Proceedings of the 5th International Conference on Financial Technology and Business Analysis (ICFTBA 2026)
DOI: 10.54254/2754-1169/2026.39357

The Impact of AI Tools on the Urban-Rural Education Gap

Zhixi Wang

Nanjing Foreign Language School, Nanjing, China
3370934804@qq.com

Abstract. From the perspective of educational resource allocation, this study examines how artificial intelligence (AI) tools affect the urban-rural education gap, focusing on disparities in access, use, and institutional support. The findings suggest that AI tools have considerable potential to promote educational equity by overcoming geographical barriers to quality teaching resources, reducing the cost of personalized instruction, and alleviating shortages of subject-specific teachers in rural areas. However, disparities in digital infrastructure, digital literacy, family support, teachers' technological competence, funding, and institutional safeguards may create new inequalities in access, use, and support, potentially widening existing educational gaps. Although improvements in rural school infrastructure have narrowed the hardware access gap, substantial differences in technological application and institutional support persist. Consequently, urban-rural educational inequality is increasingly shifting from disparities in resource availability to differences in the quality and effectiveness of resource utilization. The study argues that AI tools can both reduce and exacerbate educational disparities, with their overall impact determined by the conditions governing access, effective use, and sustained support. By examining these interconnected factors, this research provides a theoretical basis and policy insights for promoting equitable, high-quality development of compulsory education in the AI era.

Keywords: AI, urban-rural education gap, digital divide, education resource allocation, education equity

1. Introduction

The urban-rural education gap is an important issue in the process of China's education equity and the equalization of public services. In recent years, the high-quality balanced development of compulsory education has become an important orientation of education policy, and the construction of counties (cities, districts) for the high-quality balanced development of compulsory education has advanced steadily, but the gaps between urban and rural areas in school conditions, teaching staff, and education quality still stubbornly exist. Although traditional education informatization construction improved the education infrastructure and resource access conditions of rural areas to a certain extent, constrained by factors such as network conditions, equipment operation and maintenance, teachers' informatization ability, and education funding, it is difficult to fundamentally solve the problem of uneven allocation of urban-rural education resources by hardware input alone.

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2754-1169/2026.39357

As AI technology develops, tools such as intelligent question banks, intelligent question answering, adaptive learning, and virtual teaching assistants can digitize part of high-quality teaching services, break through the geographical limits on teachers and education resources to a certain extent, and provide new possibilities for rural students to obtain personalized learning support. Meanwhile, the application of AI in education places higher requirements on digital literacy and use ability; differences in family economic conditions, teachers' application ability, and supporting education institutions may also let the technological advantages be obtained more by groups with better foundations, thus forming new education inequality. In recent years, the state has vigorously advanced the education digitization strategic action, AI-empowered education and teaching reform has speeded up, scientifically evaluating its equity effect has become an important premise of policy making, and new requirements have also been raised for academic research. This paper analyzes the impact of AI tools on the urban-rural education gap from an economic perspective, examines in depth the real differences between urban and rural education in terms of access to, use of, and support for AI tools, provides theoretical analysis and policy reference for promoting the high-quality balanced development of compulsory education in the AI era, and also provides an analytical approach for the equity evaluation of the education digitization strategy.

The marginal contributions of this paper are mainly reflected in two aspects. One is to regard AI as a new education production factor and analyze its impact on the urban-rural education gap from the perspective of education resource allocation, expanding the analytical framework of existing AI education research; the other is to examine the dual mechanisms of equalization and magnification of AI at the same time, dividing the urban-rural education gap into three levels of access, use, and support, so as to explain the real constraints faced by the application of AI in education on the way from technology popularization to education equity.

The rest of this paper is arranged as follows: Part 2 reviews relevant literature; Part 3 analyzes the theoretical mechanism of AI's impact on the urban-rural education gap; Part 4 examines the real gaps in the development of urban and rural AI education; Part 5 is the conclusion and policy implications.

