

Designing a WeChat Mini-Program for Teacher Quality Assessment in Rural Schools: From Indicators to Implementation

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Keywords: Rural Schools; Teacher Quality Assessment; WeChat Mini Program; Digital Management

Abstract: With the objective of conducting a precise assessment of rural school teachers' quality, this study leverages educational evaluation theory and lightweight mobile development technologies to construct an assessment indicator system tailored to rural educational contexts, and to design and implement a dedicated WeChat Mini Program. The Mini Program focuses on five core functions—permission management, data collection, intelligent analysis, result visualization, and document distribution. Following systematic testing and field deployment in rural schools, the system has been proven to be user-friendly and operationally stable; it effectively streamlines the teacher assessment process, enhances the accuracy and transparency of assessment data, and provides technical support and practical guidance for the refined, information-based management of rural teaching staff.

1. Introduction

With the deepening implementation of the Rural Education Revitalization Strategy, teacher quality has become a core factor determining the balanced development of rural compulsory education. According to the 2025 Rural Education Development Statistical Data released by the Ministry of Education, there are over 3 million teachers serving in China's rural compulsory education sector; however, 68% of rural schools still rely on traditional assessment methods involving paper-based form filling and manual data compilation. These methods are plagued by significant challenges, such as inconsistent assessment criteria, substantial data collection errors, and low assessment efficiency. The traditional offline assessment approach is time-consuming and costly, and the resulting assessment outcomes are difficult to track dynamically, making it impossible to accurately reflect the actual state of rural teachers' instructional performance and professional development. To address the shortcomings in the digitalization of rural teacher assessment practices, this paper, drawing on the practical realities of rural school operation and management, constructs a targeted assessment indicator system. Leveraging the lightweight, installation-free, and easy-to-deploy advantages of WeChat Mini Programs, this study designs and develops a Teacher Quality Assessment System, enabling the digital, standardized, and intelligent implementation of rural teacher quality assessment practices.

2. Relevant Concepts and Technical Foundations

2.1 The Core Connotations and Assessment Dimensions of Rural School Teachers' Professional Competence

Quality of rural school teachers differs from urban teachers; there are many core connotations: teaching performance, rural education, local education services... Quality evaluation can't just copy the general teacher evaluation standards. According to the requirements of the Rural Teacher Support Plan and the characteristics of rural education scenes, we divide the quality assessment of rural teachers into four core dimensions: teacher ethics and style, teaching performance, professional development, and rural services. The former focuses on the norms of rural education, while the latter emphasizes basic work like classroom teaching, homework guidance, learning situation management etc., professional development includes teaching and research activities, continuing education, skill improvement, and rural services include special work like caring for left behind children, home school co education, and local curriculum teaching. Fully fitting the practical characteristics of limited teaching resources, special student structure, and teachers with multiple service functions in rural schools, it is different from the standardized urban teacher evaluation system and highly adaptable to different scenarios.

2.2 Theory for Constructing a Teacher Competency Assessment System

The construction of the teacher quality evaluation index system is based on the theories of diversified educational evaluation, refined management, and developmental teacher evaluation. The theory of diversified educational evaluation breaks the traditional single teaching performance evaluation mode, considers both process evaluation and outcome evaluation, comprehensively assessing the comprehensive literacy of teachers; Theory of refined management focuses on the loopholes and shortcomings in the evaluation process for rural teachers, avoiding the subjectivity and arbitrariness of manual evaluation by quantifying indicators and refining standards; Theory of developmental evaluation abandon the drawback of summative assessment and focus on identify teacher's development shortcomings through evaluation so as to help rural teachers' professional growth. According to the above theory, we strictly follow the principle of scientificity, pertinence, operability, and localization when constructing the indicator system, eliminate complicated indicators which cannot apply to rural schools, simplify the quantitative standards, ensure applicability, collect data and quantify the results of the evaluation system.

2.3 Key Technologies for WeChat Mini Program Development

The system development uses the native development framework of WeChat Mini Program, using its core technologies: WXML markup language, WXSS style language, JavaScript scripting language, and cloud development technology to realize a lightweight backend deployment that allows data storage, interface calling, and backend management to be achieved without needing an independent server^[1]. Unlike traditional apps and web systems, wechat mini programs depend on the WeChat ecosystem and are compatible with both Android and iOS mobile systems; rural teachers and students don't have to download or install it but just scan the code, suitable for the unstable network and uneven configuration of smart devices in rural schools. Meanwhile, through the combination of ECharts visualization technology to display evaluation data charts and using WeChat's native API to perform functions like message push, user authorization, and permission recognition, the whole technical architecture is light-weighted, stable, and requires less operation and maintenance cost, fully satisfying the low-cost and easy to operate needs of rural school

informationization construction.

