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A Synergistic Orientation Inquiry into Smart Teaching Feedback and High Quality Development of Teachers' Digital Literacy

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Abstracts: Focusing on the core direction of China's high-quality development of intelligent teaching and learning, and taking the change driven by the vertical large model of education as a breakthrough, we deeply analyse the key constants and essential attributes in the process of digitalisation of education. It reveals the heterogeneous impact of shallow and deep learning characteristics on learning concepts and learning effectiveness, and systematically clarifies the complex interaction mechanisms of learning feedback, methods, concepts and contexts in enhancing learning effectiveness. These findings not only provide solid theoretical support for the transformation of China's digital education, but also provide an innovative practical path for building a high-quality and sustainable education development model, which further empowers the effective implementation of the national high-level education innovation system and talent development strategy.

Keywords: 20th Plenary Session; High Quality Development; Smart Teaching and Learning; Vertical Grand Model of Education; Hierarchical Learning

Introductory

The traditional model of education has been heavily influenced by the theory and practice of quality management, which usually measures the quality of education by setting "high standards" as the guiding strategy for high-quality development of education. However, over-emphasis on "high standards" has led to the limitation of educational activities to a universal standardised framework, which has restricted the innovative vitality and autonomous development capacity of education, and it is urgent to re-examine the concept of "high standards" education in order to explore the key elements and internal logic of the development of high quality in education. There is an urgent need to review the concept of "high standard" education in order to find out the key elements of high-quality development of education and the inner logic of realisation[1] . At the same time, the new round of scientific and

technological revolution and industrial change are accelerating the all-round penetration of digital technology in society, making it a key driving force to profoundly change the way of thinking, organisational structure and mode of operation of society. The data-driven economic and social development pattern is gradually taking shape, and the digital transformation of the education sector and the exploration of smart education have also become an inevitable trend of new technological progress and productivity leap. This transformation has an important fundamental, pioneering and overall role in China's modernisation process, and as an important part of the construction of "Digital China", it is redefining the connotation and practice path of education[2] .

Under the macro pattern of global scientific and technological change and industrial upgrading, education digitalisation has become an important strategic pillar for driving education innovation and enhancing education quality and equity. The Party Central Committee and the State Council attach great importance to the promotion of education digitisation, and the report of the 20th Party Congress proposed for the first time to "promote the digitisation of education, and build a learning society and a learning country with lifelong learning for all people"[3] . In 2023, General Secretary Xi Jinping further pointed out in the Fifth Collective Learning of the Political Bureau of the Communist Party of China (CPC) Central Committee that the digitisation of education is a strategic breakthrough for China to explore a new track of education development and shape a new advantage in education. new track of education development and a strategic breakthrough for shaping new advantages in education. This high level of leadership not only promotes the structural upgrading of the education system, but also inspires educational entities at all levels to innovate their educational concepts and teaching models under digital conditions, providing unprecedented opportunities for achieving fair and high-quality development of education.[4] . In recent years, the Ministry of Education, upholding the concept of "government-led, school-led, social participation", has actively promoted the construction of an integrated system of "building, using, learning and managing" online education resources. The rapid popularity of catechism and online education is changing the way students learn, teachers' teaching methods, school management models and the overall shape of education, opening up a broad space for the development of high quality higher education and future educational innovation. Based on this, the higher education sector urgently needs to build a new type of "smart+" education ecosystem in terms of the concept of educating people, the mode of running schools, the teaching method, the learning paradigm and the evaluation method, in order to cope with the demand for deep-seated changes brought about by the digitisation of education.

1.Design and Re-optimisation of Educational Feedback Mechanisms

Based on the strategy of "integration of education, intelligence and talent training" proposed by the Third Plenary Session of the 20th Central Committee of the Communist Party of China (CPC), we will discuss in depth the key role of intelligent teaching in optimising the design of teaching and innovative development paths. Through educational feedback, it promotes the improvement of teaching quality and the optimal allocation of resources, thus cultivating a high-quality teaching force and providing global guidance for the digital transformation of the education system. From the perspective of smart teaching, the reconstruction path of digital teaching is systematically analysed, focusing on the

synergistic effects of learning concepts, feedback mechanisms, teacher development and digital literacy. The study shows that deep learning not only improves knowledge acquisition, but also significantly enhances critical thinking and comprehensive literacy, which provides forward-looking guidance for curriculum design; at the same time, it reveals the complex interaction between learning feedback, teaching methods, learning concepts and contexts, which highlights the key role of effective feedback in deep learning. Diversified teaching methods are better suited to different learning needs, and positive learning concepts stimulate students' intrinsic motivation, enabling teachers to flexibly take on the roles of learning guides, designers and feedback supporters in intelligent teaching.