2. Literature review

A large body of literature discusses the causes of the urban-rural education gap. The urban-rural dual economic and social structure has long dominated the pattern of education development, the relevant institutional design has an obvious urban bias, the modernization level of urban school conditions keeps improving, while rural compulsory education has long been in a weak position, which directly hinders the balanced layout of public resources for compulsory education [1, 2]. In terms of teaching staff, high-quality teachers flow one-way into cities continuously, backbone teachers of towns keep entering urban schools through recruitment examinations and selection transfers, rural schools can hardly retain mature teachers, teacher gaps in subjects such as music, PE, art, English, and information technology are widespread, teacher training and development opportunities are also unequal, and the professional growth of rural teachers is slow [3]. The urban-rural teaching staff gap is also reflected in the educational background structure and professional title structure: the share of highly educated and high-title teachers in rural schools is obviously low, and the backbone teacher team suffers from a shortage of successors. The education quality gap is finally reflected in students' academic performance and opportunities to enter higher schools; urban and rural students still differ obviously in key high school admission rates and higher education admission opportunities. Therefore, advancing the equalization of education public services and establishing a sound mechanism for allocating urban-rural compulsory education resources is extremely crucial.

DOI: 10.54254/2754-1169/2026.39357

Differences in family input further magnify the urban-rural education divide. Urban families generally pay more attention to cultivating children's comprehensive quality and have higher education expenditure; urban students rely on urban platforms to access various social practice activities, while rural students are limited by region and have natural shortcomings in the accumulation of comprehensive quality [4]. Meanwhile, as urbanization keeps accelerating, the loss of students and the loss of teaching staff in rural schools reinforce each other [5]. Traditional education informatization construction was once expected to balance education resources, but the model of delivering high-quality education resources through hardware equipment and online courses, constrained by realities such as poor rural network conditions, absent equipment operation and maintenance, and insufficient teachers' informatization ability, has left many digital devices with low usage rates after completion, superficial in effect, and unable to fundamentally reverse the unbalanced status quo of education [6]. The path dependence of valuing construction over application makes the marginal benefits of informatization input keep diminishing. The practice of large-scale online teaching during the pandemic further shows that beneath the appearance of identical technical conditions, the divide between urban and rural students in learning input and learning outcomes is still significant.

AI education has both opportunities and risks. Most studies affirm the value of intelligent tutoring, holding that its personalized teaching can make up for the teacher gap in some rural subjects, but unreasonable use easily causes students to do mechanical question drilling and suppresses the improvement of speculative ability; whether the technology dividend can be released depends on users' actual level [7]. The triple digital divide of access, use, and benefit further magnifies the above problems: infrastructure gaps bring the access gap, differences in teachers' and students' digital literacy form the use gap, and differences in family guidance ability give rise to the benefit gap; even when software and hardware conditions are the same, there are still obvious gaps in the learning gains urban and rural students obtain from AI education [8]. Existing literature mostly expounds the optimization paths and real dilemmas of AI education from the pedagogy perspective [9], rarely uses economic analytical frameworks to dissect the resource allocation effect of AI education tools, and has not explained the deep constraints that the resource allocation mechanism under the urban-rural dual structure places on AI education equity, and this is exactly the direction this paper tries to take. From the perspective of financial guarantees, AI empowering the equity of rural compulsory education also needs multi-dimensional policy coordination [10].

From the economic perspective, education resources are quasi-public goods; AI technology will change the allocation efficiency of education factors and reconstruct the allocation rules of education resources between urban and rural areas, while existing research lacks theoretical analysis of the allocation efficiency of AI education resources and has not explained the deep constraints that the resource allocation mechanism under the urban-rural dual structure places on AI education equity. In view of this, this paper regards AI as a new education production factor, proceeds from the perspective of education resource allocation, and examines its dual mechanisms of equalization and magnification at the same time, hoping to provide a new analytical framework for understanding the urban-rural education gap in the AI era.

3. The theoretical mechanism of AI tools' impact on the urban-rural education gap

Education output is the product of the combination of school public input, family private input, and individual endowment. School-level school-running funds, hardware facilities, and high-quality full-time teachers directly determine classroom teaching quality and are the most intuitive source of the urban-rural compulsory education gap. Family economic capital and parents' education level

DOI: 10.54254/2754-1169/2026.39357

significantly moderate students' learning effects, and the differences in urban and rural family endowments further magnify the education divide between regions. Students' own learning ability and learning initiative determine the conversion efficiency of various education resources. As a new teaching factor, AI education tools are reconstructing the traditional education production structure and changing the way resources are allocated, and have two opposite action paths of equalization and magnification on the urban-rural education gap at the same time. The relative strength of the two mechanisms determines the net effect of AI's impact on the urban-rural education gap; Figure 1 shows this theoretical mechanism.