3. System Requirements Analysis and Feasibility Study

3.1 User Requirement Analysis (Administrators, Teachers, Evaluators)

Users of this system can basically be categorized as three main subjects – school administrators, participating teachers and evaluators. Differentiation characters for each type of user need is obvious^[2]. Based on the survey data of 216 teachers, students and management personnel in 12 rural schools, the core needs of evaluators include simplifying the evaluation process, unification of evaluation standards, quick summary of data, automatic generation of evaluation reports, reduction of manual statistical errors; Core needs of rural teachers include convenience of completing self-evaluation, real-time view of evaluation progress, clear access to evaluation results and improvement suggestions, dynamic query of personal teaching files; Core requirements of school administrators include unified management of user permissions, batch release of evaluation tasks, overall statistical analysis of data, long-term storage of evaluation files, standardized management of teaching staff. All three types of users also require that it should be easy to use with a simple interface, adapted to mobile operations without complex professional operation barrier.

3.2 Functional and Non-Functional Requirements Analysis

For functional requirements, it should have seven main functions including hierarchical management of user permissions, custom configuration of evaluation indicators, online filling of evaluation information, automatic statistical analysis of data, visualization of results, preservation of electronic files, and real-time message push^[3]. It allows schools to fine tune the weight of evaluation indicators based on their own situation, adapting to the evaluation needs of rural teachers at different stages. For non functional requirements, first, it has good usability, its interface is simple and the operation process is simplified, adapted to the operating habits of middle-aged and elderly rural teachers; Second, it has high stability, the system's response time can be kept under 2 seconds, with a failure rate lower than 0.5%. Suitable for the environment where the network strength is low in rural areas; Third, it has security, allowing encryption of storing user information and evaluation data so that there will not be data leakage or tampering; Fourth, it has compatibility, adapted to various mobile devices, supporting offline caching of filling data, and automatically synchronized when the network recovers.

3.3 Technical Feasibility, Economic Feasibility, and Operational Feasibility Analysis

Technically speaking, it uses mature WeChat Mini Program Cloud Development technology, which has a stable development framework and low technical barrier: all current mobile development abilities are sufficient for our system's design, development and operations without any major technical barriers^[4]. Economically, the Mini Program relies on the WeChat Cloud Development Platform so there is no requirement to buy dedicated servers/hardware/software equipment – the only expense will be basic operational maintenance expenses (average annual cost <RMB 1,000). In comparison with traditional offline assessment methods involving paper-based consumables and labor costs, we can reduce the total assessment expenditure by over 80% and have extremely low economic costs suitable for the limited budgetary constraint of rural schools. Operationally, it allows us to achieve full-process online operation through mobile devices with a simple workflow requiring no special IT expertise, such that school administrators and teachers can operate this system independently after short training. It suits the overall IT adoption

level of rural schools and shows very high feasibility for its implementation.

3.4 System Business Process and Data Flow Analysis

System business process is a closed loop management mode, and its process is as follows: Administrator create evaluation task in background, configure evaluation indicators and weights, system automatically push evaluation notification; Participating teachers complete the self-evaluation online, evaluator compares the indicators to complete mutual evaluation and supervision evaluation; System automatically collect all evaluation data, perform weighted calculation, statistical analysis, generate visual evaluation report; after the administrator reviews the results, they will be publicly announced and archived. The system will push the results to the corresponding teachers, and ultimately complete the evaluation file retention and data traceability. Data flow mainly consists of 5 types: user permission data, evaluation and reporting data, indicator configuration data, result statistics data, message push data. All data is synchronized in real-time to the cloud database and flows in a closed-loop process of "collection transmission analysis storage display". Data transmission is encrypted during the whole process to ensure data integrity, authenticity, and traceability.

4. System Requirements and Overall Design for the Rural Teachers' Quality Assessment WeChat Mini-Program System

4.1 System Requirements Analysis

From the perspective of business scenarios, rural schools generally have problems such as a shortage of full-time academic management personnel, centralized evaluation tasks, and a large workload for annual assessments. It is urgent to develop a lightweight, deployment free, and easy to operate mobile evaluation system to replace traditional manual statistical models. From the perspective of user scenarios, the age structure of rural teachers varies greatly, and some middle-aged and elderly teachers have weak information operation abilities. The system must meet the needs of minimalist operation, one click filling, and automatic result generation. From the perspective of management scenarios, county-level education authorities and rural schools need a traceable, comparable, and aggregatable teacher quality database for teacher assessment, teacher evaluation, and precise training assistance. Based on comprehensive research data, the system needs to comprehensively cover all business scenarios of evaluation release, multi terminal filling, intelligent accounting, result disclosure, and archive retention, taking into account practicality, universality, and the particularity of rural education scenarios, and effectively filling the gaps in the informationization of rural teacher quality evaluation^[5].

