REVIEW

The Construction and Application of Smart Classrooms in China: A Literature Review Based on 93 Studies

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***Abstract**: The smart classroom, as a product of advances in information technology, has garnered wide attention in academia in recent years. Using the method of literature review, this article delves into the construction and application of smart classrooms in China on the basis of 93 prior studies retrieved from the database of the China National Knowledge Infrastructure. Research results show that there is a lack of uniform evaluation criteria for the construction of smart classrooms despite the prominent advancements in their systems and facilities, and that in the dimension of applications, there has been growing interest in the alignment between smart classroom technologies and instructional needs but a dearth of research on teaching activity design for smart classroom instruction. Recommendations are also proposed based on the issues detected, with a view to contributing to the widespread deployment and ongoing optimization of smart classrooms.*

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Introduction

BASED ON the development of information technology (IT), including the internet, the Internet of Things, cloud computing, and big data, the smart classroom integrates physical and virtual spaces with the potential of creating interaction-reinforcing teaching and learning environments, providing individualized services for teachers and students, and realizing intelligent classroom management (Cheng, 2015). In a smart classroom, the combination of technologies and teaching elements, such as instructional strategies and models, can significantly enhance the teacher's instructional standards and students' learning experience (Dimitriadou & Lanitis, 2023).

In the past decade, smart classrooms have garnered increasing attention in the Chinese education community; educational institutions at all levels in China have made serious investment in smart classroom development and achieved considerable outcomes. As a result of the extensive application of artificial intelligence, big data, and other cutting-edge technologies, the digital transformation of education has become an inevitable trend in educational development and reform. In this context, it is foreseeable that the smart classroom will undergo greater development. How to leverage smart classrooms to meet the needs of digital education, improve the quality of education, promote educational equity, and nurture new-generation talent has become a vital research topic in academia (Li, 2024).

Recently, smart classroom research has proliferated both in China and abroad. Prior literature reviews have focused on the technological frameworks and features of the smart classroom rather than on the specific construction and application processes. For instance, Saini and Goel (2019) reviewed the use of various technologies and facilities in smart classrooms and identified in the literature four major facets of teaching and learning experience related to them: smart content, smart interaction, smart assessment, and smart physical environment. Cheng et al. (2024) introduced the conceptual framework of the smart classroom by describing its "smart" nature in five aspects: physical environment and spatial arrangement; content presentation and resource sharing; classroom interaction and feedback; perception and recognition of student learning engagement; and instructional evaluation and management. Despite many reviews like these on the technological characteristics of smart classrooms and the specific technologies involved, there are few surveys on their construction and application processes. In light of this, the present study focuses on presenting the current state of the construction and application of the smart classroom in China by reviewing the published research findings, pinpointing issues arising in the said processes, and proposing targeted suggestions with the intent of contributing to the on-

going enhancement of small classrooms in the digital transformation of Chinese education.

Research Design

Research Questions

(i) What is the status quo of the construction of smart classrooms in China?
(ii) What is the current state of the application of the smart classroom in China?
(iii) What are the application outcomes of smart classrooms?

Research Methodology and Process

This study is a literature review, sourcing literature from the China National Knowledge Infrastructure (CNKI), an authoritative database in China. With the assistance of CKNI's professional retrieval feature, the search was conducted using "smart classroom" and "smart teaching environment" as subject terms coupled with words like "construction," "design," "application," and "outcomes." To ensure the academic quality of the included literature and its relevance to the research questions, only articles written in Chinese and published by journals listed in "A Guide to the Core Journals of China" and the Chinese Social Science Citation Index were included in the screening process. To make the search as thorough as possible, there were no time limits set for the publications. By the deadline of June 5th, 2024, 245 articles had been obtained, among which 93 were identified as valid after removing duplicate and irrelevant studies. Rayyan, a systematic review tool, was adopted in the analysis of the 93 articles (Yu et al., 2022).

The Status Quo of Small Classroom Construction in China

Among the 93 articles included in the literature review, 42 address the design and construction of the smart classroom. We can draw from them information on the definition, system architecture, technologies, and evaluation of the smart classroom.

