

# Implications of Information Technology Education in the United States from the Perspective of Equity and Efficiency

-- An Analysis of The Word Frequency of Education Policies in China and The United States Based on The 21st Century

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**Abstract:** Equity and efficiency are two important issues in the development of human society, and educational equity and educational efficiency are the two major value objectives pursued by education. Based on this, this paper will compare and contrast the similarities and differences in the relationship between equity and efficiency in Chinese and American education policy texts in the 21st century with the help of word frequency analysis. China's education policy is also tilted towards equity, trying to break away from the policy ideology that focuses on efficiency. This article will summarize the experiences of both sides in the development of education, with a view to providing effective references for promoting equity and improving the efficiency and quality of education in China.

**Keywords:** Equity and efficiency, American information education, Chinese and American education policies, Word frequency analysis.

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## 1. Introduction

The outbreak of Newcastle Pneumonia at the end of 2019 has had an incalculable economic impact on the global economy, but the impact of the epidemic on traditional offline education methods has also been huge. However, due to the vast size of China and the imbalance in economic development between regions, many primary and secondary schools in the central and western regions are experiencing students missing online classes and falling behind the semester's teaching schedule due to a lack of internet support or lack of proper internet reception.[1] At the same time, empirical studies have shown that online education can widen the gap between students from different families, which leads to different gains and losses in terms of educational equity and efficiency, and also reflects to a certain extent the difficulties encountered in the practice of information-based education in China.[2] Therefore, this paper will provide constructive insights into the continued development of information-based education in China through the research and analysis of information-based education in the United States, which is at the forefront of the development of educational practice, from the perspective of educational equity and efficiency.

## 2. Methodology

The most representative and authoritative education policies in the United States in the 21st century was selected to make the study more comprehensive and convincing, and secondly, they all reflect, directly or indirectly, the state's values on the relationship between equity and efficiency in education, which are closely related to the subject of this article. The policy texts are taken from the global public PDF documents available on the US Education website, while the author selects the education policies enacted in China in the

21st century for comparative study.[3] This paper will use a combination of quantitative and qualitative research methods, with the help of Wordsmith, a word frequency analysis tool, and Tu Yue, a Chinese word frequency analysis software, as well as clustering analysis and knowledge mapping with the help of Cite Space analysis tools for data retrieval, cleaning and processing, word extraction, and statistical analysis. At the same time, this paper will also adopt the policy text analysis method to conduct a critical discourse analysis on the informatics education policy texts of China and the United States, which will in turn provide more powerful textual materials to support the empirical research.

## 3. Study Results

The study found that the US education policy is tilted at the efficiency level, but also takes into account education equity while focusing on education quality and efficiency improvement; the US information technology education bill outside compensatory policies, but in the process of education information technology focus more on education efficiency, the digital divide dilemma, while ignoring education equity; China's education policy is tilted at the equity level, but also difficult to escape from the policy focusing on efficiency level. The influence of the ideology, which is closely related to the global economic and technological competition and the people's pursuit of a high quality of life.

According to the results of the word frequency analysis, the frequency of the word Fairness is only 1 time, while the frequency of the word Efficiency is 8 times. The frequency of the word online is 421, the frequency of the word effective is 409, the frequency of the word information is 849, the frequency of the word data is 333, and the frequency of the word website is 146, reflecting the US government's continuous pursuit of education informatization and

performance-oriented promotion of education in the 21st century. This reflects the U.S. government's ongoing pursuit of information technology in education in the 21st century and its performance-oriented policy goal of promoting faster and better educational efficiency. In addition, the word frequency of state, which symbolises federal and state government regulation, is 3331, and the word frequency of federal, which directly represents the federal government, is 755, reflecting the US government's firm determination to strengthen education regulation and improve education quality and efficiency, unlike the decentralisation of education regulation to state governments in the 1960s and 1970s. The word frequency of the noun program is 1209, the frequency of the adjective striking is 1526, and the frequency of the word quality is 147, reflecting the importance the US government attaches to the quality and efficiency of education and to information-based education in the new century. However, the equity-focused words such as services are 98 times more frequent, public 888 times more frequent, and grant 931 times more frequent, but the diversity and frequency of both equity and its extended semantic terms are much lower than the diversity and frequency of efficiency and its extended semantic terms.[4]

