

Cultivation of Personalized Talents Based on Education Big Data

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Abstract

With the rapid development of big data and information technology, although education big data has brought great impact to the traditional higher education mode, it also provides opportunities for the cultivation of personalized talents in colleges. Using qualitative research method, the necessity and feasibility of building a personalized talent education system is demonstrated based on the multiple intelligence theory. According to the value co-creation theory, the roles and functions of educatees, teaching units, employment units and big data service providers are analyzed in the educational value chain of "teaching-learning-using", and a multi-subject interaction cycle mode of personalized talents education is concluded. On the basis of the Deming cycle theory, the education process is divided into 3 stages of design, operation and adjustment, then the 3 stages are subdivided into 5 links including position, modeling, implementation, portrait and feedback, and a multi-link coordination cycle mode of personalized talents education is discussed. At last, a dual-cycle mode is proposed by integrating the education subjects and process, and the guarantee measures are given for the education system operation.

Keywords

Education big data; Multiple intelligence; Value co-creation; Deming cycle; Personalized talents.

1. Introduction

"I beg Old Man Heaven to bestir himself, and send down talents of more kinds than one", the cultivation of personalized talents has attracted more attention since ancient times, in the era of knowledge economy, the industries are booming and the division of labor is meticulous, which makes the domain experts and personalized talents play an unparalleled important role in economic construction. The cultivation of personalized talents has become an important issue in the development of the new era.

Education big data is the product of education informatization. The education informatization refers to the application of computer network information technology in the field of education to promote the comprehensive reform of education, which will make the education adapt to the new requirements of informatization society for education development. At present, the focus of education informatization has shifted from the construction and application of "things" to the diversified needs and services of "people", which puts more emphasis on the innovative development of education supported by information technology, rather than the simple application of information technology.

With the rapid development of education informatization, big data and intelligent information technology have promoted the intelligent construction of education ecological system, and they have made great changes for education mode, such as making education resources richer, education scenes more diverse, teaching methods more vivid, course selection time more free,

and teacher-student interaction more real-time. We believe that there is a close relationship between education big data and personalized talents education, and the value of education big data can not only be used to present the results of test, but also be used to identify students' efforts in the learning process, find students' diversified learning ability, describe students' learning growth track and stage level, and cultivate students' personality advantages. Therefore, the purpose of this article is to explore how to comprehensively and effectively use the education big data generated in the process of education informatization, strengthen the guidance of personalized education, and construct a personalized talent education system under the ability value system of social identity.

2. Literature Review

Education big data is directly generated from various education activities. Compared with traditional education data, the collection of education big data is more real-time, coherent, comprehensive and natural. Its sources are more complex and diverse, and the application is more extensive, deep and personalized. Establishing a personalized talents education system based on education big data is the inevitable trend of future higher education.

At present, the research on education big data mainly focuses on three themes. The first is discussing the importance of big data thinking in education process. The second is exploring the feasibility and measures of the combination of big data, network information technology and higher education. The third is considering the information construction and teaching reform of specific majors or courses. On study of personalized education, the relevant research and practice mainly focus on environment building, platform development, resource construction, and personalized learning recommendation. For example, Martinez (2001) pointed out that most of online personalized learning programs ignored learners' emotion and intention factors, put forward suggestions on how to adapt to e-learning by analyzing the differences in learning methods and the reasons for learning success [1]. Vandewaetere and Clarebout (2014) summarized advanced technologies, models and methods supporting personalized learning, teaching and effect evaluation, emphasizing all information related to learner's knowledge, emotion and behavior [2]. Tadesse and Davidsen (2019) divided the teaching process into steps of determining teaching design, learning tasks, teaching methods and teaching technology, then designed an online interactive learning system around these steps for students to better learn complex system theory [3]. Jia Tong and Gu Xiaoqing (2021) expounded the significant impact of current data technology on educational organization mode, educational service mode and educational teaching mode, and called for attention to the education process reengineering and innovation driven by data technology [4]. Based on the platform ecosystem theory, Li Suli and Xu Xiaodong (2021) discussed the construction path of education data resource service ecosystem around data service mode, open service platform, developer service ecology and industrial development alliance [5]. Yang Lina et al. (2020) used qualitative research method to study the personalized learning service mechanism from three levels of design, implementation and evaluation, and constructed a personalized learning service system [6]. Although these studies can enrich the research of personalized education and learning from different aspects, they only involve the narrow perspective of "teaching and learning". However, considering the complete process of service-oriented production and operations, "teaching and learning" only relates to the "input" and "transformation" stages, and the "output" stage is not discussed. The output stage belongs to the value realization and evaluation stage of higher education effect, and is the link of talent cultivating and using. The lack analysis of this stage may lead to the above research only explaining the educational value in the process of teacher-student interaction. Therefore, this article adopts the qualitative research method to carry out the research on the multi-subject interactive personalized talent

education system based on education big data according to the complete higher education value chain of "teaching-learning-using".

