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Educational Research in China

Articles from *Educational Research*

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Contents

Scientific Problems and the Growth of Pedagogical Knowledge

Zhenguo Yuan

Abstract The development of an academic discipline is that of the growth of knowledge. The richness, hierarchy, and renewal rate of a discipline's knowledge determine its social value and academic status. Maintaining continuous knowledge growth is not only the need for the construction of each discipline but the need for social development. Compared with most disciplines of the social sciences, the knowledge of pedagogy is relatively poor and grows slowly. Accelerating the rate of knowledge growth is an urgent task in the construction of pedagogy. The key lies in focusing on scientific problems, strengthening empirical research, and providing a scientific basis for pedagogy to play an important role in revealing educational laws, guiding educational practice, supporting scientific decision-making and improving the level of education.

Keywords Pedagogy · Knowledge growth · Scientific problems

Since Herbart proposed to establish pedagogy on the basis of science, and committed to exploring the objective laws of education and human development, educational researchers have been working to establish a scientific and independent pedagogy. But more than a century later, the famous psychologist Piaget (1970) in the book *The Science of education and the Psychology of the Child* raised an irrefutable fact with an embarrassing question: "Why is there no science of education?" This question has stimulated the thinking and discussion of many scholars. McKenna (1976), a professor at the Eastern Illinois University in the United States, believes that the first reason that restricts the development of pedagogy is that "teaching cannot bring as compelling, profitable and more observable results as the work of doctors and lawyers." Jordan (1976), a professor at the University of San Diego, thinks that the main reason why pedagogy cannot independently help teachers like medicine providing doctors with reliable theories is not the lack of observation results as McKenna thinks, but the lack of a knowledge principle that can organize a great deal of human growth, development, memory, emotion, learning, and behavior. Not

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only has this problem not been resolved today, but with the increasingly prominent role of education in the development of people and society, people's expectations for pedagogy are getting higher and higher, while there is a big gap for pedagogy to meet this expectation, so it becomes more and more urgent to think about and answer this question.

1 The History of a Discipline's Development is the History of Knowledge Growth

Knowledge and knowledge systems are the foundation and backbone of disciplines. The generation and accumulation of knowledge promote the continuous development of disciplines. Knowledge growth is the basic form of the development of disciplines. The richness, hierarchy and renewal rate of the knowledge system determine the development level, social contribution and education effect of a discipline.

First, knowledge growth is the fundamental driving force for the development of disciplines. The growth of scientific knowledge includes the following aspects: obtaining new data, discovering new facts, forming new concepts to form a new concept system, as well as new methodological principles and scientific world schemas derived from them. The development process of a discipline is the process of knowledge growth, which is the continuous expansion of knowledge in breadth and depth. In this regard, the natural sciences are exactly the same as all social sciences, including pedagogy.[1] Popper (2014), a scientific philosopher, made a brilliant explanation of the inherent logic of knowledge development as a disciplinary development: "I assert that continued growth is essential to the rational and empirical character of scientific knowledge; that if science ceases to grow it must lose that character. It is

[1]The development of science and the maturity of disciplines depend on the growth and accumulation of knowledge. The meaning is as follows. First, scientific understanding must continuously gather knowledge in order to understand various systems, experiences and phenomena during its development. Second, scientific exploration is based on previous research. Is the knowledge generated by educational scientific research, like that of natural science, life science and other social sciences, gradually accumulated and developed? The Committee on Scientific Principles for Education Research in the United States has organized scientists from different disciplines to illustrate how scientific knowledge is accumulated by carefully analyzing examples in four fields. First, in all examples, the accumulation of knowledge is achieved in fluctuation, that is, it is not a process of leaping directly from ignorance to epiphany. Second, competitiveness. Scientists are trained and employed as skeptical observers who are good at asking critical questions and challenging knowledge and theories through constructive dialogue with their peers. Third, the interdependence and circulation between empirical research, methodological progress, and theoretical development are mutually reinforcing in nature. Theories and methods depend on each other. They both contribute to the establishment of empirical observation and knowledge, and benefit from empirical observation and the knowledge that comes from it. Fourth, relativity. Man is a complex creature. The study on human behaviors, beliefs, actions, personality characteristics, cultural positioning and will itself is very complicated and is a major challenge in the study of social sciences. See also: YUAN Zhenguo. Empirical Research: Towards Scientific Pedagogy. Journal of East China Normal University(Educational Sciences), 2017, (3).

the way of its growth which makes science rational and empirical; the way, that is, in which scientists discriminate between available theories and choose the better one or (in the absence of a satisfactory theory) the way they give reasons for rejecting all the available theories, thereby suggesting some of the conditions with which a satisfactory theory should comply." When the growth of knowledge stops, so does the development of disciplines.

