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Review

International Empirical Research on Small-Class Instruction: Deconstructing Its Effects, Examining Its Risks, and Exploring Local Approaches

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Abstract: Against the backdrop of new demographic trends, while China's reform toward small-class instruction is advancing in an orderly manner, it still faces multiple structural challenges, and its actual effects and potential risks urgently require systematic examination. Based on core literature from the Web of Science, this study employs a systematic literature review to deconstruct the chain of effects of small-class instruction: the progressive chain linking classroom teaching, student development, and social benefits. At the same time, the study found that small-class teaching can exacerbate existing problems and give rise to new risks, manifested in issues such as highlighting disparities in teaching proficiency among teachers, potentially undermining the diversity of classroom ecosystems, increasing the risk of misallocation of educational resources, and triggering hidden inequities in the educational process. In response, the study proposes the need to construct a class-size determination model that integrates multiple factors to ensure flexible implementation of class sizes; establishing a new paradigm of human-AI collaborative teaching to drive the transition toward personalized learning in small classes; forming a "teacher–platform–collaborative model" of coupled development to ensure the development of teachers' competencies in small-class instruction; and constructing a suitable, diverse, and comprehensive evaluation system to implement a return to the fundamental philosophy of education.

Keywords: small-class instruction; class size reduction; small-class instruction reform; systematic literature review

1. Introduction

Small-class instruction, as a key reform measure aimed at improving educational quality by reducing class sizes, has attracted sustained attention and been the subject of practical exploration worldwide. However, ever since the concept first emerged, small-class instruction has faced a significant tension between ideal expectations and practical feasibility. In the past, constrained by a massive school-age population and limited fiscal capacity, China was unable to support the large-scale implementation of small-class teaching, causing the issue to remain stuck in the pilot and discussion phases for a long time [1]. Today, as China enters a stage of social development characterized by a gradually shrinking birth rate and increasingly ample fiscal resources, the conditions for carrying out large-scale small-class teaching reforms have gradually been met. As early as 1997, cities such as Shanghai and Nanjing launched pilot programs for small-class teaching, accumulating practical experience and insights into reform [2]. In 2024, China issued the "Outline of the Plan for Building a Strong Educational Nation (2024–2035)," which explicitly called for "orderly advancement of small-class teaching reform" [3], with the aim of breaking the path dependence that has long characterized China's education system under large-class instruction. To address the resulting structural challenges—such as resource allocation, institutional design, and pedagogical transformation [4]—it is

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essential to first gain a precise understanding of the mechanisms and potential risks associated with small-class teaching in order to chart a scientifically sound reform path.

Since the 1980s, Western countries such as the United States and the United Kingdom have taken the lead in exploring small-class teaching reforms. This educational reform has spanned nearly half a century, accumulating substantial research experience at both the theoretical and practical levels. However, during this exploratory process, understanding of the effects of small-class teaching has been challenged by a constant stream of new empirical evidence and conclusions, sparking numerous debates [5]. Furthermore, there is a scarcity of domestic research in China that explores the localization of small-class teaching based on international research experience. In response, this study adheres to the principles of scientific objectivity, actively draws upon international research experience in small-class teaching, and employs a systematic literature review method to deconstruct and identify the mechanisms of action and potential risks associated with small-class teaching, thereby exploring feasible pathways for implementing small-class teaching reforms in China.

2. Research Design

2.1. Literature Search

This study employs the systematic literature review methodology. Through research steps such as literature screening, coding, and content analysis, it aims to explore the mechanisms of action and potential risks associated with small-class instruction. To ensure the scientific rigor of the study, the Web of Science Core Collection was used as the primary source of literature. Keywords used included “small class,” “class size,” “small class teaching,” “class size education,” and “class size reduction,” with the research field categorized as “Education and Educational Research.” Furthermore, since international research on small-class teaching is not limited to recent years and the existing body of research is relatively small, the search time frame was set from January 1, 2000, to August 20, 2025.

