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How Do Teachers Maximize the Opportunities in A Smart Learning Environment? The Case of A Medical School in China

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Abstract:
The intelligent learning environment, as a high-end educational setting, better accommodates the needs of lifelong learning, personalized learning, and ubiquitous learning for students. However, it also places higher demands on college teachers. This study explores the opportunities and challenges faced by college teachers within intelligent learning environments through a comprehensive literature review and expert interviews. The opportunities identified include enhanced capabilities for personalized teaching, the use of big data for teaching improvements, access to abundant teaching resources and tools, and improved real-time interaction and feedback. Conversely, the challenges encompass the complexity of technology integration, issues of data privacy and security, the diverse needs of student learners, and the pressures of continuous professional development for teachers. To enhance student motivation and engagement, the study proposes strategies such as designing highly interactive learning activities, providing personalized support and feedback, encouraging student interaction and collaboration, fostering a positive learning atmosphere, and implementing incentive measures and evaluation systems. By synthesizing expert opinions and literature, this research offers valuable insights for future teaching practices in intelligent learning environments.

Keywords: wisdom education, Smart learning environment, Teacher, Opportunity, Challenge

1. Introduction

The world is at a turning point, with the COVID-19 pandemic making education "a crisis within a crisis" [1]. The pandemic not only negatively impacts current education but also erases decades of global educational achievements and affects future educational development [2](Zhang, 2021). In response to this crisis, the United Nations held the Education Transformation Summit from September 16-19, 2022, where Secretary-General António Guterres highlighted the urgent need for educational reform. During the summit, the Chinese government committed to further implementing China's Education Modernization 2035, prioritizing the development of education, promoting equitable and inclusive quality education, and preparing a new generation for future society. The commitment includes building a lifelong learning system for all, advancing the digital transformation of education, and expanding international education and cooperation [3].

On September 20, at the UNESCO High-level Steering Committee on Education 2030, Minister Huai Jinpeng emphasized the role of digitalization in leveraging overall educational reform and vigorously

promoting digital transformation [1]. The preparatory meeting highlighted the need to change the educational ecology, school forms, and teaching methods, explore digital governance in education, help people adapt to the digital age, and achieve more inclusive, equitable, and high-quality education. Education digital transformation is a systematic process involving strategic planning and comprehensive promotion of digital consciousness, thinking, and ability [4] (Dobrica Savić, 2019). As an advanced form of educational informatization, smart education aligns with the goals of digital transformation and has become a key objective for educational development worldwide.

At the World Digitalization Conference on January 30, 2024, Minister Huai Jinpeng emphasized that digital education can transcend temporal and spatial limitations, ensuring equitable access to educational resources for individuals across various countries, regions, cultures, and socio-economic backgrounds. He also highlighted how technology can revolutionize education from standardized approaches to personalized and intelligent learning experiences, allowing each student to receive tailored education plans that foster holistic development [5] (Huai, 2024).

As the ideal form of future education, smart education features five essential characteristics: perception, adaptation, care, fairness, and harmony [6] (Huang, 2014). These are embodied in a smart learning environment that provides high-quality learning experiences, including student-centered teaching and comprehensive evaluation of all educational elements and processes. This modern education system emphasizes public education, lifelong learning, equity, and inclusion. Professor Huang Ronghuai also noted that an intelligent learning environment is a key aspect of intelligent education and an effective means of delivering wisdom education [6]. According to the "Education Informatization 2.0 Action Plan" issued by the Ministry of Education of China, there is a need to innovate smart education and build a supportive learning environment. The traditional classroom teaching mode is no longer suitable for post-2000 college students who have grown up with the Internet and digital products. Designing a teaching model based on a smart learning environment is therefore imperative.

2. Literature review

Scholars from different countries have proposed the concept of an intelligent learning environment from various perspectives. Zhong Guoxiang et al. (2006) described it as an intelligent, open, and integrated digital virtual reality learning space, based on constructivism learning theory, blended learning theory, and modern teaching theory. It is learner-centered and consists of matching equipment, tools, technologies, media, teaching materials, teachers, and classmates [7]. This environment supports learners' self-construction of learning while providing timely learning guidance. Chin (1997), a Malaysian scholar, defined a smart learning environment as a learner-centered space based on the application of information and communication technologies. It can adapt to different learning styles and abilities, support lifelong learning, and foster learner development [8].

