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# Construction of Classroom Interaction Mode Based on Smart Blackboard

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Abstract

With the continuous development of technology, the smart blackboard has been widely used in classroom teaching at various stages of education in China, providing teachers with an intelligent teaching system, helping them improve the pertinence and effectiveness of teaching design in lesson preparation, teaching design, classroom writing, teaching management, teaching evaluation, teaching reflection, and other aspects. It is also conducive to stimulating learners' learning enthusiasm, interest persistence, and learning effectiveness. This article conducts a comprehensive study on the classroom interaction mode based on smart blackboards. Through an in-depth analysis of the functional characteristics of smart blackboards and their potential applications in teaching, an innovative classroom interaction mode is proposed based on a large number of previous teaching equipment classroom interaction modes such as electronic whiteboards. This model aims to fully leverage the advantages of the smart blackboard, achieve multi-dimensional and effective interaction between teachers, students, and the smart blackboard, and improve students' learning enthusiasm and participation. Through this model, teachers can better utilize the multimedia display, real-time feedback, and interactive functions of the smart blackboard, creating a more vivid and personalized teaching environment. In this mode, students can engage in effective learning, deep learning, and personalized learning to cultivate their higher-order thinking and promote their development.

Keywords: Smart Blackboard, Classroom Interaction, Mode Construction, Personalized Learning, Intelligent Evaluation

## Introduction

With the continuous development of information technology, the field of education is also undergoing a profound transformation from traditional teaching models to modernization and intelligence. Smart blackboard, as a new teaching medium, integrates high-definition display, touch operation and Internet functions, providing a diversified interactive platform for teachers and students. The integration of smart blackboards in

education is a significant development, with the potential to transform traditional teaching methods[0] (Heirdsfield et al., 2011). Smart blackboard also creates more possibilities for students to actively learn and collaborate on exploration. However, in practical applications, how to fully leverage the role of smart blackboards in classroom interaction, optimize teaching structure, and improve teaching effectiveness is still a question worth exploring.

Currently, although the smart blackboard has been widely used in various educational scenarios at all levels, teachers often struggle with operational proficiency and integrating teaching content with technology[0] (Song & Song, 2020). Many teachers still face problems such as lack of proficiency in operation, single interactive forms, and low integration of teaching content and technology during use. These issues not only affect the teaching effectiveness of the smart blackboard but also constrain the development of students' learning initiative and creativity. Therefore, it is particularly urgent to design and construct an efficient classroom interaction mode based on a smart blackboard.

This study aims to conduct an in-depth analysis of the application of smart blackboards in classroom teaching and explore and construct a teaching model that can fully leverage their interactive advantages. We will focus on how the smart blackboard promotes effective interaction between teachers and students, as well as between students, and how to enhance students' interest, participation, and learning effectiveness through the smart blackboard. Meanwhile, this study will also explore the challenges and solutions that teachers may encounter during the use of smart blackboards, providing theoretical support and practical guidance for future teaching practices.

## Literature Review

### Overview of the Development of Smart Blackboard Technology

Throughout the development history of blackboards, they have gone through traditional blackboards, electronic whiteboards, and modern smart blackboards that integrate functions such as multi-touch, high-definition display, and wireless interaction. Every advancement in technology has greatly improved the materials and related technologies of blackboards, thereby enhancing the interactivity, effectiveness, and intelligence of teaching. Each evolution of the blackboard has its unique advantages and makes up for some of the previous shortcomings, but it also brings new drawbacks[0] (Xin et al., 2020). A smart blackboard is an intelligent interactive teaching device composed of hardware devices and software systems[0] (Jun, 2023). With the continuous application of advanced technology to smart blackboards, smart blackboards have become a type of smart teaching system. In 1991, the first smart blackboard was launched based on the "interactive whiteboard". At the beginning of its development, due to issues such as slow and unstable processor speed and poor graphics processing ability, it was not widely promoted and used. Nowadays, with the advancement of technology and software optimization, smart

blackboards have been widely used in the field of education[0] (Xiao & Daguang, 2016) and have become an important component of smart classrooms and smart campuses, playing an important role in smart teaching.

