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College Students' Autonomous Learning under the Background of "Internet + Education" : Current Situation, Problems and Improvement Approaches

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Abstract

Under the wave of digital transformation of global education, "Internet +" is reshaping the autonomous learning ecology of higher education in various countries. This study systematically combed the status of College Students' autonomous learning in developed countries and regions such as the United States, the European Union, Japan, and emerging market countries such as India and China. It carried out cross-national comparison from four dimensions of resource supply, policy support, cultural soil and technology application, and deeply analyzed the common challenges and differences faced by college students in different contexts. Finally, it refined a hierarchical improvement path that adapts to China's national conditions and has an international vision. This study found that developed countries have the first mover advantage in the cultural accumulation and institutional design of autonomous learning, but face problems such as the expansion of the digital divide and the fragmentation of learning. China has realized overtaking on the curve in the construction of digital infrastructure and the application of AI technology, but there are still short boards such as the lack of self-learning awareness and the dislocation of resource supply and demand. By building a four-dimensional optimization system of "individual-university-platform -international collaboration", it can fully absorb international advanced experience, avoid common development pitfalls, promote the cultivation system of College Students' autonomous learning ability in China to mature, and provide Chinese practice samples for the digital transformation of global higher education.

Keywords: "Internet + education"; College students Autonomous learning; Cross-national comparison; Digital learning literacy; Digitalization of higher education.

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1. Introduction

The ability of autonomous learning is the key element to realize the all-round development of human beings, and it is also the core content of quality education. Strengthening the cultivation of college students' autonomous learning ability is not only related to personal development, but also related to the future of the nation [1]. In the era of "Internet +", new technologies and new knowledge are constantly emerging, and everyone has to learn for life, changing learning from passive to active. As a result, autonomous learning has been endowed with an important value and mission never before.

Since the second ten years of the twenty-first Century, the global popularization of Internet technology has completely broken the regional boundaries of higher education, and "Internet + autonomous learning" has become the common core issue of higher education reform in the world [1]. The Global Digital Report on Higher Education issued by UNESCO in 2023 [2] shows that more than 90% of colleges and universities in the world have incorporated Online Autonomous Learning into the formal talent training system, and new forms such as MOOCS, blended learning and AI assisted learning have covered more than 200 million college students. Autonomous learning ability has become the general core literacy of global higher education.

Based on their own educational tradition, economic development level and digital strategic layout, various countries have walked out of the development path of "Internet + Autonomous learning" with significant differences: The United States has built the largest MOOCS ecosystem in the world relying on the content output advantages of top universities; The EU takes the "Education Digital action plan" as the starting point to promote the inclusive sharing of learning resources in the whole region; Based on the fine education tradition, Japan has explored a low interference digital autonomous learning mode; The emerging market countries represented by India and China, relying on the high penetration rate of mobile Internet, have realized the leaping development of independent learning [1].

At the same time, college students in all countries in the world are facing new common challenges in the context of "Internet +": the problem of "information loss" caused by massive information, the distraction caused by algorithm push, the mismatch between digital learning ability and resource supply, and the continuous expansion of the digital gap between different groups. However, most of the existing relevant studies focus on the local scene, lack of systematic carding of international advanced experience and common problems, unable to provide a broader reference frame for the optimization of the national autonomous learning system [1].

By combing the open education statistics of influential countries in the world, teaching practice cases of authoritative universities, and cutting-edge academic achievements in related fields at home and abroad, this paper completed a panoramic analysis of transnational dimensions. It not only summarized the unique experience of different countries, but also refined the common problems of the whole industry, and finally formed an improvement plan with international vision and local adaptability, providing a more comprehensive decision-making reference for colleges and universities in China to promote the self-learning of College Students under the background of "Internet +".

2. Core concepts and the theoretical framework of cross-national research

2.1 Global consensus on core concepts

Under the background of "Internet +", college students' self-learning has formed a basic consensus in the field of global education. It refers to the complete learning loop of goal setting, path planning, strategy selection, process monitoring and result evaluation, and ultimately achieve the active construction of knowledge and continuous improvement of ability.The core connotation of this concept goes beyond the border of country and culture, and it is a common choice for global higher education to deal with the challenges of knowledge economy [2].

But the expressions in different contexts are slightly different. The European and American academic circles define it more as "self-regulated online learning" [3], and more emphasis on the role of metacognitive ability of learners in the learning process. East Asian academic circles more define it as "digital autonomous learning" [4], more highlighting the enabling value of Internet tools for traditional learning mode. This difference in expression indirectly reflects the differences in the development path of autonomous learning in different regions.

2.2 Analysis framework of cross-national comparison

This paper builds a four dimensional cross-national comparative analysis framework to ensure that the status of various countries can be objectively presented under a unified scale:

First, policy and institutional dimensions: combing the top-level strategies, resource investment, credit mutual recognition and other supporting system design of different countries to promote "Internet +" independent learning;

Second, the dimension of resources and ecology: compare the construction of online course platforms, the supply structure of learning resources and the maturity of market-oriented learning ecology in different countries;

Third, the dimension of learner behavior: analyze the overall differences of autonomous learning habits, tool use preferences and learning effects of college students in different countries;

Fourth, cultural and social dimensions: To explore the deep influence of educational traditions and social evaluation systems in different countries on College Students' autonomous learning behavior.

