describe the ways in which local conditions influence teaching tools (Zhai & Li, 2025). The language ecology approach focuses on language learning as dynamic processes in the interaction of linguistic practices, cultural ideology, identity negotiation practices, and institutional norms. A multilingual society does not divide the linguistic repertoire of learners into clear language boundaries, but they exist as fluid and hybrid practices (Zhai & Li, 2025). In turn, AI tools, which are programmed according to the typical language norms, might have problems in their work with contexts that are typified by variable accents, code-switching, and multi-language communication.

Besides, culturally responsive pedagogy has brought to the fore the relevance of ensuring that the content of instruction and patterns of interaction are aligned with cultural backgrounds and identity requirements of learners (Zhai & Li, 2025). The AI-generated content and responses used in a multicultural setting like Malaysia can be biased towards a specific culture or can also be insensitive to cultural limits, which will negatively affect trust in the learner (Zhai & Li, 2025). Thus, AI localisation should be accompanied not only by technical adaptation but also by cultural adjustment, which would guarantee the socially acceptable and culturally significant AI-inspired instruction.

The teacher agency also has a key role to play in AI localisation. Educators play the role of interpreters who decode the AI feedback, restructure the learning activities, and incorporate technology into the learning goals (Zhai & Li, 2025). The AI tools might not turn into consistent parts of the instructional practice; instead, they are likely to be surface-level supplements unless pedagogically orchestrated (Zhai & Li, 2025). Meanwhile, there are institutional governance and policy legitimacy, which influence the broader context of AI adoption, such as infrastructural support, resource distribution, curriculum control and local appraisal criteria (Zhai & Li, 2025). The institutional factors establish whether AI integration is sustainable or not (Zhai & Li, 2025).

Collectively, the conceptualisation of AI localisation in language education is a multi-dimensional process, which includes the institutional-policy fit, the pedagogical fit, and the cultural-linguistic fit (Zhai & Li, 2025). Nevertheless, the literature has tended to study these aspects individually, which creates mixed knowledge (Zhai & Li, 2025). There is a greater need, however, to adopt a more integrated structure to describe how these forces interplay and create a specific adaptation mechanism in particular regional settings (Zhai & Li, 2025).

Research Gaps and the Need for a Regional Adaptation Mechanism Framework

The above literature review also shows that AI-assisted language education has spawned a lot of debate about technological affordances and learning outcomes, and the international Chinese education community has also come to the realisation of how cultural sustainability and contextual responsiveness can be essential (Zhai & Li, 2025). However, the crossroads between these two fields of study are not well developed yet, especially in ASEAN contexts, where AI integration faces unique issues because of multilingualism and multiculturalism (Zhai & Li, 2025).

To start with, the current literature in AI in language education presupposes linguistic homogeneity and neglects the effect of multilingual interference and code-switching processes (Wankhade et al., 2022). In Malaysia, students often have to use a variety of languages and dialects, which can lower the quality and pedagogical soundness of AI-assisted speech recognition and automated grading systems (Wankhade et al., 2022). Second, despite the broad acceptance of teacher mediation, a limited number of studies have explained in detail the mechanism of how to mediate AI tools by teachers with localising tasks, feedback calibration, and human-AI role negotiation (Wankhade et al., 2022). Third, the institutional and policy aspect of the AI adoption is under-researched within the international Chinese education (Wankhade et al., 2022). The lack of curriculum governance, localised assessment systems, and consistent infrastructure support can make AI integration not be viewed as legitimate and sustained over time (Wankhade et al., 2022).

Thus, it is urgent not to discuss AI effectiveness and establish a mechanism-driven framework explaining how AI-assisted international Chinese education can be localised in culturally diverse areas (Wankhade et al., 2022). This research fills this gap by postulating the notion of regional adaptation mechanisms that incorporate the institutional-policy fit, pedagogical orchestration, and cultural-linguistic calibration procedures of AI localisation within the Chinese education system in Malaysia (Wankhade et al., 2022). Through this framework, the study will present an ASEAN-oriented theoretical description of AI localisation and will have practical implications for the future progress of AI-powered international Chinese education.