Touch technology, information and communication technology, big data, the Internet of Things, and artificial intelligence technology have all profoundly changed the structure and function of smart blackboards. For smart blackboards, touch technology is a revolutionary technology that has changed the way humans interact, just like touch screen phones have changed people's lives, work, and learning. The application of information and communication technology in smart blackboards has established a strong connection between computer systems and blackboards, such as cameras in classrooms, campus management systems, educational platforms, etc. Blackboards are no longer the original writing boards for information expression and writing but have become computing systems with software and hardware systems, making smart blackboards the core equipment of smart classrooms and playing an important role. The integration of Internet of Things (IoT) technology in smart blackboards has significantly enhanced resource connectivity, enabling the aggregation and sharing of high-quality resources[0] (Li, 2010). IoT technology greatly expands the connection and application boundaries of the blackboard, enabling the aggregation of in-class and extracurricular resources, achieving the sharing and sharing of high-quality resources, and making online live streaming and the "three classrooms" more effective. Big data and Artificial Intelligence (AI) technology make the smart blackboard more intelligent. The integration of AI in real-time systems, such as the smart blackboard, can enhance its capabilities, including planning and real-time control[0] (Lalanda et al., 1992). By collecting, analyzing, and visualizing teaching data such as blackboard writing, voice, and teacher-student interaction, as well as student learning situations such as focus, teacher-student interaction, and student-student interaction, teachers can understand their learning situation promptly and provide accurate feedback by grading test questions promptly.

## Theoretical Research on Classroom Interaction Mode

Interaction is a social psychology concept that means interaction or mutual influence. It has gradually been introduced into the field of teaching, mainly referring to the interaction between people[0] (Yao & Haiyan, 2010). Teaching interaction is a conscious, purposeful and specific teaching behavior[0] (Zhu Jingxi, 2021). Classroom teaching is still the main battlefield of teaching today, and classroom teaching is essentially a process of teacher-student interaction[0] (Ziping, 2017). The theoretical research on classroom interaction mode mainly focuses on how to improve teaching effectiveness and student learning effectiveness through interaction in the classroom environment. The interactive teaching mode emphasizes a student-centered approach, which improves classroom

teaching effectiveness by creating a good learning atmosphere and building harmonious teacher-student relationships[0] (Shigang & Wanlin, 2013). Research has consistently shown that the interaction between teachers and students, particularly through direct dialogue and feedback, significantly enhances students' learning motivation and participation[0] (Zhang, 2021). Encouraging students to provide feedback can also improve the teaching and learning process[0] (Svinicki, 2001). Research has consistently shown that interactive classroom activities, such as group discussions and collaborative learning, are effective in promoting student learning and satisfaction[0] (Lo, 2011). It also encourages students to actively participate and promote knowledge sharing and skill development among students through discussions or project collaborations; the problem-solving model focuses on guiding students to learn through practical problems, emphasizing critical thinking and the ability to independently solve problems. With the continuous development of technology, human-computer interaction has become a type of classroom interaction. Technology-assisted interactive modes such as online discussions and multimedia interactions provide a new platform for classroom interaction, making teaching unrestricted by time and space, and making interactive forms more diverse. The multi-dimensional interactive mode of comprehensive teacher-student interaction, student-student interaction, and human-machine interaction provides students with a more comprehensive and rich learning experience. Reasonable design and application of these interactive modes can greatly enrich teaching strategies, improve teaching quality, and promote the comprehensive development of students. The use of interactive teaching modes has been shown to increase student enthusiasm and improve learning outcomes[0] (Chen, 2021). Positive classroom interaction can promote deep understanding and application of knowledge.

In modern educational practice, the application of smart blackboards is gradually becoming an important tool to promote these interactive modes. It not only changes the traditional way of teacher-student interaction, but also greatly promotes the depth and breadth of teacher-student interaction, student-student interaction, and human-machine interaction. A smart blackboard can provide more interaction and feedback, helping teachers and students build a two-way dynamic learning environment, thereby better supporting the development of personalized learning and collaborative abilities of students. The smart blackboard not only presents data in a visual form but also enhances students' sense of participation, enabling them to explore and absorb new knowledge more actively. In short, building an effective classroom interaction mode, through various forms of communication and participation between teachers and students, can greatly promote students' learning and development. Overall, the use of a smart blackboard can create a more interactive and feedback-rich learning environment, supporting personalized learning and collaborative abilities[0] (Warren, 2011).

## Classroom Interactive Mode Supported by Technology

The eternal pursuit of educational technology is to use technology to promote the improvement of educational and teaching effectiveness. The common consensus on how technology can promote education is to leverage its advantages, especially to be used to leverage its advantages and compensate for the shortcomings of traditional teaching methods[0] (Cruz, 2013) and to deeply integrate and innovate with education and teaching. By innovating teaching concepts, changing teaching and learning methods, and changing educational paradigms, teaching effectiveness can be improved.