In 2012, Huang, R., et al. proposed that a smart learning environment is a learning place or activity space designed to perceive learning scenarios, identify learner characteristics, provide appropriate learning resources and convenient interactive tools, automatically record the learning process, and evaluate learning outcomes to promote effective learning [9]. Zhu, Z., et al. (2021) suggested that a smart learning environment, guided by modern teaching and learning theories and supported by next-generation information technology, can identify learner characteristics and learning situations [10]. It can also generate and analyze new or historical data on the learning process, creating a flexible learning environment that best adapts to learning tasks and activities.

Various scholars have defined intelligent environments based on the educational characteristics of their countries. Spector (2016) proposed a framework for evaluating whether a learning environment is "smart,"[11] while Koper, R., et al. (2014) defined it as a physical environment that utilizes digital, content-aware, and adaptive devices to enhance learning efficiency [12]. Gambo, I., et al. (2019) explored the teaching design and learning assessment process, proposing the Smart Learning Environment Teaching and Educational Needs Model (SLE-PERM) for the development and evaluation of self-regulated smart learning environments [13].

In a broad sense, an intelligent teaching environment refers to a four-dimensional space integrating concrete physical space, virtual space derived from digital devices and intelligent algorithms, social relationship space composed of various interactions, and a spiritual space concerned with thoughts, values, and concepts [14] (Wang, 2023). In a narrow sense, it builds on the traditional teaching environment by adding real and virtual teaching spaces supported by new-generation information technology. Chen Langcheng et al. (2023) synthesized definitions from domestic and international experts and proposed that an intelligent teaching environment combines "hard" and "soft" environments [15]. The "hard environment" includes smart space entities, smart classrooms, and smart laboratories [16] (Zhao Xiaowei, et al., 2022), as well as comprehensive big data platforms, smart teaching integrated platforms, national virtual simulation experiment centers, and large-scale new spaces such as data visualization display centers and integrated media centers [17] (Li Yiying, et al., 2022). The "soft environment" refers to the interaction between various subjects and elements in the smart teaching symbiosis system, the culture, and related systems required for the flow of information and resources, which directly or indirectly affect the innovative and evolutionary teaching environment.

Huang Ronghuai et al. identified six components of a smart learning environment: resources, tools, learning community, teaching community, learning style, and teaching style. Learners and teachers (designers) interact with the intelligent learning environment through learning and teaching activities [9] (Huang, 2012). He Hongwei et al. studied the current state of classroom teaching in colleges and universities under the intelligent learning environment, setting first-level and second-level dimensions based on student factors, teacher factors, and teacher-student classroom interaction factors. They designed 20 questions to understand the status quo of classroom teaching in colleges and universities within the intelligent learning environment [18] (He, 2022).

Current literature provides various definitions and frameworks for intelligent learning environments but lacks a unified model that integrates both the "hard" and "soft" aspects across different educational contexts. Specifically, there is a gap in understanding how to effectively apply these environments in higher education to enhance teaching effectiveness, address the challenges faced by teachers, and improve student motivation and engagement. This study explores the opportunities and challenges faced by college teachers in intelligent learning environments through a comprehensive literature review and expert interviews, and proposes corresponding strategies to address these issues.

3. Materials and Methods

3.1 Research Design

The study employed a qualitative descriptive design to gather data directly from individuals who experienced the subject matter firsthand [19] (Bradshaw, Atkinson, & Doody, 2017). Conducted at a medical university in China, the study focused on teachers operating within a smart learning environment. Before class, students are provided with self-study materials such as online courses and virtual simulation

experiments through the Rain Classroom platform. During class, Rain Classroom is utilized as an educational aid to facilitate flipped classrooms and case-based teaching. After class, homework and exams are assigned and managed through the Rain Classroom.

The Rain Classroom platform allows for the entire teaching process of the teacher and the learning process of the student to be recorded. This data is used to create detailed profiles of both teachers and students. These profiles, or portraits, enable both teachers and students to gain insights into the students' learning progress. Through these student portraits, educators can tailor their teaching methods to better suit individual learning needs, while students can better understand their own academic development and areas that may require additional focus.