2.2. Literature Screening Process and Data Organization

The study screened the literature based on the following criteria: 1 Research Area: The impact of small-class instruction and class size (studies related to smaller class sizes) on teaching; 2 Educational Level: Limited to preschool, elementary, and secondary school (basic education); 3 Studies must have a clear research question and hypothesis; 4 Small class size is defined as 30 students or fewer; 5 Study Type: Empirical studies (including qualitative and quantitative methods) to ensure the scientific validity and reliability of the research conclusions; 6 Exclusion of literature for which the full text was unavailable. The specific screening process is shown in Figure 1; 7 Research Quality: Studies must be indexed in the Social Sciences Citation Index (SSCI) or the Science Citation Index Expanded (SCIE). This study followed a rigorous systematic screening process. First, the retrieved literature was screened and duplicates were removed based on titles, abstracts, and journals, initially identifying 85 articles that met the criteria for the research field and educational level. Subsequently, the full texts of these 85 articles were obtained and carefully reviewed; a secondary screening was conducted based on predetermined content criteria, ultimately retaining 56 highly relevant articles for analysis.

2.3. Coding Examples and Results

This study utilized NVivo 15 to systematically code the literature. To ensure objectivity, the coding was strictly limited to research results explicitly reported in the literature. Under this principle, two researchers first independently coded the preliminarily organized literature data tables. Subsequently, the two sets of coding results were compared, and the calculated Kappa coefficient was 0.86, meeting the consistency requirements. For any inconsistencies in the coding, the researchers reached consensus by reviewing the original sources and engaging in collective discussion, ultimately establishing a unified coding scheme. Examples of the coding are shown in Table 1.

Table 1. Coding Examples (Excerpt)

Primary Dimension	Secondary Dimension	Coding Example	Journal	Author
Classroom Instruction	Classroom Management	Teachers in small classes spend less time on management and discipline issues and more time on productive teaching and learning activities.	School Effectiveness And School Improvement	Spyros Konstantopoulos
	Student Interest	Taken together, these two main findings suggest that students receive more individual attention in smaller classes.	Learning And Instruction	Peter Blatchford
	Emotional Support	Reducing class sizes is likely to help alleviate psychological anxiety among second-language learners.	Educational Research	Gary James Harfitt
	Teacher-Student Interaction	Class size also affects the overall volume of instruction. In small-class settings, there is more teacher-student interaction that directly addresses substantive subject matter, as well as the exchange of concepts, facts, or ideas.	School Effectiveness And School Improvement	Peter Blatchford
	Group Activities	Across all three grade levels, the younger classes have an average of slightly more than three groups, while the older classes have close to six groups. The size of the groups within a class decreases as the class size increases.	International Journal of Educational Research	Peter Blatchford
	Teaching Methods	Teachers did not select specific teaching methods based on class size, as the relative frequency of different teaching practices was similar across small, standard, and large classes.	Educational Evaluation and Policy Analysis	Carolina Milesi
	Student Performance	The smaller the class size, the stronger the children's social skills tend to be, the fewer behavioral problems they exhibit, and the closer the relationships among classmates.	The Journal of Economic Education	J J Arias
	Teaching Effectiveness	These results suggest that teachers' instructional practices may vary more in small-class settings than in regular classrooms.	School Effectiveness And School Improvement	Spyros Konstantopoulos
Student Development	Positive Impact	For every student removed from a class, the class's average score increases by 0.5 points. If 5 students are removed from each class, the average score will increase by approximately one-quarter of the standard deviation.	Learning and Instruction	Christian Brühwiler
	Irrelevant Impact	In contrast, there were no significant differences among the groups in terms of progress in vocabulary or math.	Early Childhood Research Quarterly	Jessica Francis

	Negative Effects	In Hong Kong, China, most math classes have between 39 and 42 students, and these classes perform better than smaller classes with 15 to 38 students.	Educational Evaluation And Policy Analysis	Suet-ling Pong
	Differences in Function	Students at the lower end of the grade distribution benefit more from CSR than those with lower grades. It appears that students in the lower-middle portion of the grade distribution do not benefit from small-class instruction.	School Effectiveness And School Improvement	Wei Li
	Functional Relationships	Estimation results from the multilevel growth curve model indicate that, in first grade, while a reduction in class size had a significant positive effect during that period, it did not result in any lasting effects. By the end of second grade, this effect had disappeared.	International Journal Of Educational Research	P Bressoux
Social Development	Economic Resources	From a societal perspective, reducing class sizes can lead to cost savings.	American Journal Of Public Health	Peter Muennig
	Social Integration	Smaller class sizes can help reduce racial and ethnic disparities in reading achievement and gender disparities in math achievement.	Educational Research	Barbara Nye

