**REVIEW**

# A Framework for High-Quality Management of Homework in the Context of Digital Education

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***Abstract**: The deepened understandings of the Double Reduction policy have instigated a transition from focusing on reduction in homework quantity to emphasizing homework quality in Chinese basic education. The digital transformation in education offers new opportunities to address the current issues with homework management, such as unscientific design of homework, a lack of process tracking, and low efficiency in homework marking. This article aims to explore a successful pathway for high-quality homework management by proposing a framework of digitally enabled homework management (DEHM), which highlights homework design and assignment, homework completion tracking and recording, and homework feedback and remedies as the three basic steps of the DEHM process; integrates initial homework data, homework completion data, homework results data, homework intervention data, and homework progress data; and involves teachers, students, parents, and school administrators as DEHM actors. The study underscores the roles of DEHM in ensuring the traceability and accountability for homework quality, reducing teachers' workloads, promoting personalized learning in students, and providing data-based evidence for educational governance.*

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# Introduction

HOMEWORK is a device for assessing and consolidating the knowledge students acquire from in-class instruction (Qi et al., 2023). A legitimate amount of homework is favorable for deepening understanding, enabling learners to transfer newly grasped knowledge to other contexts and apply newly developed concepts and methods to solve problems (Fu, 2023). Nonetheless, homework overload not only hinders academic development of students but also negatively affects their physical and mental well-being. Heavy homework loads and excessive time spent on homework completion have been pronounced issues among primary and secondary school students in China. To address them, the Chinese government mandates a substantial reduction in homework loads in 2021's Opinions on Further Reducing the Burdens of Homework and Off-Campus Training on Compulsory Education Students, which have also been referred to as the Double Reduction policy (State Council of China, 2021).

The implementation of the Double Reduction policy has posed new requirements for homework management. Homework management concerns multiple activities relating to homework, involving various participants, such as students, teachers, parents, and school administrators. Far beyond basic steps like homework assignment and completion, homework management is a sophisticated process integrating multiple roles, such as supporting student intellectual development, teaching and learning evaluation, and instructional improvement. It typically includes steps such as homework design/assignment, collection, marking, analysis, correction, and remedies (Zhang & Du, 2021). Successful homework management can significantly alleviate academic burdens and enhance learning efficiency in students. For instance, scientifically designed homework offers students more targeted exercises within a definite amount of time, avoiding unnecessary repetition, thereby freeing up more time for their hobbies, physical exercise, and social activities. Also, effective analysis of homework results facilitates the teacher evaluating students' learning progress and adjusting teaching strategies, accordingly, resulting in mutual assistance between teaching and learning.

After four years' implementation of the Double Reduction policy, practical challenges in homework management remain among many schools and teachers. Influenced by traditional teaching notions, a portion of teachers tend to emphasize quantity over quality in homework assignment, without paying attention to stratifying and personalizing homework, leading to widespread adoption of a "one-size-fits-all" approach. Furthermore, homework management is a cumbersome and time-consuming process, demanding a lot of time for marking, analysis, correction, and feedback, and often squeeze out teachers' opportunities for teaching research and professional development. Additionally, differing perceptions of the roles of homework between

parents and teachers have complicated homework management. Certain parents see homework as a "guarantee of academic success" and voluntarily heap additional work on their children with a view to securing advantages in the competitive academic landscape (Jiang & Ma, 2025).

In this context, the application of digital technology has the potential to tackle the challenges of homework management. For instance, high-quality digital resources and intelligent homework platforms can assist teachers in stratifying assignments and providing personalized recommendations based on students' learning progress, thereby enhancing the effectiveness of homework (Ke et al., 2022). AI-assisted grading technology can largely increase the efficiency of homework marking and generate detailed information on student learning circumstances, enabling the teacher to spend more time reflecting on instruction and delivering individualized tutoring.

Certain schools and teachers have initiated their experimentation with integrating digital technology into homework management, such as using online question banks to assign stratified homework or pushing video explanations for incorrect answers via WeChat mini programs. Nevertheless, experiments like these mostly focus on exploring "tool substitutes" without effort to systematically transform the entire homework management process. In the meantime, while a variety of tools like homework apps, intelligent grading platforms, and learning diagnostics systems have emerged in the market, they often feature overlapping functions and typically prioritize technical practicability over educational needs, making their incorporation into the existing teaching management systems of schools difficult. Issues like these highlight the necessity of exploring theoretical bases for digitally enabled homework management (DEHM). This study is a theoretical exploration of how to leverage digital technology to construct a high-quality homework management system, aiming to provide a reference framework for researchers and businesses in developing DEHM tools and for schools and teachers in implementing DEHM.

