

Exploration of Bilingual Teaching in Universities Based on WeChat Mini Program Development under the New Quality Productive Forces

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Abstract: In the era of new quality productive forces, technological innovation has become indispensable for university education to cultivate enthusiasm, initiative, and global communication competencies among students. However, the current educational landscape encounters challenges including those related to integration, insufficient teaching resources, and barriers to international communication, which hinder the effective implementation of these new quality productive forces in teaching. To address these challenges, the present study proposes a bilingual teaching approach in universities based on the development of WeChat mini programs. It explores the alignment of this method with the concept of new quality productive forces, highlights its pedagogical advantages, outlines the development framework for mini programs, and investigates their practical applications in higher education. Overall, the proposed approach aims to facilitate the successful integration of new quality productive forces into university teaching practices.

Keywords: Bilingual teaching; mini program; new quality productive forces.

1. Introduction

The 2023 Central Economic Work Conference of China formally introduced the concept of “developing new quality productive forces,” marking a pivotal shift in economic and educational development strategies^[1]. New quality productive forces refer to a novel form of productivity powered by technological innovation and characterized by the deep integration of emerging technologies across all production elements. This transformation fosters groundbreaking changes in industrial structures, driven by digitalization, intelligence, and sustainability, thus overcoming the limitations of traditional productivity growth and promoting high-quality economic advancement.

In the context of higher education, this new direction calls for educators in Chinese universities to prioritize technological innovation, enhancing students' learning motivation and agency through digital and intelligent approaches^[2]. Moreover, in professional disciplines, the demand for international communication and collaborative skills among students has been increasing. However, the current implementation of these goals is constrained by several key challenges:

First, technological innovation-oriented teaching resources are lacking, and the digital teaching platforms remain underdeveloped. Many universities are lagging in course offerings and content updates in emerging technology domains such as artificial intelligence (AI), blockchain, and quantum computing^[3]. Advanced and systematic teaching materials and case studies are often scarce. Second, the rapid pace of technological advancement complicates the integration of digital teaching resources. In fields like information technology, where new programming languages, frameworks, and algorithms are introduced frequently, educational content becomes outdated quickly. For instance, effective communication and collaboration between various disciplines and majors within universities is lacking, leading to the independent development and accumulation of digital

teaching resources across departments, forming isolated “information islands”. Interdisciplinary collaboration is often limited, preventing timely dissemination of breakthroughs in fields like computer science to related areas such as automation and electronic information. This siloed approach makes the efforts in this direction redundant and leads to the wastage of teaching resources. Technical compatibility and data quality issues further complicate the integration of diverse digital formats and sources. Third, international communication faces language and cultural obstacles, and global academic competition is intensifying. For example, 79% of professional courses at top 200 universities in the QS world rankings are taught in English, while only 34% of similar courses in Chinese universities are taught in English. Studies on Sino-foreign joint programs have revealed that cross-cultural teams exhibit 40% lower communication efficiency than monocultural teams, indicating significant language and cultural gaps. Additionally, discrepancies in accreditation standards—such as the 27 differences between China's system and the international engineering education certification (ABET) accreditation in the USA—have resulted in 26% of Chinese engineering graduates facing difficulties in obtaining international certifications^[4]. In cutting-edge fields such as AI ethics and green energy technology, Western countries continue to dominate the global standard setting. Under the aforementioned challenges, the full implementation of new quality productive forces in university teaching remains limited. To address this gap and promote their effective integration into higher education, this paper proposes an innovative bilingual teaching approach based on WeChat mini program development.

2. Related Work

To align with the evolving demands of new quality productive forces, bilingual teaching continuously explores innovative pedagogical models and methods. The integration of WeChat mini programs has emerged as a promising

direction for bilingual teaching. As a novel form of application, these programs offer advantages such as convenience, user-friendliness, and high efficiency, injecting new vitality into bilingual education. By bridging linguistic and cultural boundaries, the integration of bilingual teaching with WeChat mini programs reflects the following points of alignment:

2.1. Technology-Driven Innovation

A core feature of the new quality productive forces is revolutionary technological advancement. WeChat mini programs leverage cutting-edge technologies such as cloud computing, big data, and AI, enabling the introduction of innovative functionalities into bilingual teaching. Cloud computing offers computational and storage capabilities, allowing large volumes of bilingual teaching content to be hosted and accessed in real time, supporting large-scale learning and teaching interactions. Big data enables the analysis of student behavior and preferences, laying the foundation for personalized learning paths. AI introduces features such as intelligent Q&A and adaptive learning systems that can dynamically tailor content and progress based on learners' needs. These technological advancements enhance the diversity and interactivity of bilingual teaching, stimulate student engagement and creativity, and align closely with the revolutionary technological breakthroughs, which are characteristic of the new quality productive forces.

