

Research on the New Mechanisms of Collaborative Development of AI Technology and Vocational Education Resource Sharing

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Abstract: With the rapid development of artificial intelligence technology, "Artificial Intelligence + Vocational Education" is receiving more and more national attention. Relying on AI technology to establish a vocational education resource sharing mechanism is an effective way to promote high-quality development of vocational education. At present, vocational education resources in China are scattered and unbalanced; the main body of resource supply is single, mostly undertaken by the state; the awareness of sharing among sharing subjects is weak; and due to the influence of economy and technology, high-quality vocational education resources are few and poorly integrated, and no structured resource database has been formed, which is widening the gap in education and is not conducive to educational equity. In response to these phenomena, this paper believes that the country should plan the policy of the coordinated development of AI technology and vocational education resources; establish a vocational education resource database and optimally integrate vocational education digital resources, so that educational resources become truly usable by learners and can be shared across districts and schools, narrowing the digital gap and promoting the balanced development of vocational education resources.

1. Introduction

In May 2019, the International Conference on Artificial Intelligence and Education with the theme of "Planning for Education in the Era of Artificial Intelligence: Leading and Leaping" was held in Beijing, and the important outcome of the Beijing Consensus - Artificial Intelligence and Education were released, which greatly demonstrated the bright vision of various countries for the synergistic development of AI technology and education. In 2020, as China enters a new stage of development and the transformation of various industries and economic industrial structure, higher requirements are put forward for the specification of the talents needed. Accelerating the modernization of education and the cultivation of innovative talents is undoubtedly an important strategic means for China to transform from a country with a large population to a country with strong talents and from a country with a large manufacturing industry to a country with strong manufacturing industry. As a kind of career-led education, learning and work are closely linked. The

high-quality teaching resources are the primary factor to ensure good learning. We should make full use of AI technology to promote the construction and high-level sharing of vocational education resources. Vocational education is work-oriented and is an important means to promote the employment of rural population and address the livelihood of the people. Vigorously develop vocational education, tilt high-quality vocational education resources to rural areas and developmentally weak areas, and promote the large-scale sharing and balanced development of vocational education resources, which plays an important role in realizing the rural revitalization strategy and improving people's livelihood. At present, the development of vocational education in China, especially in the context of artificial intelligence, is just in the state of "small lotus just shows sharp corners". So how to coordinate the development of AI technology and vocational education is a problem that we need to consider and solve urgently.

2. Current Situation and Dilemma of Vocational Education Resource Sharing

2.1. The Resources of Vocational Education Are Scattered and Unbalanced

According to the data released by the Ministry of Education on the National Secondary Vocational School Student Information Network in 2021, there are 7294 secondary vocational schools nationwide, with an enrolment 4.8899 million students, 13.1181 million students enrolled and 695400 full-time teachers in secondary vocational education. There are 1486 vocational (junior) schools, with an enrolment 5525800 students, 15.9100 students enrolled and 570200 full-time teachers. There are 32 vocational schools at the undergraduate level, with an enrolment 41400 students and 25600 full-time teachers [1]. Compared with the number of ordinary undergraduate colleges, vocational institutions are developing on a smaller scale, and the high-quality educational resources, such as educational concepts, teaching resources and teaching equipment, as well as the development of teachers' team is still in the early stage of development.