# Inadequacies in Current Homework Management

Research suggests that despite the reduction in the amount of student homework and the time spent on written assignments as a result of the execution of the Double Reduction policy, the improvement in the homework results has not been significant, and teachers have struggled to balance the reduction of homework quantity with the ensuring of learning outcomes. In the meantime, a tendency to shift student academic burdens onto parents has been identified in the wake of the policy's release (Lin et al., 2022; Qi et al., 2023). Issues like these reflect a lack of mature mechanisms for homework management in Chinese compulsory education, making the policy's outcomes unpredictable. The inadequacies in current homework management in China include:

- Lack of Professional Homework Design: Teachers primarily rely on personal teaching experience in assigning homework without a proper understanding of the effects of the quality of homework and its difficulty level on student knowledge mastery. Additionally, due to the typically large class sizes in primary and secondary schools, it is challenging for teachers to stratify homework by student academic level and ability to suit the learning needs of the individual.
- Dearth of Data on the Homework Completion Process: Current modalities of homework management exhibit a biased emphasis on summative assessment, focusing on analyzing students' homework scores or the correctness of their answers, but neglecting examining students' thinking processes, problem-solving strategies, and cognitive changes in homework completion. Solely relying on summative data makes it difficult for teachers to gain a holistic understanding of students' actual learning states, which hinders problem diagnosis and attendant teaching adjustments.
- Low Efficiency in Homework Marking: The marking of homework remains predominantly manual, consuming much of teachers' time and energy, which could be otherwise spent on teaching research and professional development. Hence, this work burden is not only an impeding factor for the improvement of teaching quality but also potentially leads to occupational burnout in teachers.
- Fragmentary Homework Data: The process of homework management can generate colossal amounts of data on homework completion, distribution of incorrect answers, student mastery of essential knowledge, and more. Yet, current data collection practices rely heavily on manual devices or isolated tools, lacking uniform standards and norms. Data incompatibility between different digital tools causes severe information silos. Furthermore, data analysis mostly produces superficial results like rates of correct answers and performance rankings, without sufficient power of in-depth interpretation, failing to provide robust evidence for teaching improvement.

# Practicability of DEHM

Traditional homework management has limitations in homework design, completion process monitoring, data utilization, and other aspects, with difficulties meeting the Double Reduction policy's requirement of "enhancing the quality of homework and boosting student outcomes." Luckily, the ongoing improvement of digital infrastructure and advancement of digital education in China has helped to create a basic technological environment for DEHM's adoption, which is also supported by state-level policies and legislation and needed by the basic education community.

First off, from a technical perspective, there is relatively universalized digital infrastructure in place for DEHM's enactment. The introduction of the Education Informatization Action Plan 2.0 has popularized network connectivity and smart teaching terminals in Chinese basic education schools, establishing the basic conditions for digital homework management. The collection and analysis of homework data have become more convenient with the widespread adoption of learning analytics. In the meantime, the advancements in natural language processing technology have made intelligent homework marking and feedback workable. Tang et al. (2023), using the Smart Homework Platform of Jiangxi Province, researched into the application results of an AI-based automated homework marking system. Their research results reveal that the system could identify 89% of all homework questions submitted, capable of automatically marking one submission of homework of a class of 50 within 20 seconds, with accuracy of 98.58%, which could significantly ease the burden of homework marking on the teachers. Additionally, the widespread use of cloud computing and mobile terminals has eliminated the temporal and spatial constraints in homework management. Teachers can manage all processes, including homework assignment, submission, assessment, and results reporting through cloud platforms, and students and parents can instantly access homework marking results and feedback via mobile devices. Technological applications like these have laid groundwork for DEHM.