3. Deconstructing the Mechanisms of Small-Class Instruction

3.1. Classroom Instruction as the Foundation: Direct Positive Impacts

As the core process of teacher-student interaction and cognitive development, classroom instruction serves as the foundation for the effectiveness of small-class teaching and the achievement of its objectives; it is also the focal point of research on small-class teaching. Research has found that small-class instruction has multiple effects on classroom teaching. First, it reduces the difficulty of classroom management. In large classes, teachers must spend more time addressing individual student issues, resulting in reduced actual instructional time. Reducing class size, however, minimizes the time teachers spend on classroom management or addressing disruptive behavior, thereby effectively lowering the difficulty of classroom management [6,7]. Second, it enhances teachers' instructional effectiveness. In small-class settings, as class sizes decrease, teachers take a more proactive role in guiding the learning process and assess students' classroom performance with greater precision [8]. At the same time, they exert a greater influence on the learning process, even though total instructional time decreases [9], thereby demonstrating an improvement in teachers' instructional effectiveness [10,11]. Third, it promotes interaction between teachers and students. Smaller class sizes significantly increase the frequency of teacher-student interaction; in terms of content, there is a reduction in procedural dialogue and an increase in unscripted dialogue [10,12]. Fourth, it increases teachers' attention to students. Compared to large-class instruction, teachers in small classes have more time to diagnose and understand individual student needs, making it more likely that each student will be the focus of the teacher's attention [13,14]. Fifth, it optimizes student academic performance. Students in small-class settings demonstrate increased concentration [7], reduced disruptive behavior [15], and a significantly lower frequency of task-disengagement behaviors. Consequently, students in small classes are more likely to complete assignments [13] and make faster progress in their studies [16]. Sixth, it enhances emotional support for students [17]. Due to the appropriate reduction in class size, teachers are able to provide students with more comprehensive emotional support in small-class settings [16], which helps alleviate

student anxiety [18] and ultimately leads to a healthier overall psychological state among students [19]. Seventh, reducing the size of collaborative learning groups improves the learning experience. A reduction in class size simultaneously reduces the size and number of collaborative learning groups, thereby improving students' actual learning experience [20]. It is evident that the impact of small-class instruction on the classroom teaching process is direct, multifaceted, and predominantly positive.

3.2. Student Development as an Outcome: An Indirect Positive Association

Promoting student development is a key objective of small-class instruction, and academic performance is typically used as a key indicator of students' developmental progress. These academic results essentially reflect the impact of small-class instruction on classroom teaching. Existing research has found a correlation between small-class instruction and student development, with a sustained yet gradually diminishing positive effect between the two [21]. Furthermore, some studies indicate that the positive effects of small-class instruction are most pronounced in the initial school year, while others emphasize that these effects are cumulative over the long term and are not limited to the initial year [21,22]. However, in practice, the causal relationship between reduced class size and student development remains uncertain. Research explains this uncertainty from the following three perspectives: First, when examining different data sources, some studies using data from the ECLS-K and Tennessee found that smaller class sizes have a positive impact on academic achievement [21,23]. In contrast, related studies using data from Florida and TIMSS found no association—or even a negative association—between smaller class sizes and academic achievement [24,25]. Second, when examining different academic subjects, the impact of smaller class sizes on performance in reading, literacy, mathematics, and science has not yielded consistent results. For example, Ting Shen A et al. found that improvements in reading and mathematics scores were positively correlated with reduced class sizes, but the opposite trend was observed for science scores [9]. In contrast, a study in Spain indicated that smaller class sizes did not affect students' performance in mathematics or language arts [26]. Third, when examining different educational stages, experiments on small-class instruction have primarily covered preschool, elementary, and secondary school levels. However, research conclusions across these stages have yielded mixed results—ranging from "positive" to "no effect"—and a consensus has yet to be reached. Findings by Brouville et al. suggest that small-class instruction has a significant impact on students in elementary and preschool settings [8]. However, analyses based on TIMSS 2011 data, as well as another study focusing on the preschool stage, found no significant positive impact of reduced class sizes on elementary or preschool students [22,27]. Although some studies suggest that such effects require accumulation to become significant, the relationship between class size and student learning development remains uncertain. This uncertainty suggests that class size alone cannot directly determine student development but rather exerts an indirect effect through improvements in classroom instruction (such as learning activities and teacher management) [7,28]. Therefore, the relationship between small-class instruction and student development should be viewed as an indirect positive association mediated by improvements in classroom instruction—that is, small-class instruction promotes student development by first fostering improvements in classroom instruction.