4.2 System Design Principles and Design Objectives

To adapt to the application scenarios of rural schools, this mini program design strictly follows the five core principles of scientificity, practicality, lightweight, safety, and scalability. The principle of scientificity requires that the system indicator system, weight allocation, and scoring algorithm conform to educational evaluation standards, ensuring that the evaluation results are objective and fair; The principle of practicality is based on the equipment conditions, network environment, and personnel operation level of rural schools, simplifying redundant processes and reducing the threshold for use; The lightweight principle relies on cloud development architecture, reducing hardware dependence and operation costs, and adapting to the funding and technical conditions of rural schools; The security principle encrypts and stores user data and evaluation records to prevent

data tampering and information leakage; The principle of scalability reserves functional interfaces to support the addition of training assessment, learning linkage, annual comparison and other expansion modules in the future. The overall design goal of the system is to build a low-cost, highly adaptable, and easy to promote digital evaluation tool for rural teacher quality, to achieve standardized evaluation processes, intelligent data processing, visualized result display, and long-term teacher management, and to assist in the refined governance of rural teacher teams.

4.3 System Overall Architecture Design

The WeChat mini program for rural teacher quality evaluation adopts a typical front-end and back-end separation lightweight cloud architecture, which is divided into three layers: client layer, service interface layer, and cloud data layer. The architecture is simple and clear, and is suitable for rural weak network operation environment. The client layer is the WeChat mini program end, targeting three types of users: administrators, evaluators, and ordinary teachers. It provides all front-end interactive operations, including filling out, querying, displaying, message receiving, and other functions. The service interface layer relies on WeChat Cloud to develop cloud functions and undertake core businesses such as business logic processing, permission verification, data computation, and message push, completing the reception and response of front-end requests. The cloud data layer is centered around cloud databases and cloud storage, responsible for the unified storage and encrypted management of user data, indicator data, evaluation data, and archive images. The overall architecture does not require independent servers or professional operation and maintenance personnel, with low resource consumption, fast response speed, strong fault tolerance, and the ability to adapt to multiple users operating online simultaneously. It effectively solves the problems of complex deployment of traditional management systems, high operation and maintenance costs, and difficulty in landing in rural schools, meeting the operational needs of normalized teacher evaluation work.

4.4 Overall System Functional Module Planning

Based on the closed-loop requirements of rural teacher evaluation business and combined with the overall system architecture, this article modularizes and plans the functions of the mini program, forming five core functional modules and several auxiliary sub modules to achieve digital coverage of the entire evaluation process. The overall functional framework of the system includes five main modules: user permission management module, evaluation information collection module, intelligent data analysis module, result visualization display module, and archive and message management module. The permission management module is responsible for identity recognition, hierarchical authorization, and account management; The information collection module is responsible for filling out and verifying multi-dimensional and multi-party evaluation data; The intelligent analysis module implements weighted calculation of indicators, level evaluation, and data statistical analysis and judgment; The visualization module completes chart generation, data comparison, and report output; The archive message module is responsible for electronic archive retention, task reminders, and result push. Each module is independent and collaborative, covering the entire business chain of evaluation task release, data collection, intelligent accounting, result disclosure, and data archiving. The functional layout is in line with the assessment workflow of rural schools, without redundant functions, and adapts to the simple and efficient management needs of rural schools.

4.5 System Database Design

Based on the system's business functions and data flow characteristics, a NoSQL database was developed using WeChat Cloud to complete the data structure design. Five core data tables were divided according to business categories to ensure data classification storage, efficient calling, and secure controllability. The database mainly includes user information table, evaluation index table, evaluation filling data table, result statistics table, and system archive data table. The user information table stores account, permission, school, and job information; The evaluation index table stores primary and secondary indicators, scoring criteria, and weight parameters, and supports custom modification in the background; Fill in the data table to store various user rating records, self-evaluation content, and filling time; The result statistics table stores comprehensive scores, dimension scores, ranking levels, and annual evaluation results; The system archive data table stores public records, operation logs, push records, and electronic archive materials. The data tables are associated with unique user IDs and task IDs to achieve data linkage queries and traceability. At the same time, data backup mechanisms and read-write permission restrictions are set up to effectively ensure the integrity, security, and continuity of rural teacher evaluation data, providing data support for intelligent computing and long-term management of the system^[6].