Second, knowledge growth is a lasting guarantee for the social contribution of the discipline. Knowledge is the result of cognition, the cognition of a certain subject. People rely on knowledge to carry out purposeful activities. Pedagogy, like all disciplines, contributes to society through systematic knowledge. There are six ways in which pedagogy can contribute to society: the first is to make a factual explanation of educational phenomena and their causes; the second is to make a scientific clarification of various views or opinions on education; the third is to provide new ideas, technologies and methods to promote positive change in education; the fourth is to invent and create a variety of useful technologies or tools to evaluate various educational activities and their results and provide suggestions for improvement; the fifth is to provide both positive and negative experiences and lessons for educational decision-making so as to make decisions on the basis of science; the sixth is to make predictions about future education trends so that people can plan ahead. All of these contributions must be based on precise and professional knowledge. The speed of knowledge growth determines the contribution of the discipline to society. Without increasing knowledge, pedagogy will do nothing in the face of increasingly rich and complex educational phenomena.

Third, knowledge growth is an inevitable requirement for the discipline to improve the effect of educating people. Teaching knowledge is the main way to cultivate talents. The sharp differentiation of disciplines after the eighteenth century is an important reason for the rapid development of education. At the same time, the division of different disciplines and specialties has established the concept of specialization and professional talents. Higher education in the modern sense has truly developed. The richness, hierarchy, and update rate of a discipline's knowledge determine the level of professionalism in training talents in a discipline. At the same time, the thinking method of discipline is trained and developed in the process of learning specialized knowledge. The historical process of continuous innovation and breakthrough of subject knowledge is the most vivid, effective, and specialized material for cultivating students' thinking mode. The professional level of education talents is not enough, the discipline thinking method is not clear, and there are obvious gaps compared with medicine, law, financial accounting and other disciplines. The most important reason is that the total amount of knowledge and the growth rate of knowledge in pedagogy are lagging behind.[2]

[2]Not long ago, the author interviewed more than ten sophomores from different normal universities in pedagogy, asking them if they could change their majors at will and whether they would consider changing to other majors. 80% of them said "yes". When they were asked "why", most of them answered: "Education is too vague to learn anything".

With the increasing importance of education in social development, the expectations placed on pedagogy to reveal educational laws, guide educational practices, support scientific decision-making, and improve the level of education have become higher and higher. Reducing the obvious gap between the needs of social development and the possible reality of pedagogy, and accelerating the growth of pedagogic knowledge are the historical responsibilities of each of pedagogical colleagues to improve teaching contributions and their own dignity.

2 Focusing on Scientific Problems is the Key to Accelerating the Growth of Pedagogic Knowledge

How to accelerate the growth of pedagogy knowledge? The key is to focus on scientific problems. Scientific problems are the unresolved problems raised by scientists of a certain era in the context of specific knowledge about scientific knowledge and scientific practice. Since the 20th century, Dewey, J. has been the first to think deeply about the role and mechanism of problems in research. One hundred years ago, Dewey made an incisive analysis of the problem-solving process in *How We Think*. He summarized the problem research as a "five-step method": a felt difficulty, its location and definition, suggestion of possible solutions, development by the reasoning of the bearings of the suggestion, and finally verifying or confirming them. Scientific research starts with problems, and problems guide to research and promote research. Science acquires and accumulates knowledge in the process of finding problems, analyzing problems, and solving problems. The history of science is the history of the unfolding and deepening of the problems it studies. Albert and Infeld (1938) summarized the history of disciplinary development and personal research and said with his experience: "The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science." Popper (2014) summed up the history of human scientific knowledge growth and concludes: "the most lasting contribution to the growth of scientific knowledge that a theory can make are the new problems it raises, so that we are led back to the view of science and of the growth of knowledge as always starting from, and always ending with, problems—problems of an ever increasing depth, and an ever increasing fertility in suggesting new problems." Similarly, Dewey (1997) said after describing the five steps of thinking, "If it is found that the experimental results agree with the theoretical, or rationally deduced, results, and if there is reason to believe that only the conditions in question would yield such results, the confirmation is so strong as to induce a conclusion at least until contrary facts shall indicate the advisability of its revision." Although pedagogy has tens of thousands of papers and countless forums each year, most of them are subjective opinions and individual experiences, and have not formed objective knowledge. To accelerate the growth of knowledge in pedagogy,