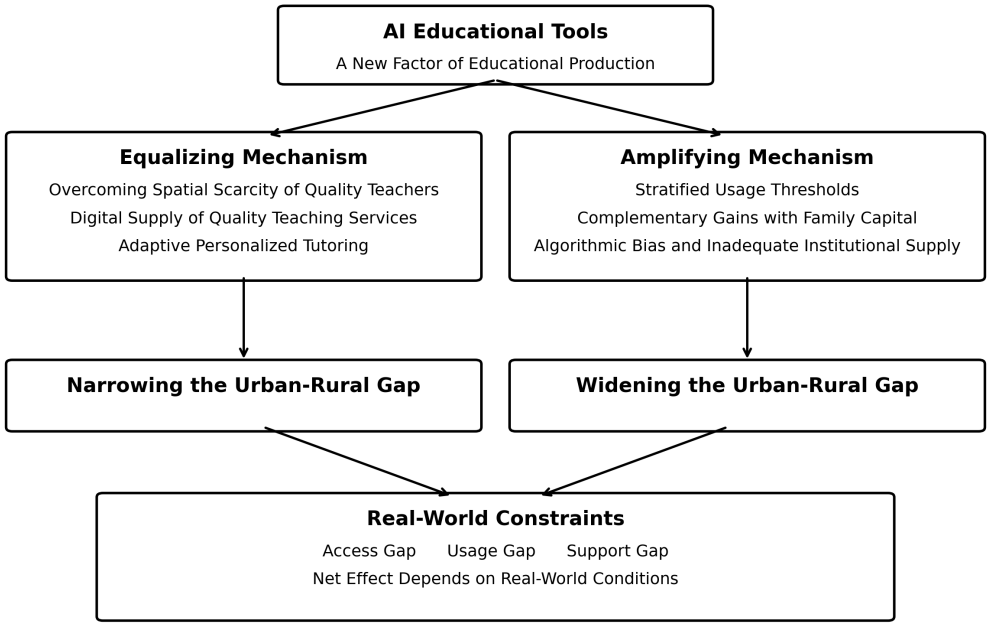

Figure 1. The theoretical mechanism of AI tools' impact on the urban-rural education gap

3.1. The equalization mechanism

The equalization mechanism means that AI education tools have the potential role of narrowing the gap in urban-rural education development. First, the core root of the imbalance of urban-rural compulsory education lies in the spatial scarcity of high-quality teaching staff. Affected by factors such as salary, career development, and living facilities, high-level teachers keep gathering in cities; the phenomenon of teacher shortage in some subjects is widespread in rural schools, and it is difficult to reverse the pattern of teacher flow in the short term by financial funding input alone, forming long-term solidified education shortcomings [11]. Second, AI tools change the supply nature of high-quality teaching services. Traditional high-quality education highly depends on individual teachers and has characteristics such as being non-replicable, high in supply cost, and limited by region; applications such as intelligent question banks, intelligent question answering, and virtual teaching assistants can digitize standardized, high-quality teaching content, replicate and promote it at extremely low marginal cost, and break through the limits of physical space, so rural schools can obtain stable high-quality teaching resources without large-scale introduction of full-time teachers. Finally, adaptive learning systems can provide tiered teaching and personalized tutoring, precisely push exercises and carry out after-class question answering according to learning

DOI: 10.54254/2754-1169/2026.39357

conditions, make up for the shortcoming of insufficient attention in rural classroom teaching, remedy the weakness of rural students' insufficient learning resources, and push urban and rural students to obtain relatively balanced learning support conditions [10]. In addition, tools such as intelligent grading and learning condition diagnosis can also reduce rural teachers' clerical burden and let them focus more on classroom teaching itself; the use data of AI tools can also provide decision support for teaching management, helping rural schools precisely identify students with learning difficulties and intervene in time.