3.2 Data Source

This study adopted a purposive sampling approach, involving approximately 10 teachers from a medical school in Shandong. These teachers have been teaching in a smart learning environment for at least two years, ensuring that they have substantial experience and insights to contribute. Data were collected through semi-structured interviews, which were designed to provide both flexibility and depth. This interview format allowed the participants to fully express all aspects of their experiences and perspectives on teaching in smart learning environments.

The semi-structured interviews were crafted to elicit detailed and nuanced information, enabling the interviewees to discuss their experiences comprehensively. This approach facilitated the exploration of diverse viewpoints and the uncovering of rich, qualitative data. The collected responses were then meticulously analyzed using inductive processes. These processes included focusing on key points, coding the data to identify patterns, summarizing the main findings, and categorizing the information until coherent themes emerged. Through this rigorous analysis, the study aimed to develop a thorough understanding of the opportunities and challenges faced by teachers in smart teaching environments, as well as the strategies they employ to enhance student engagement and learning outcomes.

3.3 Participants:

For a case study design, Jones (2019) recommends a sample size of 15-30 for in-depth interviews. In some cases, a minimum of 10 is sufficient [20]. A total of 10 teachers participated in the interviews, with an average age of 45 years. The group consisted of 6 males and 4 females, all hailing from Shandong Second Medical University. Each participant had been teaching in a smart learning environment for at least two years, providing them with considerable experience and familiarity with the system.

The interviews were conducted either one-on-one or via telephone, depending on the preference and availability of the participants. This approach ensured that the teachers could share their insights and experiences in a comfortable and convenient manner. The varied interview methods helped accommodate different schedules and facilitated more candid and comprehensive discussions. Through these interviews, the study sought to gather in-depth perspectives on the benefits, challenges, and practicalities of teaching within a smart learning environment.

4. Results and discussion

4.1 Converging understanding of intelligence teaching environment

Teachers have different understandings of smart teaching environments, but their perspectives tend to converge around a few key concepts: advanced technology (such as artificial intelligence, big data, and cloud computing), smart classrooms (featuring intelligent interactive whiteboards, freely movable tables and chairs, group discussion screens, recording and broadcasting systems, etc.), flexible learning spaces

(encompassing both online and offline elements, as well as virtual simulations), educational concepts (like flipped classrooms, problem-based learning, case teaching, etc.), inquiry-based learning, productive learning, personalization (customized learning experiences), interactive independent learning, and rich online learning resources.

To organize these keywords, the researchers employed the "Pedagogy-Space-Technology" (PST) framework proposed by Radcliffe et al [21]. (Radcliffe & Wilson, 2009)

Pedagogy: Advanced technologies such as AI and big data can analyze students' learning behavior and performance in real-time. By collecting and analyzing vast amounts of learning data, teachers can gain deeper insights into students' learning habits, knowledge mastery, and areas of interest. This data-driven approach allows for precise adjustments in teaching strategies, enhancing the effectiveness of flipped classrooms, problem-based learning (PBL), case teaching, and inquiry-based learning. The support of advanced technology provides a strong foundation for teachers to implement these educational concepts with greater accuracy and relevance.

Space: The space in a smart teaching environment can be understood as a smart classroom, which can be configured according to different needs. Typically, these classrooms include intelligent interactive whiteboards, high-definition cameras and microphones, and movable tables and chairs that can be freely combined. Additionally, they feature a digital teaching platform that integrates a wide array of teaching resources and tools. High-end smart classrooms may also provide students with tablets to facilitate class interactions and homework submissions. These classrooms enable various functions such as remote interaction, classroom engagement, group discussions, group sharing, course recording, online live broadcasts, classroom statistics, supervision and evaluation, and teaching observation.

Technology: The smart teaching environment offers various forms of learning resources, including video courses, e-books, online tests, and virtual experiments, which support students' independent learning and diverse educational needs. The resource library can be continually updated and expanded, ensuring that students have access to the latest and highest quality learning materials to enhance learning effectiveness and satisfaction. This environment emphasizes interaction between people and smart devices and software. For instance, intelligent assistants can answer student questions, virtual laboratories can facilitate simulated experiments, and interactive teaching tools can enrich classroom activities. Students can learn independently using smart devices, with the system providing instant feedback and support based on their learning status, thereby improving learning initiative and effectiveness.

Teachers leverage intelligent technology to design and implement teaching activities, such as online tests, virtual experiments, and interactive discussions. Students engage and interact through technological platforms, increasing the interactivity and participation in teaching. Technology supports teachers in monitoring students' learning progress and performance in real-time, offering targeted guidance and feedback, and optimizing teaching outcomes.