we must focus on scientific problems, strengthen empirical research, take real and objective problems as the basis, focus on core and major problems, and take forward-looking, future-oriented problems as the guide to continuously deepen issues and be effective Locally acquire and accumulate knowledge, and promote pedagogy into a new stage of development.

3 Focusing on Real Problems

Scientific problems must first be real ones. The so-called real problems are those that are worthy of research, can be researched and can be verified. Only based on the research of real problems can accurate conclusions be reached, the consensus of the academic community can be achieved, and the growth of knowledge can be achieved.

First, the real problem is the one worth studying. Objective problems that can reveal the inherent contradictions in the development of things, rather than "making a fuss about an imaginary problem", are worth studying. Polanyi (1957), a British philosopher of science, said in his famous speech *Problem Solving*: "Nothing is a problem or discovery in itself; it can be a problem only if it puzzles and worries somebody and a discovery only if it relieves somebody from the burden of a problem". In his book *Human Understanding*, the American philosopher of science Toulmin (1972) defines the problem as the gap between the ideal of interpretation and the current ability. Toulmin gave a formula: scientific problem = ideal of interpretation—current ability. He thought that "scientists find or determine the defects of current concepts by understanding the gap between their current ability to interpret the relevant characteristics of nature and their ideal of natural order and full comprehensibility." Popper (1972) pointed out sharply, "A problem is a difficulty, and understanding a problem lies in discovering the difficulties and discovering where they are." First of all, the real problems exist objectively. They are not created by themselves, and not a scarecrow set up to be a target, talking to themselves or guiding themselves. Objective problems hinder the improvement of work or the deepening of knowledge. If these problems are not solved, correct understanding cannot be obtained and work cannot be improved. Conversely, if these problems are solved, we can improve people's understanding and bring a leap forward to the work.

Second, the real problem is one that can be studied, which means that the research method is operable and a definitive conclusion can be reached. There is no endless argument, and we can continuously obtain the conclusions of stages and promote the continuous extension of the knowledge chain. Some problems can be discussed but not worth studying in a scientific sense, for example, "Shall we offer one or two history courses in high school?" If two courses are required, then students will learn more historical knowledge, but whether two courses are necessary or not, the answer to this question depends on different value judgments. If there are no certain preconditions, the issue is not worth studying (Wiersma 1995). For another example, "Where is China's education modernization going?" "Which is better, eastern education or

western education?" "cat mother or a tiger mother?" etc...Everyone can express his opinion according to his own experience, but we cannot study it, because the meaning of the question is uncertain, and the result is a matter of experience. Therefore, no objective conclusion can be drawn and the growth of knowledge cannot be promoted.

Whether the problems can be studied or whether we can transform unresearchable problems into researchable problems, that is, transform subjective opinions into verifiable or falsifiable problems, is exactly the significance of research design and research method innovation. In fact, major scientific breakthroughs often result from breakthroughs or innovations in research methods. The most important meaning of research is to convert feelings and conjectures into empirical research questions, that is, to design scientifically according to the characteristics of the questions, and to find suitable research approaches and methods that can obtain evidence. Research design ability is the most important research ability, and it is the concentrated reflection of ideology, imagination and professionalism. The level of research design is the most important indicator of the academic level of a discipline and a scholar. Transforming unresearchable issues into researchable ones and improving the researchability of educational problems is precisely the ability that pedagogy needs to be improved.

Third, the real problem is one that can be verified. The real problem is unknown. It requires careful research design, appropriate research methods, the use of certain research skills and strategies, and the creative wisdom of educational researchers to obtain evidence, conclusions and solutions to make "research" contributions. This kind of research can obtain the same results through common concepts, common rules established under a specialized background with common methods and tools. This is a necessary condition for science to be established, and it is also the ultimate criterion for judging the authenticity of a problem.