3.3. Extending the Impact to Social Development: Potential Positive Linkages

The value of small-class instruction extends beyond mere educational benefits; its more far-reaching significance lies in its impact on society. Research has found that the reform toward small-class instruction primarily yields two types of social benefits. First, it reduces fiscal expenditures. Although, in the short term, the reform toward smaller class sizes requires greater government financial investment to ensure its effective implementation, from a long-term economic perspective, the high-quality education provided by smaller class sizes can increase high school graduation rates; the positive effects on students' physical and mental health can reduce national healthcare subsidies; and the high-quality education offered can lower crime rates, thereby reducing

expenditures on policing, the judicial system, and other costs associated with crime—ultimately generating positive socioeconomic returns [29]. Second, it promotes integration among different groups. Appropriately reducing class sizes can effectively facilitate interaction among different ethnic groups and special populations, help narrow existing academic disparities among these groups, and break down barriers stemming from differing cultural backgrounds, thereby promoting social integration among them [19,30,31]. It is worth noting that the social benefits of small-class instruction are not absolute [28]; in fact, they are based on the positive impact of small-class instruction on classroom learning and student development, and represent an extension of these effects to the societal level. Therefore, the relationship between small-class instruction and social development should essentially be viewed as a potential positive link that can potentially drive social progress.

4. An Examination of the Risks of Small-Class Instruction

4.1. The "Amplification" of Teachers' Instructional Effects Highlights Disparities in Teaching Proficiency among Teachers

Although smaller class sizes offer teachers greater opportunities for personalized instruction, these opportunities do not necessarily translate into actual teaching practices [9]. In small-class instruction, reduced class sizes give teachers greater control over the teaching process, resulting in more pronounced instructional effects [29]. However, teachers do not typically proactively adjust their teaching methods simply because class sizes have decreased [32,33]. This also implies that in small-class settings, objective changes in classroom instruction are more likely to occur passively as a result of the reduced class size. Meanwhile, the optimization of deeper instructional structures—such as the quality of teacher-student interaction—relies more heavily on teachers' intrinsic reflection and restructuring, and cannot be directly brought about by an external variable like class size [12,30]. Consequently, the extent to which reduced class size improves teaching outcomes depends more on teachers' own professional competence, while small-class instruction acts as a "magnifying glass" that amplifies teachers' instructional effects. However, in reality, there are inherent and objective differences among teachers in terms of professional ideals and teaching abilities; these differences are further magnified through small-class teaching practices, thereby more clearly highlighting the disparities in teaching proficiency among teachers.

4.2. The Pursuit of "Excessively Small" Class Sizes May Potentially Undermine the Diversity of the Classroom Environment

Most studies suggest that smaller class sizes are beneficial for classroom instruction and student development. A reduction in class size leads to changes such as increased teacher-led instruction and a decrease in students' off-task behavior. Although these changes can help students better complete learning tasks and achieve higher grades, they also, to some extent, limit students' social interaction and cognitive development. When class sizes are too small, there is actually a slight increase in children's aggressive, antisocial, and exclusionary behaviors, which in turn leads to social difficulties among learners [7]. At the same time, when class sizes are too small, the size of the learning community simultaneously shrinks, making it difficult for learners to create a space for the exchange of diverse perspectives. Students are prone to falling into a monolithic, homogeneous communication pattern [28], which affects the depth and breadth of collaborative communication among learners and, in turn, limits the development of higher-order thinking skills such as critical thinking [31]. This also directly manifests in a decline in the development of students' reading abilities [22]. It is evident that blindly pursuing excessively small class sizes may be counterproductive. Once class sizes fall below the optimal threshold, the resulting erosion of classroom interaction diversity may offset the benefits gained in specific areas.