1.1 Shaping of Deep and Shallow Learning Contexts

Under the framework of smart teaching, optimising the design of deep and shallow learning contexts has become a key proposition to enhance students' learning experience and effectiveness. Shallow learning contexts are usually based on mechanical memorisation and repetitive exercises, which can improve memory effects in the short term, but when faced with complex cognitive tasks, they often lack the motivation to stimulate students' deeper learning motivation, which can easily lead to burnout and a sense of detachment. The limitations of such contexts in terms of content and format make it difficult to support students' active adaptation and flexible transfer in higher-order tasks, making it difficult to effectively internalise what they have learnt into comprehensive abilities to cope with dynamic situations, and thus weakening their potential for cognitive expansion[5] . In contrast, smart teaching-oriented deep learning contexts emphasise the stimulation of students' subjectivity and sense of self-knowledge, and through the construction of diversified learning paths, students are motivated to choose appropriate learning contents and methods according to their individual needs, so as to achieve deep understanding and promote the long-term retention of knowledge[6] . In this context, students' intrinsic motivation is stimulated, and they gradually form self-driven learning habits. Through cooperative learning, project-based learning and other diversified forms, Smart Teaching provides students with personalised growth paths and significantly broadens their learning experience, which not only realises the education concept of tailoring teaching to students' abilities, but also allows students to flexibly adjust their strategies and strengthen their adaptive abilities in a variety of contexts. Students develop the core qualities of critical thinking, communication skills and complex problem solving through group work, independent research and project investigation, and gradually build up comprehensive academic competence.

The design of deep learning contexts goes beyond the single goal of traditional knowledge transfer to enable students to cope with future uncertainties and complex situations through the cultivation of multidimensional competencies. In this process, the efficient design of the feedback mechanism is especially critical. Personalised feedback helps students identify their cognitive blind spots and optimise their learning strategies through reflection. Fine-tuned feedback not only enhances learning outcomes, but also promotes the development of critical thinking and higher-order cognitive skills[7] . The feedback-driven learning model of Smart Teaching and Learning guides students to self-assessment and strategy optimisation, helping them to adapt to complex learning situations while building up their

confidence and ability to learn independently, thus laying a solid foundation for their future academic and professional careers.

1.2 The Deeper Utility of Learning Feedback

In shallow learning situations, feedback is often limited to a simple judgement of the correctness of the answer, focusing mainly on the completion of the task and failing to explore in depth the students' understanding of knowledge. This unidimensional feedback model cannot effectively support knowledge transfer or in-depth internalisation, and often results in students remaining in the shallow cognitive stage[8] . In the absence of systematic and inspirational feedback, students tend to repeat their mistakes or avoid them rather than optimise their learning strategies through reflection, thus further limiting the development of independent learning[9] . In contrast, the deep feedback advocated by Smart Teaching sees feedback as the core mechanism driving students' self-assessment and reflection, and aims to help students deepen their understanding through comprehensive support. This feedback mechanism not only focuses on learning outcomes, but also emphasises all-round support for the learning process. Through accurate identification of knowledge blind spots and inspirational guidance, the multi-dimensional feedback mechanism of Smart Teaching can help students re-examine the knowledge structure and gain new cognitive perspectives, thus effectively promoting the in-depth internalisation and transfer of knowledge.

Structured and precise feedback guides students' reflection and strategy adjustment through heuristic question design and in-depth analysis, thus gradually enhancing their resilience and cognitive flexibility. Specific and timely feedback not only enhances learning outcomes, but also boosts students' confidence and their engagement and self-efficacy in complex tasks. In the framework of deep learning, feedback has evolved from a traditional "assessment tool" to a "support mechanism" throughout the learning process. Feedback in Smart Teaching and Learning optimises learning strategies and develops students' critical thinking, exploratory perspectives, and self-directed learning skills to support their ability to cope with complex problems and lifelong learning needs. This feedback-driven model ensures that students are equipped with a solid foundation of cognitive depth and breadth of knowledge and are motivated to continue learning.