Theoretical Framework

The theoretical framework used in the current study is regionally informed, as can be seen in the conceptual framework (Wankhade et al., 2022). This framework is based on two complementary theoretical approaches: the Technology-Culture-Pedagogy Integration (TCPI) framework and the notion of regional adaptation in AI-based global Chinese education (Wankhade et al., 2022). Combined with these views, these two views give an analytical framework of how AI-based Chinese education is localised in the Malaysian multilingual and multicultural environment.

Technology–Culture–Pedagogy Integration (TCPI) Framework

The TCPI model is created to address the sustainability of AI-based Chinese education in the interaction of technological, cultural, and pedagogical aspects (Wankhade et al., 2022). Technologically, AI can be viewed in terms of its instructional affordances (speech recognition, feedback based on natural language processing, intelligent assessment, and generative learning tools), which can be used to improve input, practice, and evaluation of the language (Wankhade et al., 2022). Regarding the cultural aspects, the Chinese education in Malaysia is associated with heritage preservation, identity formation, and multicultural values; thus, the use of AI should be culturally appropriate and respectful of cultural sustainability instead of being culturally neutral or disruptive (Wankhade et al., 2022). In the pedagogical view, successful AI implementation depends on the mediation of teachers in the classroom practices, specifically in the design of tasks and in the interpretation of feedback and the role negotiation between human educators and artificial intelligence systems. Only in the case when these three dimensions are aligned and mutually reinforcing, the AI-supported Chinese education will gain pedagogical significance and become sustainable within the framework of the TCPI.

Regional Adaptation Perspective

The paper also uses the TCPI framework but employs the regional adaptation approach to understand the localisation of AI in the Chinese education system in Malaysia. Regional adaptation is the dynamic process according to which AI technologies are adapted to the local institutional policy, multilingual actualities, and culturally specific teaching practices. Curriculum governance, provision of infrastructure, resource distribution and localised evaluation standards are at the institutional level and determine the introduction and regulation of AI. At the classroom level, educators are at the centre of arranging AI applications by means of instructional redesign and pedagogical calibration. On the cultural-linguistic level, there is a need to be sensitive to multilingualism, switching between languages, and culturally responsible content to achieve the acceptance and trust of the learners. Since the Chinese education in Malaysia is under a sociocultural framework that is

not similar to that of mainland China, AI-supported teaching should be systematically adapted regionally so as to facilitate effective learning, minimise the challenges of adjustment and ensure long-term survival of the Chinese education abroad.

Methodology

Research Design

This paper followed the qualitative research design to assess the regional adaptation processes of AI-enabled international Chinese schooling in Malaysia. Since AI localisation is context-dependent and mechanism-driven, a qualitative approach was deemed to be suitable to investigate the perceptions of the stakeholders, institutional practices, as well as the implementation processes at the classroom level. In particular, the multi-site qualitative case study approach was used in this study, which emphasises Malaysia as a representative ASEAN context in which the introduction, interpretation, and localisation of AI tools are closely intertwined with the institutional-policy, pedagogical, and cultural-linguistic factors that predetermine the integration of AI.

Research Context

The country offers a unique sociolinguistic and educational setting of international Chinese education. Malaysia, being a multilingual society, has the coexistence of Malay, Chinese, English, and other dialects. Thus, there is a high level of code-switching and hybrid linguistic behaviours in day-to-day communication and in learning institutions. Meanwhile, Chinese education in Malaysia has institutional roots over a long period of time, such as the Chinese-medium primary schools, independent Chinese secondary schools, as well as the Chinese language in institutions of higher learning. The contextual features of Malaysia can be combined with the characteristics of the country to describe the ways in which AI-mediated Chinese education is adapted regionally using the technology-culture-pedagogy model.