Therefore, technology-based classroom interaction mode has been an important development direction in the field of education in recent years. With the rapid development of information technology, especially the popularity of the Internet, mobile devices and various intelligent electronic devices, the traditional teaching model has been unable to meet the needs of modern education. Therefore, utilizing modern information technology to promote classroom interaction and improve teaching effectiveness has become an important direction of educational reform. Draper emphasizes the importance of pedagogic methods in utilizing electronic equipment for student interaction[0] (Draper et al., 2002), while Ullah underscores the positive impact of technology and interactive activities on learner engagement[0] (Ullah & Anwar, 2020). Elsayed further supports this, highlighting the potential of technology to enhance the dynamics between teachers and students, improve class discussion, and deepen student involvement in their education[0] (Elsayed et al., 2017). In previous studies, classroom interaction modes supported by electronic whiteboards and other devices have significantly improved the interaction between teachers and students, enhancing learners' learning enthusiasm. The emergence of the "Internet plus" education model has further promoted the development of the classroom interactive teaching model. This model uses information interactive tools to attract students' attention and enable them to participate in classroom teaching to improve the learning effect[0] (Na, 2021). In addition, the application of mobile technology also provides new ways to support classroom interaction, such as collecting student data through mobile applications and centralized platforms, achieving a more convenient and modern interactive teaching system[0] (Fardoun & Awada, 2017).

The smart blackboard, with its support of software and hardware technology, can effectively support classroom interaction. The collaborative learning approach supported by intelligent technology provides more space for interaction among students. The layout of the smart classroom space, mainly equipped with a smart blackboard, is flexible and variable. Its movable tables and chairs greatly facilitate group collaborative learning for students in the classroom. The use of smart split screens and tablets further supports group discussions and collaborative exploration[0] (Röbling et al., 2004). In addition to physics classroom teaching, smart teaching also provides opportunities for students to

communicate online. Students can use online learning platforms to share learning experiences with other students or engage in peer evaluations. It can be seen that with the assistance of technology, the interaction between students is more free and convenient, and the forms are more diverse and diverse.

## The Role of Smart Blackboard in Classroom Interaction

The role of a smart blackboard in classroom interaction is multifaceted. It not only enhances direct interaction between teachers and students, but also enhances student initiative and participation in learning, enhancing the presentation effect of teaching content.

### Enhance Teaching Interactivity

The use of smart blackboards has been shown to enhance multi-dimensional interaction in the classroom, enabling real-time interaction between teachers and students, students and students, and human-machine interaction[0] (Heirdsfield et al., 2011). By utilizing touchscreen technology and interactive software, teachers can invite students to come on stage to solve problems and annotate or summarize course points. This direct participation can significantly enhance students' learning motivation and interest. Students can visually demonstrate their thinking process through the smart blackboard, and share problem-solving methods with classmates. Further, it is stated that students who presented their understanding of course content to their peers on a smart blackboard were more engaged and effective in their learning[0] (Malmstrom & Eriksson, 2018). Students can directly provide feedback on their learning situation through the smart blackboard, such as raising their hands electronically to ask questions or providing real-time evaluation and feedback on course content, helping teachers adjust teaching strategies to meet student needs.

### Promote Active Learning among Students

Anwar further emphasized the role of multimedia-based learning in increasing student enthusiasm and learning achievement[0] (Anwar et al., 2023). The multimedia display function of the smart blackboard transforms abstract knowledge points into vivid visual presentations through various forms such as videos and animated demonstrations, greatly attracting the attention of students and stimulating their curiosity and exploratory desire. This teaching method not only makes the classroom lively, but also promotes the enthusiasm of students to actively participate. In addition, students can directly engage in interactive operations on the blackboard, personally simulate scientific experiments, gradually track the path of solving mathematical problems, and reproduce historical scenes.

These functions greatly enhance students' understanding and mastery of knowledge points. With the help of a smart blackboard, students can learn through hands-on practice, absorb and consolidate new knowledge more deeply, improve their ability to explore and solve problems independently and achieve a dual improvement in the efficiency and effectiveness of self-directed learning.