2.2. Optimal Resource Allocation

The new quality productive forces emphasize the innovative configuration of production factors to boost production and resource utilization efficiencies. In bilingual teaching, high-quality educational resources are often concentrated in a few institutions or regions, leading to unequal access^[5]. WeChat mini programs provide a platform to overcome these geographical and institutional limitations. Students in remote or resource-scarce areas can access a wide range of bilingual content, such as online courses, interactive exercises, and learning materials, anytime, as long as they have internet connectivity. This resource-sharing mechanism allows the broader application of high-quality educational resources, promotes educational equity, and significantly improves the overall efficiency of resource utilization, in line with the principle of optimized factor allocation under the new quality productive forces.

2.3. Expansion of Labor Objects

As new quality productive forces evolve, the scope of labor objects continues to expand. In bilingual teaching, language data becomes a new type of critical production factor, especially in areas such as data collection, annotation, and intelligent application. Through the accumulation and precise annotation of bilingual language data, large-scale language databases can be developed to support intelligent teaching tools, such as machine translation and voice interaction. Machine translation helps students rapidly and accurately comprehend foreign texts, thereby enhancing efficiency. Voice interaction technologies offer more natural and fluid language practice, improving communication skills. This expanded role of language data fosters deeper integration between language education and practical industrial needs, ultimately cultivating students with stronger applied skills and innovative capabilities.

Based on the aforementioned convergence points, the

combination of WeChat mini programs and bilingual teaching offers many unique teaching advantages, which are reflected in the following aspects.

2.4. Lightweight and Convenience

WeChat mini programs are inherently lightweight and require no downloading or installation. Students can access bilingual courses, complete interactive exercises, and engage in cross-cultural simulations directly through their mobile devices, anytime and anywhere. This flexibility supports fragmented learning and lowers entry barriers. For example, similar to the multifunctional "Kun Railway+" mini program, a bilingual teaching mini program could integrate educational content, assessment tools, and social interaction features into a single interface. Students can complete various learning tasks such as course learning, knowledge consolidation, and communication interaction on a single platform without needing to frequently switch between multiple applications. Additionally, the cross-platform compatibility of mini programs ensures a consistent learning experience across various mobile devices.

The convenient and cross-platform nature of mini programs facilitate students' learning and allow the widespread dissemination and sharing of educational resources. It overcomes temporal and spatial limitations of traditional education, enabling increased access to high-quality educational resources. Moreover, mini programs are undoubtedly a fairer learning tool for students from remote areas or those who cannot install professional learning software.

2.5. Data-Driven Precision Teaching

WeChat mini programs can capture rich data on user learning behaviors, such as accuracy rates, learning duration, and learning progress, which together constitute each students' digital profile. By integrating knowledge graphs and natural language processing technologies, these programs can conduct comprehensive, in-depth analyses of individual learning patterns^[6]. For example, intelligent dialogue modules powered by generative pre-trained models can assist students in bilingual oral training. These modules can generate personalized speaking prompts and dialogue examples based on learners' proficiency levels and language characteristics, offering real-time feedback through both voice and text. This helps students improve pronunciation and refine their expression skills. Through this type of data analysis, mini programs can recommend tailored learning materials to students of varying proficiency levels, effectively achieving personalized instruction—commonly referred to as teaching students in accordance with their aptitude. This personalized approach empowers each learner to progress at their own pace and attain optimal learning outcomes.

Data-driven precision teaching marks a significant advancement over traditional, uniform teaching models. By addressing individual differences, it ensures each student receives instruction customized to their needs. However, it also raises concerns regarding data privacy^[7]. Ensuring the security and legal protection of student data is essential. Developers must continuously refine data analytics algorithms and teaching resource recommendation engines to deliver more accurate, efficient, and personalized educational services.

2.6. Cross-Cultural Immersive Experience

With the aid of virtual reality (VR) or augmented reality (AR) technologies, WeChat mini programs can create immersive, cross-cultural learning environments, such as simulations of multinational internship or corporate communication scenarios. These functions allow students to take on roles and engage in realistic language-based tasks, enhancing their linguistic skills and cultural adaptability. For example, in a simulated international business negotiation, students can assume roles as representatives from different countries, conducting negotiations and consultations in English. This not only reinforces their business language skills but also familiarizes them with etiquette and communication norms across cultures. Such immersive experiences offer deeper insight into cultural nuances of various countries, ultimately enhancing students’cross-cultural communication abilities and global outlook. This approach aligns with the concept of “immersive cross-cultural communication scenarios”, supporting the cultivation of well-rounded, internationally minded professionals.