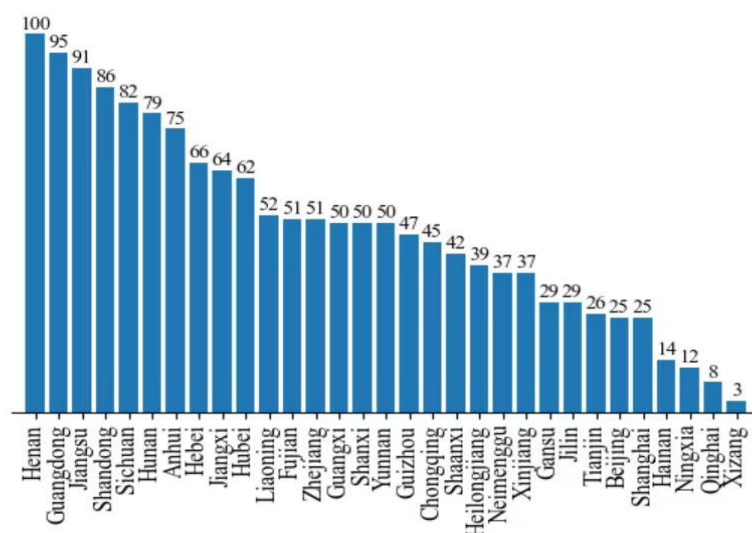


Figure 1: Bar chart of the distribution of vocational schools in all provinces in 2022.

According to a notice released by Sohu.com, by June 2022, there were 1522 higher vocational institutions nationwide, including 33 vocational institutions at the undergraduate level and 1429 vocational institutions at the specialist level (75.4% of public institutions and 24.6% of private institutions). The top three provinces in the number of higher vocational institutions in China are:

Henan Province, Guangdong Province and Jiangsu Province, with 100, 95 and 91 respectively. As shown in Figure 1.

Teachers are the key to promoting educational reform and innovation and providing a good education to the satisfaction of the people. The number of teachers is also an important indicator to measure the development of vocational education. According to the statistics of the 2022 Annual Report on the Quality of Higher Vocational Education, the average number of full-time teachers in 2021 is about 385, including 399 per school and 341 in private higher vocational institutions. From a regional perspective, the average number of full-time teachers in Henan is the highest, reaching 538; Guangdong ranks second with 529; and Shandong ranks third with 493. The average number of teachers in the above three provinces has increased by more than 15% compared with the figure three years ago, and the growth rate in Guangdong is estimated to be more than 20%, which is very large. According to statistics, the schools with more full-time teachers in higher vocational institutions are shown in Figure 2.

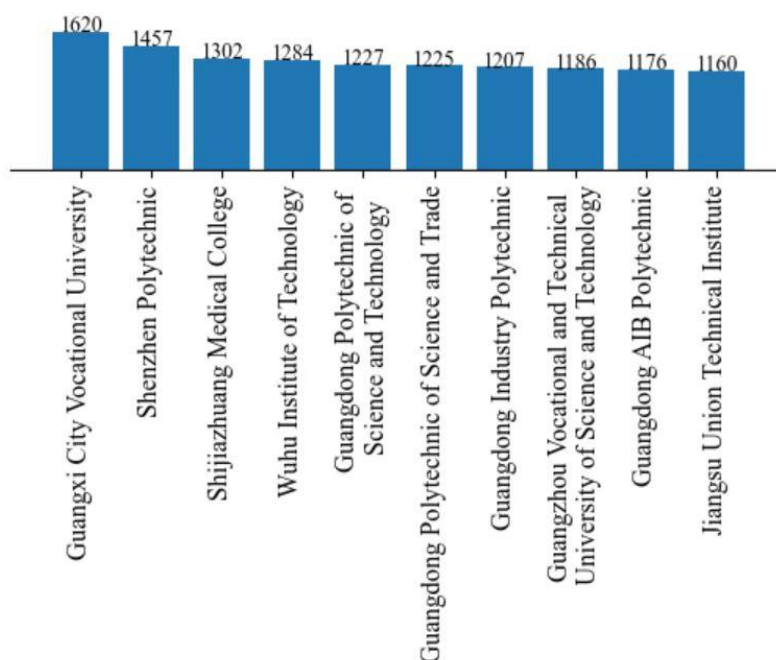


Figure 2: Some vocational colleges with a large number of full-time teachers.

It is not difficult to see the development of vocational education from the number of colleges, geographical distribution and the scale of full-time teachers. From the data of higher vocational colleges obtained above, it can be seen that most of the schools with large development scale and large number of teachers and students are concentrated in the central, southern and eastern regions with relatively developed economy and superior geographical location, such as Henan, Jiangsu, Guangdong, Sichuan, etc. Due to the geographical location and low economic development level, the number of higher vocational colleges in Xinjiang, Tibet, Qinghai and other western regions is relatively small, which restricts the development of vocational education.