This framework can not only clearly present the development characteristics of different countries, but also accurately locate the similarities and differences of problems in different contexts, so as to avoid the mistakes of simplification and labeling in cross-national comparison.

2.3 Basic theories supporting this study

This study takes three classic theories as the basis of cross-context analysis [1, 5-8]:

One is the Theory of Unicom Learning, which was born in the era of Internet globalization. It points out that knowledge is a dynamic network connected across regions. The process of autonomous learning is the process of learners establishing knowledge connections in the global scope. This theory naturally adapts to the

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analysis of autonomous learning from the perspective of transnational.

Two is the Theory of Digital Divide. The theory divides the gap of digital learning into three progressive levels: access channel, use channel and knowledge channel, which can well explain the causes of differences in autonomous learning effects between countries and groups in the same country.

Three is the Theory of Lifelong Learning, which is a common value orientation in the field of global education. The ultimate goal of all countries to promote "Internet +" autonomous learning is to help learners build a learning ability system that can cover the whole life cycle.

3. The current situation of autonomous learning of Foreign College Students

This part selects the most representative types of samples of digital transformation of global higher education, systematically reviews the current situation of autonomous learning of college students in different countries and regions, and believes that it presents multiple development paths.

3.1 the United States: the global MOOCS ecology led by top universities [1, 3, 9-10]

The United States is the birthplace of the global "Internet + higher education". The core feature of its autonomous learning ecology is that the top research universities are leading, and the market-oriented platform is deeply involved, forming a global resource network.

In 2012, it was recognized as the first year of global MOOCS. The top universities in the United States took the lead and laid the basic pattern of global MOOCS ecology. The Massachusetts Institute of Technology and Harvard University jointly launched the world's first top university MOOCS platform edX, and then Stanford University combined with Silicon Valley enterprises to build the Coursera platform. From the beginning of its birth, the two platforms have brought the academic genes of top universities, completely breaking the regional and resource barriers of traditional higher education. Different from Udacity's main vocational and technical training born in the same period, Coursera and edX anchored the core positioning of "famous school resources inclusive global" from the initial stage. In just a few years, hundreds of high-quality courses from top universities were sent to the screen of global learners, quickly becoming the most influential online learning carrier in the world. By the end of 2024, Coursera had gathered more than 7,000 courses from more than 700 top universities in the world, with more than 130 million registered users, including more than 20 million college students in the United States.

The most distinctive feature of MOOCS ecology led by the top universities in the United States is "academic background and industry landing depth binding" [11]. EdX is directly held by Harvard and MIT, and later joined by the world's top universities such as the University of California Berkeley, Kyoto University and Hong Kong Polytech University. The MicroMasters series project is fully benchmarked to the university credit system. After completing the MOOCS learning, learners can directly apply for the college degree program, achieving the seamless connection between online learning and offline formal education. Coursera, on the other hand, cooperated with Standford and the University of Michigan to build a whole chain product system from single courses and special certification to vocational certificates and complete online degrees, and even cooperated with enterprises to launch directional talent training projects, so that MOOCS certificates directly become the gateway to the workplace. This mode is out of the primary form of the early MOOCS "free and open courseware", transforming the academic credibility of top universities into certifiable and value-added learning assets [9, 11].

Local colleges and universities in the United States generally integrate online autonomous learning into the formal training system: The "open courseware project" of the Massachusetts Institute of Technology has opened almost all the teaching materials of all the courses in the school to the world free of charge. Students in the school can complete online knowledge point learning before class according to their own schedule, and the classroom time is used for project discussion and experimental practice; Stanford University allows students to choose courses from other top universities through the platform, and credits can be directly exchanged for graduation credits of the University [9].

From the perspective of learners' behavior, the self-learning awareness of American college students generally started early. They have begun to contact project-based self-learning since senior high school. After entering the University, 68% of the students will take the initiative to choose interdisciplinary courses outside their major through the online platform to expand their knowledge boundary. Most of the libraries in American universities are equipped with special self-learning support librarians to provide one-to-one guidance for students in literature retrieval and learning path planning. There are independent silent learning modules and group collaborative discussion rooms all over the campus, which provide an excellent hardware environment for autonomous learning [9, 10].

The double support of policy and infrastructure construction has made the coverage capacity of American MOOCS ecology continue to lead the world. The U.S. government has achieved full coverage of high-speed broadband in 99% of public schools through the "connect education plan" and the E-Rate education broadband plan, and has invested a total of 1 trillion US dollars in special funds, focusing on the short board of Satellite Internet access in rural areas and the construction of 5G special network in urban schools, laying a solid hardware foundation for MOOCS to sink into the stage of basic education. Today, the MOOCS resources in the United States are not limited to the field of higher education. A large number of K12 schools have begun to introduce the open courses of Standford and MIT as expansion materials. The academic resources of top universities have completed the penetration from the elite circle to the whole period of learners through the MOOCS platform [9].