### Visualization of Teaching Information and Data

The high-resolution display screen of the smart blackboard can display charts, flowcharts, and other visual materials, which not only helps students better understand complex concepts but also increases the visual appeal of the classroom. Teachers can use smart blackboards to highlight key points, highlight keywords, or edit and organize classroom content in real time. This dynamic information presentation method can greatly improve learning efficiency. Meanwhile, the smart blackboard can conveniently display students' learning outcomes, such as assignments, projects, etc. Students can improve their confidence and cooperation in learning by showcasing their learning outcomes, communicating and sharing with classmates. Additionally, the visual display of learning data on smart blackboards can help students and parents better understand learning outcomes and progress[0] (Rojanarata, 2020).

### Optimize Classroom Management

The smart blackboard greatly optimizes the classroom management process and provides teachers with more efficient and accurate teaching aids. Through the smart blackboard, teachers can monitor student attendance, homework submission status, and learning performance, making more accurate teaching decisions based on real-time data. With the help of a smart blackboard, classroom management becomes more systematic and scientific, significantly increasing instructional effectiveness and operational efficiency. Moreover, by recording the interactive course process, these tools can empower teachers and students to better understand feedback and interaction during the learning process (Perinpasingam et al., 2021). This delivers useful materials for post-class analysis and evaluation. The smart blackboard can significantly advance the standard of instruction by streamlining classroom administration.

## Research Design

### Theoretical Base

According to constructivist learning theory, the smart blackboard encourages the students to explore the materials actively and improves learning interactivity (Ms, 2020 Makewa, 2019). Furthermore, it avails the teachers with teaching strategies that are

adaptive and rich in the tools used for instructions. Smart blackboards help the students to participate in and study all the courses related to interactive activities arranged inside the classroom. Besides, it also enhances and increases their participation and motivates them towards a better teaching-learning process. The teachers can enhance their students learning by presenting different kinds of instructional tools and other resources by using smart blackboards.

As described by the connectionist theory of learning, the use of a smart blackboard improves instruction through collaboration (Wang et al., 2019). To connect different kinds of information, it play an essential role that connects both the learning and instructions. The positive use of the smart blackboard motivates the student to take initiative and bring creativity to their knowledge. Moreover, the use of smart blackboards brings innovation and advancement in the educational setting. It facilitates the process of modernizing and information education and offers a platform for the deep integration and innovation of information.

## Building Principles and Frameworks

The principle of constructing a classroom interaction mode based on a smart blackboard is to create an efficient interactive teaching environment centered on students, guided by teachers, and assisted by technology. The following principles should be followed: ensuring the close integration of smart blackboard technology with course content and teaching objectives, and improving the relevance and practicality of teaching. Designing; diverse forms of interaction, this can be achieved through diverse forms of interaction, such as group collaboration, real-time Q&A, and feedback, which can stimulate students' enthusiasm for participation[0] (Kang & Yang, 2023). Using a smart blackboard to achieve real-time feedback and evaluation, allowing teachers to adjust teaching strategies promptly; Emphasize flexibility and adaptability, so that the interactive mode can be effectively adjusted for different courses and student groups; Emphasize process evaluation and continuous improvement, and continuously optimize the interactive mode by collecting student feedback and teaching data. These principles will ensure the effective use of the smart blackboard, promote deep learning and classroom participation among students.

The construction framework of classroom interaction mode based on smart blackboard aims to achieve efficient interaction between teaching and learning through high-tech means. This framework first establishes a learner-centered interactive concept, a learner-centered interactive concept is the foundation of a classroom interaction mode based on a smart blackboard, which integrates touch interaction, multimedia display, and network resource access[0] (Barneva et al., 2017). Next, implement diverse teaching strategies, such as group discussions, real-time feedback, and gamified learning, to

stimulate active student participation. At the same time, teachers should act as guides, using the smart blackboard to collect learning data and adjust teaching content and methods promptly. Finally, through reflection and analysis after class, continuously optimize the interactive mode and form a closed-loop education ecosystem. This framework will drive the transformation of traditional classrooms into dynamic interactive learning spaces.