In addition, under the wave of digital transformation, the efficiency of the feedback mechanism is closely related to the improvement of teachers' digital literacy. Teachers' roles in smart teaching have gone beyond mere knowledge transmitters to become learning guides, resource designers and feedback coordinators. The improvement of teachers' digital literacy provides important support for the optimisation of feedback mechanisms and personalised learning. For example, through the flexible use of data analysis tools, teachers can adjust their feedback strategies in real time to ensure that they are highly compatible with individual student needs, thus further optimising learning outcomes. The effectiveness of deep feedback is reflected in its ability to stimulate students' intrinsic motivation and cultivate their strategic flexibility. Through the use of diversified teaching resources, teachers are able to construct multi-dimensional contexts to suit the cognitive characteristics and developmental needs of different students. This feedback model not only helps students consolidate their knowledge, but also

enhances their ability to reflect, explore, and solve complex problems, ultimately laying a solid foundation for their future academic growth and career development.

In the paradigm transformation of smart teaching, the refined reconstruction of the feedback mechanism and the comprehensive improvement of teachers' digital literacy together constitute the key support for the digitalisation of education. This double-wheel drive synergy not only promotes the dynamic improvement of teaching quality, but also opens up innovative practical paths for students to adapt to the complex and diverse challenges of the future. In a technology-driven education ecosystem, teachers need to combine digital tools with deep feedback design to ensure a dynamic balance between the essence of education and technological empowerment, thus promoting the realisation of high-quality development in education.

2.Teacher Professional Development and Digital Literacy

Along with the acceleration of the global digitalisation of education, the role and competence needs of teachers are undergoing a profound transformation. As the key implementers of smart teaching, teachers not only need to be skilled in the use of digital technology, but also need to act as innovators of digital resources and drivers of pedagogical change. High-quality improvement of digital literacy directly determines the ability of teachers to achieve in-depth innovation of teaching models in a dynamic educational environment, and at the same time relates to the satisfaction of diversified educational needs and optimisation of teaching quality. It provides a continuous driving force for the overall transformation of the education system, promoting the diversification of teaching methods and the innovation and upgrading of education models.

2.1 The Meaning, Importance and Impact of Digital Literacy

As the process of education informatisation advances, teachers' digital literacy has moved from a single skill to a multi-dimensional competency system. Digital literacy consists of three key dimensions, namely, technical competence, information literacy and digital creativity, covering the whole process from the proficient use of educational technology to the critical analysis of information resources and the enhancement of classroom interactivity and creativity through digital tools[10] .

Skillful use of technology is the foundation of digital literacy, requiring teachers to be proficient in tools such as online teaching platforms, classroom management systems and data analysis. Through these tools, teachers can optimise the organisation of teaching and allocation of resources, and monitor students' learning performance in real time, thus providing scientific support for the development of personalised teaching strategies. The level of technological competence directly determines the ability of teachers to promote the effectiveness of smart teaching in the digital environment[11] .

As the core dimension of digital literacy, information literacy emphasises teachers' ability to acquire, filter, analyse and integrate information resources. In the digital era of information overload, teachers not only need to be the screeners of high-quality information, but also need to guide students to develop information discernment and critical thinking. By constructing in-depth learning contexts, information literacy empowers teachers to design more inspiring and challenging teaching programmes to help students achieve deeper learning in diverse information environments[12] .

Digital creativity represents an advanced form of digital literacy, which is reflected in teachers'

ability to design innovative teaching and learning activities through digital resources, enhance the attractiveness of the curriculum, and stimulate students' creative thinking. Through digital creativity, teachers can not only enhance the interactivity and immersion in the classroom, but also facilitate students' transfer of knowledge and innovation by applying knowledge to complex problem situations[13] . Educational policies around the world generally require teachers to enhance their digital creativity to meet the needs of modernising education. For example, the EU's Digital Education Action Plan (2020) and China's Education Informatisation 2.0 Action Plan both explicitly state the strategic goal of enhancing teachers' digital creativity[14] . The implementation of these policies not only provides institutionalised support for the enhancement of teachers' digital literacy, but also pushes teachers to become a key driving force for education modernisation in the global wave of education digitisation, further consolidating their central position in education transformation.