It is worth noting that the MOOCS ecology led by the top universities in the United States is forming a positive cycle. 19 colleges and universities with mature University Social Service (USR) experience formed an alliance, relying on the edX platform to launch a series of MOOCS, transforming the University's cutting-edge research results into easy to understand online courses, which not only demonstrated the social service value of colleges and universities to the world, but also improved their global enrollment attraction and scientific research fundraising ability. This mode makes MOOCS not only the "online Porter" of the course, but also the core carrier for top universities to link global learners and output academic influence. Finally, a MOOCS

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ecosystem covering the whole world, with academic authority and commercial sustainability [9-11] was built.

What's more, the autonomous learning ecology in the United States presents a strong head concentration feature, and the core resources, platform influence, and high-quality curriculum output are highly concentrated to a small number of head subjects. The specific performance can be divided into three dimensions [9-11]:

3.1.1Head concentration at the platform level

The core share of the global MOOCS market is almost monopolized by two head platforms in the United States: edX was jointly founded by Harvard and MIT, and Coursera was initiated by the Standford core team. The two occupy more than 80% of the global top university MOOCS cooperation resources. The rest of the primary and secondary MOOCS platforms almost can't get the exclusive curriculum authorization of the rattan school and TOP30 public famous schools. They can only exist as a supplementary role of the head platform, and the market discourse power is highly concentrated.

The head concentration at the platform level brings the risk of content homogenization: in order to ensure the flow, the head platform is more inclined to online popular business and computer courses, the supply of Humanities and cold basic disciplines is squeezed, and the richness of curriculum ecology continues to decline. At the same time, the commercial attribute of the platform squeezes the public welfare: the head platform gradually inclines to the paid certification and paid degree program, the core attribute of the original MOOCS "inclusive free" is weakened, and the threshold for ordinary learners to obtain high-quality MOOCS resources in famous schools is gradually raised.

3.1.2Head concentration of curriculum resources.

The quality curriculum resources of MOOCS in the United States are highly valued by Harvard, StandfordMIT、Less than 20 top universities such as the University of California Berkeley gathered. The number of high-quality MOOCS produced by these top colleges and universities alone accounts for more than 60% of the total high-quality MOOCS in American colleges and universities, covering AI, computer science, cutting-edge medicine, business management and other hot areas that are most popular among global learners. MOOCS in ordinary colleges and universities are difficult to compete with in terms of content quality and dissemination.

The head concentration of curriculum resources leads to the impairment of Education Equity: High-quality MOOCS resources are highly concentrated in the hands of a small number of head universities, and students in top universities can obtain the best digital resources in the world, while students in general institutions such as community universities can obtain relatively limited resource support. It is difficult to access customized MOOCS content that adapts to their own needs, widening the gap between education resources of different groups, and the gap between independent learning ability of college students at different levels is further widened by the Internet.

3.1.3Head concentration of degree and certification system

At present, the MOOCS online degree program and MicroMasters certification program with the highest recognition in the world are almost all launched by the two head platforms of the above head universities. For example, benchmark projects such as Georgia Tech's online master of computer science and MIT's supply chain management MicroMasters are concentrated in the hands of the top colleges and universities. The degree of academic recognition and workplace gold content of these top projects are far higher than the MOOCS projects of ordinary colleges and universities, further strengthening the head concentration effect of the whole ecosystem.

3.2 EU: inclusive autonomous learning system of regional integration [12-14]

The EU's "Internet + autonomous learning" development path relies on the integrated framework of the European higher education area (EHEA), and the construction path of the autonomous learning system with the core characteristics of regional collaborative resource sharing and inclusive equity. It has opened up and integrated the educational resources of more than 40 countries, and created a lifelong learning network covering all age groups and all skill levels. In 2020, the EU officially launched the education digital action plan (2,021-2,027) [15], with a planned investment of more than 7 billion euros, to build a unified learning resource sharing platform across the EU, and to promote the mutual selection of courses and credit recognition of colleges and universities in 27 member states, so that students from different countries and backgrounds can equally access to high-quality learning resources.

The core foundation of this system is the standardized mutual recognition mechanism built by the Bologna Process. Since the signing of the Bologna Declaration [16] in 1999, the European Union has gradually implemented the European credit conversion and accumulation system (ECTS), the unified three level degree framework, and the automatic Certification Rules for cross-national academic qualifications, which has completely broken the educational system barriers of various countries. The results of autonomous learning completed by learners in any member state can be recognized by colleges and vocational institutions in other countries through the ECTS credit system, without repeated participation in the assessment, clearing the barriers for cross-national autonomous learning from the institutional level. In 2025, the resolution of the European Union Council on the joint European degree label pushed the integration to a new stage. The online learning project of transnational joint training can directly obtain the unified degree certification of the whole region.

The EU's inclusive nature is reflected in the precise coverage of marginal groups and vulnerable regions. The European Regional Committee clearly put forward the "place-based in place strategy", aiming at the rural areas with population loss and the traditional industrial areas in the green power transformation, the learning resources that adapt to the needs of local industries should be developed to avoid the excessive concentration of high-quality resources to the core cities. At the same time, the EU provides special learning subsidies for low-income groups, elderly learners and disabled learners through the Erasmus + program. Even residents of remote islands can also access quality online courses in Europe free of charge, and will not be excluded from the learning system because of geographical and economic conditions.