In summary, the smart teaching environment boasts robust software and hardware support and an abundance of online teaching resources. It can deliver personalized teaching materials tailored to individual needs and supports various learning approaches, including problem-based, inquiry-based, and collaborative learning, as well as self-directed study. Furthermore, this environment emphasizes the interaction between humans and machines, and among teachers, students, and machines, fostering a dynamic and responsive educational experience.

4.2 The Role of Teachers in Smart Learning Environment

In contrast to the traditional teaching environment, the smart learning environment transforms the role of

teachers from merely imparting knowledge to serving as multifaceted guides, promoters, and innovators of student learning. Teachers are responsible for helping students set learning goals, develop comprehensive study plans, and provide necessary guidance using tools such as knowledge graphs. Throughout the independent learning process, teachers must closely monitor students' progress and challenges, offering timely feedback and guidance.

Moreover, teachers in a smart learning environment are expected to proactively engage in educational innovation. They must stay abreast of the latest developments and trends in the field of education, continuously refine their educational concepts, and explore novel teaching methods and strategies. This proactive approach ensures that teaching practices remain relevant and effective, fostering an environment where students can thrive and achieve their learning objectives.

4.3 Enhanced Teaching Methods Enabled by Smart Teaching Environment

Most respondents believe that smart teaching environments facilitate personalized instruction, immersive learning experiences, distance education, and collaborative learning opportunities. By analyzing students' learning data, smart teaching platforms can provide customized educational resources tailored to individual students' difficulties and interests. Additionally, these platforms enable interaction and communication among teachers, students, and AI, facilitating a three-way interaction that enhances the educational experience.

The smart teaching environment also offers virtual simulation and virtual reality-based learning resources, immersing students in their educational content. This immersive experience allows students to attend classes without geographical or time constraints, promoting distance education and thus contributing to the equalization of educational resources and the promotion of educational equity. Furthermore, the environment supports collaborative learning across different disciplines. For instance, clinical medicine students and nursing students can work together to simulate patient rescues using the same virtual simulation software.

However, some interviewees expressed reservations about the ability of smart teaching environments to provide specialized teaching methods. They argued that while the teaching environment serves as an auxiliary tool to enhance teaching design and improve student learning outcomes, the development of teaching methods remains primarily the responsibility of the teachers themselves. The real initiative in designing and implementing effective teaching strategies lies in the hands of educators, who must leverage the capabilities of the smart teaching environment to its fullest potential.

4.4 Aspects of the intelligent teaching environment that can provide support for teachers

The respondents unanimously acknowledged that the smart teaching environment encompasses a plethora of teaching resources and technological tools, thereby facilitating convenience in instruction and enhancing teachers' pedagogical efficiency. Moreover, it fosters students' learning outcomes while concurrently supporting teachers' professional growth.

Firstly, the smart teaching environment provides a wealth of teaching materials, including digital textbooks, e-books, video lectures, virtual simulation experiments, interactive games, and online courses. These diverse resources not only enrich teaching methods but also create a more engaging and dynamic classroom atmosphere, catering to various learning styles and preferences.

Secondly, the smart teaching environment is capable of tracking students' learning progress and collecting and analyzing their academic data to achieve personalized insights. This data-driven approach enables teachers to offer customized instruction tailored to each student's unique abilities and needs. Educators gain real-time visibility into individual learners' performance levels, allowing for immediate and targeted

intervention to support student success.

Thirdly, the automated functions of the smart teaching environment significantly enhance teaching efficiency. For example, AI can generate test questions based on the teacher's content with just one click, allowing educators to choose whether to use or modify them. The platform's AI teaching assistant can also grade assignments and provide comments, thereby saving educators valuable time. This allows teachers to focus more on designing effective courses and providing comprehensive student support, ultimately improving teaching outcomes.

Overall, the smart teaching environment's integration of advanced technologies, rich resources, and automated functionalities creates a supportive ecosystem for both teaching and learning. It not only enhances the efficiency and effectiveness of instruction but also promotes continuous professional development for educators and improved learning experiences for students.