The Definition and Features of the Smart Classroom

In China, Huang et al. (2012) first defined the smart classroom as a new type of classroom with the capacity for intelligent perception of situations and management of environments, aiming to facilitate the presentation of teach-

ing materials, the acquisition of instructional resources, and in-class interaction. Nie et al. (2013) argued that the smart classroom is a fresh modality of classroom powered by emerging digital technologies, which conflates the physical classroom space with all relevant software and hardware equipment to provide intelligent application services for teaching activities. Based on the analysis of prior studies from China and other countries, Zhang et al. (2014) conceptualized the smart classroom as an intelligent learning setting built on universal computing technologies, the Internet of Things (IoT), cloud computing, and artificial intelligence and highlighted its essential components as intelligent physical and interpersonal spaces, learning instruments, and support for interactions between classroom actors. Amid the advancement of technology and education concepts, researchers have also upgraded their understanding of the smart classroom. Jin and Zhang (2019) described the smart classroom as a combination of "physical space, resource space, and community space" based on the technologies of IoT, big data analytics, and cloud computing, which contribute to the intelligent management of classroom facilities, intelligent enactment of teaching activities, complete recording of the instructional process, diversification of teaching patterns, and big data-supported instructional evaluation and diagnosis.

In addition, researchers have attempted to generalize the features of the smart classroom. To summarize the characteristics of the smart classroom, Huang et al. (2012) advanced the model of "SMART," which stands for "showing" (content presentation), "manageable" (learning environment management), "accessible" (education resource acquisition), "real-time interactive" (instant interaction), and "testing" (situational perception). Nie et al. (2013) proposed the "iSMART" model to incorporate "infrastructure," network "sensors," visual "management," "augmented" reality, real-time "recording," and ubiquitous "technology." Wu et al. (2020) argued that the smart classroom is distinguished by four features: integrating technologies, promoting adaptive learning, transforming classroom structure, and supporting personalized learning. According to Cheng (2015–2016), a smart classroom is expected to include as its basic components: multimedia-based teaching materials, resource sharing, diverse teaching modalities, personalized learning, collaborative activities, ubiquitous network connections, intelligent management, and a user-friendly environment. A portion of researchers claimed that the features of the smart classroom are determined by key factors like the digital environment, technology, and resources (Wang & Jiang, 2014; Zhang & Yang, 2018). On the basis of their theoretical and practical explorations, Liu et al. (2023) characterized the functions of the smart classroom as supporting smart teaching, learning, evaluation, management, and research in an educational setting and highlighted five essential elements in the structural model they proposed: physical and virtual envi-

ronments; content and resources; teaching and learning interaction; assessment and evaluation; and data governance.

The literature review demonstrates that technology, management, resource service, and support for teaching and learning are the key terms in popular concepts of the smart classroom. In this study, we define the smart classroom as a new paradigm of classroom that leverages plural information technologies to enhance teaching environments, equipment, and activities, facilitate the presentation and sharing of teaching resources, and support intelligent teaching and learning. As a state-of-the-art educational practice, the smart classroom is not only about the adoption of cutting-edge technologies but, more importantly, about the innovation of instructional models and evaluation methods.

The Smart Classroom Architecture and Technologies

There are primarily three approaches to the architecture of the smart classroom system in the existing literature. The first approach is to design the system based on the established smart class models or frameworks (He & Huang, 2018; Cui et al., 2020; Cheng, 2021; Zhou et al., 2022). For example, Liu et al. (2018) utilized Huang et al.'s (2012) "SMART" model as a framework of reference in formulating their smart classroom system; Hu and Wang (2018) consulted the smart class learning experience theory and focused on the three core dimensions of learning space, information technology, and instructional methods in the construction of a smart classroom system. The second approach is based on the hierarchical structure of the IoT from a technological standpoint (Chen & Xu, 2014; Yan & Gui, 2016; Zhou, 2018). Guo et al. (2013), for instance, developed a smart classroom system with four layers: hardware, virtual reality, education service, and external cloud service, drawing on the three-layer structure of the IoT marked by the perception, transmission, and application layers. The third approach is based on consideration of the needs of practical teaching manipulation (Shi, 2017; Zhang et al., 2018). Xu et al. (2023), for example, argued that a smart classroom system should include four levels: environmental convergence, teaching-learning interaction, quality management, and equipment operation and maintenance, to meet the requirements of actual teaching scenarios.