4.3. Continuing to Use an "Outdated" Traditional Assessment System Increases the Risk of Misallocation of Educational Resources

Research has found that reductions in class size have not been accompanied by corresponding adjustments to the assessment system. Whether in the control group or the experimental group, class composition and the criteria for class placement still rely primarily on random assignment or score-based placement; however, both of these methods have negative implications for teaching [11,34]. Furthermore, research in the United Kingdom on class size reduction has revealed problems arising from class placement and student selection under traditional evaluation systems. As the number of classes increased, schools continued to allocate spots evenly across classes. Consequently, some students who were originally eligible lost their opportunities due to competition within their own classes, with their spots being taken by ineligible students from other classes [35]. This implies that if class placement and student selection continue to be conducted according to a rigid evaluation system in the context of smaller class sizes, individual differences among students are magnified. Evaluation standards originally based on large-sample averages struggle to adapt to the dynamic characteristics of small-class instruction, leading to situations where reforms toward smaller class sizes may affect the outcomes of selection processes [36]. Throughout their long educational careers, students face not only the selection process for free school meals but also various other selection processes, such as scholarships and class placement. If traditional evaluation systems continue to be applied in an outdated manner, the potential for errors increases, thereby heightening the risk of misallocation of educational resources.

4.4. Neglecting Differences in Group Performance May Lead to Hidden Inequities in the Educational Process

Small-class instruction yields different effects for groups of different genders and academic performance levels. First, regarding gender groups, although small-class instruction may help narrow the gender gap in academic achievement [23], practice shows that female students benefit more significantly and sustainably than male students in reading, literacy, and mathematics. This disparity in effects has also exacerbated developmental differences between male and female groups [31,37]. Second, regarding student groups with different academic achievement levels (high-achieving, moderate-achieving, and low-achieving students), relevant studies have yielded differing findings on which groups benefit most from small-class instruction. Li Wei's analysis of TIMSS-licensed data found that small-class instruction had a more significant effect on high-achieving students than on low-achieving students [38], however, Brachford's findings suggest that small-class instruction has a more pronounced effect on students with moderate and low academic achievement [39]. Although the specific manifestations of these differences in impact are not yet clear, it is evident that small-class instruction does have varying effects on groups at different academic achievement levels. Given the two distinct patterns of impact observed for small-class instruction across different gender groups and academic performance levels, it is evident that such differences exist among various student groups. If these disparities are not effectively addressed through classroom interventions, they may become a catalyst for imbalances in educational provision and lead to inequities in the educational process.

5. Conclusion

5.1. Establish a Model of Coupled Development among "Teachers, Platforms, and Collaborative Models" to Ensure the Development of Teachers' Competence in Small-Class Instruction

An analysis of the mechanisms underlying small-class teaching reveals that whether its value can extend to student development and societal progress hinges on whether the intrinsic values inherent in small-class teaching—such as humanistic care and educational equity—are genuinely implemented during the classroom teaching process. The realization of these values, in turn, depends on whether teachers possess the professional competence to effectively design and implement small-class instruction; this effectively imposes new requirements on teachers' competence in small-class teaching. In response to these new developmental needs, this study proposes that teachers' professional

competence, service platforms, and collaborative models should be integrated as a trinity within a continuous, ascending "practice–reflection–optimization" pathway, forming a "teacher–platform–collaborative model" coupled development pattern to ensure the development of the teaching staff's competence in small-class instruction.