Participants

Purposive sampling was used to select the participants, so that the people with first-hand experience of AI-supported Chinese education were taken into consideration. The data collection took place with three major types of institutions, specifically, primary schools (n = 15, 8 teachers, 6 students and 1 administrator), secondary schools (n = 16) and universities/colleges (n = 14) to have a representation of different levels of education. The respondents involved in the study are summarised as follows: 15 participants were recruited at primary schools (8 teachers, 6 students, and 1 administrator), 16 participants at secondary schools (9 teachers, 6 students, and 1 administrator), and the teacher respondents indicated that the majority of them had used at least one type of AI-supported tool, including speech recognition software, automated feedback tools, intelligent assessment tools, or a generative AI tool (e.g., ChatGPT-like tools) in teaching Chinese. Participant students were multilingual students who had participated in AI-mediated and supported Chinese learning activities in a classroom or blended learning classroom. The stakeholder chosen sampling strategy was the sample of curriculum coordinators, school administrators, and those interested in the digital education practices, which implied that the dataset will contain the information on the classroom-based practice and the institutional-policy interactions that will define AI localisation.

Data Collection

The results of this research needed to be made more credible by triangulation by using three primary sources of information, namely policy and institutional documents, classroom observations and semi-structured interviews.

Document Analysis

The data conveyed through policy and institutional reports connected with Chinese education and AI-aided learning was gathered and examined. These consisted of curriculum instructions, institutional policy on digital education, teaching plans, and AI platform implementation reports, in the case that they were supplied. The analysis of documents presented macro-level information on the governance framework, institutional demands, and practices of localised evaluation affecting the adoption of AI.

Classroom Observations

Classroom observation sessions were carried out in three levels of education (4 schemes in the primary schools, 4 schemes in secondary schools and 4 schemes in the universities). The observations centred around the integration of AI into instructional practices, such as pronunciation training, automated feedback on writing, intelligent quizzes, and interactive learning tasks with the help of an AI. Field notes were also made to capture instructional design, teacher mediation strategies, learner interaction, and human-AI interaction processes.

Semi-Structured Interviews

All the participants (n= 45) were interviewed in semi-structured interviews. Interviews were undertaken in a face-to-face and an online setting, and lasted about 30-60 minutes, depending on the availability of the participants. The interview questions examined the motivations of AI adoption, perceived advantages and limitations, institutional support conditions, pedagogical strategies of adaptation to AI, and a cultural-linguistic dilemma in AI-assisted Chinese schooling. Interviews were recorded with the permission of the interviewees and transcribed verbatim to analyse them.

Interview Protocol

An interview protocol was created to have consistency and comparability in all the participants and provide a contextual depth that relied on the TCPI framework and the three suggested adaptation mechanisms. The protocol also incorporated general questions for all participants and stakeholder prompts. Sample questions were used in the interviews, as shown in Table 1.

Table 1
Interview Protocol (Sample Questions)

Dimension	Key Focus	Sample Questions
AI Adoption and Use	AI tools used and frequency	What AI tools have you used for Chinese teaching/learning? How frequently are they used in your classroom or learning activities?
Institutional-Policy Alignment	Governance, support, evaluation	What kinds of institutional support (training, infrastructure, policies) are available for AI-supported Chinese education? Are there evaluation standards or guidelines for AI use?
Pedagogical Orchestration	Task design and teacher mediation	How do you integrate AI tools into lesson design? How do you decide whether to accept, modify, or reject AI-generated feedback?
Cultural-Linguistic Calibration	Multilingualism and cultural sensitivity	How does multilingualism (Malay/English/dialects) influence AI-supported Chinese learning? Have you encountered cultural sensitivity issues in AI-generated content?
Challenges and Risks	Limitations and concerns	What difficulties have you experienced when using AI tools (e.g., accuracy, trust, student dependence, fairness)?
Future Expectations	Sustainability and optimization	What improvements are needed to make AI-supported Chinese education more sustainable and effective in Malaysia?