2.2. The Main Body of Vocational Education Resources Supply Is Single

Vocational education is an important part of education ^[2], and the nature of education as a quasi-public product makes the public welfare of vocational education more prominent. Therefore,

vocational education resources have always been provided by the government. Enterprises and individuals that focus on economic benefits rarely participate in the supply of vocational education resources and have low enthusiasm. This makes vocational education, which is task-oriented and directly produces economic benefits, rarely supply resources to other subjects, and largely derails vocational education and the cultivation of talents required by enterprises. Especially in rural and remote areas, if we want to achieve cooperation between schools and enterprises, and promote the sharing of vocational education resources, we can only rely on the relevant policies issued by the government. The sharing mechanism is not perfect and the duration is not long. The sharing consciousness among the subjects who enjoy vocational education resources is weak, and the sharing barrier is high.

2.3. The Sharing Consciousness among the Subjects who Enjoy Vocational Education Resources Is Weak, and the Sharing Barrier Is High

For a long time, China's view of vocational education has been subtly influenced by the traditional idea of "learning to be an excellent person is an official". People's understanding, concept and acceptance of vocational education are low and different, which makes the sense of cooperation in the field of vocational education weak among provinces, cities, regions and schools, and the development of vocational education resource sharing mechanism lags behind other types of education. The government, enterprises, education departments and schools have jointly signed and issued a series of documents on resource sharing and cooperation, held various exchange and cooperation projects, and made some achievements in resource sharing to some extent. However, the sharing behavior is under pressure from the government. The "cooperation" adopted to complete the government work is not a spontaneous behavior between various units, enterprises and education subjects. Therefore, in the long-term practice of resource sharing, because all parties only care about their own interests, resource sharing is still in a low state, and there is a lack of overall awareness of resource sharing among individual subjects, leading to cooperation is only a form. "Thought is the guide of action". Only by reaching a consensus on resource sharing in thought can it not lead to lag in action. Therefore, only by mobilizing the enthusiasm of the subject who enjoys vocational education resources can we strengthen the sharing mechanism within vocational education, expand the scope of vocational education sharing, make resources "live", and promote the sharing and balanced development of vocational education resources.

2.4. There Are Few High-Quality Vocational Education Resources and Poor Resource Integration, and No Structured Resource Pool Has Been Formed

Compared with foreign countries, China's vocational education started relatively late, and the initial construction of the resource base was to informatise the typical and exemplary teaching resources. The 2018 edition of the Working Manual on the Construction of Teaching Resource Database for Vocational Education defines educational resources as "independent knowledge points or complete performance materials, complete structure and comprehensive attribute labeling" [3]. Although the existing resource pool has been accumulated for many years, the number of resources available for learners is not large. Zhou Yun et al. [4] found in their research that due to the low technology and manufacturing of educational resources.

3. A New Mechanism for the Coordinated Development of AI Technology and Vocational Education Resources

Based on the above situation, in order to better highlight the technical advantages of AI

education, promote the modernization and digitalization of vocational education, realize the sharing and balanced development of vocational education resources, and realize education equity, the following resource sharing coordination mechanism is proposed.

3.1. The State Strengthens Top-Level Design, Plans to Develop Artificial Intelligence Technology and Vocational Education Resource Sharing, and Favors Remote Areas

3.1.1. Strengthen Top-Level Design at the National Level

China has entered a new era, and high-quality development needs the support of a large number of highly skilled technical personnel. Promoting the sharing of vocational education resources between provinces and regions urgently needs to rely on the overall planning of national policies. We can formulate specific legal provisions for the sharing of vocational education resources, and tilt high-quality vocational education resources to areas with weak development and remote areas, which is more conducive to the solution and implementation of livelihood issues and rural revitalization strategies. The state can set up a special department to promote the sharing of vocational education resources, research and develop effective management models, rules and regulations, and feedback and evaluation mechanisms for the sharing of artificial intelligence technology and vocational education resources, so that the implementation subject has evidence and rules to follow.