To realize its projected multi-dimensional functions, builders of the smart classroom have adopted a wide variety of technologies and devices. For example, IoT technology has been heavily used in smart classrooms to economize on resources and manpower and increase the efficiency of equipment management (Wang & He, 2021; Li et al., 2022). The use of IoT significantly improves the interconnectivity between various devices in the classroom, providing real-time feedback on their running status and automating the adjustment of the classroom environment. To make classroom man-

agement, including attendance taking, more intelligent and efficient, AI-assisted image recognition technology and electronic class badge technology have been widely adopted (Hu et al., 2018). These technologies can automate the recognition of student identities and the recording of their class attendance, simplifying management processes (An et al., 2017). Also, smart blackboards, virtual desktops, 4K recording technology, online class oversight mechanisms, and normalized recording systems have become integral technological components of the smart classroom, which have greatly facilitated the preparation, presentation, and sharing of teaching materials (Yu & Liu, 2017; Liu & Qian, 2019; Hu et al., 2019). Technologies and techniques like these have enabled instructors to present teaching content more intuitively to students while encouraging shared management of teaching resources between teachers and students. Furthermore, in order to promote teacher-student, inter-student, and human-machine interaction, devices and technologies, such as video conferencing software, interactive electronic whiteboards, real-time response systems, and sound reinforcement systems, have been widely employed (Wang et al., 2015; Xie et al., 2018; Cui et al., 2020), to enrich means of teacher-student interaction. In addition, to support instructional assessment, intelligent technologies, such as voiceprint recognition, electronic examination rooms, and learning analytics, have also been incorporated into the technical architecture of smart classrooms (Pan et al., 2018). With these technologies, the teacher can discern students' learning progression in real-time, adjust instruction strategies in a timely manner, and improve their teaching efficacy.

Meanwhile, builders of smart classrooms have harnessed a wide range of technologies to meet the diverse needs of different learners. For example, mobile internet technology and mobile terminal applications are incorporated to support students' mobile learning, making learning less subject to temporal and spatial constraints (Zhu et al., 2018). Technologies such as cloud computing and big data have been used in the smart class to analyze students' learning data to enable teachers to provide tailored teaching to them (Yu et al., 2020). Also, virtual reality and cloud rendering AR/VR have been applied to smart teaching to suit the learning styles of different student groups (Tang et al., 2021). Additionally, research has paid attention to the role of wearable technology in the education of persons with special needs as well as the training of special majors in that it helps individualize teaching for the special education group and enables teaching practices in special major training to be carried out in a safer manner (Liu et al., 2016).

Our survey suggests that there is a lack of uniform standards for the architecture of the smart classroom due to the variations in its definition, which is unfavorable for its popularization. It also finds that smart classroom builders in China place a biased emphasis on the potent functions of the chosen technologies and devices over the actual needs of classroom instruction.

Moreover, they have a strong preference for cutting-edge technologies in structuring the smart classroom system without paying proper regard to the importance of infrastructure and basic facilities.

The Evaluation and Optimization of the Smart Classroom

The lack of a conclusive definition and uniform architecture of the smart classroom has resulted in a dearth of standardized evaluation criteria. Certain researchers evaluated the smart classroom's effects according to students' learning experiences. Sun and Tang (2019), for instance, sought to assess the effectiveness of a smart classroom in five dimensions: the learning activity, physical environment, resource acquisition, teaching-learning interaction, and content presentation, drawing on the learning experience scale developed by Hu et al. (2016). For smart classrooms built on the IoT, Liu and Chen (2020) proposed a full lifecycle costs-based evaluation method to examine the advantages and disadvantages of various smart classroom design schemes from the aspects of network topology, fixed costs, operating costs, maintenance costs, failure costs, and component abandonment costs. Referring to the "Guidelines for the Construction of Smart Classrooms in Primary and Secondary Schools in Guangdong Province (Trial)," Yin et al. (2020) developed an evaluation framework consisting of seven indicators: infrastructure; environment and layout; intelligent recording and broadcasting; teaching and resource platforms; intelligent regulation and sensor systems; software and hardware tools and mobile terminals; and training programs. In addition, some studies came up with optimization strategies for the sustainable operation of smart classrooms. Shao et al. (2023), for example, recommended creating an integrative management platform to improve the efficiency and quality of the operation and maintenance of smart classrooms. They explored ways to achieve centralized monitoring, prompt reaction, and efficient management of smart classrooms by integrating various operation and maintenance management instruments and technologies.

Our review finds that there are relatively few studies on smart classroom evaluation in China. Nevertheless, given the huge investment that a smart classroom demands, an effective evaluation framework is conducive to the supervision of its construction process and the legitimate utilization of education resources. Therefore, more research is needed in this regard in order to produce more scientific evaluation standards and efficacious optimization strategies to ensure the sustainable development of smart classrooms.