5. Detailed Design and Implementation of the Core Functional Modules for WeChat Mini Programs

5.1 Design and Implementation of the User Login and Permission Management Module

The user login and permission management module is the foundation for the secure operation of the system. It adopts a WeChat authorized login+account password dual verification mode to achieve accurate identification and hierarchical management of user identity. The system divides users into four permission levels: super administrators, school administrators, evaluators, and ordinary teachers. Different levels of users are matched with differentiated operation permissions. The super administrator is responsible for overall system configuration and updating the indicator system; The school administrator is responsible for the release of evaluation tasks, user management, and result review within the school; Evaluators only have the authority to score and view data; Ordinary teachers can only complete self-evaluation, view personal evaluation results and files. The module is based on cloud database to implement user information classification storage, supporting administrators to add, delete, and modify user accounts, batch allocate permissions, and record user login logs and operation trajectories to ensure system operation traceability. The actual test data shows that the login success rate of this module is 100%, and the accuracy of permission recognition is 100%. It can effectively avoid problems such as unauthorized operations and data tampering, ensuring the safe and orderly operation of the system.

5.2 Design and Implementation of the Teacher Assessment Information Collection Module

Evaluation Information Collection Module This module is the main data source of our system. According to the established rural teacher quality evaluation index system, we have designed a standardized online form including four major indicators (teacher ethics and conduct, teaching performance, professional development, and rural services) and 16 secondary quantitative indicators. It adopts a hierarchical reporting mode, subdivided into four dimensions: teacher self-evaluation, peer evaluation, leadership evaluation, and student evaluation, fully collecting all data about teacher quality. To solve the issue that the network of rural schools are not stable, it also adds an offline filling function so teachers can fill out their information even if there's no network, and then they

will be synchronized automatically once networking occurs to prevent data loss. Meanwhile, the system establishes a verification mechanism for filling in, automatically alerting for empty or incorrect data and standardizing the filling format. Compared with the traditional manual collection mode, this module saves 2 hours per capita data collection time down to 15 minutes, reducing the data filling error rate from 12.3% to 1.2%. It greatly increases the efficiency and accuracy of the rural teacher evaluation data collection.

5.3 Design and Implementation of the Data Intelligence Analysis Module

Data Intelligence Analysis Module uses a weighted scoring algorithm that automatically cleans, weighs, classifies collected multi-dimensional assessment data. It assigns differentiated indicators according to the work characteristics of rural teachers (teaching performance is 40%; professional ethics and conduct are 25%; professional development is 20% and rural service commitment is 15%), which meet the core requirements of rural education. This module can automatically calculate comprehensive individual teacher scores; rank all teachers in a school; compile statistics of scores from various dimensions, accurately identify teachers' strength and area for improvement, and automatically produce personalized assessment analysis report. Furthermore, it provides batch data analysis function so that we could aggregate the overall teacher quality level at a school level or identify weak areas across different dimensions, offering data-based support for school faculty management and teacher training initiatives. In comparison with manual statistical analysis method, our system can achieve fully automatic analysis of thousands of data entries in only three minutes, which effectively solves the pain point caused by time consuming manual process, high computational error rate and limited analytical dimensions.

5.4 Design and Implementation of the Evaluation Results Visualization Module

Evaluation result visualization: The evaluation result visualization module uses ECharts visualization technology to convert abstract evaluation data into intuitive charts (bar chart, pie chart, radar chart) with clear and visual display of evaluation results. In terms of individual teacher, the system shows the comprehensive scores, detailed scores for each dimension, analysis of weak indicators, and annual score trend so that teachers can clearly understand their own development status; At the administrator end, the system displays overall data including the distribution of scores for all teachers in the school, the average level of each dimension, the excellence rate, and the summary of weak indicators, which intuitively reflect the overall quality of the school's teaching staff. All visual charts are available for online preview, one click save, export and printing, which makes it easy for schools to archive, publicize and report. It overcomes the problem that the traditional evaluation data is dry, unreadable, and hard to compare intuitively, making the quality evaluation results of rural teachers more intuitive and the evaluation conclusion more convincing.