The concept of new quality productive forces introduces both fresh momentum and deeper meaning to the development of education^[8]. The integration of bilingual

teaching with WeChat mini programs aligns closely with this national development strategy and brings significant instructional benefits. This synergy offers promising new avenues for innovation in bilingual education and is poised to play a key role in cultivating cross-culturally competent talents with a global perspective.

3. Core Modules & Technical Architecture

The system adopts a layered application architecture. At the top is the user interface layer consisting of multiple view components that interact through event data and data flows. The middle layer incorporates the IS Bridge, which enables inter-module communication and seamless data exchange. The bottom layer includes native system functionalities, such as file systems, task scheduling, and network operations. The application service layer manages business logic and condition-based rules. It communicates with the interface layer via JS API to support data transmission and event handling. This architecture ensures seamless integration and a streamlined flow of data from the user interface to the underlying system functionalities, as shown in Figure 1.

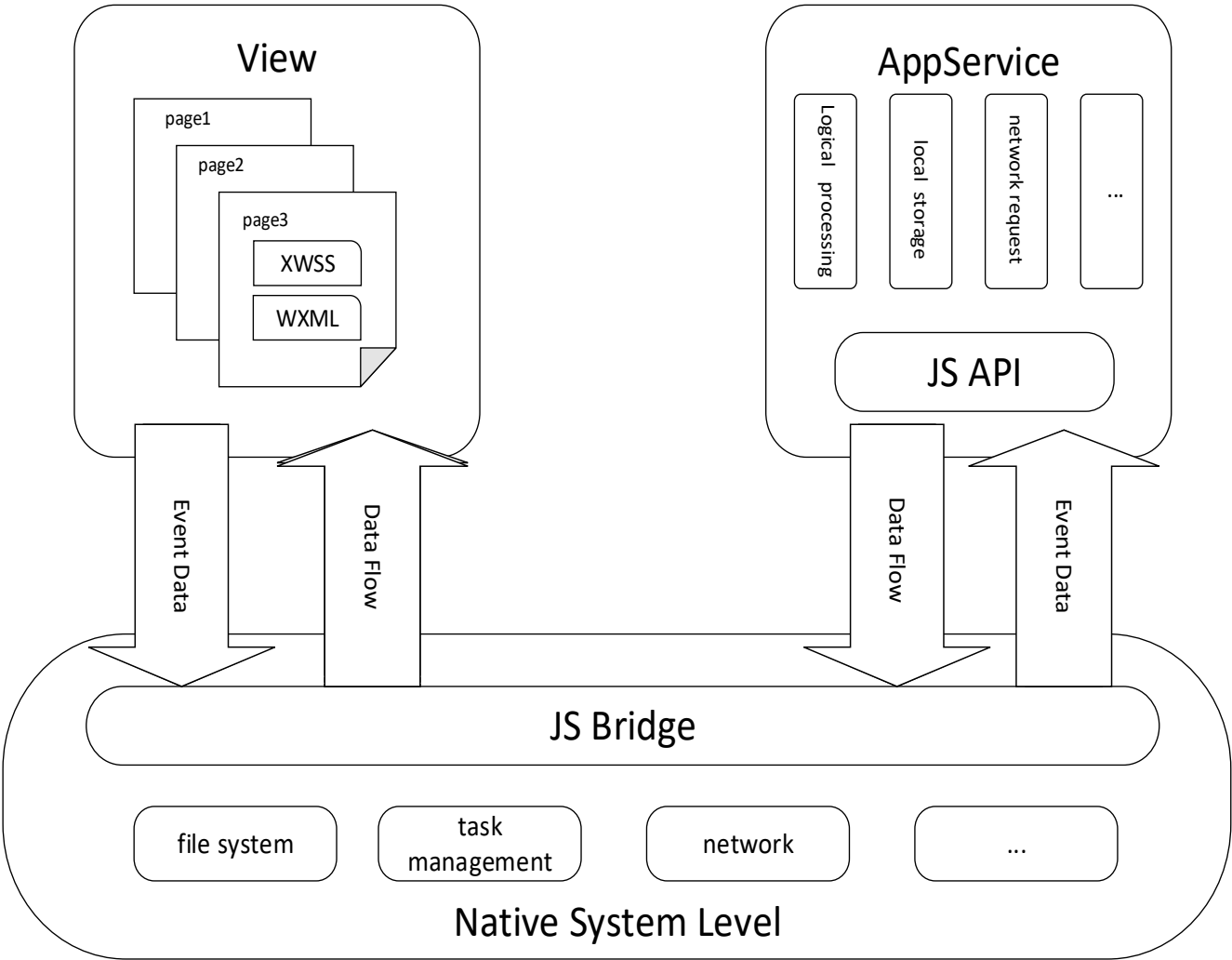


Figure 1. Overall frame diagram of the system

3.1. Core Functional Modules

The primary modules of this system include language switching, course content management, user learning, and

interactive function.