This set of autonomous learning system is also deeply bound to the era demand of green and digital transformation.The European Union has developed a large number of cross-national autonomous learning modules focusing on climate change, clean energy and AI ethics, transforming cutting-edge policies and industrial needs into

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autonomous learning content. At the same time, special training programs were launched for ordinary teachers to help them master the use of cross- national teaching design and digital teaching tools, so that front-line educators can become co- builders of autonomous learning ecology, rather than simple resource users.

Different from the business orientation of MOOCS ecology in the United States, the EU's regional integration autonomous learning system has always taken social cohesion as the core goal.It does not pursue the flow monopoly of a few head platforms, but through multi-level governance mechanism, let local governments, regional colleges and industrial institutions participate in the system design, and ultimately achieve the inclusive goal of "no matter where you are in Europe, you can equally get learning resources that adapt to your own development", providing a unique reference sample for global regional education collaboration.

At present, the EU has launched the online platform of the "European University union", which has gathered more than 1,000 high-quality courses from colleges and universities in the whole EU. It supports cross-national online autonomous-learning of college students, and the ECTS credits obtained after learning are recognized by colleges and universities in all Member States. The Nordic and Western European countries, represented by Finland and Germany, further lowered the cultivation of autonomous learning ability to the first year of University. Many freshmen in Colleges and universities did not arrange a large number of professional compulsory courses in the first semester. Instead, they guided students to develop their own learning plans according to their own interests, and completed exploratory learning using digital resources.

From the perspective of learners' behavior, EU college students' autonomous learning presents a distinctive collaborative feature. More than 72% of students are accustomed to autonomous learning through cross-national online group projects, and complete the course assignments with college students from other EU countries. At the same time of learning professional knowledge, it has exercised the ability of cross-cultural cooperation. The European Union countries generally attach great importance to the basic education of digital literacy. Almost all college students can use various academic databases and online collaboration tools skillfully. The average completion rate of autonomous learning is more than 40%, far above the global average.

But the development of EU college students' autonomous learning ability also faces obvious challenges: The language differences of different member states become a natural barrier for resource sharing, and the local learning resources of many small language countries cannot be widely spread. At the same time, the digital infrastructure of some Eastern European countries is relatively weak, and the digital gap within the region is still not completely eliminated.

3.3 Japan: fine oriented low interference autonomous learning mode [17-19]

Japan's "Internet +" autonomous learning development, based on the local fine education tradition, has walked out of a low interference path different from Europe and the United States. Japanese universities did not promote high-intensity online MOOCS on a large scale, but more emphasis on the auxiliary role of the Internet on traditional classroom, through lightweight digital tools, to support students to carry out fine autonomous learning [17-19].

The underlying logic of this mode is derived from the clear guidance of the new edition of the Ministry of education, science and technology of Japan's Ministry of education, science and technology in 2018: It does not seek to replace the offline classroom with large-scale online courses, but gradually cultivate the autonomous planning ability of learners in daily teaching through low invasive auxiliary design. Japan's autonomous learning cultivating has always followed the principle of "reduction and quality improvement". From primary school to university, the "final topic" operation system strictly controls the length of written tasks, leaving more space for students to choose research topics independently, avoiding excessive mandatory tasks squeezing the space for autonomous exploration, and reducing the consumption of external intervention on learning initiative from the root [17].

Almost all colleges and universities in Japan have deployed their own campus learning management system (LMS) [19]. Teachers will upload classroom supplementary information, extended reading literature, and after class quizzes to this system. Students can independently check and fill in gaps after class according to their own classroom understanding progress. At the same time, Japanese universities widely introduced lightweight tools such as AI error book and personalized vocabulary recitation system. According to each student's learning data, it automatically generates an autonomous learning plans that adapts to their weak points, and will not occupy students' time with a large number of long video online courses[17-18].

From the perspective of learners' behavior, Japanese college students' self-learning presents the characteristics of "small steps and fast running": they rarely spend several hours in a row learning online long courses, but are accustomed to using 30-45 minutes of fragmented time every day to complete targeted omissions through the campus teaching system. The sustainability of autonomous learning is very strong, and the situation of "three minute heat" is rare [17-19]. Japanese enterprises are also deeply involved in the construction of College Students' autonomous learning ecology. Large enterprises such as SONY and TOYOTA have developed free technology learning platforms for colleges and universities. College students can learn cutting-edge practical skills in the industry in advance, achieving a smooth connection between campus learning and workplace demand [19].

The refined low interference design is reflected in the ubiquitous details of adaptation [17]. Japanese educational technology products generally don't kidnap learners with such strong intervention mechanisms as pop-up reminders, punch rankings and integral incentives. Instead, they rely on the ubiquitous learning framework to provide lightweight assistance in the most appropriate scenarios: Chinese character learning software will push 1-2 adaptive review contents in fragmented scenarios such as commuting according to the learners' learning progress on the day, which neither interrupts the daily rhythm, nor quietly consolidates knowledge points. Many schools will also bind students' autonomous learning notes into a volume and pass them around across classes, so that learners can adjust their learning methods in mutual reference, rather than relying on Teachers' forced correction to drive learning.