Data Analysis

The theoretical framework used in this study was the thematic analysis (Braun & Clarke, 2006) to create essential themes and regional adaptation mechanisms based on the qualitative data. The analysis of data was done through an iterative coding. To become familiar with the data, all the documents, observation notes, and interview records were sorted and re-read several times. Second, an open coding was carried out to come up with preliminary codes on patterns of AI adoption, localisation, institutional regulation, teacher mediation, and cultural-linguistic issues. Third, the code was axially coded to group codes into wider categories that were consistent with the TCPI framework. Lastly, selective coding was applied to generalise the results into three broad regional adaptation processes, which are institutional-policy alignment, pedagogical orchestration, and cultural-linguistic calibration. Also, patterns of results found in institutional documents, participant narratives, and classroom observations were synthesised analytically into a staged regional adaptation model, i.e., institutional-policy alignment, pedagogical orchestration, and cultural-linguistic calibration.

Coding Reliability and Intercoder Agreement

Intercoder agreement procedures were introduced to increase the level of analytic rigour and the reliability of the qualitative coding of interview transcripts (Kirk & Miller, 1986). A portion of the interview transcripts (around 20 per cent of the data) was coded by two researchers (Kirk & Miller, 1986). The consistency of the coding was evaluated with the help of Cohen's Kappa coefficient (Kirk & Miller, 1986). The coding generated a total Cohen's Kappa = 0.82, indicating that the coders have a high level of agreement (Kirk & Miller, 1986). The coding framework was narrowed down to discrepancies, which were discussed and only at the end did the entire dataset go through an analysis.

Trustworthiness

Several strategies were used in this study to achieve trustworthiness (Kirk & Miller, 1986). To begin with, the triangulation was attained through the fusion of evidence obtained using the documents, observations, and interviews. Second, contextualised interpretations of the localisation practices of AI in Malaysia were given through thick description. Third, peer debriefing consisted of frequent debriefing of the researchers to specify the decisions to use in coding and thematic interpretations. Member checking was used where possible by distributing thematic representations amongst a sample of respondents to ensure they were accurate.

Ethical Considerations

There were ethical considerations that were observed during the research. The purpose of the study and their rights, such as the right to participate on their own free choice and the right to withdraw, were explained to all the participants. The informed consent in writing preceded data collection. The identities and institutional affiliations of the participants were to remain anonymous to ensure confidentiality. All the information received was of a safe deposit and was only applicable in academic research. purposes.

Results

Institutional-Policy Alignment Mechanism

The initial mechanism of adaptation is related to the institutional and policy terms of facilitating or limiting the use of AI. Respondents continually stressed that Chinese education with AI-aids will not be sustainable eternally unless there is institutional legitimacy, infrastructural, and localised governance structures.

Curriculum Governance and Institutional Legitimacy

It was found that teachers in various educational settings introduced AI tools as individual endeavours as opposed to institutional programs. At the beginning, the use of AI was often viewed as an additional supplement as opposed to a formally recognised teaching method. The participants emphasised that institutional recognition and alignment of the formal curriculum played a vital role in motivating systematic adoption.

A university lecturer noted:

"If AI-based learning is not formally recognized in the curriculum, teachers will treat it as temporary and optional." (P12, Lecturer)

Similarly, a secondary school teacher highlighted the importance of policy guidance:

"Teachers need clear institutional guidelines. Otherwise, we are uncertain whether AI use will be supported or questioned." (P07, Teacher)

These findings indicate that institutional legitimacy functions as a foundational condition for AI localization, shaping teachers' confidence and willingness to invest in AI-supported teaching design.

Infrastructure Support and Resource Allocation

It was noted several times that the implementation of AI requires well-established digital infrastructure and access to resources. The Chinese learning using AI needs access to the internet, devices, and occasionally subscriptions to platforms. Inequality of resources in schools produced unequal opportunities in the implementation of AI.

A primary school teacher stated:

"AI tools are useful, but in many cases students do not have devices, and the internet connection is unstable." (P03, Primary Teacher)

A stakeholder further noted that infrastructure inequality may widen educational gaps:

"Schools with better digital resources can adopt AI faster, while less-resourced schools may struggle to implement it." (P40, Stakeholder)

These responses suggest that AI localization is shaped not only by pedagogical readiness but also by institutional capacity and resource distribution.