3. Design of the Personalized Talent Education System

Higher education is an education process combining knowledge dissemination and soul shaping. It is not reading in a narrow sense, but refers to the internal and external cultivation of ideological enlightenment, personality awakening, mind shaping and so on. It is not only a process of knowledge acquisition, but also a process of realizing social value. Therefore, we should achieve our goal of personalized talent cultivation accord with the social expectations and the rules of higher education.

3.1. Theoretical Foundation

(1) Multiple intelligence theory. Traditional intelligence theory believed that human cognition was unitary, and individual intelligence was single and quantifiable. Howard Gardner, a famous educational psychologist, proposed that intelligence was the ability of individuals to solve practical problems or to produce and create effective products under the value standard of social or cultural environment. Everyone had at least linguistic intelligence, logical and mathematical intelligence, musical intelligence, spatial intelligence, physical exercise intelligence, interpersonal intelligence, introspection intelligence, or natural intelligence. This theory is called Multiple Intelligences [7]. According to the theory, there is no simple intelligence and no only way to achieve goals. Everyone will use their own way to explore their own brain resources. This kind of individual intelligence to achieve goals is the real intelligence. The difference of individual intelligence also leads to the difference between people. The theory illustrates that our education should focus on the cultivation of multiple intelligences, rather than unified standard of talents. We should identify and cultivate students' personality in the value system recognized by the society and maximize their individual advantages.

(2) Value co-creation theory. Value co-creation refers to the process in which participants jointly allocate, exchange, integrate and utilize resources through direct interaction to create new value beneficial to at least one party. The concept originated from Ramize (1999)'s idea of value co-production, he focused on the interaction between enterprises and consumers, believed that value was created in their interaction process, and explained the co-production process of value in the production field [8]. Then Prahalad and Ramaswamy (2000) proposed that the personalized consumption experience created by consumers and enterprises together was the core of realizing value co-creation, and formed the value co-creation theory based on consumer experience logic [9]. Vargo and Lusch (2004) believed that all economic activities in the market belonged to the service economy. In the process of service exchange, customers were partners of enterprises, enterprises and customers provided services to each other, the value was created by integrating the resources of both enterprise and consumers, and a value co-creation theory based on the service-dominant logic was formed [10]. Since then, Grönroos (2008) and Heinonen et al. (2010) elaborated value co-creation theory based on service logic and customer-dominant logic respectively [11, 12]. Although these studies enrich the theory of value co-creation, the focus of interaction process still remains on the dual relationship between enterprises and customers. Finally, Vargo et al. (2016) expanded the scope of value co-creation under the service-dominant logic, proposed the concept of "service ecosystem", focused on the resource interaction under the complex network systems, and highlighted the interaction and value co-creation among multiple participants in socio-economic networks [13]. The research perspective of interaction process changes from dual situation to multiple relationship, which makes a foundation for us to explain how multi-subject participate in value co-creation in the higher education network system.

(3) Deming cycle theory. Deming cycle is an important analysis tool in quality management. Its working principles can be summarized into 4 steps and 8 links. The 4 steps include plan, do, check/study and act. These steps can be subdivided into 8 links, including finding out the existing quality problems, analyzing the causes and influencing factors, distinguishing the main influencing factors, formulating measures to improve the quality, implementing the plan or measures, checking the implementation effect of the plan, summarizing the experience and putting forward the unsolved problem. The 4 steps constitute an external large cycle, the 8 links constitute an internal small cycle, and each group of small circle is embedded in each large step. The management process will work step by step, and link by link. After each cycle, the process will start a new circle again, then the quality management will be improved to a higher level [14]. Using Deming cycle to plan higher education process can provide quality guarantee for the cultivation of personalized talents.