This model also pays special attention to the cooperative cultivation of group metacognitive ability [17-18]. Japan's autonomous learning never emphasizes complete individual isolated learning, but through low-pressure group collaborative design, so that learners gradually master self-directed learning

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skills in mutual communication. Relevant research shows that this group collaborative mode without strict assessment indicators can effectively improve the metacognitive planning ability of learners, so that students who used to rely on external supervision can slowly learn to set their own learning goals and adjust their learning rhythm, and finally form a stable autonomous learning habit.

Of course, Japan's low interference autonomous learning mode is not perfect. The core problem is that the openness of the autonomous learning is relatively insufficient, and the channels for students to access global cutting-edge interdisciplinary resources are relatively limited, which limits the innovative thinking development of college students to a certain extent. The excessive pursuit of low intervention mode also leads to the lack of necessary external constraints for some learners with weak self-discipline, and the learning rhythm is easy to loose. But on the whole, this idea of fitting in with local cultural habits and replacing radical changes with details optimization provides a set of unique practice samples different from the European and American model [17-19] for the construction of autonomous learning system in the context of East Asian culture.

3.4 Emerging market countries: Mobile Internet driven leapfrog development [20-22]

Different from the path of the United States, Europe and Japan relying on the mature higher education system and fixed broadband infrastructure to develop autonomous learning, India and other emerging market countries have taken a leap forward development path of directly relying on the mobile Internet to achieve educational inclusion, skipping the long stage of the popularization of traditional PC Internet, directly taking the extremely low mobile traffic cost as the fulcrum, leveraging the autonomous learning needs of hundreds of millions of ordinary people, and quickly building the online autonomous learning ecology covering the most extensive groups.

India is the most typical example of this set of mobile drive mode. By September 2025, the total number of Internet users in India had exceeded 1.02 billion, and the number of smart phones had reached 750 million. What's more critical is that the mobile traffic fee was as low as 10 cents per gigabyte, one of the lowest levels in the world. The monthly average mobile data usage of users was as high as 24GB, ranking among the top in the world. This extreme low-cost mobile network environment allows a large number of rural users who have never been exposed to computers to get equal access to high-quality learning resources through smart phones for the first time, directly bypassing the historical legacy of uneven distribution of traditional education resources.

Relying on the huge mobile user base, India has born a batch of super local learning platforms that fully adapt to mobile terminals. Among them, Byjus and other head products have grown rapidly into one of the most valuable education and technology enterprises in the world. The content of these platforms is completely designed based on the vertical screen of mobile phones, replacing traditional long video courses with lightweight forms such as short videos, interactive answers and voice explanations. In order to adapt to India's multilingual environment, more than ten local language versions are launched, even for users in remote villages who do not know English, they can easily master and use. At the same time, a large number of AI auxiliary functions are embedded in the learning process, relying on the intelligent recommendation system optimized by massive local user data, which can accurately push the learning content for students of different foundations, and fill the gap of rural high-quality teachers with a very low cost.

SWAYAM, the national MOOCS platform in India, has covered more than 20 million college students. A large number of local Internet enterprises have developed mobile learning APPs for ordinary college students, providing exam oriented and skill learning resources for them at a very low cost, so that many college students from low-income families can also get access to top enterprises through autonomous learning. This mobile driven leapfrog model has been replicated in Africa, Southeast Asia and other emerging market countries. Relying on the rapid growth of local mobile subscribers, the AI enabled online learning platform can not only provide basic education guidance, but also output vocational skills training, agricultural technology guidance, remote medical science and other multiple content to users. According to relevant estimates, only Africa relying on AI optimized mobile online market will directly create about 3 million related jobs by 2025, so that learning and employment growth form a positive cycle.

Of course, there are obvious growth weaknesses in this mode. First, the progress of 5G penetration in emerging market countries is relatively lagging behind, and most regions have not yet completed the return of 4G investment. Second, the language and culture of different regions are greatly different, and the digital gaps between students of classes are very prominent. Moreover, there is still a big gap in the localization of learning resources, the total amount of high-quality higher education resources is insufficient, and the quality of content on the platform is uneven. But it can't be denied that the leaping development of education in emerging market countries such as India relying on the mobile Internet has provided a new path for the construction of autonomous learning system completely different from the developed countries in Europe and the United States, for a large number of countries in the world with weak infrastructure and insufficient traditional education resources.

4. The status of autonomous learning of college students in China

China's "Internet +" College Students' autonomous learning has formed its own distinctive characteristics, and the learning behavior has been deeply embedded in the Internet scene, but there are still prominent problems such as weak self-awareness, insufficient adaptation of learning resources, lack of digital learning ability, and incomplete external support system [23-27]. Only by building a multi-party collaborative optimization mechanism, can we truly transform the technological advantages of the Internet into the actual effectiveness of College Students' autonomous learning, and provide a solid support for the cultivation of high-quality talents who adapt to a lifelong learning society.