The results show that US education policy is skewed towards efficiency, but also towards equity, while focusing on using information technology to improve the quality and efficiency of education. However, the focus on education equity may be to better serve the US national strategy, as the frequency of the words reformed and amended amended in the typical bills selected for the study is 893, showing that the US government in the 21st century continues to pay attention to the issues of education reform in the US since the 1970s and to make corresponding policy changes to better serve the US national strategy in education development. The US government is aware of the importance of education reform in the 21st century.[5] However, the US government is also aware that a sense of change is not enough for comprehensive innovation in the field of education, so since the introduction of the information technology education policy in the 1990s, it has been focusing on the rapid development of information technology education in basic education and higher education, as reflected in the word frequency analysis studies.

In view of this, the author also used the CiteSpace research tool to analyse the papers collected at home and abroad (based on CNKI and WOS databases) to draw a cluster analysis chart of US education policy in the 21st century as well as keyword emergence, according to the research chart although some scholars still focus on the US information-based education policy to promote education equity, a significant proportion of scholars A significant proportion of scholars believe that US information technology education policy has led to an efficiency-first education policy, which is reflected in the allocation of educational resources and public education funding. This is also evident in the keyword emergence mapping, where the intensity of the priority of efficiency is 1.97, higher than that of equity at 1.84, and the intensity of educational inequity, which directly reflects inequity, is also 1.74. Although the intensity of information technology in education reaches the maximum intensity of 8.98, the intensity of information technology in basic education, which is closely related to educational equity, is only 1.83. Therefore, I believe that information technology education in the United States focuses on improving educational efficiency. Therefore, the author believes that information technology education in

the United States focuses on improving educational efficiency at the expense of educational equity.

## **4. The Effectiveness and Shortcomings of Information Technology Education Policy in The United States**

### **4.1. The Emphasis and Enhancement of Educational Efficiency at The Infrastructure, Leadership, And Assessment Levels In 21st Century US Information-Based Education Policy**

The goal of US information-based education policy at the infrastructure level is to make a robust and comprehensive learning infrastructure readily accessible to all students and educators, thereby protecting students and ensuring that the infrastructure is used to support learning guidelines. For example, in the Coachella Valley of California, a region of wide socio-economic diversity, equitable access is a challenge, so the Unified School District decided to implement a plan to transform learning through technology - bringing connectivity to the poorest communities. There is also the Choctaw Nation tribal area that has demonstrated how through a combination of grants, loans and donations, private enterprise can bring critical access to these underserved communities.[6]

The goal of US information technology education policy at the leadership level is to embed an understanding of technology-enabled education into the roles and responsibilities of education leaders at all levels and to set state, district and local visions for technology in learning. State and local authorities leverage the power of technology and business to improve the quality of learning, such as the Edgecombe County Public Schools' creative financing solution for going digital, which was able to combine multiple funding sources to cover the high costs of informatics education.

The goal of US ITE policy at the assessment level to improve the efficiency and quality of education is reflected at all levels, for example, online education systems will use the power of technology to measure what is important and use assessment data to improve learning, and this goal will also allow regulators to control the quality of education. In addition, the use of technology will provide a more complete and detailed understanding of students' needs, interests and abilities than traditional assessments, enabling educators to personalize learning.

### **4.2. The Improvement of Educational Efficiency and Quality at The Student and Pedagogical Levels as A Result of Information Technology Education Policies in the United States**

The US Information Technology Education Policy is committed to engaging and empowering students through technology to achieve engaged and empowering learning experiences for all learners in both formal and informal settings. Its informatics education policy therefore focuses on the integration of technology to promote personalized and blended learning, helping students build non-cognitive skills and providing hands-on opportunities while fostering a

growth mindset - technology-based programmers that drive student achievement, thereby enhancing educational effectiveness and producing globally competitive and engaged citizens. Back in the summer of 2015, San Francisco's Exploratorium partnered with Coursera to launch its first MOOC called Tinkering Fundamentals, engaging in creation - that is, the Exploratorium created a massive open online course (MOOC) for exploring circuits and electricity to inspire STEM-rich tinkering. This also reflects the pursuit and enhancement of educational efficiency in US informatics education at the student learning level.[7]

And at the pedagogical level US ITE policy promotes teaching with technology, empowering and motivating them to deliver more effective instruction for all learners. Technology provides teachers with the opportunity to increase collaboration and extend learning beyond the classroom, thus effectively improving their teaching and helping them. For example, the International Education and Resource Network (iEARN) community for educators promotes teacher professional development and global collaboration.