The language switching module uses Dynamic Language Resource Scheduling to support seamless, real-time switching between bilingual (Chinese/English) interfaces. When a user

activates the language switch, all elements (including but not limited to menus, buttons, and text prompts) and related course content are updated instantly, ensuring a coherent multilingual experience. To enhance usability, the system saves user language preferences in local storage using methods such as `wx.setStorageSync` provided by the WeChat API. Thus, upon reopening the app, the system retrieves these language settings to automatically load content in the preferred language, enabling persistent language settings.

The course content management module builds a multilingual course framework that supports synchronized Chinese and English content, encompassing various formats such as text, audio, and video. For example, video resources are embedded using the `<video>` component of the WeChat ecosystem, allowing learners to select materials based on language preferences. This constitutes the bilingual course structure system. To reduce the initial load time and app size of the mini program, content is dynamically fetched from the server or cloud storage based on the selected language. When a user switches languages, the system sends a request to the backend or cloud server to retrieve and render the appropriate language version of the course resources. This architecture enables efficient dynamic loading. Below is an excerpt of the example database design:

The user learning module comprehensively tracks users' progress across different language modes. Whether studying in Chinese or English, the system accurately records data such as course completion status, learning duration, and exercise performance, enabling personalized learning recommendations and progress tracking. This creates a multilingual learning record. Based on a user's language preferences and learning history, the system intelligently recommends appropriate content. For example, English-speaking users may be recommended international courses, original English textbooks, and content from instructors with overseas teaching experience. By contrast, Chinese-speaking users may receive suggestions aligned with the domestic curriculum and learning needs. This creates a multilingual learning record.

The interactive function module includes a bilingual discussion board and real-time translation chat function. Users can post in Chinese or English, and the system will automatically tag the language used, enabling easier filtering and navigation. The keyword-based search function allows users to quickly find relevant discussions, tailored to their language preferences. To support communication between users of different language backgrounds, the platform integrates Tencent Cloud Translation API for real-time, two-way message translation. When a message is sent, it is automatically translated into the recipient's preferred language and displayed accordingly on the recipient's interface. Replies are similarly translated, ensuring seamless multilingual communication between both parties.

3.2. Technical Implementation Plan

The development of this mini program adopts a robust, mature technology stack aimed at delivering a high-performance, scalable, and user-centric bilingual teaching

platform. It spans front-end development, back-end services, database storage, and bilingual translation capabilities. Additionally, the bilingual translation functionality combines professional cloud services and manual proofreading to ensure translation accuracy and professionalism. The mini program uses Taro 3.x + React for the front end, Node.js + NestJS for the back end, MongoDB Atlas for the database, and Tencent Cloud Translation + manual proofreading for bilingual translation.

During front-end development, the interface leverages WeChat Mini Program's native framework (WXML + WXSS + JS) to maximize compatibility and performance across devices. Native development allows the user to better adapt to different devices and screen sizes, ensuring a smooth experience. Back-end services are powered by Node.js + NestJS, with WeChat Cloud Development (CloudBase) serving as the Backend as a Service(BaaS) platform. CloudBase simplifies setup by offering a built-in database and file storage and cloud function services, enabling efficient backend development and maintenance-free operation. Through WeChat Cloud Development, developers can directly create and debug within the WeChat Developer Tools without being perturbed about server configuration and maintenance.

The system supports intelligent language recognition by detecting the user's WeChat system language preference, adjusting the mini program interface settings accordingly. For example, if the system language is set to English, the mini program interface and content will be displayed in English upon first launch. When a user switches languages, the system retains their current session state, such as scroll position and video playback time, ensuring uninterrupted learning.

Through this comprehensive technical architecture, developers can create a feature-rich, user-friendly, and stable bilingual teaching platform based on WeChat mini programs. This platform delivers a seamless, engaging, and adaptive bilingual learning experience across user demographics with different language backgrounds.

4. Discussion

The integration of new quality productive forces into bilingual teaching mini programs brings transformative innovation and convenience to modern education. The key application scenarios are as follows:

4.1. Course Learning and Teaching

The mini program supports simultaneous display of course content in Chinese and English, including text, visuals, images, videos, and audio. For example, in an English course, grammar explanations in English can be paired with Chinese translations and explanations to aid comprehension of complex knowledge points through comparison. In specialized subjects like Automation Control Technology and Applications, this dual-language model helps students learn technical terminology in both languages, broadening their global competence and laying a foundation for future career development. The interface diagram is shown in Figure 2.