3.1.2. The Local Government Has Set up a Promotion Office for the Sharing of Vocational Education Resources

First of all, the local government implements the decisions of the high-level vocational education resource sharing group according to the national guidelines and policies as well as the specific conditions of each region, develops a set of feasible resource sharing technical routes, organizes the development of various management, supervision and assessment systems for resource sharing, and assumes the daily management, supervision and assessment responsibilities. The local government shall formulate the credit mutual recognition system for vocational education. In recent years, the credit mutual recognition system has attracted the attention of the government and some colleges and universities. In the field of higher education in China, the research on the credit mutual recognition system is more and more in-depth, while the research on the credit mutual recognition system in the field of vocational education is relatively weak. The credit mutual recognition in China is mainly manifested in various forms of teaching alliances and exchange cooperation between neighboring schools or within the university city^[5]. For example, many schools in Beijing, Tianjin, Shanghai, Nanjing, Yunnan and other places use the adjacent geographical location and their own superior educational resources to mutually select courses and credit each other to realize the sharing of educational resources. Thirdly, the local government issued relevant incentive policies. Especially for enterprises, an appropriate amount of incentive policies will help to promote the enthusiasm of resource sharing. Enterprises are more advanced masters of AI technology. The participation of enterprises in the sharing of vocational education resources has largely enabled vocational colleges to understand the new trend of AI development, especially technology-oriented technology companies. Reward the enterprises that share resources and the units that promote the progress of resource sharing. After receiving rewards in resource sharing activities, they will participate in resource sharing more actively, enhance their awareness of the benefits of resource sharing, and promote the virtuous circle of resource sharing^[6]. Therefore, the government should formulate corresponding incentive strategies, formulate unified standards, give material rewards, subsidies or preferential policies to enterprises and individuals that have made outstanding

contributions and promotion in the process of resource sharing, and give warning or punishment to units and individuals that hinder or ignore the promotion of resource sharing, so as to improve the power of all sectors of society to actively participate in resource sharing.

3.1.3. The School Has Set up an Evaluation and Feedback Mechanism for the Sharing of Resources between Teachers and Students to Promote Virtuous and Recyclable Resource Sharing.

The supervision and evaluation is conducive to the timely development of unreasonable links and existing problems in resource sharing by resource sharing managers, and should guide teachers and students to timely feedback and evaluation in the process of operation. The resource sharing system is mainly aimed at teachers and students. The different effects of students' practice before, during and after class can be analyzed through the status data generated by students' learning. The teachers then provide targeted guidance and evaluation to students, and finally form an evaluation and feedback mechanism between teachers and students and between human and machine.

The resource sharing coordination mechanism is shown in Figure 3:

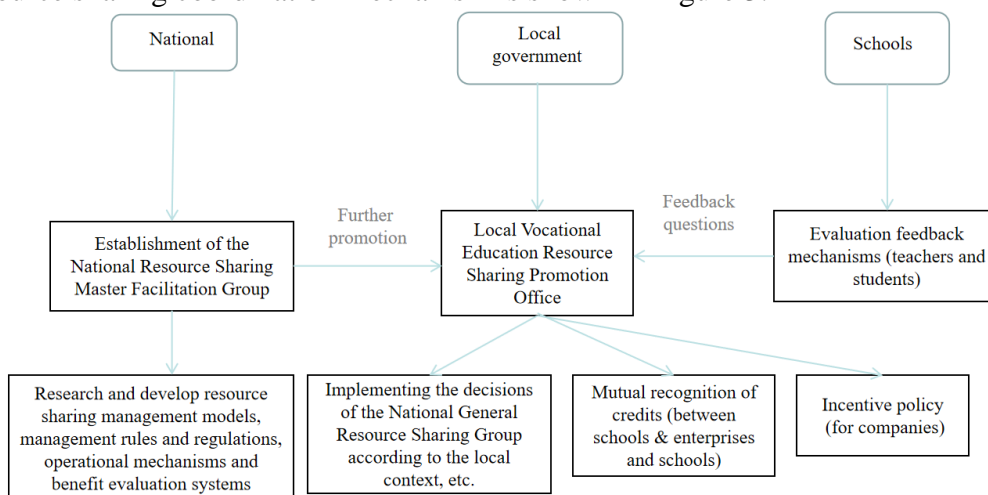


Figure 3: State-led AI technology and vocational education resource sharing and coordination mechanism.