First, steadily advance the effective enhancement of teachers' professional competence. Against the backdrop of a continuously shrinking school-age population and a steadily expanding teaching workforce, it is necessary to establish a scientific and reasonable mechanism for workforce adjustment (such as retirement and job reassignment). This mechanism should strike a balance between ensuring job security and stimulating professional ambition, thereby safeguarding and fostering teachers' intrinsic motivation for self-development. On this foundation, we must further consolidate and develop the professional competencies required for teachers to conduct small-class instruction, including values, key competencies, essential character traits, and core knowledge. In the digital and intelligent era, acquiring conceptual knowledge is no longer a challenge; rather, the effective application of this knowledge in teaching practice has become more critical. To this end, teachers' professional development must be deeply embedded in the routine practices of real classrooms. Through continuous teaching practice and in-depth reflection, we can promote the creative transformation of teachers' professional competence, ensuring that the essence of small-class teaching is fully realized in instructional design and practice. Second, we must build an integrated service platform that accommodates diverse patterns of teacher development. Functionally, the platform must not only promote the deep integration of existing teacher development modules—such as professional development and instruction—but also provide new technical support services tailored to the needs of small-class teaching. For example, within the professional development module, it should offer teachers precise diagnostic and planning services to assess their competence in small-class teaching and design customized development pathways. In terms of resources, the platform needs to supplement its offerings with micro-competency courses focused on the core competencies required for small-class teaching, effectively providing the foundational course resources teachers need. Additionally, it must offer a blended virtual-physical environment for small-class teaching practice, providing teachers with practical simulation scenarios covering various small-class classroom settings—including problem-solving and interdisciplinary contexts—to enhance their ability to design and implement small-class teaching. In terms of instructional functions, the platform must integrate or provide instructional support modules that cover the design of small-class courses or classrooms and the entire "teaching–learning–assessment" process in small-class teaching practice, helping teachers demonstrate strong competence in small-class teaching through practical application. Finally, a "teacher–platform" collaborative development model must be established. On the one hand, within the teacher development ecosystem, the construction and iteration of a mature, efficient collaborative model between teachers and the platform must be continuously driven through practice, helping teachers demonstrate strong competence in small-class teaching and translate the ideal principles of small-class teaching into practice. On the other hand, "teacher–platform" collaboration is not merely a process of facilitating teachers' demonstration of strong small-class teaching competence; it also requires establishing a subject-centered development mechanism of "targeted professional development—teaching practice—evidence-based feedback" within human-computer collaboration practices. This mechanism drives the mutual development of teachers and the platform, thereby indirectly promoting the iterative development of the "teacher–platform" collaborative model.

5.2. Developing a Multi-Factor Correlated Model for Determining Class Size to Ensure Flexible Implementation

Establishing class size standards is a key starting point for the small-class teaching reform; at the same time, the scientific and reasonable setting and implementation of class

size standards are essential foundations for ensuring the reform's effectiveness. The establishment of class size standards for small-class teaching requires, under the guidance of national policies, a careful assessment of the specific roles played by the three core influencing factors—society, the classroom, and technology—as well as the intrinsic relationships among them, thereby ensuring that the setting and implementation of class size standards align with local realities. Accordingly, this study preliminarily proposes a model for determining class size standards, which provides decision-making support and a practical framework for various regions to establish adaptive class sizes, as shown in Figure 2.

First, at the societal level, the setting of class sizes must be fully grounded in current social realities. Based on a comprehensive consideration of macro-level factors—such as strategic goals, enrollment numbers, the teaching workforce, and the allocation of educational resources—the range for establishing class size standards should be defined in a manner tailored to the specific circumstances of each region. Second, at the classroom level, class size must be determined by comprehensively considering factors such as the spatial layout of the classroom environment, the threshold for personalized learning supported by teachers' professional competence, and the optimal number of students for specific teaching models, thereby achieving dynamic adaptation of class sizes to classroom teaching practices. Third, at the technological level, the actual levels of computing power, network coverage, and educational digitization in each region not only directly impact the scale and quality of small-class instruction supported by technology but also determine whether such instruction can operate stably and sustainably. Therefore, comprehensive decision-making must also be based on the current status and future trends of technology application. At the same time, there are interdependent relationships among society, technology, and the classroom: technological factors such as the internet can promote the equitable allocation of educational resources and break down the temporal and spatial boundaries of classroom instruction, while social factors—including culture, policy, and economics—directly influence educational objectives and determine whether technology can be applied in classroom instruction. As a crucial component of education, the classroom influences whether education can effectively promote human development and technological progress. Therefore, it is necessary to examine and apply class size determination models from a dynamic, interrelated, and comprehensive perspective.