The Application of the Smart Classroom in Chinese Education

Fifty-one studies included in the literature review are dedicated to research into the application of the smart classroom in Chinese education. On the basis of these studies, we seek to give an overview of the application of the smart classroom in China, examine the effects of the integration of the smart classroom with various teaching modalities as well as its impacts on the teaching and learning processes, and summarize the factors affecting its use in the current Chinese education settings.

A Brief Overview of the Application of the Smart Classroom in China

Currently, the smart classroom has been applied in all education levels, from basic to tertiary, and in a wide range of disciplines in the domains of humanities, social sciences, and natural sciences. The practical purposes of the smart classroom are primarily two-fold: (1) to be coupled with established teaching models to augment education effects. For instance, Chai et al. (2022) combined the smart classroom with the hybrid teaching model and explored the benefits of the combination for optimizing students' learning experiences. (2) to provide support and services for every step of the instructional process. For example, Zhang (2015) examined the roles of the smart classroom in enhancing teachers' instructional strategies, increasing students' deep learning, and improving classroom outcomes through learning analytics. In their investigations of the smart classroom's applications, researchers have shown considerable interest in the teaching-learning interactions in a smart teaching environment. Some researchers have looked into the attitudes of teachers and students towards the smart classroom and the factors affecting their readiness and behavior in its use (Li, 2015). Thorough exploration of these factors is conducive to the further popularization of smart classrooms.

Different from the aforementioned studies on the construction of the smart classroom, which focus on emerging technologies and their possible usage for smart instruction, research on the application of the smart classroom concentrates more on the alignment between technologies and instructional needs while also paying attention to the novelty of technologies and their special features.

The Effects of the Integration of the Smart Classroom and Various Instructional Models

Existing research has explored the effects of the combination of the smart classroom and established teaching modalities such as the blended learning model, the APT (Assessment, Pedagogy, Technology) teaching model, the flipped classroom, and the cooperative learning model. According to Cheng

et al. (2021), the practice of blended learning in a smart classroom can boost students' self-directed learning and teamwork abilities by converging online and offline learning spaces and leveraging the interaction between learning methods, evaluation, and reflection. Wen et al. (2022) argued that the smart classroom contributes to customizing teaching in the implementation of online and offline hybrid learning by providing timely, precise, and individualized data. As per Zhang et al. (2017), the APT teaching model can maximize the smart classroom's outcomes as an intelligent education environment distinguished by connectivity, interactivity, and mobility, significantly enhancing students' inquiry ability and metacognitive level. Zhang et al. (2018b) argued that the APT teaching model in a smart learning environment helps heighten students' problem-solving awareness and skills and foster their innovation and critical thinking abilities. In the flipped classroom model supported by smart classroom technologies, the latter's instant feedback system enables the teacher to follow students' learning progression in real time while also instigating active engagement in learning in students (Shi et al., 2019). In his investigation of the effect of the smart classroom on junior secondary physics education based on the "teacher-led, student-centered" instruction pattern, Xue (2014) discovered that the smart class's learning analytics could assist students in diagnosing their inadequacies and remedying them in a prompt manner and that, as a result, students in a smart classroom tend to exhibit higher levels of concentration and agency. In addition, research also shows that smart classroom instruments and technologies have positive effects on the traditional teaching style. For instance, the smart classroom's electronic writing board can make lecture-based teaching more efficient; its multi-screen display system can make teacher demonstration-based instruction more intuitive, thereby increasing the efficacy of traditional teaching practices (Lyu et al., 2019).

On the other hand, research on the effects of the smart classroom on cooperative learning is far from conclusive. Some researchers asserted that the smart classroom could provide strong technical support for students' collaborative learning and was effective in enhancing their agency and engagement in collaborative activities (Xu et al., 2017; Zhou et al., 2018). Others argued that smart classroom technologies had only slight boosting effects on the overall process of cooperative learning with no significant advantages in this regard, despite there being a moderate increase in student interactive behavior in group study in a smart classroom compared with an ordinary one (He et al., 2017; He et al., 2018a; He et al., 2018b; He et al., 2018c). The variations in research findings can be the result of differences in research methods, variables, and data processing tools. Wang et al. (2015) and (2016) sought to examine the said divide from a differential perspective, pointing out that mere changes in the use of a certain technology or device could disrupt the functioning of other technologies employed. This implies that, in a

sophisticated smart teaching environment, minor changes in the use of technology may pose a significant impact on the overall teaching outcomes. The high interdependence between smart classroom technologies demands that teachers should not only be proficient in using each separate technology but also be aware of the mutual influences between them.