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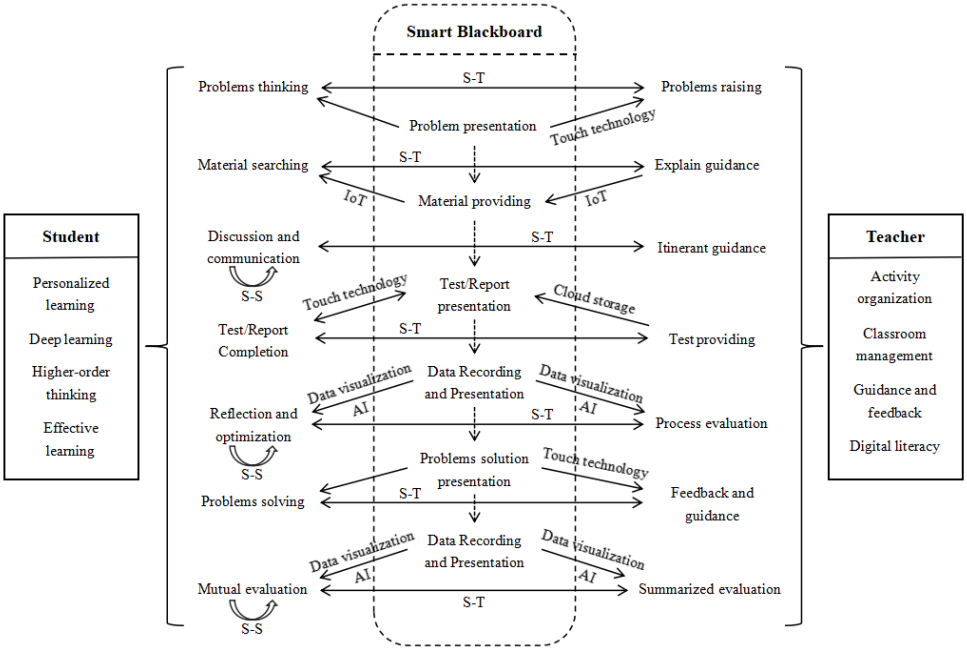


Figure 1: Classroom interaction mode based on smart blackboard

Based on the literature review above, this article constructs a classroom interaction model based on a smart blackboard as shown in Figure 1. The classroom interaction mode based on the smart blackboard reflects the deep integration of modern information technology and education, and a student-centered learning mode. With the help of IoT technology, cloud storage technology, artificial intelligence technology, interactive devices and other technological means in the smart blackboard, a convenient and efficient interactive platform has been built for teachers and students.

The most important form of classroom interaction is the interaction between teachers and students. With the help of tools such as smart blackboards, the interaction between teachers, students, and students can be strengthened. To some extent, the interaction between teachers, students, and students can be achieved through human-machine interaction.

Teachers can use smart blackboards to transmit and present teaching content in real-time, and ask questions in various forms such as text, images, audio, video, etc., allowing students to learn knowledge in a vivid and intuitive atmosphere. Using the Internet, the Internet of Things, and cloud storage technologies, teachers can upload curriculum materials and classroom tests in the smart blackboard, and students can retrieve their own resources in the materials provided by teachers or in the massive resource database of the smart blackboard. The main goal of classroom interaction based on smart blackboard support is to promote personalized learning, deep learning, and effective learning for learners, allowing learning to take place proactively in each learner, enabling each learner to achieve deep and effective learning, and getting rid of ineffective and large-scale passive learning.

Teachers integrate teaching design based on the analysis of teaching content, the functions of the smart blackboard, teaching needs, and learner situations. They design learning interaction from different aspects such as learning objectives, learning content, learning media, learning activities, teacher-student interaction, teaching evaluation, and feedback. In the classroom teaching process, the interaction between teachers and students mainly includes presenting learning problems, providing learning materials, presenting learning test reports, recording and presenting learning activity data, presenting problem-solving strategies, recording and analyzing overall data, and visualizing them.

In the problem presentation stage, teachers can use the touch function of the smart blackboard to propose and present problems to learners in real-time. The visualization function, virtual reality function, and resource library function of the smart blackboard can be used to present problems in multimedia and other forms, creating problem scenarios for scholars to understand and promoting learners to think and enter problem scenarios. After learners enter the problem context, providing them with diverse, personalized, and rich media resources and materials is crucial for their active engagement, sustained learning interest, and problem-solving. Through IoT technology, teachers can provide learners with carefully selected learning resources, such as China Smart Education Platform resources, high-quality online resources, digital textbooks, etc. Learners can also use their learning terminals to search and screen resources. Based on the provided problem scenarios and learning materials, teachers allow students to engage in different teaching interactions such as self-reflection, group discussions, and tests to test the learning situation of learners. For example, using exercises, group reports, personalized displays, and teacher observations, teachers use smart blackboards, student smart terminals, other smart devices, etc. to conduct real-time detection, accompanying data collection and recording of learners' learning situation, and automate statistical analysis of the data. The visual data statistics, analysis, and display function of the smart blackboard is used to present the test results, so that teachers can timely understand the true learning situation and learning shortcomings of learners, adjust learning progress and content, and provide collective guidance,