3.2. System Construction

3.2.1. Multi-subject Interaction

According to the relationship between supply and demand, the educational value chain includes at least four stakeholders: educatees, teaching units, employment units and big data service providers. Educatees refer to the objects of education and training, specifically college students receiving higher education. Teaching units refer to the organizations or institutions that provide higher education with teachers as the main body. The teaching units in this article specifically refer to colleges and universities. Employment units are the social organizations or enterprises that provide employment opportunities for graduates. Big data service providers refer to professional institutions or enterprises that provide big data information solutions such as platform design, data analysis and data management, and specifically refer to the big data service providers involved in the education industry in this article. According to the supply-demand matching relationship in "teaching-learning-using", the four stakeholders form a multi-subject interaction network structure, see Figure 1. The interaction among each subject not only completes their own interests, but also realizes the social significance of education value, which is consistent with the value co-creation theory of multiple subjects.

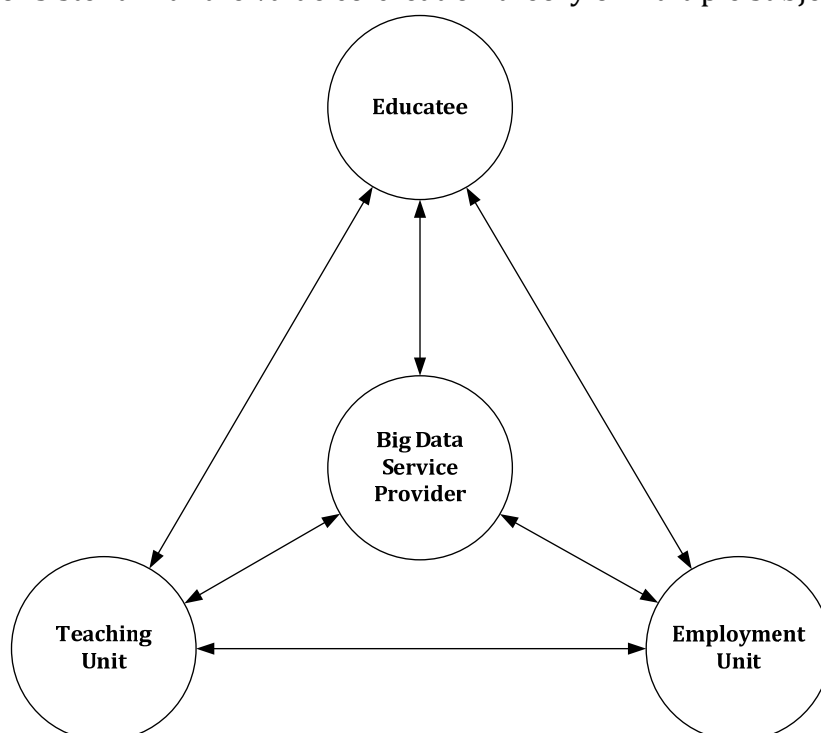


Figure 1. Multi-subject interaction in personalized education

(1) Node analysis. In the process of traditional higher education, teaching units are responsible for the education of college students. Employment units provide employment opportunities for college students and complete talent selection and subsequent development training. Educatees cooperate with colleges and employment units to complete education, training, and work tasks of each stage. The role of professional big data service providers is not obvious during this period, and a large amount of data and information management work is completed by stakeholders themselves. With the advent of big data era, the roles and functions of higher education have changed. In the process of education informatization, educatees, teaching units and employment units are still the core subjects of the educational value chain. However, with the improvement of the data specialization, customization and outsourcing of big data services become possible, and the roles of big data service providers are increasingly prominent. It receives most of the information services from the education stakeholders, such as recording the whole process of learning, discovering students' personality, understanding the students' real learning state and so on.

(2) Connection analysis. Due to the existence of information barriers, there is a horizontal chain-styled relationship among the traditional higher education stakeholders of teaching units, educatees and employment units. In general, it shows a two-stage relay education characteristics of learning before using. Teaching units help educatees complete their degree education, then the educatees look for suitable employment units to obtain jobs. While with the development of education informatization, the emergence of big data service providers has brought three changes to higher education. First, the information communication among multiple subjects becomes easy. Second, value co-creation among multiple subjects becomes possible. Third, information mining among multiple subjects becomes important. Therefore, the relationship among the stakeholders presents an interactive network characteristics and has become so complex. The connection pattern of stakeholders in the educational network includes not only single point connection, but also multiple point connection. For example, in the process of teaching and learning, teaching units are the producers of educational products, and educatees are the consumers and experiencers of educational products. In the process of talents using and allocation, employment units are the evaluators and users of the educational products, and educatees are the final products of higher education. Big data service providers are the suppliers of data services and teaching tools in the whole education process, and teaching units, educatees and employment units are the experiencers of big data services. These complex relations can be explained and managed by the theory of value co-creation.