3.2. Realize the Sharing of Vocational Education Resources by Using Artificial Intelligence Technology Based on Connectionism and Education Knowledge Map

In 2005, George Simmons, a Canadian scholar, put forward connectionist learning - a "learning view" facing the network era [7], and learning is no longer a personal activity, but a network of personal knowledge, which is incorporated into the learning system, and in turn, the knowledge of the learning system is fed back to individuals for learning, which emphasizes the connectivity of knowledge. Based on the connectionism, Rui Shen and others put forward "the construction mechanism of three-stage and double-role education resources". Among them, the three stages are: online stage, atlas stage and intelligent stage. Double roles refer to the cooperation between human and artificial intelligence [8].

3.2.1. Online Stage: Human-Computer Co-Construction to Enhance Knowledge Adaptability

The "growth" knowledge production mode is to input some information and conditions into the artificial intelligence system to generate new knowledge. The idea of changing to the education

knowledge map is to construct resources through the joint operation of human and machine. The work of human experts is mainly the construction of resource ontology and information annotation, and intelligent machines are responsible for knowledge acquisition and ontology construction. At the initial stage of establishing the educational knowledge map, the map improves the relevance and adaptability of existing teaching resources and the knowledge inside the machine, and ensures the accuracy of later retrieval by constructing ontology and human expert information annotation, as well as the use and collation of existing teaching resources. At this stage of knowledge acquisition, it is necessary to determine the source and acquisition method of data. The data source includes the existing teaching resources and the open network encyclopedia knowledge base, but the data in the open network is complex, so it is necessary to introduce human experts for knowledge verification and human-computer cooperation to improve the adaptability of knowledge.

3.2.2. Mapping Stage: Connect the Knowledge Built by Human and Machine, and Initially Form the Education Knowledge Map

In the last stage, the main work of intelligent machine is entity naming, relationship mining and knowledge fusion. At this stage, important information such as entities and their attributes in the atlas are determined through the ontology construction and information annotation of human experts and intelligent machines. Next, we should explore the entity relationship to build the education knowledge map.

3.2.3. Intelligence Stage: Build an Open and Shared Learning Environment, and the Intelligence of Knowledge Map Tends to Mature

In the intelligent stage, intelligent machines are used to draw user portraits based on educational knowledge maps and add high-level functions such as search functions. The user portrait at this stage not only counts the learning time, learning time and test scores of learners, but also recommends relevant learning content according to learners' learning behavior, builds their own knowledge map, and forms relevance-based learning. The educational knowledge map from the perspective of students' learning is a schematic representation of students' cognitive state. Students choose personalized learning paths and complete learning activities according to their existing knowledge level, interests and learning methods ^[9]. For example, the search of the "Internet of Things" in the knowledge map will recommend relevant content around the "Internet of Things", such as relevant cases and corresponding new technologies and knowledge, and form a relevant knowledge network centered on the entity. With the exponential growth of Internet information, the educational knowledge map can expand its content in an iterative way. This method uses core entities and their relationships to search in the knowledge base, extracts entities and entity relationships from the search results again, and then uses the extended entities and relationships between entities to search again, thus expanding the entire knowledge map ^[10].

At different stages of construction, the content of human-computer co-construction is different, which can be applied to different teaching scenarios through different educational and teaching activity carriers, forming intelligent teaching resources, and developing into a mature mechanism for sharing vocational education resources. The construction model of "three stages and two roles" is shown in Figure 4:

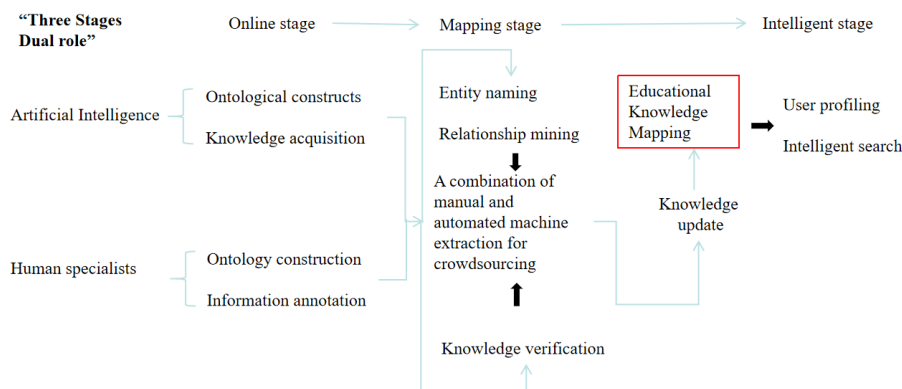


Figure 4: Construction model of "three stages and two roles".

3.3. Strengthen the Construction of Vocational Education Resource Database

The Ministry of Education has set up a major comprehensive reform project of the vocational education resource base after the release of the "National Demonstration Higher Vocational College Construction Plan", which is an important strategic choice to promote the cross-regional and cross-industry co-construction and sharing of vocational education resources, and gradually realize the full coverage of high-quality digital education resources in all disciplines. At the same time, with the mature application of AI technology, it is imperative to use AI to promote the construction of vocational education resource database.

3.3.1. Strengthen the Organizational Guarantee of Resource Database Construction

Vocational education belongs to cross-border education, and the construction of vocational education resource pool must involve multiple parties, including vocational colleges, enterprises, industries and other units with good professional construction foundation, so there must be strong organizational guarantee. The general leading group, resource pool co-construction and sharing alliance, construction joint docking group and expert group were established respectively. The general leading group is responsible for the overall layout, coordination, organization and implementation of all links of the project construction, and strictly control all major issues in the project construction. The general leading group can set up secondary working groups such as technical support group, financial audit group, supervision group, etc., to clarify the responsibilities of each group and promote in coordination. Secondly, the general leading group will take the lead in establishing the resource pool co-construction and sharing alliance. The alliance includes many units participating in the construction of the resource pool, industry associations, institutions, enterprises and relevant government departments promoting the construction and application of the resource pool. The Alliance is responsible for studying and formulating the standards, curriculum system and content of the resource pool curriculum resource construction, sorting out the resource pool courses that can be applied together according to the professional talent training program of the universities in the Alliance, and clarifying the content and presentation form of the resource construction according to the actual situation and needs. Third, set up the construction joint docking group. The docking team plays the role of "middleman" in the general leadership team and colleges and universities participating in the construction of the resource pool. The docking working group is composed of course directors, enterprise technicians and information technology teachers of colleges and universities. The docking working group is responsible for the implementation and timely feedback of various work tasks, data reports and other matters of the co-construction

colleges and universities, and continues to follow up to ensure the timely implementation of all work, so that the co-construction colleges and universities can keep pace with the general working group. Fourth, hire experts to form a special guidance team. The expert group is composed of enterprise industry experts, discipline experts, information technology experts, etc. It can effectively guide and evaluate the top-level design and resource construction of the database.

3.3.2. Establish a Unified Quality Standard for the Resource Database

First of all, we should ensure the integrity of educational resources, the comprehensiveness of all kinds of educational resources, and the standardization of resource naming. Secondly, the quality standard should strengthen the rationality of the knowledge presentation and the scientificity of the content in the curriculum resources. Avoid making up the number of resources and playing sidelines. Resource types usually include text, audio and video, virtual simulation and other materials. For example, video materials often appear in the form of "micro-class", with complete content, and are used to explain knowledge points. Institutions with good professional construction foundation can make various resource templates for reference.

3.3.3. Strengthen the Full-Time Training of Teachers and Improve the Awareness of Building and Using Databases

Teachers are the main body of the construction of the resource base, and their ability and level directly affect the construction effect of the project. At the initial stage of construction, teachers should be familiar with the objectives, paths and contents of the construction of the resource base through systematic training; In the middle of construction, we will combine learning and training with resource review and inspection to correct the problems in the construction process in time and ensure the quality of resources. During the application and promotion period of the resource database, teachers need to systematically learn how to use courses across schools, especially to carry out experience exchange and work discussion on the cross-school selection of courses among colleges and universities, so as to improve the promotion effect of the resource database.