personalized support, and collective explanation to learners based on actual situations Personalized display, etc. Students can conduct personalized learning based on actual learning data, including real-time viewing of different push resources, using different learning media such as learning videos for different learning, and improving their personalized learning and problem-solving abilities. The smart blackboard will record, analyze, and provide feedback on a complete lesson, forming a complete learning report for teachers to reflect on and adjust subsequent teaching. Each learner can also clear their own learning situation based on their own data.

## Discussion

The classroom interaction mode based on the smart blackboard greatly enhances student participation and learning motivation through real-time and diverse interactive methods, making educational practice more vivid and effective. The application of smart blackboards not only enhances the interaction between teachers and students but also promotes cooperation and communication among students, thereby promoting the improvement of teaching effectiveness. It provides an efficient teaching platform for teachers to adjust teaching strategies in real time, pay attention to the learning needs of each student, and achieve personalized teaching. At the same time, the smart blackboard can also record and analyze interactive data, helping teachers better evaluate and optimize teaching methods, and further improve teaching quality.

In practical applications, after smart blackboards and other devices enter the classroom environment, the role of teachers needs to change, that is, to become organizers of teaching, designers of activities, data analysts, etc., and higher requirements are put forward for teachers' digital literacy. Teachers should not only fully utilize the rich functions provided by the smart blackboard, such as multimedia display, real-time interaction, and data recording, but also focus on cultivating students' information literacy. In an era where the internet offers almost unlimited content, teachers are essential in guiding students to navigate this vast information landscape critically and responsibly[0] (Hendrarso & Habib, 2022). Faced with the diverse resources presented on the smart blackboard, students need to have the ability to screen, analyze, and evaluate information. By carefully designing teaching activities, guiding students to actively participate, think deeply, and make reasonable use of the smart blackboard for classroom management and evaluation, to achieve more efficient and accurate teaching. At the same time, teachers should also pay attention to the personalized needs of students, provide customized learning paths for each student with the help of smart blackboards, ensure that each student can fully demonstrate their potential in classroom interaction, and achieve effective and deep learning for students.

Although the classroom interaction mode based on the smart blackboard greatly enriches teaching methods and enhances student participation, there are also some

limitations. Technology dependence may lead to challenges for teachers and students without technology, affecting the continuity and stability of teaching. In addition, uneven resource allocation among different regions and schools may lead to significant differences in the application of smart blackboards, and schools with limited resources may struggle to keep up with the demands of maintaining sophisticated technology systems, which can hinder the effectiveness of technology-enhanced learning environments and extent exacerbates educational inequality$^{0}$ (Mokoena et al., 2022). At the same time, excessive reliance on visual presentation while neglecting the thinking and internalization process of students can easily lead to weak mastery of knowledge. In response to the above challenges, future research can focus on multiple aspects. Improve the popularity and ease of use of technology, enabling more teachers and students to conveniently use smart blackboards and reduce technical barriers. Develop interactive software that is more adaptable to different learning styles to meet the needs of different students and improve the personalization of teaching. Explore the best combination of technology and traditional teaching methods to ensure that the application of technology can truly improve teaching effectiveness, rather than simply replacing traditional teaching. With the development of artificial intelligence and big data technology, the smart blackboard is expected to achieve more accurate analysis of student behavior, provide more personalized learning paths for each student, and promote the education field towards a more efficient and fair future.

## Conclusion

The construction of a classroom interaction mode based on a smart blackboard has achieved innovation in teaching methods by integrating advanced information technology and innovative teaching concepts. This mode emphasizes the multi-dimensional real-time interaction between teachers, students and the smart blackboard, and uses the multimedia display, touch operation and other functions of the smart blackboard to stimulate students' learning interest and motivation. To use technologies like AI, smart blackboard can give on-the-spot feedback in a visual form. It also makes it easier for both the students and the teachers to interact regularly enhances the teaching-learning process and permits quick tasks and on-time feedback (Uziak et al., 2018). The application of a smart blackboard can significantly affect the student's understanding and help to identify the students' limitations as well as their strengths to learn more and more. Besides, it also plays an important role for teachers to assess their teaching efficacy (Shamsi & Khalid, 2020).

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