The project's practice shows that in improving the quality of education and promoting equity in education, the US information-based education policy has produced some results. For example, Learning Times has partnered with the New York Department of Education's Office of Higher Education Readiness to develop DIG / IT, a digital learning course that introduces students in transfer schools (second-chance high schools) to digital literacy skills while developing their plans for college, career and post-high school life, and DIG / IT is currently being used in 36 transfer schools in New York City. Student attendance in DIG / IT-based courses is reported to be higher than in courses that do not use this method, and the programmer has received positive feedback from teachers and students.

In summary, US information-based education policies are effective in improving the quality of teaching and learning in the broad areas of enabling enhanced types of questions, measuring complex competencies, providing real-time feedback, improving accessibility, adapting to learners' abilities and knowledge, and embedding in the learning process.

### **4.3. Neglect of Educational Equity and Compensatory Measures in The Implementation of Information Technology Education Policies in The United States in The 21st Century**

The focus on educational efficiency and the neglect of educational equity in US informatics education policy has led to increasing inequity in education, while on the other hand reduced educational mobility has had increasingly negative social effects such as social stratification. The 2016 and 2017 US ITE policies, however, aim to achieve equity in learning through technology and implement new compensatory measures to narrow the digital divide. The efforts made by US informatics education in terms of educational equity lie in the focus on building equitable experiences, such as the online education project Black Girls Code (BGC), which aims to increase the number of women of colour in the digital space by enabling girls of colour to develop thinking in STEM subjects through exposure to computer science and technology.

However, the implementation of US ITE policy continues to result in increasing educational inequities due to performance accountability systems and the digital divide, and the effectiveness of its compensatory measures is greatly diminished as the new crown epidemic spreads. While the emphasis on information technology in education in the US and other important legislation such as the No Child Left Behind Act and Every Child Succeeds Act has been somewhat balanced in terms of educational equity, in reality, the digitization process has been more rapid in developed regions and educational inequities have become more pronounced with the introduction of virtual technologies such as VR and AR into primary and secondary school classrooms. Because the technology grant scheme in the bill is performance-based to increase funding for schools, publishing school performance does have a significant impact on parents, according to an analysis of large data from North Carolina in the US by researchers. If schools fail to make yearly progress, there is a significant increase in turnout for school board races and more competitive races, suggesting that parents will "vote with their hands" to protect their children's rights. At the same time, these schools will lose more students, as disappointed parents will "vote with their feet" to move their children to another school. However, parents who do so are concentrated in predominantly white and wealthy groups, and in districts with high turnout for school board races, while blacks, Hispanics, the poor and disadvantaged groups with low turnout rarely do so. As a result, policies that were intended to enhance performance accountability could end up further widening the gap between the rich and the poor and further entrenching class disparities.[8]

In addition, the new crown epidemic has increased unemployment in the US, and children from poor families at the bottom of the US languish in a school failure crisis because they lack good internet access and cannot afford the high cost of internet traffic. For example, several public schools in Baltimore have joined together to screen more than 7,000 eligible low-income families through a program called Internet Essentials and provide them with special funding to prevent their children from losing school because they cannot afford to pay their internet bills. However, these low-income families usually have more than 2 children and there are conflicts in the school schedules of the children, so there are still absences from online classes. Many disadvantaged pupils have already had to leave school as a result of the new crown epidemic. In addition, the negative impact of the high dropout and non-attendance rates is difficult to overcome in a short period of time, and the educational crisis caused by the impact of the epidemic will have an incalculable long-term negative impact on the individual students who are out of school and who have dropped out. The crisis in information technology education caused by the Newcastle pneumonia epidemic is, to a certain extent, a reflection of the root of the problem of the US information technology education policy, which focuses on improving educational efficiency at the expense of educational equity.