Localized Evaluation Standards and Governance Support

The other bright theme was the absence of more localised criteria of evaluation of AI-assisted Chinese learning. One of the arguments proposed by the participants was that AI-created assessments must not be evaluated only based on standardised metrics because the lingual background of the Malaysian learners is too different in monolingual settings.

An administrator explained:

"We need localized evaluation criteria. AI assessment cannot simply follow external standards because our learners' language background is different." (P35, Administrator)

This shows how governance support contributes to the formation of the possibility of the institutionalisation of AI as a reliable learning and assessment instrument. In general, the mechanism of institutional-policy alignment indicates structural forces that determine the potential of AI adoption going beyond experimentation towards stable integration.

Pedagogical Orchestration Mechanism

The second mechanism emphasises the role of teachers as active intermediaries in the localisation of AI. Teachers who were not direct adopters of AI tools facilitated the use of AI by means of task redesign, interpretation of feedback, and negotiation of human and AI roles.

Task Redesign and Instructional Sequencing

Teachers insisted on the fact that AI tools could only be practical under the conditions of being used in well-thought-out learning activities. Instead of applying AI systems as isolated processes, the teachers integrated AI functionalities into the instructional patterns like pre-class preparation, in-class engagement, and post-class practice.

A secondary school teacher described:

"AI is useful only when tasks are redesigned properly. Otherwise, it is just a tool without learning impact." (P09, Teacher)

A university lecturer similarly stated:

"Students use AI outside class for practice, and in class we focus on discussion and correction. AI becomes part of the learning cycle." (P15, Lecturer)

These results indicate that pedagogical orchestration suggests that teachers must equate AI affordances to curriculum-related goals and classroom practices.

Feedback Calibration and Human Mediation

Another significant prerequisite of the interviews was that teachers needed to tune AI-generated feedback. Respondents said that an AI response might be too machine-like, ambiguous or irregular in writing, correction and pronunciation testing. The teachers, thus, were crucial in deciphering and translating AI feedback to a teachable meaning.

A primary school teacher noted:

"Sometimes AI gives corrections, but students don't understand why. Teachers still need to explain and guide them." (P02, Primary Teacher)

A student confirmed the importance of teacher mediation:

"AI tells me my sentence is wrong, but I don't know how to improve it. Teachers help me understand the feedback." (P22, Student)

These findings indicate that AI feedback alone does not guarantee learning improvement; pedagogical value is achieved only through teacher mediation.

Human–AI Role Negotiation

Participants also emphasised the importance of balancing human teaching and AI assistance. Teachers and learners tended to view AI as effective for repetitive practice and surface-level correction, while teachers remained essential for cultural explanation, communicative competence, and critical thinking development.

A university student stated:

"AI helps with practice and small mistakes, but teachers help us understand meaning, culture, and real communication." (P27, Student)

A stakeholder further warned about over-reliance on AI:

"If students depend too much on AI, they may lose independent thinking. Teachers must guide the boundary." (P42, Stakeholder)

Pedagogical orchestration, therefore, is not only the issue of instruction design but the bargaining of the allocation of responsibility between teachers, learners, and AI tools.

Mechanism of Cultural-Linguistic Calibration

The third process is the cultural and language adaptation that AI tools must undergo to be used in the Malaysian multilingual and multicultural setting. According to the participants, the correct calibration of the culture-linguistic factor was a key to the establishment of trust, adherence to motivation among the learners, and sustainable integration of AI.

Multilingual Practices and Problems in Code-Switching

The ecology of multilingualism in Malaysia had a strong influence on the learning of Chinese with the support of AI. It was also common to find many learners who were confused between Malay, English, and Chinese, and this tended to lower the accuracy of speech recognition systems and automated feedback tools. Contributors referred to code-switching as one of the primary concerns towards the fairness of AI evaluation. A student explained:

"When I speak Chinese, I sometimes mix English words. AI cannot recognize it correctly." (P19, Student)

A teacher similarly stated:

"Students' pronunciation is influenced by Malay and dialects. AI evaluation is sometimes inaccurate." (P10, Teacher)

Such results indicate that AI technology needs to be linguistically tuned to accept a multilingual input instead of punishing the practices of hybrid languages.