2.2 The key role of digital literacy in deep learning and feedback mechanisms

In the smart teaching ecology, the improvement of teachers' digital literacy accelerates the leap in teaching technology capabilities, and through the deep coupling of technological tools and teaching objectives, learning environments that support the development of students' independent inquiry and critical thinking can be effectively constructed. The design and implementation of such deep learning contexts provide multi-dimensional support for students' personalised growth and learning effectiveness. Deep learning contexts are different from the mechanical memorisation and repetitive practice of shallow learning, and focus more on students' intrinsic motivation and the flexibility of learning strategies. Teachers create a challenging and inspiring multi-dimensional learning environment for students through innovative digital resource design and integration of teaching methods. Research has shown that when students are able to choose their own resources and tasks within flexible learning pathways, their depth of understanding is significantly increased, and they are more likely to develop long-term memory and critical thinking skills[15] . Through collaborative and project-based learning supported by digital tools, students are able to develop core literacy skills in complex tasks, setting them up for future academic and professional challenges.

Feedback is an important driver of deeper learning, and improved digital literacy of teachers enables this mechanism to be more accurate and adaptable. In traditional teaching, feedback is often limited to a simple assessment of the correctness of answers, which is difficult to support knowledge transfer and learning strategy optimisation. In a smart teaching environment, data-driven feedback accurately identifies students' knowledge shortcomings and guides in-depth reflection through multi-dimensional analysis to promote knowledge internalisation and transfer[16] . Teachers provide immediate and targeted feedback to assist students in identifying learning errors and optimising their cognitive pathways, while developing reflective thinking and self-regulation to enhance learning effectiveness and independent learning ability. This feedback mechanism is used throughout the learning process to guide learners to adjust their strategies and optimise their perceptions, thus enhancing their learning effectiveness and motivation[17] . Under the framework of deep learning, the feedback and reflection mechanism provides strong support for students' growth in complex contexts through personalised design and dynamic adaptation.

The construction of deep learning context and high-quality feedback mechanism provides a solid theoretical foundation and practical support for the application of intelligent feedback technology. With the advancement of educational intelligence, teachers can further optimise the feedback paradigm on the basis of digital literacy, using artificial intelligence and big data analysis to provide personalised support for students with different cognitive characteristics. This feedback paradigm is not only reflected in the application of technical skills and the design of innovative resources, but is also the core driving force for the construction of deep learning contexts and the optimisation of feedback mechanisms[18] . By improving digital literacy, teachers are able to flexibly respond to complex tasks, accurately meet students' diverse needs, and guide students to realise knowledge transfer and thinking innovation through efficient feedback mechanisms in a smart teaching environment[19] .

3.An Innovative Paradigm for Instructional Feedback and Intelligent Strategies

In the intelligent teaching system, teaching feedback, as a key link between teachers, students and the learning process, has transcended the function of one-way transmission of information in traditional education, and transformed into a core driving force to promote the improvement of the quality of teaching and personalised learning changes[20] . With the rapid development of Artificial Intelligence (AI), learning analytics and big data technologies, intelligent feedback is profoundly reshaping the interaction mode in the education field. The transition from static, generalised feedback to dynamic, personalised feedback has given greater precision and adaptability to the instructional design and feedback mechanism, enabling it to respond effectively to the individualised needs of students, while promoting the collaborative development of teachers and students in deep learning environments. The introduction of intelligent feedback marks the paradigm shift of educational practice from traditional "outcome assessment" to "process optimisation", laying the foundation for a comprehensive transformation of teaching and learning activities. In the basic learning stage, intelligent feedback monitors learning behaviours in real time and quickly generates accurate error diagnosis and guidance suggestions to strengthen students' knowledge base. For example, when a student completes an exercise task, the intelligent system can instantly identify his/her cognitive bias and provide specific guidance for error correction. This rapid response feedback mode not only improves students' learning efficiency, but also enhances their motivation and participation in learning, laying a solid foundation for higher-order learning.