Furthermore, the state-level strategy for the digital transformation of education have provided clear direction for the development of digital homework management. 2022 Government Work Points of the Ministry of Education propose to build a digital education system that covers teaching, homework management, assessment, and other educational processes, to prompt the shift from experience-based to data-informed approaches to educational management (Ministry of Education of China, 2022). Circular on Implementing the Action Plan for Promoting Teacher Development Leveraging Digital Technology further emphasizes the application of educational technology, calling for the development of large language model-based intelligent teaching assistants to support lesson preparation, homework management, student evaluation, and professional development of teachers (Ministry of Education of China, 2025). Moreover, the *Data Security Law and the Personal Information Protection Law* provide legal frameworks for the collection, storage, and application of educational data, regulating data management practices of digital homework platforms and preventing the breach of student privacy. Policies and legislation like these have helped create a stable institutional environment for the practice of DEHM.

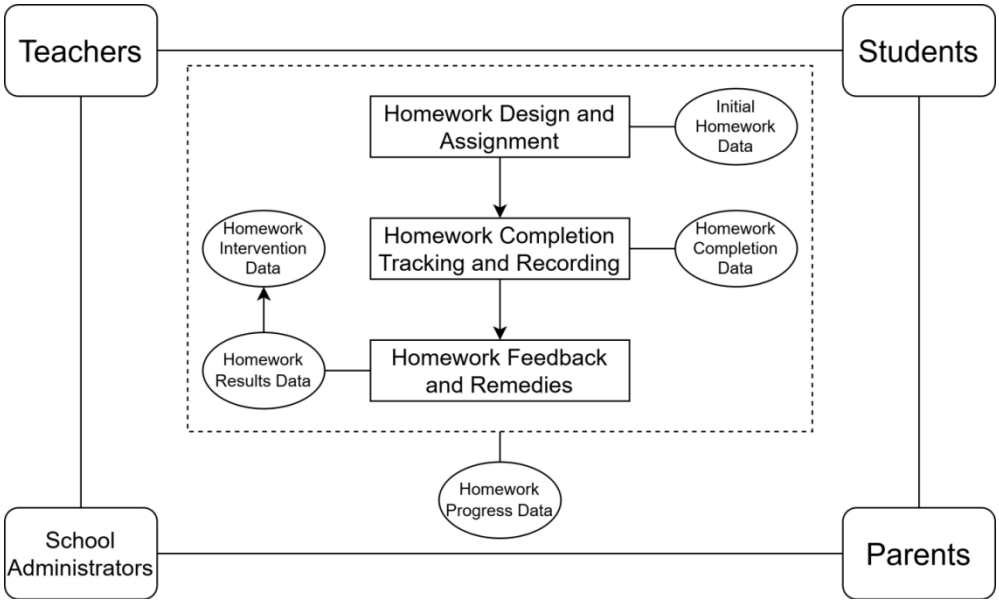


**Figure 1. A Framework of Digitally Enabled Homework Management (DEHM).**

In addition, the practical needs of teachers, students, and parents necessitate the digital transformation of homework management. For teachers, manual homework marking is time-consuming, and it takes time to receive students' reactions to the marking results, whereas digital platforms offer features such as stratified homework assignment, automated grading, and error summary, significantly improving the efficiency of homework management and providing data-based evidence for instructional decision-making. For students, digital homework systems can help them get personalized exercises, which suit their academic levels, and adapt to more proper learning strategies utilizing instant feedback. From the standpoints of parents and school administrators, digital platforms make homework-related information more transparent, which allows parents to stay informed about their children's academic progress and enables school administrators to monitor teaching quality and enhance educational decision-making leveraging homework data. The needs of multiple stakeholders are powerful drivers of DEHM's development

# A DEHM Framework

Based on the above analysis of current issues with homework management and the practicability of DEHM in Chinese basic education, this study proposes a theoretical framework for developing professional, high-quality homework management systems.

## *Basic Structure*

As shown in **Figure 1**, the framework in question comprises three basic components: the DEHM process, DEHM data, and DEHM actors. (i) The DEHM process. The framework streamlines the homework management process to include three steps: Homework Design and Assignment, Homework Completion Tracking and Recording, and Homework Feedback and Remedies, all of which are intensely facilitated by digital technology. (ii) DEHM data encompass initial homework data, homework completion data, and homework results data, generated in the above three steps, as well as homework intervention data, derived from homework results data, and homework progress data from multiple assignments and periodic assessments. (iii) This framework underlines the roles of teachers, students, parents, and school administrators as DEHM actors. The purpose of counting parents as DEHM actors is two-fold: to highlight the important role of parents in student learning and education; and to clarify the boundaries of parental responsibility in homework management, preventing a shift of the student's academic burdens onto their parents. Including school administrators as DEHM actors is meant to delegate specialized tasks, such as administrative duties and data analysis, to dedicated staff, to reduce the burdens on teachers. It should be noted that the framework is developed based on existing homework management practices and research, aiming to provide a reliable basis for exploring workable ways to address existing challenges, rather than to resolve specific issues with homework management all together.