Figure 2. Multi-language course resources display

Based on language preferences and learning progress, the mini program dynamically and automatically adjusts content recommendations and interface language, and offers personalized learning paths. For example, more challenging English original courses and extended reading materials can be recommended to students with higher English proficiency, whereas more supportive Chinese supplementary

explanations and practice content can be offered to students with weaker English foundations. Users can personalize their experience by selecting interface language, voice playback language, and display preferences—resulting in a customized and flexible learning journey. The interface diagram is shown in Figure 3.

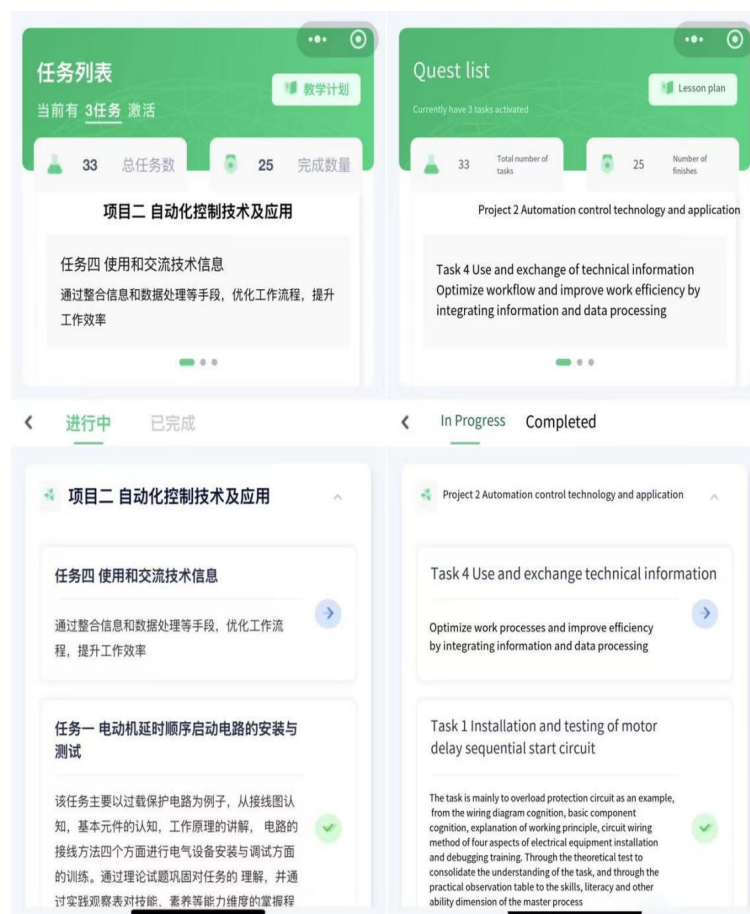


Figure 3. Personalized learning experience

4.2. Teacher Teaching Support

Teachers can conveniently upload and manage bilingual teaching materials, assignments, and assessments directly through the platform's backend. Additionally, teachers can

monitor and track students' real-time learning data, promptly understanding their learning status and needs and offering personalized instruction. The interface diagram is presented in Figure 4.



Figure 4. The interface diagram

In addition to asynchronous resources, teachers also can use the mini program to conduct online teaching and tutoring activities, such as live-streamed lectures, online Q&A sessions, and assignment grading. During live-streamed lectures, teachers can switch between languages and use the real-time translation chat to assist students from diverse language backgrounds.

5. Conclusions

This study highlights that the WeChat mini program-based bilingual teaching model aligns with the goals of new quality productive forces and offers significant advantages for innovations in education. Through thoughtful technical design and strategic application, it supports the modernization of teaching in colleges and universities while nurturing innovative multilingual talents to adapt to globalization under the background of new quality productive forces. In the future, advancements of AI, 5G, and other virtual technologies, including bilingual teaching mini programs, are expected to achieve breakthroughs in the following directions: they can be integrated with the metaverse to build a more immersive virtual language learning environments and achieve the integration of virtual and real. In addition, these technologies can be deeply collaborated with industries like cross-border e-commerce and international cultural tourism to foster talent

with language proficiency and technical skills. They can also be used to form industrial synergy. Finally, to achieve these goals, the government, universities, and enterprises must collaborate and build an open and inclusive innovation ecosystem that truly realize the virtuous cycle of “education – science and technology – talent”and offer intellectual support for the sustainable development of new quality productive forces.

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