In the process of achieving continuous learning goals, intelligent feedback relies on data analysis to pinpoint students' cognitive blind spots and learning bottlenecks, and provide them with in-depth customised improvement paths. For example, by dynamically tracking students' learning trajectories, the system identifies their weaknesses in understanding complex concepts and pushes supplementary resources or adjusts the difficulty of learning tasks to match them. By dynamically adjusting students' learning paths, this kind of deep-tracking feedback not only enhances the effectiveness of knowledge transfer, but also significantly increases students' adaptability and flexibility in diverse task contexts[21] . Intelligent feedback is further extended to reflective guidance and metacognitive skills development, becoming a higher-order tool to promote students' deep learning. In cognitive conflict situations,

intelligent feedback can guide students to deeply examine the logical deviations behind their errors by generating illuminating questions or designing reflective tasks, so as to optimise their learning strategies and deepen their knowledge internalisation. For example, in the face of repeated errors, the system not only provides the correct answer, but also guides students to analyse the problems in their own learning process, which fundamentally promotes the restructuring and strengthening of their cognitive structure. This form of feedback not only cultivates students' critical thinking and self-regulation, but also makes them more creative and adaptable when dealing with complex problems. The innovation of intelligent feedback is not only in the application of technical tools, but also in its overall empowerment and reshaping of instructional design. In modern intelligent teaching, feedback mechanisms and curriculum design have formed a dynamic ecosystem of organic integration. Through the support of intelligent feedback, teachers are able to adjust the teaching objectives and content in real time, thus optimising the implementation path of the teaching programme. Based on the personalised analysis of learning data, intelligent feedback provides highly customised learning support for students with different cognitive characteristics and learning needs. For example, for students with different learning styles, the system can provide graphical overviews, contextualised cases or textual explanations to improve the relevance and adaptability of the feedback content[22] .

In addition, intelligent feedback also effectively promotes collaborative learning and the construction of learning communities. In group collaborative learning, the intelligent system can monitor the interaction dynamics among members in real time and generate overall feedback reports to help the team identify deficiencies in collaboration and optimise cooperation strategies. This collaborative feedback mode not only improves the overall efficiency of the learning team, but also promotes the development of students' collaborative and social skills in social learning contexts. This functional extension of smart feedback further enhances its key role in promoting group learning and knowledge co-construction. In the context of smart teaching and learning, the scope of smart feedback is expanding, and its application in interdisciplinary teaching is particularly valuable[23] . For example, in an interdisciplinary course combining science and art, the intelligent feedback system can integrate students' learning outcomes through multidimensional data analysis, and help them achieve effective transfer and integration in complex knowledge networks. This feedback-driven interdisciplinary teaching model not only expands students' cognitive boundaries, but also stimulates their cross-disciplinary innovation ability, laying the foundation for future multidimensional problem solving.

As smart teaching continues to advance, intelligent feedback is gradually transforming from a mere technological tool to a strategic pillar in the education ecosystem. It not only promotes the improvement of education quality through accurate support and personalised feedback, but also shows significant potential in terms of educational fairness. However, the full-scale rollout of smart feedback also faces ethical and value challenges, including data privacy protection, fair algorithm design, and support for teachers' professional competence. Based on this trend, teachers' digital literacy and professional competence remain key factors in maximising the effectiveness of smart feedback. The empowerment of technology must be deeply integrated with the core values of education to ensure that smart feedback not only enhances students' learning, but also serves their holistic development and stays true to the essential mission of education.

4.Two-Way Drivers of the Nature of Smart Teaching and the High Quality Development of Teachers' Digital Literacy

Based on the continuous evolution of the global digitalisation wave, technological innovation has become an important engine of paradigm change in the field of education, complementing the "Stronger Country in Science and Technology, Stronger Country in Education" strategy put forward in the report of the 20th National Congress of the Communist Party of China (CPC) and the 3rd Plenary Session of the 20th CPC Central Committee[24] . However, the key to the application of technology in education does not lie in its instrumental character, but in how to take the essence of education as the core to achieve the deep integration of technology and the goal of educating people. The reconstruction of the essence of intelligent teaching feedback and the high-quality development of teachers' digital literacy constitute a two-way driven synergistic mechanism, which provides a new theoretical support and practical path for the extension of the value of modern education.