## *Specific Elements of the DEHM Framework*

### The DEHM Process

Digital technology acts as crucial tools in Homework Design and Assignment, Homework Completion Tracking and Recording, and Homework Feedback and Remedies, the three sequentially connected steps in the DEHM process. In the first step Homework Design and Assignment, teachers, giving consideration to the lesson's objectives and students' knowledge levels, need to decide on the type, difficulty, and quantity of homework. Digital technology provides three types of support in this step: aggregating and presenting high-quality digital homework resources, facilitating teachers designing homework in an efficient manner; evaluating the quantity of homework for each subject and the completion time needed, assisting teachers in coordinating and managing students' total homework loads on a daily basis; and providing stratified or personalized homework recommendations based on student performance data, making homework assignment more targeted. The second step Homework Completion Tracking and Recording requires

students to complete their homework in a digital environment using electronic devices (tablets or computers) or smart pen-and-paper systems. Digital applications or smart pens collect data from the homework completion process and transmit them to the data analysis backends. In the last step Homework Feedback and Remedies, generative AI technology and high-speed scanning equipment are adopted to replace human marking; the teacher simply needs to review and check the machine's marking results. Data generated in this step are uploaded to the cloud or school platform for analysis, and different analysis results are pushed to various actors according to their respective roles. Teachers are provided with analysis results of the class's homework performance and recommended with intervention measures for them to decide whether to conduct an explanation of the common mistaken answers for the whole class or to have conversations with individual students, and how to adjust subsequent homework design. Students, together with their parents, receive personalized feedback, as well as remedy resources and improvement strategies, so as to identify and address gaps and adapt learning paces accordingly. The three steps make up a complete cycle of DEHM, with the data drawn from it offering implications for Homework Design and Assignment in the ensuing cycle.

## DEHM Data

DEHM involves five categories of data: (i) Initial homework data derive from the Homework Design and Assignment step, referring to details of homework, such as question type, source, subject, grade level, difficulty, and knowledge point tag. (ii) Homework completion data are gathered in real-time in the Homework Completion Tracking and Recording step, indicating information like time spent on homework, draft traces, pause points/frequency, and correction behaviors. It is noteworthy that this type of data may contain personal images or other private information (e.g., human images in video recordings of foreign language oral practice). Such sensitive data needs to be selectively deleted with only anonymized numerical fields (like duration) retained for subsequent analysis. (iii) Homework results data derive from the marking process, including information on the percentage of the students submitting their work, homework accuracy rates, error distribution, and gaps in key knowledge points, for a single assignment. (iv) Homework intervention data are generated based on the results data from a single piece of homework, including three components: descriptions of remedy resources, such as resource types (e.g., exercises, micro-lectures, reading materials), difficulty, knowledge point tags, etc.); records of students' remedy usage behavior (e.g., whether the student views/completes the remedy exercises, the scores achieved, etc.); and types of intervention or