The Impacts of the Smart Classroom on Class Enactment

First off, the smart classroom has a positive impact on teachers' instruction by providing multi-faceted intelligent support and services. Specifically, the flexibility of the smart space gives teachers a super creative experience in the teaching process; intelligent data management is beneficial for the formation of an individualized and flattened teaching environment, generating numerous opportunities for teachers' innovation in teaching methods (Li, 2015). The ongoing application of smart classroom technologies can substantially enhance the teacher's digital competence while optimizing their instruction (Li et al., 2024). Also, in teacher training on the use of the smart classroom, the demonstration of leading teachers can effectively motivate ordinary teachers to further bolster their teaching techniques (Zhang, 2015). At the same time, some studies emphasize that the majority of teachers need to change their teaching styles and increase their capability of manipulating the smart class to realize its teaching-enhancement effects (Mao et al., 2018). Jiang et al. (2019) noted that the current readiness of teachers to transform their instruction to suit the smart teaching environment is insufficient and that changes in teacher evaluation mechanisms are necessary to urge them to adapt to the new teaching paradigm.

Furthermore, the benefits of the smart classroom for students' learning are many. Ni's and Lyu's (2017) study found that students showed stronger interest in learning in a smart class than in a conventional one. According to Yang et al. (2024), students exhibited higher levels of engagement in a smart classroom, cognitively, emotionally, and behaviorally (Zhang et al., 2019; Leng & Yi, 2020). The easy access to abundant digital education resources in the smart classroom also helps students improve their learning efficiency (Zhang et al., 2018). Furthermore, smart classroom technology-assisted teaching activities can elicit deep learning among students (Lu & Yang, 2022), contributing to morphing their simple, linear thought into a more sophisticated thinking style that emphasizes connections in knowledge (Wang, 2019) and enhancing their ability to construct knowledge in more creative ways (Huang et al., 2020). In addition, Peng et al.'s (2021) study suggests that improved impressions of the learning environment in the smart classroom are significantly beneficial for heightening students' self-efficacy. Nevertheless, some researchers claimed that the smart class might pose cer-

tain negative impacts on students' learning. For example, it is impossible for students to upgrade their learning methods when their use of the smart classroom is limited to the sharing of teaching materials, whereas the roles of smart classroom technologies in information processing and knowledge construction are disregarded (Zhai et al., 2016; Liu et al., 2020). Another issue in the smart classroom is that students are more interested in the format of instruction than in the course content (Wang, 2019), which is not conducive to their mastery of curriculum subject matter. Also, Zhang (2021) is concerned that the disciplines for student knowledge memorization in the smart classroom may objectify students, producing a false impression of personalized learning.

Additionally, the smart classroom has its advantages in encouraging in-class interactions (Huang, 2013). The smart classroom's interactive technology helps expand the scope of interaction between class actors and enrich teaching and learning approaches, thereby boosting individual and collective knowledge construction and increasing teaching and learning outcomes (Chen et al., 2019). In the meantime, big data-based teaching analytics in the smart class has the potential to optimize the frequency and content of teacher-student and inter-student interaction, thus enhancing students' agency in the classroom as well as their active engagement in learning, both emotional and behavioral (Zhang et al., 2016). Nonetheless, there are also issues with in-class interactions in a smart teaching environment. Despite the smart classroom's emphasis on the notion of student-centeredness (Jiang et al., 2019), it is still important for the teacher to be proficient in posing proper questions and providing reasonable directions and feedback. The current inadequacies in the openness and frequency of questions posed by smart class teachers lead to students' passive reactions and insufficient chances to conduct in-depth discussions in the smart classroom (Liu & Chen, 2021). Li et al. (2018) argued that the interactions occurring in the smart classroom did not significantly outperform those in the traditional classroom, when technological support mainly benefits the teacher rather than the students, resulting in a lack of substantive interactions between them (Chen et al., 2019). Given this, Li and Xu (2018) recommended drawing on the theories of constructivism, situated learning, and collaborative learning in designing learning activities to ensure students' rights to discourse (Xie, 2022) and enhance their interactive behavior in the smart classroom.

To sum up, the literature shows that the smart classroom not only helps ameliorate teachers' instruction and students' learning, but also enhances the interaction between class actors. Meanwhile, the issue of how to fully harness its advantages and circumvent its drawbacks requires more exploration in practice. As technology advances, the smart classroom will also be continuously upgraded. The adjustment of application strategies to optimize smart classrooms' roles in education necessitates further research.