4.5 Challenges that teachers face in the context of smart teaching

The utilization of digital resources: Intelligent learning environments provide teachers with an abundance of digital teaching resources of varying quality. As a result, teachers must invest significant time in selecting appropriate high-quality resources to integrate into their teaching practice. This meticulous process is essential to ensure that the chosen materials effectively support educational objectives and enhance the learning experience.

Technological challenges: While connectivity issues, software malfunctions, and device compatibility problems are no longer the primary technological concerns, the rapid advancement of modern educational technology presents new challenges. Teachers must stay updated with the evolving landscape of educational technology and smart learning environments. The diversity of smart classroom setups and the myriad functions of different software platforms can be particularly daunting and require continuous learning and adaptation from educators.

Individualized instruction: Although intelligent learning environments can provide personalized teaching materials and resources, effectively designing customized lesson plans for each student remains an ongoing challenge. This is especially true in large classes, which may have over a hundred students. While these environments can generate student profiles based on online assessments, assignments, and test scores, and promote student self-awareness of their learning progress, it remains difficult for teachers to accurately assess individual student performance and provide targeted feedback. The scale of these classes often complicates the delivery of truly individualized instruction.

Student engagement: Intelligent learning environments introduce innovative teaching methods, such as blended learning, which differ significantly from traditional teaching approaches. Ensuring student understanding, cooperation, and sustained engagement in these new formats poses additional challenges. This is particularly crucial in online education environments, where it is essential for students to immerse themselves fully in the learning process. The challenge of maintaining student enthusiasm and continuous participation in online teaching is significant, as highlighted by Wang Zeheng's research on online learning behavioral intention [22] (Wang, 2023). Developing strategies to boost students' motivation and sustained engagement in online settings remains a major challenge for educators.

Overall, while intelligent learning environments offer significant advantages, they also present unique challenges that require careful consideration and proactive strategies from educators. By addressing these challenges, teachers can better leverage the potential of smart learning environments to enhance educational outcomes and support student success.

4.6 Increasing students' engagement and motivation

Most respondents believe that increasing student engagement and motivation is a challenge for teachers using smart learning environments. How can students' motivation to participate be improved?

Creating a supportive and encouraging learning environment is paramount. Teachers can foster a positive learning atmosphere through regular praise, rewards, and positive feedback. For instance, establishing a student reward system that recognizes students' efforts and achievements with points, badges, and honorary titles can be effective. Regular praise not only boosts students' self-confidence but also motivates them to continue striving. Additionally, organizing class discussions and inviting students to share their learning experiences and successes can encourage peer support and create a conducive learning atmosphere.

Designing engaging and interactive learning activities is also crucial. Utilizing multimedia resources and interactive features can stimulate students' interest and participation. For example, teachers can employ virtual reality (VR) technology to create immersive learning environments, allowing students to experience historical events or scientific experiments virtually, thereby enhancing their engagement and interest. Interactive teaching tools, such as online voting, real-time Q&A, and group discussions, can promote student interaction and cooperation, increasing classroom participation. Furthermore, incorporating challenging tasks or gamified learning activities can ignite students' competitive spirit and enthusiasm for learning through group competitions and task unlocking.

Providing timely feedback and support is another key strategy. Helping students recognize their strengths and weaknesses can significantly boost their motivation to learn. Teachers can use the automatic grading systems of intelligent learning platforms to evaluate students' homework and test scores in real-time and provide detailed feedback. For high-performing students, special praise and encouragement can be given, while those facing difficulties can receive one-on-one tutoring and support to overcome their challenges. Regular learning analysis sessions, where teachers discuss students' progress and areas for improvement, can help develop personalized learning plans and ensure that each student receives the necessary support and guidance.

Finally, teachers' demonstration and motivation can greatly influence students' engagement. By showing their enthusiasm and a positive attitude towards learning, teachers can inspire students. Leading by example, actively participating in various learning activities, and demonstrating a passion for knowledge and persistence in learning can motivate students to pursue excellence. Sharing personal learning experiences and success stories can show students how to overcome difficulties and continuously improve. Actively participating in class discussions and group activities, interacting with students, and setting clear learning goals and expectations can further stimulate students' motivation and self-drive, guiding them to actively engage in learning.

5. Conclusion

A smart learning environment plays a crucial role in supporting educational reform in the era of "Internet Plus." It integrates advanced information and communication technologies such as cloud computing, artificial intelligence, virtual reality, and big data, alongside the widespread adoption of online learning and the sharing of open educational resources.