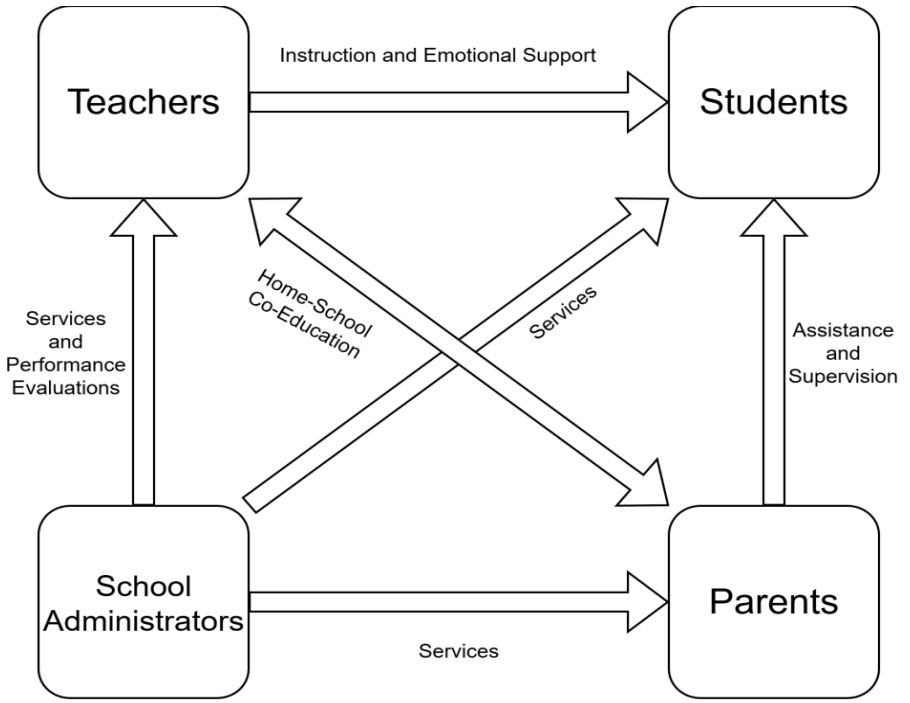


**Figure 2. Relationships between DEHM Actors.**

improvement strategy (e.g., redoing questions with incorrect answers, practicing similar problems, or receiving personal tutoring). (v) Homework progress data are longitudinal data based on the student's homework performance across multiple assignments, representing the trajectory of their knowledge mastery, skill growth, and learning habit development, and can be used to calculate comparative metrics like class/grade ranking and the extent of progress.

# DEHM Actors

In a DEHM system, teachers, students, parents, and school administrators collaborate to enhance the overall outcomes of homework management. Teachers play a crucial role throughout the system. They lead the Homework Design and Assignment and Homework Feedback and Remedies steps by designing and releasing homework tasks, reviewing machine-generated feedback on student homework performance, adjusting subsequent teaching, and selecting improvement recommendations. Students are the primary beneficiaries of the DEHM system. They complete homework in the digital environment, view individualized homework-analysis reports, actively address gaps using remedy resources, and evaluate and adjust their learning leverag-

ing homework completion and results data. Parents of basic education students assume a supervisory role. They need to ensure their children complete homework in time and use electronic devices for legitimate purposes. Also, they provide teachers with feedback on student in-home behavior, which is beyond the capabilities of digital tools (e.g., moods, authenticity of reported time spent, etc.), as supplementary contextual information. School administrators are responsible for platform operation and maintenance, data security, access permission allocation, and usage training. They reduce technical barriers for other DEHM actors through providing technical support and enforcing rules. Additionally, they are accountable for evaluating teachers' performance, based on their DEHM platform usage rates and adoption of interventions, and students' outcomes based on the progress they make.

**Figure 2** illustrates the interconnected relationships between the four groups of DEHM actors as collaborators:

- Teachers provide instruction and emotional support to students.
- Teachers and parents collaborate through home-school co-education, sharing students' performance in homework completion and negotiating the intensity of remedies.
- Parents offer assistance and supervision to their children, helping them apply system-generated recommendations to their homework improvement actions.
- School administrators provide ongoing services, including technical support, data backup, privacy audits, and more, to all other actors, and use performance indicators to prompt teachers to make the most of DEHM's features to bolster teaching outcomes.

# Discussion

The DEHM framework in question has significant implications for digital education. First, DEHM ensures the traceability and accountability of homework quality. With the assistance of digital technologies, quantifiable data can be recorded in various processes, such as homework design, completion, marking, and feedback, providing reliable evidence for homework quality evaluation. This is conducive to the realization of the goal of reducing the burden of homework while boosting student outcomes of the Double Reduction policy, facilitating shifting the focus from mere reduction of the quantity of homework to enhancement of its quality. Second, the framework is effective in easing teachers' workloads and supporting their professional growth. The homework analysis reports and intervention strategies provided by the digital platforms are particularly helpful to novice teachers in that these devices accelerate their mastery of homework assignment and assessment techniques, increasing their capacities to make scientific instructional decisions. Third, the framework offers technical support for students' self-