Identity Sensitivity/Cultural Appropriateness

It was also revealed by the participants that Chinese education in Malaysia is highly connected to the cultural identity and heritage transmission. Consequently, AI-based content and feedback should be culturally relevant and oriented towards the local social standards.

Educators raised the issue that examples generated using AI might accidentally create culturally insensitive or offensive content.
A teacher noted:
"Chinese education here is not only about language; it is connected with identity. AI content must be culturally respectful." (P06, Teacher)
A stakeholder added:
"AI sometimes generates content that does not match local cultural norms. Teachers must check before using it." (P44, Stakeholder)
This fact indicates that the cultural calibration is necessary to ensure that the Chinese education enhanced by AI can help to bring about cultural sustainability, but not cultural wrongness.

Enduring, Engaged and Relied upon
The adoption of AI became a significant factor in the trust of the learners. The respondents were inquired, and some of the learners were discovered to be motivated if AI tools had been viewed as precise, fair and pertinent. Inconsistent responses or frequent misunderstanding, vice versa, can demotivate and destroy the interest. A university student stated:
"If AI always marks my pronunciation wrong, I feel discouraged. I trust the teacher more." (P31, Student)
A lecturer explained:
"For AI-supported learning to be sustainable, students must trust the system. Otherwise, they will stop using it." (P14, Lecturer)
Such findings indicate that cultural-linguistic calibration is not a technical change but also a psychological process that affects the acceptance of learners and their sustainability in the long term.

A Staged Regional Process of Adaptation
Besides the three mechanisms, the findings also suggest that the process of AI localisation of the Chinese education system in Malaysia is a progressive one. These observations and accounts provided by the participants demonstrate that there are four stages: introduction, alignment, integration and optimisation.

Single teachers or institutions can use AI tools mostly on an experimental basis at the introduction level, and a formal policy does not always back this. During the alignment phase, institutions start to offer infrastructure, training, and governance advice, and the AI application is correlated with curriculum goals. When the stage of integrating AI with teaching occurs, it becomes part of an everyday routine due to the more stable task design and the clarity of human-AI role assignments. Lastly, under the optimisation stage, AI-based Chinese education will be sustainable with the localisation of the platform, feedforward, and a teacher capacity building cycle in the long term.

A stakeholder described this process:
"AI adoption is not immediate. It needs time to align with curriculum and culture before it becomes stable." (P43, Stakeholder)
This simulated example demonstrates the system of institutional policy alignment, pedagogical orchestration, and cultural-linguistic calibration interacting dynamically over the years and allowing AI to become legitimate and sustainable.

Discussion

This research paper explored the international adaptation of the AI-based international Chinese education in Malaysia. Using the Technology-Culture-Pedagogy Integration (TCPI) framework, the findings revealed three interdependent mechanisms, which include institutional-policy alignment, pedagogical orchestration, and cultural-linguistic calibration, as well as conceptualised AI localisation as a stage-progressive process developing between introduction and optimisation. The findings indicate that the incorporation of AI into the multilingual and multicultural environment is to be viewed as a socio-pedagogical process, but not merely as a technological transfer process.

Firstly, the findings show that institutional-policy alignment provides the structural foundation of AI sustainability. Curriculum governance, infrastructure-supporting, and localised standards of evaluation were the key conditions to legitimise AI-assisted Chinese education. This is based on the earlier studies on the adoption of technology by pointing out that multilingual learning environments necessitate institutional legitimacy and localised assessment formations.

Second, the notion of pedagogical orchestration became one of the most significant processes that identify the educational worth of AI tools. Teachers were also mediators, and they actively participated in the redesign of the tasks, the generation of feedback by AI and the negotiation of teaching between humans and AI. This fact proves the conception that AI does not negate the work of the teachers but transforms them into more of an orchestrator who is able to refine AI outputs into learning resources that are actually useful, particularly in the domain of international Chinese education, in which cultural clarification and communicative aptitude remain the core focus.