3.3.4. Improve Credit Mutual Recognition and Deepen Inter-School Resource Sharing

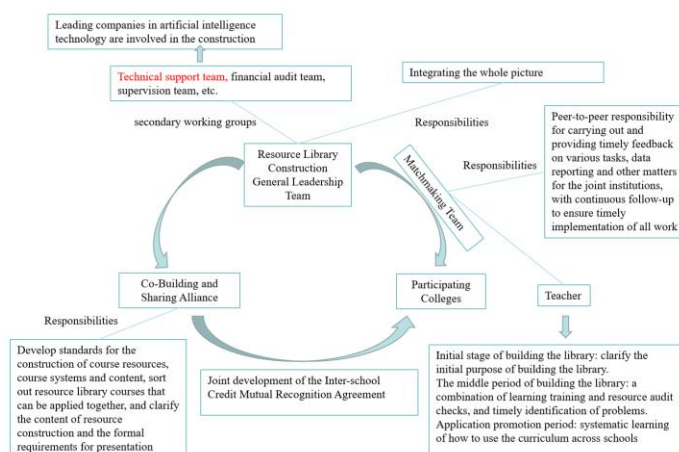


Figure 5: AI technology helps vocational education share education resource database construction.

The co-construction and sharing alliance should organize all participating institutions to jointly discuss and formulate the Intercollegiate Credit Mutual Recognition Agreement, reach a consensus on cooperation and sign a contract. Students can obtain credits through online learning resource

library courses, which are regarded as valid scores for colleges and universities in the alliance. On the credit mutual recognition platform, according to the data generated by students' learning behaviors, AI technology can be used to analyze students' learning preferences and weaknesses, and through intelligent analysis strategies and reasonable evaluation mechanism, students' learning achievements can be identified to create conditions for credit mutual recognition in colleges and universities. The construction of the shared resource pool promotes the sharing of vocational education resources.

The operating mechanism is shown in Figure 5.

3.4. Accelerate the Development of Digital Education Resources in Vocational Education and Promote the Balanced Development of Education

Due to the continuous progress and innovation of science and technology, China has ushered in a new upsurge of digital driven development. The implementation of the new infrastructure is centered on the new generation of information technology such as artificial intelligence, big data and 5G, which has a significant impact on the upgrading and structural transformation of all industries. In 2018, the Ministry of Education released the Education Informatization 2.0 Action Plan, pointing out that China's education should follow the trend of the times, build a large platform of "Internet plus education" ^[11], and achieve efficient sharing of educational resources. As an important type of education, in the era of new education infrastructure, vocational education should also actively seek the development path of digital education resources, transform vocational education resources from single and uneven distribution into vocational education resources that everyone can learn, can learn at all times, can learn everywhere, and promote the sharing and balanced development of vocational education resources. The key point of resource sharing is how to use resources. Only high-quality education resources are the basis of sharing. A new mechanism of vocational education resource sharing that cooperates with artificial intelligence technology can be established from five aspects: the initial construction of resources, the formation of resource system, the effective management of resources, the effective application of resources, and the late supervision of resources.

3.4.1. Preliminary Construction of Resources

The construction of resources can be started from the macro and micro levels: at the macro level, actively call on the government, schools, industries, enterprises and other resource providers to participate in the construction of vocational education digital education resources, integrate and optimize high-quality education resources, the government plays the role of coordinating all parties, enterprises provide technical knowledge and technology, and schools are the main resource users, The construction of the resource pool should realize the complementary advantages and win-win cooperation of all subjects, and promote the circulation and sharing of digital education resources across regions, cities and towns, and schools; At the micro level, guide individual teachers and students to actively build online collaboration mechanism.

3.4.2. Form a Resource System

From resource construction to the formation of a complete education resource system, technology-driven development is the key. As a technical means, technological innovation provides a technical means for building a resource sharing platform and resource pool. For example, the virtual reality technology is used to develop immersive experience digital education resources, the artificial intelligence technology is used to create human-computer collaborative digital education resources, and the knowledge map technology is used to reorganize the resource structure ^[12].