The essence of education is to enable students to achieve balanced and holistic development in the cognitive, emotional and social domains. This concept extends to the core practice of smart teaching, which is to reshape the teaching model to strengthen students' independent learning ability, depth of thinking and social adaptability with the help of technology, while ensuring that technology's supporting role does not replace the educator's dominant position. Bruner emphasised that the ultimate goal of education is to develop whole individuals with critical thinking, independent inquiry and a deep sense of social responsibility[25] . Smart teaching practices need to be orientated in this way, with technology seen as a supportive tool to promote independent learning, stimulate depth of thinking and strengthen social adaptability, rather than replacing the educator's leading role[26] .

The reconstruction of intelligent teaching feedback requires a dynamic balance between technological empowerment and educational value. Although artificial intelligence and big data technologies can generate highly accurate learning analyses in real time, significantly improving the immediacy and adaptability of feedback, the cultivation of students' deeper understanding, higher-order thinking and critical cognition still relies on teachers' professional judgement and inspirational design. The core function of the feedback mechanism should not be limited to simple knowledge transfer and correctness assessment, but should be further expanded into a comprehensive support system that guides students to realise knowledge transfer, stimulates innovative thinking and shapes values. For example, AI-based learning analytics systems can pinpoint students' cognitive bottlenecks in complex tasks, but the final presentation of the feedback content needs to be adapted by the teacher in accordance with the teaching objectives and contextual needs to ensure that it meets the intrinsic requirements of the educational value[27] .

The connotation of digital literacy includes not only the ability to operate technology, but also the understanding of the ethics of educational technology, the definition of the boundary between technology and teaching goals, and the deep insight into the individualised needs of students. The efficacy of smart teaching feedback depends on teachers' ability to apply intelligent tools in depth and to translate data-driven analyses into educational practices[28] . The dynamic adaptability of intelligent pedagogical feedback further highlights its unique advantages in different educational contexts, as its design in different learning stages and target tasks needs to accurately match students' cognitive

characteristics and needs. For example, in the basic learning stage, feedback should focus on immediacy and operability to help students quickly master core knowledge, while in the advanced learning tasks, it should emphasise inspiration and reflection to stimulate students' motivation and ability to explore problems in depth. Although technological tools provide efficient support in this process, the educational value of feedback is still deeply dependent on teachers' professional design and creative practice. Teachers play a crucial role in promoting the transformation of students from surface cognition to deep learning through precise guidance, ensuring that technological empowerment is always centred on the core goal of students' holistic development. The two-way driving mechanism of intelligent teaching feedback and teachers' digital literacy not only improves the quality of teaching, but also provides a new realisation path for educational fairness. This technology-enabled feedback model not only reduces the inequality in the distribution of educational resources to a certain extent, but also provides a key reliance on achieving balanced development of the education system. However, to ensure the fairness and sustainability of this mechanism, special attention must be paid to the ethical nature of technology application. For example, algorithmic transparency, data privacy protection, and sensitivity to individual heterogeneity need to be incorporated into a rigorous policy regulatory framework to prevent technological bias or misuse from posing a threat to educational equity[29] . The digital literacy of teachers, as regulators of technology applications and practicing subjects in the design of feedback mechanisms, plays a key leading role in this process.

Looking ahead, the continuous optimisation of intelligent teaching feedback should fully implement the concept of "people-oriented", take technological innovation as the core driving force of education reform, and deeply integrate with China's strategy of "education as a strong nation" and the policy objective of making digital intelligent science and technology the first productive force. Integration. The application of technology should not only be committed to the overall improvement of education quality, but also focus on the overall development of students and enhance their social adaptability and innovation potential. The reconstruction of the nature of smart teaching feedback and the high-quality improvement of teachers' digital literacy together constitute a two-wheel-drive framework for promoting the synergistic development of the smart education system. This mechanism not only injects a strong impetus for the continuous improvement of teaching quality, but also provides a solid support for the realisation of the national strategies of "modern integration of education" and "high-quality development" through the in-depth integration of technology and the core values of education. In the future, the development of intelligent teaching feedback needs to continue to deepen on the basis of fairness, ethics and personalisation, and to organically integrate innovation with the goal of educating people, so as to provide more profound theoretical guidance and practical paths for the construction of a sustainable, comprehensive and balanced modern education ecosystem.

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