Third, the findings indicate that the cultural-linguistic calibration is necessary to gain confidence among the learners and ensure the continued AI uptake. The standardised AI systems frequently found it difficult to cope with the multilingual ecology of Malaysia with the multicultural code-switching, accent oscillation, and identity sensibility. In turn, AI applications require both language adaptation and the creation of culturally aware content to be adopted and culturally feasible.

It is on account of these processes that the proposed study will offer a staged model of regional adaptation (introduction-alignment-integration-optimisation) that suggests the manner in which AI is gradually finding legitimacy and sustainability within the Malaysian Chinese education ecosystem. The model introduces an ASEAN-directed clarification of localising AI and extends the clarification of mechanisms in the AI-aided language teaching.

The results also have some practical implications. Teacher development programs should reinforce AI literacy and orchestration competence. The developers of AI platforms ought to improve the localisation of their products by incorporating multilingualism and culture-related materials. Localised standards of governance and assessment should be put in place by the institutions in order to encourage sustainable AI implementation. Lastly, educational collaboration between China and Malaysia can be enhanced through partnership in platform building, local corpus building, and teacher training.

Conclusion

This paper examined the regional adaptation processes of AI-based international Chinese education in Malaysia and how AI technologies can be localised in a multilingual and multicultural learning environment. Based on the Technology-Culture-Pedagogy Integration (TCPI) model, the results indicate that AI localisation cannot be considered a technological transfer process but a context-specific socio-pedagogical change when several interacting forces play a role.

The findings found three mechanisms that are interrelated and allow AI-based Chinese education to acquire legitimacy and sustainability in Malaysia: institutional-policy alignment, pedagogical orchestration and cultural-linguistic calibration. The institutional-policy alignment offers the structural basis of AI integration by governing curricula, supporting it with infrastructure, and localising the standards of evaluation. Pedagogical orchestration emphasises the critical role of teachers in redesigning tasks, calibrating feedback, and negotiating the roles of humans and AI to make AI an effective instructional tool as opposed to a shallow supplement. Cultural-linguistic calibration points to the need to support the reality of the Malaysian multilingual ecology, code-switching, and the sensibility of cultural identity, which are critical to gain the trust of the learners and the continuity of AI usage.

Based on these results, this research presented a model of staged regional adaptation (introduction-alignment-integration-optimisation) to describe the dynamic mechanism according to which the AC-assisted Chinese education develops into early experimentation and long-term optimisation. This model adds an ASEAN-oriented theoretical explanation of AI localisation and builds on the current studies by providing a mechanism-driven conceptualisation of AI introduction to Chinese international education.

There are also practical implications of the study for the stakeholders. The priority of the teacher development programs should be AI literacy and pedagogical orchestration competence. The creators of AI platforms need to focus on enhanced localisation by using multilingual and culturally sensitive content design and providing more readable feedback mechanisms. Institutions should set up decentralised structures and assessment criteria in order to instil sustainability in the process. Besides, China-Malaya educational cooperation can have advantages in joint platform development, local corpus building and cross-border teacher training programs.

Some limitations must be realised. First, being a qualitative study, the results might not be statistically extrapolatable to other environments besides Malaysia. Second, the data were mainly based on the opinions of stakeholders and classroom-based observations, and future research can use large-scale learning analytics or longitudinal learner outcome data. Third, the staged adaptation model can be further confirmed by conducting cross-national similarities and differences by comparing AI localisation practices of the ASEAN countries in future.

In general, this study highlights that sustainable AI-empowered international Chinese education needs to be adapted in an integrated manner, both on institutional, pedagogical, and cultural-linguistic levels. This study can provide theoretical and practical recommendations to build culturally sustainable Chinese education based on AI support in

Malaysia and other ASEAN societies by promoting a regional adaptation framework and gradual model.

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