3.4.3. Effective Management of Resources

We can integrate high-quality educational resources through the use of modern technologies such as artificial intelligence technology, and semantically divide educational resources through subject knowledge map technology and educational knowledge map technology, so as to make the resource division precise and easy to manage. The convenient search and accurate push of resources provide accurate and personalized learning resources for learners, provide visual data for teachers' guidance, and turn the sharing of vocational education resources to intelligent and personalized.

3.4.4. Effective Application of Resources

During the COVID-19 epidemic, "class suspension", "air class", etc. have made full use of digital education resources. Especially for vocational education, the virtual reality, augmented reality and image recognition of AI technology can enable learners to immerse in learning, improve learning enthusiasm and consolidate learning effect. Mixed teaching will become the mainstream of classroom teaching. Digital educational resources can promote the balanced development of education, narrow the teaching gap between regions, urban and rural areas, and schools to a certain extent, and promote the sharing and balanced development of educational resources. For example, natural language processing, speech recognition and other technologies of the intelligent teaching assistant platform can conduct composition evaluation and correction, and human-computer interaction.

3.4.5. Post-Resource Supervision

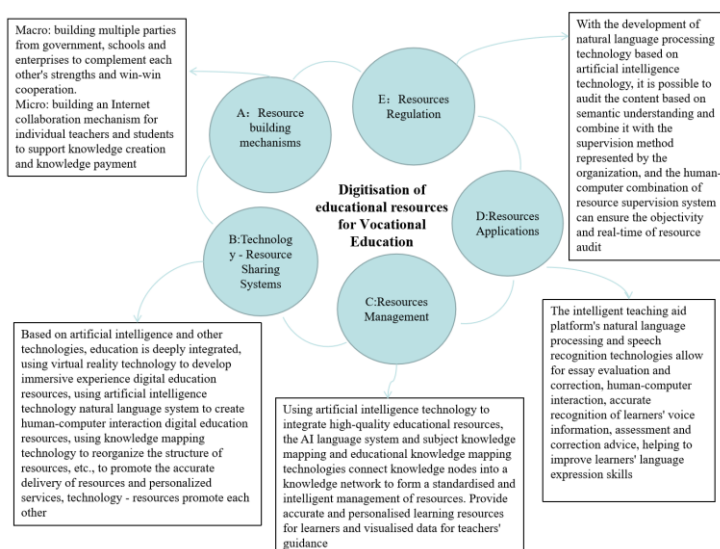


Figure 6: New mechanism of artificial intelligence technology for the construction of digital education resources in vocational education.

With the development of artificial intelligence technology and natural language processing technology, its content audit application based on semantic understanding has matured. The supervision of digital resource construction can take the supervision mode represented by organizations and the supervision mode combining artificial intelligence technology and natural language processing technology. The human-machine resource supervision system, on the one hand, can ensure the effectiveness, objectivity and timeliness of educational resources, on the other hand, it also reduces the pressure on human resources, and is a new idea to promote the development of digital educational resources to standardization and intelligence.

The resource sharing coordination mechanism is shown in Figure 6.

4. Conclusion

The development of "artificial intelligence+vocational education" is still in the initial stage of development, and will affect the direction of vocational education in the future. Due to the influence of the traditional Chinese concept of "learning to be an excellent official", the public's view, attitude and acceptance of vocational education are not as good as that of general education. In recent years, the enactment of the Vocational Education Law has provided policy guarantee for the its development. As a quasi-public product, vocational education needs the country to strengthen the top-level design, and the national government departments should take the lead in coordinating the advanced artificial intelligence technology of enterprises, and enterprises and schools should coordinate the talent training objectives, and improve the diversified modern school-running pattern. The continuous integration, innovation and development of "AI + Education" provides technical support for the sharing of vocational education resources. In the teaching process, AI technology will be mainly used in automatic evaluation and feedback, immersive learning, human-computer interaction and feedback in a game-based environment, which will help deepen the reform of vocational education and share resources on a wider range.

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