3.2.2. Multi-link Collaboration

The production and operations system is composed of people and machines, which can convert a certain input into a specific output. Production and operations management is the planning, organization and control of the system and its activities, including the management of system design, system operation and system improvement [15]. Higher education transforms high school graduates into senior professionals through the education process, which is a typical service-oriented production and operations activity. The teaching and management process of higher education also conforms to the general law of production and operations management. Therefore, the higher education process can be divided into three stages: design, operation and adjustment. Design is the stage of formulating the goal and program of personalized talent education. Operation is the specific design and implementation stage of the education plan. Adjustment is the stage of comparison and optimization of education effects. In addition, in order to ensure the quality of personalized education, the 3 stages can be divided into 5 specific links according to the theory of Deming cycle, including position, modeling, implementation, portrait and feedback. The final personalized talent education process includes 3 stages and 5 links, as shown in Figure 2.

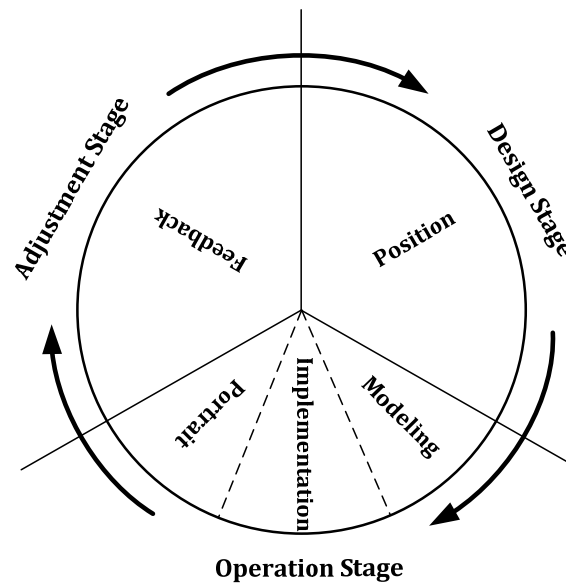


Figure 2. Multi-stage collaboration in personalized education

(1) Position. This link corresponds to the system design stage of production and operations management, focusing on the input tasks of the higher education system, mainly including determining the training objectives and growth direction of personalized education and clarifying the roles and functions of each stakeholder. Education big data has changed the traditional teaching mode and teaching relationship. On the one hand, the traditional higher education mode only focuses on the examination results of college students, and the education big data generated in the process of education informatization has not been fully used. On the other hand, there is a passive relationship among teaching, learning and using in the traditional higher education mode. For example, teachers pay too much attention to the teaching of book knowledge, employment units don't participate in teaching, and students don't know why to learn. There is an asymmetry problem between supply and demand of education information. Education informatization breaks the information island, and stakeholders can achieve barrier-free information communication. With the help of big data service providers, teaching units can better understand the learning needs of students, and educatees can also clearly understand the employment requirements of employment units, which will make the goal and value position of higher education more clearer and targeted. In this link, we should allow stakeholders to fully interact and design the personalized talent education objectives according to specific major characteristics, and construct the ability training system to make the personalized talent education have rules to follow. For example, Peng Lei and Yang Lv (2015) refined and summarized the professional ability evaluation system of law science students [16]. In addition, the tasks and roles of all stakeholders in the education process should be further clarified to ensure the cooperation in subsequent links.