Furthermore, given that China's school-age population trends exhibit a complex pattern—with an overall decline but fluctuating numbers across different educational levels—in order to precisely adapt to changes in student numbers across different educational stages and trends in the overall enrolled population, it is necessary to establish a "digital foundation" based on a cluster of technologies such as big data, cloud computing, and blockchain, while simultaneously building an "intelligent platform" supported by artificial intelligence and visualization technologies. This will result in a large-scale, multi-tiered digital and intelligent monitoring system capable of supporting all regions and the nation as a whole. By conducting real-time, dynamic, and precise monitoring of multidimensional key factors related to class size determination models—such as the number and spatial distribution of teachers and students across educational levels, as well as the level of educational resource allocation and the degree of digital and intelligent transformation in various regions—the system provides evidence-based decision support for regions and schools in setting and dynamically adjusting class size standards during the reform toward smaller class sizes. At the same time, given the significant disparities among China's provinces and cities in terms of educational resource allocation and student distribution, rural and remote areas generally face a "double shortage" of teachers and students, while some urban schools often operate under chronic high workload due to a high concentration of students. Given such complex and diverse real-world circumstances, it is necessary—within the framework of national guidelines—to appropriately delegate authority for setting class size standards, allowing local authorities to flexibly establish and implement these standards based on regional realities,

using key indicators reflected by regional digital monitoring systems and the class size standard determination model.

5.3. Establishing an Appropriate Evaluation System for Small-Class Teaching to Implement a Return to the Essence of Education

The risk of resource misallocation inherent in small-class teaching reform may appear, on the surface, as operational challenges in class placement and student selection; however, its root cause actually lies in the core issue of educational evaluation. Therefore, an evaluation system tailored to small-class teaching reform must be established to ensure the achievement of the reform's objectives. Currently, discussions on educational evaluation emphasize the need to "resolutely overcome deep-rooted problems such as an excessive focus on test scores," yet various issues persist in practice. Therefore, an evaluation system for small-class teaching in the new era must further advance evaluation concepts, approaches, and feedback mechanisms to a higher level, thereby enabling small-class teaching practices to truly return to the essence of "nurturing students."

First, a conceptual breakthrough is needed by focusing on the evaluation of students' diverse individual development. In terms of values, the evaluation of small-class teaching should de-emphasize excessive focus on outcomes such as scores and college admissions, and instead prioritize effort, reflection, and progress during the learning process, making the promotion of individual student growth and development the core objective. Second, regarding measurement philosophy, we need to promote the integration and application of diverse measurement theories—such as cognitive diagnosis, network psychology, and situational measurement—to shift evaluation from overt indicators (such as the school level at which learners are enrolled, academic performance, or homework completion rates) toward observing intrinsic cognitive and non-cognitive abilities, thereby providing a more comprehensive, nuanced, and precise understanding of each individual learner. Finally, regarding assessment design, we must further respect the uniqueness of each learner. Assessments should take into account differences in cultural context, developmental potential, and developmental pathways, gradually transitioning from standardized assessments to individually tailored ones, thereby creating personalized assessment plans for each student.

Second, we must drive innovative reforms in the assessment pathways for small-class instruction. To meet the systemic upgrade requirements that small-class instruction places on the assessment system, assessments must undergo systematic transformations across multiple dimensions, including content, participants, mechanisms, and contexts. First, regarding assessment content, we must move from limited standardized measurements toward rich, multifaceted diagnostics that comprehensively reflect learners' holistic development through diverse factors such as cultural background, academic foundation, and competency structure. Second, regarding evaluation agents, we must further break free from the limitations of a single dominant agent in traditional evaluation. We should promote the deep integration and complementary strengths of "human-machine" multi-agent systems, balancing technological rationality with humanistic values to form a model where "human intelligence" and "machine intelligence" synergistically empower multi-agent collaborative evaluation. Third, regarding assessment mechanisms, we need to establish a diverse, process-oriented system that combines formative, comprehensive, and value-added assessments to ensure the accuracy, comprehensiveness, and scientific rigor of the results derived from this multifaceted evaluation. Finally, regarding assessment contexts, we must move beyond the confines of the classroom and extend assessment to other settings—such as the campus and society—to build a panoramic, immersive network for observing student development.