In addition to the impact of the Newcastle pneumonia epidemic and enhanced performance accountability policies, there is a new digital divide that is exacerbating educational inequity. This new digital divide is the difference between students who use technology to create, design, build, explore and collaborate, and those who only use technology to passively consume media, i.e. the 'physical access' and 'skills intervention' that scholar VanDijk J. defines as the 'digital

divide'. "The concept of 'motivational access' was innovatively introduced by VanDijk J. when defining the 'physical access', 'skill-based access' and 'access by use' categories of the 'digital divide'. For example, in a study by Bettinger et al. (2017) in the US, it was noted that online education led to a decline in college students' grades and a decrease in their likelihood of continuing their studies in college. In terms of equity in information-based education, Emanuel (2013) has shown that 83% of students who choose to participate in MOOC (Massive open online courses) have a university degree; in BRICS countries, nearly 80% of students who choose to participate in MOOCs are from wealthy or highly educated populations, suggesting that information-based education is increasing through a new digital divide.

In summary, although US information-based education policies have been effective in improving the efficiency and quality of education, changes in the complex social environment have also brought to the fore the essential problem of neglecting educational equity and have become a huge and inescapable obstacle to the progress of American society.

## 5. Implications of US Informatics Education Policy for The Development of Informatics Education in Western China

The author used the Cite Space research tool to analyze papers collected at home and abroad (based on CNKI and WOS databases) to draw a cluster analysis map of China's informational education policies in the 21st century and keyword emergence, from which it can be seen that China's informational education theory practice process to the United States informational education policies, such as in the keyword emergence map of education. For example, the highest intensity of informatization is 8.98, the intensity of the unique education voucher system in the United States is 3.41, the intensity of social equity is 2.4, and the intensity of education equality is 2.07. According to the word frequency analysis of China's informational education policy, the word frequency of "equity" is 60 times, while "efficiency" is 9 times. "This shows that China's education policy is tilted towards equity and is gradually moving away from a policy ideology that focuses on efficiency. This is closely linked to the global economic and technological competition and people's pursuit of a high quality of life.

In addition, the author also used the research method of policy text analysis to conduct a discourse analysis of China's informational education policy texts, and found that the reform and development of information education in the western region still faced a series of outstanding contradictions and difficulties. For example, the policy text of the 2004-2010 Development Plan for Education in the Western Region mentions poor schooling conditions in the central and western regions, backward educational methods and information, the overall quality of the teaching force needs to be improved, there is a shortage of qualified teachers, a relatively large number of substitute teachers, the quality of education is not high, teaching content and methods need to be improved, and the ability of education to serve the development of the western region. There is a need to strengthen the capacity of education to serve the development of the west. In contrast, urban schools, and even developed

cities on the eastern seaboard, have generally entered a stage where information-based education resources are being used on a regular basis and with precision, after years of practical exploration of information-based education development. Therefore, the huge gap between the weak application of digital resources in rural schools in the less developed areas of the western region and the developed urban schools on the eastern coast is challenging the hard-won equity in education, and the inequities in the promotion of information-based education in the east and west, such as the digital divide, need to be taken seriously.

The key to solving the problem of inequity in information technology education in the East and West is to improve the efficiency and quality of information technology education in the West by drawing on the information technology education in the United States to improve teachers' information technology literacy and to stimulate their initiative as "application subjects", while at the same time increasing the investment in network. The key is to improve teachers' information technology literacy in the United States and to stimulate their motivation as "application subjects", while at the same time increasing investment in the network infrastructure in the western region to reduce the financial burden on students and families in the less developed areas. The State Council's Rural Teacher Support Plan (2015-2020), for example, is a national policy document that aims to improve the welfare and quality of rural teachers and ensure the stability of the rural teaching force. In addition to ensuring the stability of the rural teacher workforce, new artificial intelligence technologies, such as VR and AR, which have become commonplace in information-based education in the US, should be used to create an artificially intelligent teacher workforce to collaborate on teaching and further education. This will narrow the gap between the developed eastern coastal regions and the remote and backward western regions in terms of access to information technology education, improve the level of information technology education for teachers in the western regions, stimulate their willingness to teach and guide their students to make better use of information technology education.

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