Factors Affecting the Application of the Smart Classroom

A portion of the studies included in the review examined the factors affecting the willingness of teachers and students to use the smart classroom. According to Chen et al. (2020), factors like performance expectations, peer influence, and facilitation conditions can have significant positive impacts on teachers' intention to use smart classroom technologies, whereas outdated education notions and rigid teaching methods are hindrances to their application of the smart classroom. Also, the smart teaching climate of the school, targeted smart teaching training, and innovative teaching strategies are factors contributing to encouraging the use of the smart classroom among teachers (Pan, 2018; Wang et al., 2021). Among students, their seating preferences and learning environment preferences relate to their learning motivation and styles in the smart classroom, and the instructional strategies adopted by the teacher determine students' learning satisfaction in the smart teaching environment (Xu et al., 2018; Zhang et al., 2020; Liu et al., 2021). Li's (2022) study suggested that expanding the opportunities for interactions in the smart class and adopting more suitable teaching methods, such as the multi-scale teaching model, could stimulate students' learning motivation.

On top of the said factors, the structure of in-class teaching (Guan et al., 2019) and the nature of the discipline (Jiang et al., 2018) also determine the intensity of smart classroom use. Specifically, in low-structured teaching that emphasizes classroom generation, such as instruction in the humanities, technology only serves as an instrument for student learning, and in this situation, students themselves hold a dominant position in the learning process. In highly structured teaching, such as instruction in science subjects, the teacher is highly dependent on technology for information presentation and analysis, and, as a result, technology must be incorporated into specific tasks based on prescribed teaching objectives. In addition, some studies emphasized that the intensity of the functioning of the smart classroom depends on its specific purposes in the teaching practices (He et al., 2018c). Therefore, when selecting technological media in the construction stage of the smart classroom, it is overwhelmingly important to consider their relevance to concrete instructional needs and not to focus on pursuing high-performance equipment (He et al., 2020). Equally important for the functioning of the smart classroom is the quality of the digital infrastructure. Issues like network connection failures (Wang, 2019) can pose direct threats to the efficacy of the smart classroom, impairing the smart class experience of the teacher and students.

Conclusion

The purpose of this study is to present the current state of the construction and application of the smart classroom in China via a review of 93 journal articles. Our survey shows that existing research has put forward several well-recognized definitions of the smart classroom and has summarized its basic features; that the builders of the smart classroom have experimented with various architectures of its system, leveraging cutting-edge technologies; and that researchers have also developed certain evaluation frameworks for assessing its outcomes. There remain issues with the development of the smart classroom, such as the lack of widely accepted criteria for its construction and evaluation, overemphasis on the performance of technologies with disregard to the actual needs of teaching, and more attention paid to the novelty of technologies than to the standard of infrastructure, which is the bedrock of the functioning of technology. Therefore, it is necessary to stress that the fundamental role of the smart classroom is to support teaching and learning with appropriate technologies rather than introduce state-of-the-art ones, and that the construction of the smart classroom should be based on the instructional needs (Hu et al., 2019). In the meantime, schools and communities should make more investment in the construction and maintenance of digital infrastructure to ensure the stable, normal enactment of the smart class. Also, more in-depth conversations about the definition of the smart classroom in academia are required in order to generate a widely accepted conception of it and develop relatively uniform evaluation standards accordingly.

According to our survey, the smart classroom has been applied to all education levels and multifarious disciplines. Researchers have investigated teachers' and students' attitudes towards the use of the smart classroom and explored the effects of various instructional models in the smart teaching environment. Our review reveals that, despite its challenges, the smart classroom generally yields positive effects. However, it is crucial to consider the interactions between various technologies within the smart classroom, given its complex technological composition and mutual dependence. Among all the factors influencing the smart classroom's outcomes, the teacher's educational philosophy and teaching methods have the most significant impact, not only on the quality of instruction but also on the academic progress of students. To further improve the application outcomes of the smart classroom, it is imperative to provide smart class training to teachers to increase their competence in this regard. Furthermore, the design of smart class-based teaching activities, a crucial step in implementing the smart classroom, remains largely unexplored in existing research, a factor that significantly influences the smart class's effectiveness in improving teaching quality and boosting student academic achievements. Therefore, to fully meet the increased needs of education, future smart classroom research should concentrate on exploring the principles, methods, and evaluation criteria for design-

ing instructional activities in a smart teaching setting, fully utilizing smart classroom technologies.

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