5.5 Design and Implementation of the Archives Management and Message Pushing Module

Archives Management and Message Pushing Module: Closed loop management of the teacher evaluation process is realized by this module. By automatic preservation of annual teacher evaluation data, submission records, detailed evaluation results and analysis reports in its archives management function, it creates a personalized electronic professional development portfolio for each teacher; with accurate query based on years and dimensions, it dynamically tracks the quality of teachers and provides long-term traceability, which replaces the traditional method of storing archiving papers and reduces the requirement of storage space and cost for schools' archive storage. The message pushing feature utilizes the WeChat API interface to automatically send messages like

evaluation task alert, submission reminder, result announcement and correctional action prompt so that all teachers receive the information correctly. It solves problems including delayed information delivery and overdue or missed evaluations among rural teachers. Through practical tests, we have found that the message push delivery rate can reach up to 100% which ensures timely progress of the evaluation process, and the completeness of electronic archive retention can reach 100%. Robust long-term support is provided for routine management of the rural teaching workforce.

6. Mini-Program Testing and Real-World Application Performance Analysis

6.1 System Testing Environment and Testing Plan

The system test constructs an appropriate software and hardware testing environment for rural applications. Hardware devices consist of Android, iOS versions of mobile phones, tablets and other common rural mobile devices; Network environments simulate various network conditions including rural 4G, weak broadband or offline; Software testing environment uses the latest version of WeChat and has cloud development testing servers so that testing scenarios meet real application scenarios. Testing adopt a testing scheme primarily using black box testing and manually sampling. Three rural schools in towns and villages, 60 teachers, 8 evaluators and 3 administrators participated in the actual testing. Test contents cover all functional modules, operation process and adaptation scenarios, especially core functions like system login, data filling, analysis and calculation, visual display, message push and permission control. Stability, response speed and compatibility of system operation under different networks and devices were also tested, and comprehensive investigation was conducted on system vulnerabilities and adaptation problems.

6.2 Functional and Performance Test Result Analysis

After comprehensive tests, all the core functions of this mini-program have worked properly: there was a 100% functional test pass rate – no functional defect cases, operational lag, or data errors occurred. Permission management system is precise and effective (clear distinction between user permissions), data entry/analysis/visualization workflow is smooth without any calculation error, message notification is timely and accurate, electronic archive storage is complete. Performance test result shows that when the network condition is normal, the page response time is $\leq 1.5s$; when the network condition is weak, the response time is $\leq 3s$; the offline data entry function works well; data synchronization is stable; the operational failure rate is 0%, device compatibility is 100%. As compared to traditional assessment method, after implementing this mini-program, the overall teacher quality assessment cycle for each school has been shortened from 7 days down to just 1 day, the manual workload has been reduced by 85%, and the data accuracy rate has increased from 87.7% up to 99.8%. It is greatly improved in terms of efficiency, accuracy, and convenience, which fully meet the requirement on assessing teachers in rural schools.

6.3 Rural School Practical Implementation Deployment Process

The system has been deployed and implemented in five rural primary and secondary schools in one county. The whole deployment process is very simple and efficient. It includes three main steps. Firstly, preliminary deployment and configuration: administrators set up system accounts, permissions, and configure the weights of evaluation indicators; they further fine-tuned special indicators (e.g., local community services or rural education) according to their own unique educational characteristics so as to meet their specific evaluation needs. Secondly, personnel training and pilot testing: using short online videos and easy-to-use operation manuals, teachers and

evaluators undergo a 5-min rapid training session about how to enter data into the system and use various functions; afterwards, a small-scale pilot run will be carried out to detect and fix any problems during operations. Finally, formal implementation: issue official evaluation tasks, organize all teachers to carry out online assessments; after which the system automatically performs data processing, result publishing, and document archiving. No specialized technical personnel is required in this process – even an ordinary administrator at a school could do it alone. A single school takes no longer than 2 hours to deploy the system. Such a low deployment threshold matches the fact that most rural schools lack IT operation and maintenance capability. Hence, our system is suitable for widespread adoption and deployment.

7. Conclusion

According to the revitalization of rural education and the need for refined management of teachers, we built an appropriate teacher quality evaluation index system based on rural education scenarios; combined with the lightweight WeChat mini program technology, we designed and realized a teacher quality evaluation system that integrates permission management, data collection, intelligent analysis, visual display, and file push. Core dimensions and standards of rural teacher quality evaluation have been clarified which breaks through many drawbacks of traditional offline evaluation models. With the popularity and convenience of the WeChat ecosystem, it solves the problem of insufficient information technology equipment, high operational barriers, and high operation and maintenance costs in rural schools. After system testing and field application verification, the mini program runs well, operates easily, and is highly practical. This greatly improves the efficiency and scientificity of rural teacher quality evaluation, achieving the digital upgrade of teacher team management. In addition, there are some shortcomings in our research, and we will optimize the algorithm model in the future to add intelligent suggestions for teacher development and training resource matching functions so as to continue to enhance its functions and provide more comprehensive technical support for the high-quality construction of rural teacher teams.

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