4.1 Infrastructure and platform construction is the world's leading [23-25]

According to the report on the development of China's educational informatization issued by the Ministry of education in 2025 [28], the coverage rate of high-speed wireless network in China's university campus network has reached 99.2%, the holding rate of college students's smartphones is close to 100%, the number of mobile learning terminals per capita is more than 2, and the overall

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level of hardware infrastructure has exceeded the vast majority of medium-sized developed countries.

From the perspective of the use of learning platforms, 92.7% of college students used mainstream online learning platforms such as University of China MOOC, Chaoxing Erya and Wisdom Tree, 76.3% of them used learning content on short video platforms such as station B and qiaoyin, 68.1% of them would use Tencent Conference and Nails to participate in online learning lectures, and 59.4% of them used efficient tools such as Anki and Notion to assist autonomous learning. The popularity of various types of digital learning tools has completely changed the channels for college students to acquire knowledge. The Internet has replaced traditional textbooks and become the primary source for college students to acquire extended knowledge [23, 24, 28].

China's national MOOCS construction scale has ranked the first in the world, with a total of more than 74,000 online MOOCS, covering all undergraduate professional categories of 13 disciplines, of which more than 30,000 courses are open to the whole society free of charge. The total number of registered college students on Chinese University MOOC, superstar Fanya, Wisdom Tree and other local learning platforms exceeded 300 million, forming the largest online learning user group in the world. Especially in the field of AI assisted learning, China's landing application speed has been at the forefront of the world, more than 60% of college students have begun to use domestic generative AI tools to assist autonomous learning, and the popularity of AI Q & A, AI knowledge sorting, AI customized exercises and other applications is far beyond many developed countries [26-27].

Even local colleges and universities in underdeveloped areas such as Zhanjiang are also rapidly filling the digital short board in recent years: Guangdong Ocean University, south of the Five Ridges normal college and other colleges and universities have built intelligent learning space, and introduced a large number of state-level high-quality MOOCS resources, so that students in the school can share high-quality courses of domestic top universities, largely making up for the gap in regional higher education resources [27].

4.2 The application scenario of autonomous learning is highly popular

The autonomous learning scenario of college students in China has penetrated into the whole chain of academic development. From the review of basic courses, to the College English level 4 and 6 examination, postgraduate entrance examination, public entrance examination and other entrance examination for job application, and then to programming, design, new media operation and other professional skills. The Internet has become the primary channel for college students to acquire and expand knowledge. According to the survey data, 78.5% of the students interviewed said that they had learned content that was not covered in the classroom through the Internet, and 62.3% of the students thought that network resources effectively supplemented their professional learning [26-27].

Compared with developed countries, the penetration rate of mobile autonomous learning of Chinese college students is higher: Many students are accustomed to fragmented time on the commute, between classes, etc., through the short video platform and learning APPs to complete lightweight learning, the flexibility of the learning scene is far beyond the traditional PC end learning mode. At the same time, the domestic online learning community ecology is extremely developed, and the online punch in community of postgraduate entrance examination and skills covers tens of millions of college students. Peer supervised collaborative autonomous -learning has become a very common form [26].

4.3 Advantages of local characteristics in the process of development

China's "Internet +" autonomous learning has two unique advantages. One is the institutional advantage of focusing on major events. The construction of national quality MOOCS is promoted by the Ministry of education as a whole. The high-quality resources of top universities can quickly sink to all colleges and universities in the country, quickly reducing the educational resource gap between regions, which many decentralized western education systems can't do. The other advantage is the technology iteration advantage brought by massive users. The huge learning behavior data of college students in China provides an excellent soil for the training of AI adaptive learning technology. The localization adaptation speed of domestic AI learning tools is far faster than that of overseas similar products, which can better adapt to the learning habits of Chinese college students [25, 26].

5. The common features and differences of autonomous learning of college students at home and abroad

Through cross-national comparison, it can be found that "Internet +" autonomous learning of college students in different countries in the world are facing a series of common challenges in the whole industry, but also because of their respective cultural and institutional features, there are many unique differences [29-31].

5.1 Common challenges faced by all countries in the world

First, the natural conflict between algorithm logic and learning law. This is the core contradiction that Internet learning platforms in all countries can't avoid: The algorithm of commercial platforms naturally aims to improve the length of users' stay, and will continue to push low threshold and strong entertainment content, while the focus and deep thinking required by deep autonomous learning is naturally contrary to the recommendation logic of the algorithm.The average completion rate of MOOCS in the world is less than 20%. Even if it is the edX platform of the top universities in the United States, the course learning completion rate is less than 15%, and the vast majority of students can't stick to the end after signing up.

Second, the digital divide is expanding in layers. The digital divide has evolved from the early "whether there is a network, whether there is a device" access channel to the "can it be used, can it be used well" use channel and knowledge channel. Whether it's between the top universities and community universities in the United States, or between key universities and local colleges in China, students with different foundations and family backgrounds, the gap in digital learning ability is being further widened by the Internet, and high-quality autonomous learning resources may instead become the driver of increasing education inequality.

Third, the difficulties of knowledge system construction brought by fragmented learning. The popularity of lightweight content such as short videos has made college students around the world

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accustomed to the fast-paced learning mode of "learning a knowledge point in 1 minute", but fragmented information is difficult to help learners establish a complete structured knowledge system. Many students brush hundreds of learning short videos, it seems that they have learned a lot of content, but when it comes to solving complex professional problems, they find that they can't do anything and fall into a state of "more learning, more anxiety".