(2) Modeling. This link is the detailed design stage of personalized education program, involving the formulation and implementation of educational content, teaching methods, assessment details and evaluation standards, which corresponds to the beginning stage of the production and operations management. Education big data is the key factor influencing the implementation of personalized education, and it is also the data basis for depicting the learners' personality, and evaluating their learning effect. Baced on the study of Yang Lina et al. (2020) , we divide personalized education big data into three types: learning process, situational perception and learning preference. Learning process big data can be used to master and judge the progress and degree of learning, involving learning behavior (browsing, speech, notes), practical testing (practice, testing, examination), learning effect (experience, reflection)

and other data. Situational perception big data is information that records learning needs and attitudes, such as learners' demographic information, use information (place, time, frequency), learning objectives and content selection. Learning preference big data mainly records learners' evaluation and emotional information about teaching resources. In order to analyze the learners' study habits and preferences, we should pay attention to the use of learning resources (download, upload, share, comment) and learning interaction (question, answer, identification) and other related contents. We can design teaching programs and modulators around the above three types of big data information. The richer the education big data is collected, the more detailed the learners' personality and learning effect we will get. However the above data types are only a summary of experience. In the actual teaching process, we can formulate a more specific teaching contents, interaction tasks, scoring standards and data modules according to the education objectives and programs.

(3) Implementation. This link is not only the implementation stage of personalized talent education, but also the generation and collection stage of education big data. In this link, we will arrange teaching work according to the previous designed teaching module, and complete the collection and monitoring of relevant education big data. The main task of this link is to complete the education program and arrangement with high quality. According to different curriculum contents and ability training needs, the teaching content can be flexibly completed using various teaching methods such as online self-study, offline teaching or mixed teaching can be flexibly used to complete the teaching content, and the teaching theme and teaching scene can also be changed according to the learning needs. For example, employment units participate in teaching or provide employment oriented training. Two principles can be followed in this link. One principle is the flexibility of teaching methods. We should make full use of the education information platform, do well in the inheritance and replacement of old and new teaching methods, and in the interaction and combination of various teaching methods. The other principle is the interaction of education stakeholders. We should promote the cooperation of various stakeholders, enrich the learning materials, ensure the possibility of personalized learning, and make a foundation for follow links.

(4) Portrait. This link is the effect evaluation and visualization stage of personalized education, and its task is the application and processing of education big data. This link will make a "user portrait" analysis for each educatee. The "user portrait" refers to the labeling of user information. It is the users' feature extraction and demand analysis based on data mining, and also is a personalized service generated around "user-centered" in the big data era. The label model is a product abstracted from users' social attributes, living habits, consumer behavior and other information [17]. In order to analyze education big data, we can select mature portrait technology according to the data modules and data characteristics of personalized education, or we can design our own methods. Here we introduce a quantitative recognition method (Liu Sen and Zhao Xi'nan, 2018) [18], which can deeply excavate and characterize learners' individual advantage characteristics. Based on the comprehensive evaluation technology, this method endows the indicator weight with new significance of personalized advantage tendency, and proposes a recognition model for personalized advantage feature. When the evaluation indicators (from the ability training system and teaching modules) and value utility function are given, based on the education big data, we can calculate a set of indicator weights to show the best learning effect from the perspective of being most beneficial to each learner, and the indicator weights can describe their personalized advantages. The indicators with large weight are the aspects having personalized advantages, and different combinations of weights reflect the different learners' personalized advantage structures. In order to comprehensively describe the learning dynamics and characteristics of the educatee, the user portrait work should include two types data analysis of phased and whole process.

(5) Feedback. This link corresponds to the system improvement stage of production and operations management, and its task is to evaluate the effect of personalized education and adjust the education program. Compared with traditional education mode, test results are not the only standard to evaluate students in our mode, and we should also pay attention to the achievement of the ability development indicators. Evaluating the professional quality of educatee is as important as the personalized learning results. This link includes two main tasks. One task is to evaluate and feedback the learning effect. We should summarize the phased learning results and the final learning results according to the big data portrait, draw the corresponding learning growth curves and target achievement degrees, and feedback the growth suggestions to all educatees. The other task is to adjust and correct the teaching program. According to the original educational objectives and teaching orientation, on the one hand, we should analyze the reasons for unfinished objectives, adjust the curriculum, and redesign the education goal and ability training system. On the other hand, we can summarize the successful experience of goal realization, analyze the possibility of effect improvement, and consider the further optimizing of ability training system. In short, this link should do well in the mining and application of big data analysis, make a perfect connection with the position link to form a closed-loop cycle, and ensure the personalized talent education process will run cycle after cycle and keep continuous improvement, see Figure 3.