Third, an individual-centered assessment feedback network must be established. Feedback from small-class teaching assessments must not only positively influence the individual learner but also feed back into other elements that radiate horizontally and vertically from the learner, thereby ensuring that such assessments consistently serve the development of the "individual." From a learner-centered vertical perspective,

assessment must effectively inform key influencing factors along the learner's developmental trajectory—such as admission, class placement, learning communities, classroom learning, and incentive-based selection—thereby playing a dynamic role in guiding and optimizing the process. From the perspective of the horizontal network related to learner development, evaluation must dynamically influence factors closely tied to the learner's growth process—such as family members, subject teachers, and administrators—to guide the optimization, development, or transformation of these elements. At the same time, it is necessary to comprehensively clarify the interrelationships among these "feedback elements," thereby transcending the isolated, linear evaluation feedback mechanisms of the past and constructing a learner-centered, vertically and horizontally integrated, dynamically interconnected evaluation feedback network.

5.4. Establishing a New Learner-Centered Paradigm of Human-AI Collaborative Teaching to Promote the Transition to Personalized Learning in Small Classes

While the reform toward small-class instruction presents opportunities for realizing personalized learning, it also carries the risk of having disparate impacts on different groups of learners. If we continue to rely on existing standardized models of educational delivery, it will be difficult to effectively address educational disparities, let alone achieve truly high-quality education. Achieving educational equity and quality hinges on breaking away from a single, one-size-fits-all model of educational provision, which places higher demands on personalized learning. Although artificial intelligence can provide learners with efficient, personalized support through features such as content customization, precise assessment, and learning planning, the application of the technology itself does not equate to solving the fundamental issues of deepening and implementing personalized learning. To this end, we must move beyond a mindset that views technology merely as a tool and, through the intelligent restructuring of teaching agents, promote the deep integration and complementary strengths of human intelligence and artificial intelligence in educational settings. This will enable the construction of a personalized teaching paradigm characterized by deep collaboration among the three key agents—teachers, students, and AI—thereby ensuring the effectiveness of small-class instruction.

First, we must rely on human-AI collaboration to determine the starting point of each learner's personalized learning journey. The assessment of a learner's starting point should not rely solely on quantifiable, superficial behavioral indicators such as attention rates, nor should it be limited to "outcomes" of learning—such as records of completed tasks or results from periodic assessments. Instead, it requires deep collaboration between teacher observations and technological insights to collect behavioral, cognitive, and affective data generated by students across all learning contexts—including tests, discussions, and experiments—throughout the entire learning process. Building on this foundation, human-AI collaboration enables in-depth data mining to thoroughly deconstruct and describe the entire process—including the cognitive structures, emotional changes, evolution of thinking, and social networks—underlying students' learning behaviors. This process constructs a multidimensional digital trajectory of the learner's entire learning journey and generates a personalized, dynamic profile, providing precise "targets" for the diagnosis and delivery of personalized instruction. Finally, personalized learning is delivered through human-AI collaboration. Personalized learning in small-class settings is not merely about providing learners with personalized learning resources or pathways; rather, it should focus on the learner's holistic development, designing and delivering tailored tasks and activities based on each learner's profile and growth trajectory, and adopting a human-AI "co-judgment" approach—combining human teachers' value judgments with data-driven, evidence-based support from intelligent systems—to precisely provide personalized cognitive and non-cognitive scaffolding interventions, thereby realizing personalized learning models tailored to each learner. Furthermore, it is necessary to further upgrade and promote

national-level digital and intelligent learning platforms to ensure the stable implementation of large-scale human-AI collaborative personalized learning. Whether it is the precise identification of a learner's starting point for personalized learning or the large-scale implementation of a personalized teaching paradigm based on the "teacher–student–machine" tripartite collaboration, both rely on advanced digital and intelligent learning platforms. To this end, it is necessary to integrate the efforts of multiple stakeholders—including government, industry, and educational institutions—to leverage emerging technologies such as new computing power, large-scale data warehousing, knowledge graphs, and artificial intelligence. Together, they should build a national-level personalized learning platform that provides practical environmental support for the large-scale implementation of personalized learning and ensures the long-term stability of such initiatives within small-class teaching settings.

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