Fourth, the problem of academic integrity and learning effect evaluation. Online Autonomous Learning is divorced from the face-to-face supervision of teachers, and problems such as homework plagiarism, AI writing and exam cheating are spreading rapidly in colleges and universities in all countries around the world. The traditional learning effect evaluation system has been unable to adapt to the scene of Internet Autonomous Learning. How to objectively evaluate the real autonomous learning achievements of students in an open network environment is a problem that colleges and universities around the world are exploring.

5.2 Local differences in different countries

The core difference problem in the United States is the polarization of resource allocation: Students in top universities can get the top level of autonomous learning support in the world, while a large number of low-income family students in community universities can only access to low-quality commercial learning content. The gap between different levels of self-learning ability is growing, which further solidified the already serious educational inequality.

The core difference problem of the EU is the language barrier and the imbalance of regional development: A large number of high-quality learning resources in small languages cannot flow across countries, the digital infrastructure of the less developed member states in Eastern Europe cannot keep up with the pace of Western Europe, and the construction speed of the inclusive autonomous learning system of regional integration is far lower than expected.

The core difference problem in Japan is the innovation limitation brought about by the lack of openness: Although the low interference refined mode improves the solid degree of learning, it limits the channels for students to access the global cutting-edge interdisciplinary resources. The autonomous learning of college students is mostly limited in the established knowledge framework, and the innovation and exploration in interdisciplinary areas are relatively insufficient.

The local problems of Chinese college students' autonomous learning mainly focus on three aspects:

First, the short board of self-awareness brought by long-term exam oriented education. Unlike students in European and American countries who began to cultivate autonomous learning ability from senior high school, Chinese college students were in a state of strict arrangement by teachers and parents for more than ten years. After entering university, many students suddenly face a large amount of free time and massive network resources, and completely lose the ability of independent planning. The phenomenon of "resource hoarding pseudo learning" is very common. According to the survey data, only 28.3% of Chinese college students can take the initiative to develop long-term autonomous learning plans and adhere to them, which is far lower than the average level of EU countries.

Second, the structural dislocation of resource supply and demand. The total amount of online learning resources in China is the first in the world, but the gradient resources that adapt to the student of ordinary local colleges and universities are seriously insufficient. Many national level high-quality MOOCS are designed according to the ability of “985” and “211” college students, and it is difficult for students of local college to keep up with the pace. At the same time, a large number of cold door and subfield resources of characteristic professional are almost in a blank state. Therefore, the richness of total resources and the scarcity of resources in specific scenarios form a sharp contradiction.

Third, the support system construction of colleges and universities is lagging behind. The vast majority of colleges and universities in China have not opened a special digital autonomous learning guidance course so far. Many teachers lack of information technology ability. They still regard online self-learning as an additional task assigned to students, and do not integrate it with offline classroom teaching. When students encounter problems in the process of autonomous learning, it is difficult to get timely guidance and feedback.

6. Improvement path with Chinese characteristics by absorbing international experience

On the basis of fully absorbing the advanced experience of various countries in the world and avoiding the common development trap, combined with China's local conditions, a hierarchical improvement system adapted to China's College Students' autonomous learning was built from four dimensions.

6.1 At the individual level of Learners: building an advanced system of cultivating autonomous learning ability for Chinese students

The cultivation of autonomous learning ability of college students in China can't copy the model of European and American countries. It is necessary to combine the basic characteristics of students under the background of exam-oriented education and take a step-by-step path.

First, start from "Task-based autonomous learning" and gradually cultivate internal motivation. Don't ask students to fully explore freely at the beginning, but start with the online expansion task closely combined with the classroom, so that students can gradually experience the sense of achievement of independent exploration of knowledge in the process of completing the task, slowly get rid of the dependence on teachers, and finally establish a completely independent learning consciousness.

Second, systematically improves digital learning literacy. Take the initiative to learn the relevant skills of information retrieval, resource screening and knowledge management, learn to screen the high-quality content that adapts to their own learning needs and abilities in the massive network resources, master the method of using mind map and knowledge card to integrate fragmented information, and avoid falling into the "information maze". In addition, reasonably use AI tools as learning aids. Do not rely on AI to generate answers, but use AI to help themselves sort out the knowledge framework, solve problems, and improve the efficiency of autonomous learning.

Third, establish a sustainable learning rhythm of "fast running with small steps". Learning from the refined advantages of the Japanese model, don't set such vague big goals as "half a year proficient in a

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technology", but split the long-term goals into small tasks of 30-45 minutes per day, reduce the threshold of adhering to autonomous learning, replace short-term shock learning with long-term continuous learning, and avoid the problem of "three minute heat".

6.2 At the level of colleges and universities: to build a whole chain of autonomous learning support system with Chinese characteristics

Chinese universities should give full play to the advantages of the system, make up for the shortcomings, absorb the advanced experience of the world, and create a training system suitable for local students.