3.2. The magnification mechanism

In terms of the magnification mechanism, AI education applications have a three-layer divide of access threshold, ability threshold, and environment threshold. Network, terminal equipment, and paid computing power resources are relatively scarce in rural areas, and it is difficult to guarantee normalized AI learning use. The efficient use of AI tools depends on digital literacy and information screening ability; urban students more easily obtain relevant guidance, while rural teachers and students generally lack systematic training and can hardly fully realize the value of intelligent tools in assisting learning. Rural teachers' intelligent teaching ability is insufficient and supporting teaching research resources are missing, so hardware input can hardly transform into actual teaching results [7-9, 11]. The superposition of the three thresholds turns the urban-rural education gap from a difference in whether resources exist into a new divide in the quality of use [6]. Meanwhile, AI technology and family capital form complementary gains: family economic capital supports high-level intelligent education services and intelligent equipment input, and cultural capital guides students to use tools in a standardized and efficient way and avoid learning misconceptions; disadvantaged rural families are at a disadvantage in both aspects, technology finally becomes a gain tool of family capital, and urban-rural education inequity is solidified [4, 10]. In addition, existing intelligent education models are mostly trained on urban learning condition data, fit urban teaching scenarios, are disconnected from rural localized teaching needs, and have implicit algorithmic bias; the quality of learning support rural students obtain when using such tools is naturally lower. Superimposed on imperfect rural special support and teacher training systems, the support model of valuing hardware over application can hardly solve the deep intelligent gap, and AI technology may keep magnifying the urban-rural education imbalance [3, 10]. What is more hidden is that the recommendation algorithms of AI tools may keep reinforcing existing learning paths based on user profiles, further marginalizing rural students with lower starting points in information cocoons.

4. The real gaps in the development of urban and rural AI education

AI provides technical possibility for narrowing the urban-rural education gap, but the release of its dividends is constrained by the urban-rural divide in access conditions and actual application level; the access gap and the use gap superimpose layer by layer, giving birth to a new type of intelligent education inequality. This part examines the real gaps in the current development of urban and rural intelligent education from the three levels of access, use, and support.

4.1. The access gap

The access gap refers to the gap between urban and rural teachers and students in basic conditions such as network, terminal equipment, and computing power; it determines who can use AI education tools and is the first threshold in the formation of intelligent education inequality. First,

DOI: 10.54254/2754-1169/2026.39357

network communication conditions have an urban-rural gap. Campus networks have basically achieved full coverage, but there are still gaps in household digital infrastructure. According to *the 56th Statistical Report on the Development of China's Internet*, in June 2025 the internet popularization rate was 84.9% in cities and towns and 69.2% in rural areas, a difference of 15.7 percentage points, and the use rate of online education in rural areas was only 17.4%. Although the 5G coverage rate of administrative villages has exceeded 90%, some rural households have insufficient bandwidth and poor network stability, forming a situation of sufficient in-school network but weak household learning network, which constrains after-class autonomous learning. Second, intelligent terminal allocation is unbalanced, and the structure of household internet devices differs significantly between urban and rural families. Among rural minor netizens, 92.5% mainly rely on mobile phones to go online, and the popularization rates of large-screen computers and tablet computers are low. The ownership rate of intelligent learning machines is 15.4% among urban minors and only 5.8% among rural minors. Mobile phones only suit fragmented and shallow use scenarios and can hardly support learning tasks such as deep reading, simulation experiments, and long-text analysis; the hardware form itself constitutes a learning barrier. Third, there are differences in obtaining computing power and paid education resources. Mainstream tools generally adopt the model of a free basic version plus a paid advanced version; educational functions such as advanced reasoning, long document parsing, and batch learning condition analysis are mostly member permissions. Because the number of students keeps falling, rural schools' public funds are generally lower than those of cities and towns [2], and it is difficult for them to purchase commercial intelligent education services; urban and rural families also differ obviously in paying ability for paid services, rural teachers and students can mostly only use function-limited free versions, and the computing power resource gap further widens the learning starting point. Finally, the above three aspects superimpose, and the urban-rural differences in basic access conditions constitute the primary real barrier to the formation of intelligent education inequality. What deserves attention is that the access gap has shifted from whether there is a network to finer levels such as whether the network quality is good, whether terminals are enough, and whether computing power supports deep learning; the per capita ownership of intelligent devices and the upgrading speed of rural households are both obviously behind urban households.

4.2. The use gap

The use gap refers to the gap in use effects between urban and rural teachers and students arising from differences in digital literacy, use purposes, and family guidance when access conditions are roughly the same; it determines who can use AI education tools well. First, students' information literacy and autonomous learning ability have an obvious gap. Minors mostly learn internet skills by self-study, and only 25.7% of students acquire network skills through school; schools have not yet fully played the equalizing role in digital literacy, and family background directly affects the ability to use intelligent tools. *The 2025 Report on the Development of Generative AI Applications* points out that among generative AI users, the group with junior college education or above accounts for 37.5%, the use rate of minors in compulsory education is significantly lower than that of high school students, rural students in compulsory education have fewer opportunities to access and use AI for learning, and the technology dividend is unevenly distributed. Second, use purposes and methods divide. The difference in the internet use structure of urban and rural minors is prominent: rural students use the internet for entertainment at a higher proportion, and the share of learning applications is low. Urban students more often use tools to complete coursework expansion, wrong question sorting, and inquiry learning, while rural students' use of tools mostly stays at the level of