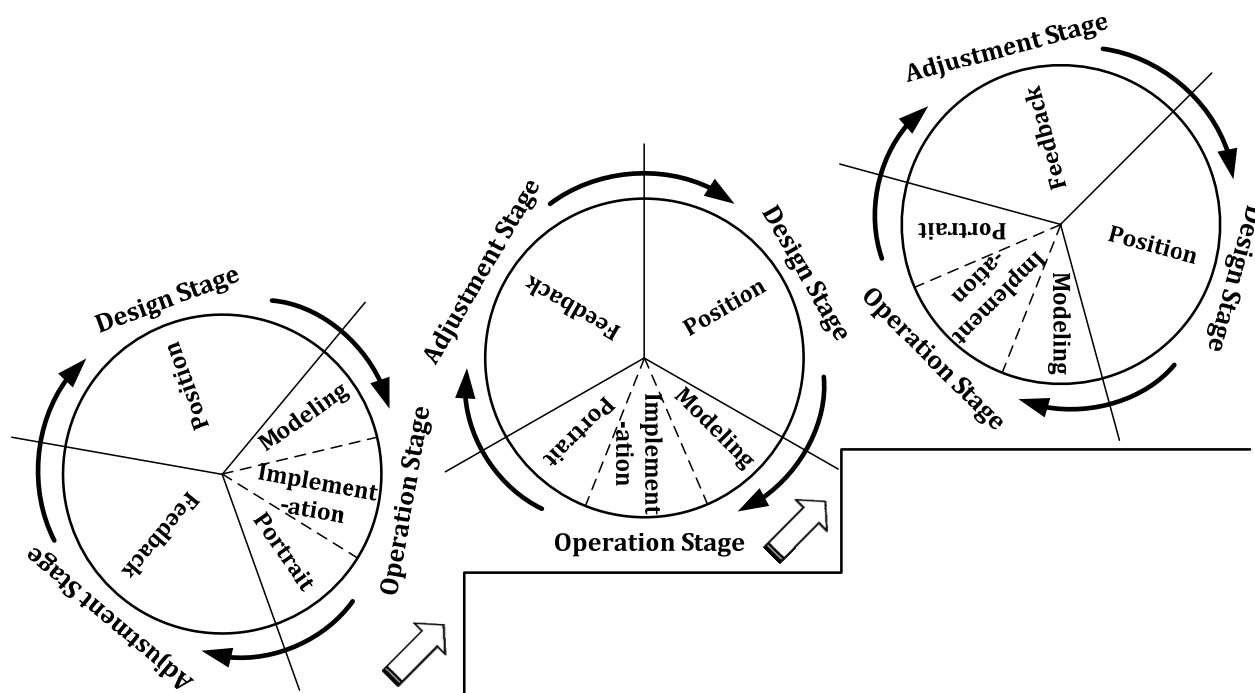


Figure 3. The rise of each stage of personalized education

3.2.3. Dual-cycle System

(1) Operation mechanism. The personalized talent education system based on big data integrates multi-subject interaction cycle and multi-stage collaboration cycle. The education system operates according to 3 stages and 5 links in the interactive network composed of four stakeholders. In the internal cycle, 3 stages and 5 links circulate step by step, round by round, and the cycle process is constantly discovering and solving problems, to ensure that the quality of personalized talent education is continuous improvement. In the external cycle, with the improvement of the quantity and quality of big data services, big data service providers, educatees, teaching units, and employment units break the information island, and the value co-creation relationship in the educational value chain is also increasingly enhanced. According to the value co-creation theory and practice, the four stakeholders also act on the operation of 3 stages and 5 links, whenever in the design, operation, and adjustment stage of education

system, or in the position, modeling, implementation, portrait, control link, they participate in the whole process just with difference roles and functions. For example, during the design stage, in order to formulate a scientific education plan, teaching units can design preliminary teaching content and plan according to the major characteristics and teaching experience. Employment units can join and provide their employment standards and even participate in talent customized education. Educatees can also express their learning expectations and future career ideals. Big data service providers can take advantage of data analysis to provide information interaction, analysis results, decision suggestions and other services. The four stakeholders reach an agreement through consultation and interaction, and the situation is the same in other stages. In short, the education system is driven by the joint interweaving of internal and external cycles, as shown in Figure 4.