Smart teaching environments offer a wealth of possibilities for enhancing education. They provide access to a vast array of teaching resources available around the clock and facilitate advanced and diverse teaching methods. Teachers can leverage these technologies to offer personalized learning resources and

guidance tailored to students' individual differences and learning needs. Additionally, the use of technology tools in smart learning environments allows for efficient classroom management, reducing teachers' administrative burdens and enabling them to focus more on interactive and supportive roles with their students.

These environments foster a new teaching paradigm characterized by the interaction between teachers, students, and technology, often referred to as the "teacher-student-machine" model (Figure 1). This approach supports the creation of engaging learning scenarios and interactive activities, providing timely and effective assessments and feedback that help boost student interest and motivation. Consequently, it enhances learning outcomes and overall student satisfaction.

However, the shift to smart learning environments also presents significant challenges. One of the primary concerns is how to effectively increase student participation. Teachers must continually update and adapt their knowledge to keep pace with the rapid evolution of educational technology. This ongoing need for professional development and adaptation underscores the complexities involved in leveraging smart learning environments to their fullest potential.

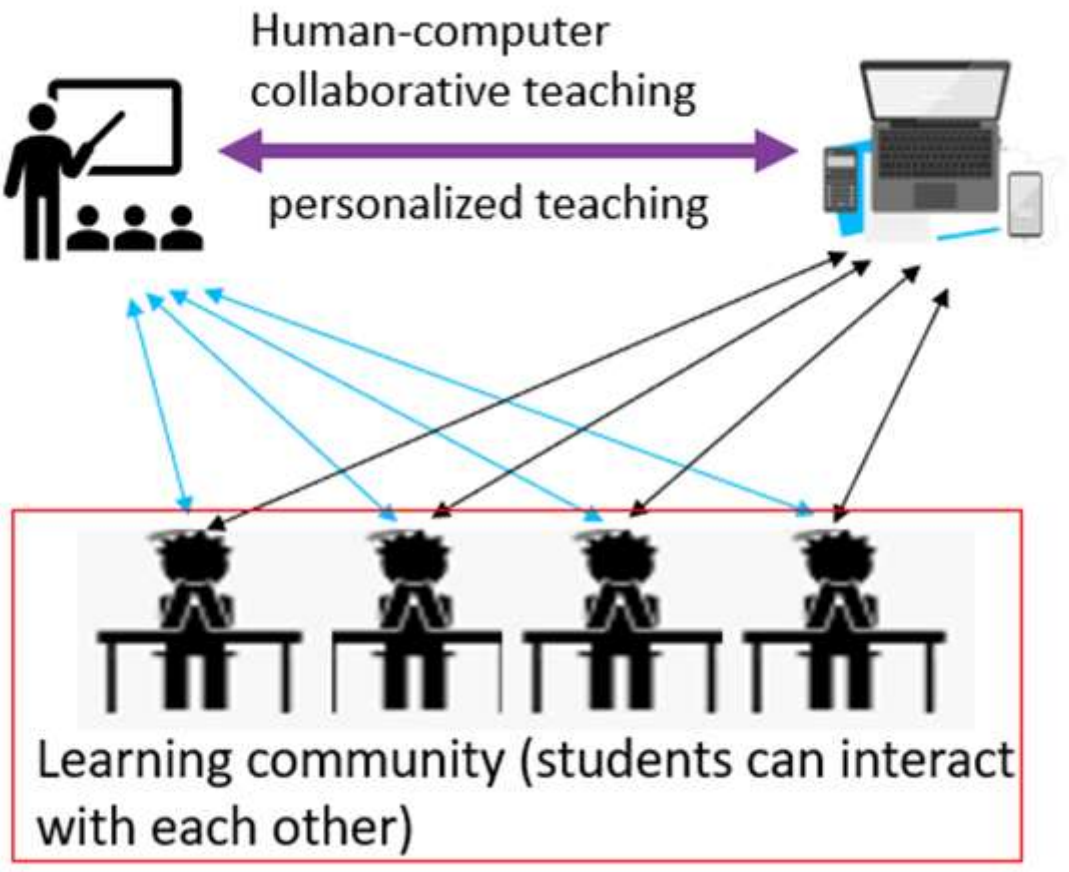

Figure 1 New teaching form of "teacher-student-machine" in smart learning environment

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