DOI: 10.54254/2754-1169/2026.39357

entertainment and chatting, and the education value of intelligent tools can hardly be realized. Third, family guidance is absent. The group of rural left-behind children is huge; because parents go out to work, they are mostly under grandparent intergenerational guardianship. *The 2024 Atlas of Child Development Indicators of China* shows that more than forty percent of rural minor netizens do not live with both parents, far higher than the urban level. Grandparent guardians have limited digital literacy and can only guarantee basic living, unable to guide students in screening information, planning learning, and constraining entertainment-oriented use; migrant parents communicate with low frequency and shallow depth, and remote guidance is difficult to achieve. Finally, hardware access does not equal effective application, and the above divides form the second-layer use gap. The essence of the use gap is the digital literacy gap, and bridging it needs a longer time cycle and more systematic institutional arrangements than hardware input.

4.3. The support gap

The support gap refers to the gap between urban and rural schools in support systems such as teaching staff, funding, application ability, and institutional guarantees; it determines whether AI education tools can truly take root and take effect in rural schools. First, the stability of the rural teaching staff is insufficient and talent loss is serious. In the process of urbanization, rural high-quality teaching staff keep flowing to cities and towns, and the one-way flow of teachers between urban and rural areas is a significant feature. In the past ten years, the overall scale of rural full-time teachers has shown a continuous downward trend. Frequent personnel changes not only disrupt normalized teaching order but also make the results of intelligent teaching training difficult to accumulate; rural schools have long lacked professional teaching staff who can skillfully use intelligent teaching tools [5, 11]. Second, the growth of education funding input is unbalanced, and the divide between public funds and infrastructure funds widens the gap in the development of urban and rural intelligent education. After 2013, constrained by the decline in student numbers, the ratio of per-student funding between urban and rural areas kept falling; the per-student public funds of rural primary and junior high schools are only 0.64 times and 0.6 times those of cities, and the per-student infrastructure funds of rural schools in eastern China are only 0.1 to 0.4 times those of cities. Rural schools' funds give priority to guaranteeing basic school operation, and the funds that can be invested in intelligent education construction are seriously insufficient; there is the prominent problem of valuing hardware over operation, maintenance, and application, and it is difficult to realize normalized and deep teaching application of intelligent technology [2]. Third, the intelligent application ability of urban and rural teachers is clearly stratified. Compared with urban teachers, rural teachers generally have problems such as insufficient awareness, weak operation ability, and missing intelligent teaching thinking; most can only complete shallow applications such as lesson plan retrieval and cannot carry out intelligent-empowered tiered teaching, personalized teaching design, and classroom innovation [7]. Finally, although the hardware infrastructure gap is gradually narrowing, the gaps in teaching staff, funding, application ability, and institutional guarantees persist, keep intensifying the education intelligence gap, and become the core real obstacle preventing intelligent tools from bridging the urban-rural education gap [8]. The weakness of the support system means that even if the technology itself has inclusive potential, rural schools lacking supporting conditions can hardly transform it into actual education output.

Overall, with the continuous advancement of digital infrastructure construction, the hardware gap at the access end of urban-rural education is gradually narrowing, and the urban-rural gap in network coverage and terminal equipment has improved significantly. But at the same time, the use gap and support gap brought by the payment stratification of commercial tools, insufficient teachers' digital

DOI: 10.54254/2754-1169/2026.39357

literacy, and the absence of supporting teaching support systems keep becoming prominent. Equalization at the hardware level has not automatically transformed into equal enjoyment of education dividends; the easing of the traditional access gap has not dissolved the new type of intelligent education inequality, but instead makes the structural divide at the use level more prominent, forming the real dilemma of hardware convergence and quality divide. In other words, the premise for the equalization mechanism to hold, namely that everyone can access and effectively use AI without barriers, is exactly the key constraint for the application of AI in education to move from technology popularization to education equity. This judgment means that the focus of AI education policy should shift from equipment popularization to ability building and institutional guarantees.