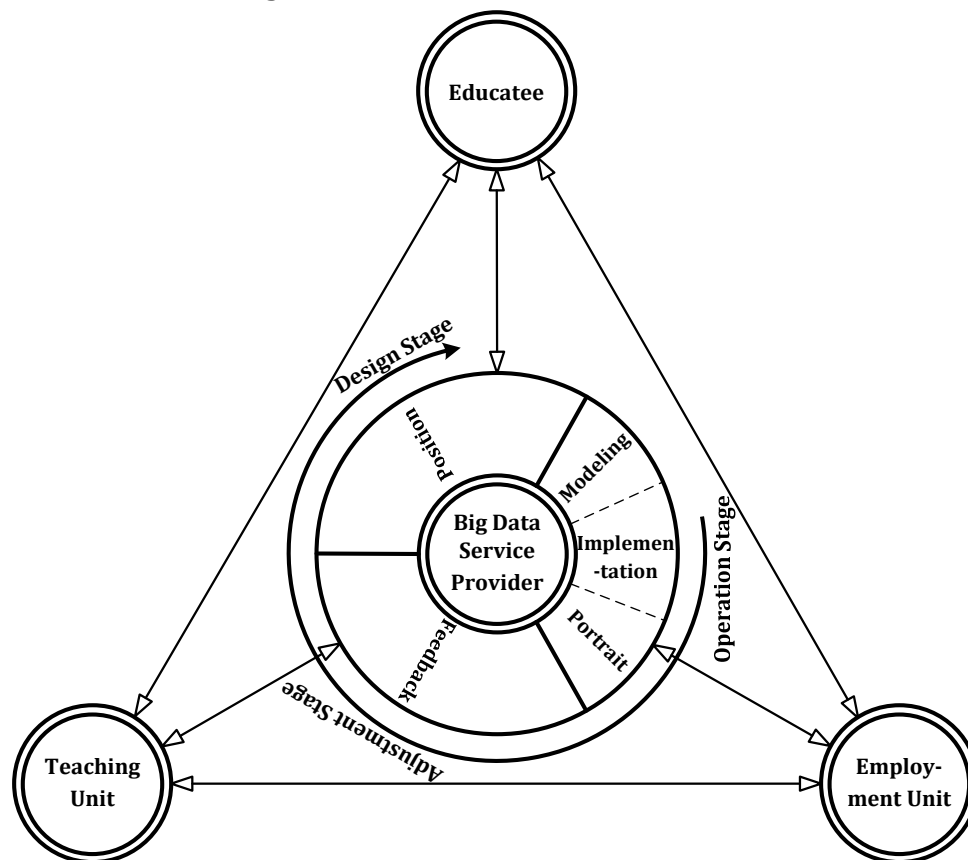


Figure 4. Dual-cycle system of personalized education mode

(2) Guarantee Measures. The smooth operation of personalized talent education system also needs certain guarantee measures. The first is cognitive guarantee. Multiple stakeholders in higher education should fully understand the essence of education information construction. The value of education big data lies not only in showing learning results, but also in understanding education details such as learning interests, learning habits and ability characteristics from educatees. At the same time, we should promote and encourage learners' personalized development. The theory of multiple intelligence explains the necessity of personalized education, and the positive psychology also emphasizes the importance of developing individual advantages. Everyone has a series of advantages in his life. Identifying, developing and using these individual advantages can bring positive effects of happiness, achievement and self-realization. Therefore we should abandon the unified talent education mode and promote personalized education. The second is technical guarantee. In the construction of education platform, we can use the value co-creation theory to find appropriate big data service providers with technical advantages, and develop relevant teaching platforms

and curriculum modules together to ensure the smooth implementation of personalized education. In the operation of education big data, in order to ensure the smooth transmission, analysis, processing and feedback of education big data, it is necessary to reasonably design the data modules and real-time supervise the data platform. In addition, regular maintenance of the data system is also important.

4. Conclusion

The personalized talent education system of higher education is the product of the deep integration and application of education concept and information technology, and it is an important topic in the field of education informatization. Based on the theories of multiple intelligence, value co-creation and Deming cycle, the changes of roles and relationships among education stakeholders are discussed, the personalized education mode containing 3 stages and 5 links is put forward, then the operation mechanism and guarantee measures of the education mode are expounded. These studies can provide reference for personalized education research.

Acknowledgments

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2. University of Science and Technology Liaoning Foundation (2017RC11, 2017YY04).

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