directed learning and self-regulated homework completion. Personalized feedback generated by the system can aid students in identifying their gaps and optimizing learning strategies accordingly, as well as enhancing awareness of self-reflection and developing good study habits. Fourth, the framework underscores information sharing to support home-school co-education. Through the data-sharing mechanism, parents can keep track of their children' homework completion and learning states in real time, and schools can conduct data-based communication with parents. Also, the sharing of homework data can effectively alleviate parental educational anxiety and is helpful in cultivating rational attitudes towards homework in parents, which can largely prevent the incidence of "academic burdens being reduced in in-school education but increased in home education" (Yang, 2021). Lastly, the framework also proposes a new pathway for scientific educational governance. The aggregation of homework data can provide educational authorities with quantifiable indicators of teaching quality, supporting evidence-based decision-making and resource allocation, and enhancing the level of precision educational management.

Despite the DEHM framework being theoretically practicable and forward-looking, its application in actual educational settings may face a variety of constraints. First off, its implementation relies on well-developed digital infrastructure and a high-quality data collection system; nevertheless, there are currently technological obstacles in relevant areas. For example, students' capacity to handle digital tools like smart pen and paper remain inadequate, leading to issues such as writing delays and untimely feedback (Jiang et al., 2024), which compromises the authenticity and completeness of homework behavior data. Also, there are practical difficulties in building the digital homework resource repository required by DEHM. This is evidenced by Liu and Shen's (2024) findings that the digitization of homework materials was an onerous effort, with complications in the annotation of resource attributes, and that a high-quality, standardized homework resource repository was inaccessible in the near term. Additionally, existing homework management systems and learning analytics tools are provided by various developers, without uniform standards for data interface. The lack of regional or national standards and regulations can easily induce new "information silos," hindering the full utilization of data.

Furthermore, the framework may face challenges in the scope of homework data. Currently collectible homework data mostly demonstrate students' academic results, such as answer accuracy, knowledge mastery, and time spent on homework, but can hardly represent non-cognitive development of students. Zeng and Xu (2022) noted that student outcomes were also significantly affected by non-cognitive factors, such as attitudes to learning, emotions, and moral character, which current digital systems are insufficiently advanced to recognize and quantify. Teachers' over-reliance

on the biased data may lead to homogeneous feedback and one-sided student evaluations, potentially undermining the humanistic concerns of education.

In addition, outdated notions of technology use in education may be an impediment to DEHM's implementation. Understandings and acceptance of digital management of homework vary greatly among teachers, students, parents, and school administrators. A portion of teachers have worries about student technological dependency, some parents and students have concerns about data privacy, and some school administrators have low awareness of digital governance of education. Currently, training for the digital transformation of homework management within the education system remains insufficient; an improvement in information and data literacy on the part of teachers and other stakeholders are warranted to support effective application of this framework.

Hence, the practical translation of this theoretical framework requires ongoing explorations in areas such as technological standardization, improvement of data systems, and educational notion updating. The widespread adoption of DEHM is contingent on further technological breakthroughs and changes in popular attitudes towards educational technology, which will unleash DEHM's power to promote high-quality development of basic education.

# Conclusion

Homework management plays a crucial role in ensuring the quality of school education. It is also key to the successful implementation of the Double Reduction policy in China. To address the practical issues with homework management in Chinese basic education, this study proposes the DEHM framework in a bid to provide a structured, practicable blueprint for high-quality development of homework management. The core value of DEHM lies in its ability to make homework behaviors visible and traceable, facilitate data-driven decision-making, and support teacher professional growth and student personalized development. Also, DEHM helps break down barriers to communication between schools and parents to build an educational community based on mutual understanding and support. Yet, it is evident that widespread successful application of this theoretical framework depends on further improvement of the level of digital education and increased acceptance of educational technology in relevant stakeholders.

Future homework management research and practice need to focus on three areas: first, standardizing educational data to promote data interoperability at the regional level; second, improving the mechanics of homework data collection and analysis processes to increase their capacity to identify students' non-cognitive skills; and third, enhancing digital literacy training for teachers, students, parents, and other stakeholders to facilitate the introduction of advanced educational notions and management models.

Overall, DEHM is not merely a technological replacement of traditional homework management systems but a profound innovation in educational governance. Its overarching goal is to realize scientific and precise homework management leveraging digital technology, truly actualizing the Double Reduction policy's vision of "reducing academic burdens while enhancing student outcomes."

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