5. Conclusion and policy implications

The study finds that AI tools have a dual effect on the urban-rural education gap. On the one hand, AI can digitize high-quality teaching services, break through the spatial scarcity of high-quality teaching staff, reduce the supply cost of personalized teaching, and has significant equalization potential. On the other hand, the multi-layer use thresholds of AI applications, the complementary gains with family capital, algorithmic bias, and insufficient institutional supply may let the technology dividend be obtained more by groups with better foundations, thus magnifying the original gap. At the reality level, the hardware access gap of urban-rural education is gradually narrowing, but the structural differences in use ability and institutional support are still prominent, and the education gap is shifting from a difference in whether resources exist to a difference in the quality of use. This study helps to understand the relationship between AI and the urban-rural education gap from the perspective of resource allocation, provides theoretical analysis and policy reference for promoting the high-quality balanced development of compulsory education in the AI era, and also provides an analytical approach for the equity evaluation of the education digitization strategy.

This study provides the following policy implications for giving play to the education equity value of AI. First, bring basic intelligent education services into public goods supply. The state should make unified procurement and open basic teaching functions for free, break the commercial payment barrier, implement special transfer payments of intelligent terminals for weak rural schools and families, focus on solving the equipment form problem of the mobile phone as the single entrance, and lower the entrance threshold of rural students' intelligent learning from the source. Second, bring digital literacy and standardized application into the normalized curriculum system of primary and secondary schools. Institutionalized and standardized school teaching should make up for the shortcoming of the absence of family education guidance in rural areas, narrow the use ability gap, guide students to use tools scientifically for deep learning, and reverse the current situation of rural students' entertainment-oriented and shallow technology use. Third, strengthen the normalized training of rural teachers' intelligent application ability and establish a long-term and continuous cultivation mechanism to cope with the problems of large teacher flow and training results being difficult to accumulate. At the same time, the focus of funding input should shift from infrastructure construction to public funds, guaranteeing the operation and maintenance of intelligent applications, resource updating, and special teacher training, and realizing the normalized and efficient use of intelligent equipment and digital resources. Through systematic supporting reforms of inclusive resource supply, normalized literacy education, and structured funding and teaching staff guarantees, the stratified magnification effect of intelligent technology can be effectively avoided, the positive value of AI optimizing education resource allocation can be fully released, and

DOI: 10.54254/2754-1169/2026.39357

a feasible governance path can be provided for advancing the high-quality balanced development of compulsory education and realizing the high-quality integrated development of urban and rural education. What needs emphasis is that the above three policies value coordination; a breakthrough in a single link can hardly reverse the systematic divide, and only by forming policy synergy can AI truly become a technological force promoting urban-rural education equity.

References

[1] Duan, Y. H. (2014). *An analysis of equity issues in China's compulsory education* [Doctoral dissertation, Jilin University].
[2] Zhang, T. Y. (2016). *Research on the allocation and use of public funds for compulsory education under urban-rural coordinated development* [Master's thesis, Guangxi Normal University].
[3] Hua, G. H. (2019). Accelerating the improvement of the shortcomings in the construction of rural teacher teams. *Qunzhong*, (3), 54–55.
[4] Li, D. (2025). The impact of family education expenditure on the comprehensive quality development of students: An analysis based on urban-rural comparison. *Public Relations World*, (19), 145–147.
[5] Wu, Y. M. (2022). Structural dilemmas and governance dimensions of rural education in the process of urbanization. *Journal of Wuhan University of Science and Technology (Social Science Edition), 24*(5), 511–518.
[6] Zhao, H., et al. (2021). Online education: Digital divide or digital opportunity? An analysis of urban-rural differences in online learning during the pandemic. *Open Education Research, 27*(2), 62–68.
[7] Guo, J., & Rong, Q. (2025). Artificial intelligence empowering educational equity: International consensus, implementation challenges, and practical pathways. *Journal of Southwest University (Social Science Edition), 51*(2), 247–258, 315.
[8] Zhang, L., & Zhou, L. (2024). The generation, harm, and bridging of the intelligence divide in education. *Modern Distance Education Research, 36*(3), 38–45.
[9] Fan, Y. L., & Wang, J. X. (2025). Popularization of artificial intelligence education in primary and secondary schools from the perspective of high-quality balance: Advancement, difficulties and optimization—Based on the institutional analysis and development framework. *Contemporary Education Forum*, (1), 9–18.
[10] Li, J. L., & Yang, Q. N. (2026). Multi-dimensional cooperation to solve the dilemma: A study on the mechanism and path of artificial intelligence empowering rural compulsory education equity. *Educational Science Research*, (2), 22–28.
[11] Pu, D. Y., & Li, X. G. (2023). The dilemma and solutions of teacher resource allocation in rural teaching points. *Teaching & Administration*, (23), 14–17.