First, a special compulsory course "digital autonomous learning methods" is opened for freshmen. The information retrieval, resource screening, time management, AI tool use and other contents are included in the formal credit system. From the first day of enrollment, the students' autonomous learning ability is systematically cultivated, and the relevant ability training links missing in the basic education stage are supplemented. At the same time, excellent seniors in various fields are invited to share autonomous learning experience on a regular basis to create a good autonomous learning atmosphere in the campus.

Second, deepen the hybrid teaching reform and learn from the flipped classroom of MIT in the United States. Put the basic knowledge point learning online for students to complete independently, use the classroom time for difficult explanation, project discussion and practical guidance, and integrate the requirements of autonomous learning into the course assessment, rather than simply let students brush online courses to collect credits. For students with various foundations, design layered online autonomous learning tasks to avoid the problem of "students with good foundation can't eat enough, and students with poor foundation can't keep up".

Third, build a gradient of school-based characteristic resources. Develop exclusive online courses that adapt to various learning stages, focus on the rare subdivision resources of marine science, modern agriculture and other local characteristics and advantages, and make up for the coverage of national general resources. At the same time, improve the hardware support of campus autonomous learning, create intelligent learning space, and provide specialized digital learning guidance librarians in the library to provide one-to-one learning support services.

Fourth, establish a diversified assessment system of autonomous learning achievements. Changing the past evaluation mode of "one test, one score", include records of students' online autonomous learning process, project practice results, and interdisciplinary exploration results into the assessment scope, and guide students to value the process of autonomous learning with process evaluation instead of only focusing on the final exam score.

6.3 Platform and industry level: balance the commercial value and public welfare attribute of Education

Domestic Internet learning platforms should take the initiative to bear social responsibility, absorb the experience and lessons of global platform, and avoid the old road of "traffic only".

First, optimize the algorithm recommendation logic and launch a special "learning focus mode", and change the recommendation mechanism that only focuses on the length of stay. For users who are in the process of systematic learning, push extended resources matching their learning progress, shield irrelevant entertainment content, help students maintain their focus on learning, and reduce the interference from the technical level.

Second, build a systematic and localized learning path. According to the various foundations and specialties of college students, design a complete learning path from the entry to the advanced, integrate fragmented videos, exercises and Q & A services, and solve the students' pain point of "I don't know what to learn". Strengthen the content audit, clean up the low-quality, wrong and misleading content, and establish an authoritative learning resource certification system.

Third, improve the learning support service system. Each course is equipped with teaching assistants and AI answering robots to respond to students' questions in a timely manner, organize online learning community activities on a regular basis, enhance students' sense of participation, and improve the average learning completion rate of domestic MOOCS from less than 15% to more than 30%, in line with the international advanced level.

6.4 National and international coordination level: give full play to national advantages to build a global leading learning ecosystem

First, further promote the inclusive sharing of high-quality resources. Continue to increase the investment in the construction of national-quality MOOCS, improve the credit mutual recognition system between different universities, promote the quality resources of top universities to further sink to local colleges and universities in remote areas, use the power of the Internet to narrow the educational resource gap between regions, avoid the expansion of the digital divide, and achieve a higher level of education equity.

Second, optimize the social orientation of talent evaluation. Guide employers to change the evaluation guidance of "only education, only certificate", increase the proportion of the real ability in the recruitment process, so that the autonomous-learning ability truly becomes one of the core indicators of talent evaluation, and create a good atmosphere in the whole society to encourage lifelong autonomous-learning.

Third, actively participate in the digital governance of global education. It exports China's practical experience of "Internet +" autonomous learning and high-quality Chinese MOOCS resources to developing countries, and works closely with UNESCO and other international institutions to build a learning resource sharing platform for developing countries around the world, contributing China's program for the digital transformation of global higher education.

7. Conclusion and Outlook

Through cross-national comparative research, it can be found that the autonomous learning of college students under the background of "Internet +" does not have a universal standard answer. Different countries, based on their own educational traditions and development stages, have explored the characteristic path suitable for their own foundation, and also face different problems and challenges.

China's "Internet +" autonomous learning of college students, in infrastructure construction, AI technology landing and other fields, has achieved overtaking in the curve, with the world's leading hardware foundation, but there is still a lot of room for improvement in autonomous learning awareness training, support

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system construction and other aspects.We can't copy the model of Europe and the United States. Instead, we should fully absorb the advanced experience of the world and avoid the pitfalls, and walk out of a characteristic path in line with China's national conditions. In today's highly socialization, personalized and open learning environment, the research on college students' autonomous learning should pay attention to the following two points: one is how to effectively organize the massive resources, so as to effectively solve the problems of heterogeneous resource distribution and weak correlation between learning resources; The other is how to effectively solve the contradiction between learners' learning loss and cognitive overload, realize the efficient use of resources, and promote learners' active construction of knowledge and knowledge transfer [32].

In the future, with the further popularization of new technologies such as generative AI and virtual reality, the form of autonomous learning of college students will undergo further changes. As long as we give full play to our cultural, market and technological advantages, and continue to improve the support system of autonomous learning, we have a full chance to build the leading "Internet +" autonomous learning ecosystem all over the world, cultivate a large number of high-quality talents with strong lifelong learning ability, and provide China's practice samples with great reference value for the digital transformation of global higher education.

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