After the thinker Bacon, F. proposed that "knowledge is power" and made a historic contribution to the method of generating knowledge, people gradually formed a belief in the logic of scientific discovery: only through verification by observation, experiment, and investigation, can a knowledge of what and why things are be gained and their internal connections are discovered; through the induction of a large number of tiny and specific research results, we can obtain an overall understanding and rise to a theory. This is the verification logic of scientific development. After the 1960s, the philosopher of science Popper proposed the theory of falsificationism, arguing that the falsifiability—discovering the facts or theories conflicting with existing knowledge rather than the verifiability of inductivism is the criterion for distinguishing between science and non-scientific. Popper's falsification theory has greatly deepened people's understanding of scientific discoveries, but he has denied the significance and reasonableness of verifiability and has moved to the extreme of relativism. In fact, verifiability has been the basic principle driving scientific discovery and knowledge growth in the past, present and future. Popper's conjecture-rebuttal theory is not a substitute for verifiability, but a richness for it. But whether it is verified or falsified, it is necessary to obtain evidence based on facts, and to process and analyze the evidence, and to obtain logical answers through logical summarization or reasoning.

Although there are many differences between the social sciences and the natural sciences in terms of research objects, research contents, and research tasks, revealing the internal connections of things and the laws of movement are the common goals of the research. Solving problems by finding facts and evidence is a common method. Fu Sinian said: conducting research is "to go everywhere to find evidences"; Hu Shi said: there should be a basis for speech, "there is some evidence to say something, and there are seven evidence to say nothing.". the speech must be evidence-based, "I will speak according to the evidence obtained. Without enough evidence, I will not express my opinion easily." These are the spirit and methods of empirical research. The reason why personal opinions and subjective feelings are not research is that they have no factual basis and evidence to support them. They have no strict logical reasoning and cannot be verified or falsified.

Grasping scientific problems is not only a matter of method and ability, but also a matter of attitude and spirit. Scientific problems and scientific knowledge, scientific attitude, scientific methods and scientific norms are an organic unity of interdependence and mutual support. On the one hand, scientific problems are based on existing scientific knowledge, relying on a scientific attitude of seeking truth from facts, using appropriate scientific methods, and abiding by the norms of scientific activities, which are becoming increasingly clear, specific, and in-depth; on the other hand, putting forward and researching questions not only enrich the content of scientific attitudes, methods, and technologies but also enrich the total amount of knowledge. As the *Scientific Research in Education* published by the National Research Council (2002): "At its core, scientific inquiry is the same in all fields. Scientific research, whether in education, physics, anthropology, molecular biology, or economics, is a continual process of rigorous reasoning supported by a dynamic interplay among methods, theories, and findings. It builds understandings in the form of models or theories that can be tested."

4 Exploring the Core Problems

Each discipline has its own specific research objects and exclusive fields, and each has its own core problems. The proposal of these core problems and their solutions have opened up new horizons for the development of the discipline and made progress. Newton, I. has been thinking hard about the three major problems of calculus, gravitation and optics, and has provided a system model of scientific thinking. Newton kept asking: Why can the planets consciously orbit in their own orbits; why does the apple fall to the ground, but the moon does always revolve around the earth without falling down? After repeated observations, reflections, and experiments, he found that "the gravity of the earth must be smaller and smaller as the distance changes", and then deduced the theory of "every particle attracts every other particle in the universe with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers", which has laid the foundation of classical physics and has become the standard scale of modern

science. In the famous report of *Mathematical Problems* in 1900, German mathematician Hilbert, D. put forward 23 mathematical problems that mathematicians should strive to solve in the new century. These questions formed the basic framework of mathematical research in the twentieth century and attracted the research interest of mathematicians around the world. Although some problems have been solved, new problems have arisen. Although some problems have been rejected, new research approaches have been opened up, showing the eternal charm of core problems.

British philosopher Whitehead (1967) has devoted himself to the study of education. He believes that the aim of education is to master the skill of "how to utilize knowledge". Indeed, the study, understanding and utilization of knowledge have always been the core problem accompanying education. For example, the question of "what knowledge is of most worth" by Spencer, H. in the late nineteenth century ended the theological era of pedagogy and promoted pedagogy to enter the scientific era; the question of "what knowledge is of most worth" by Apple, M.W. reveals the true face of "objective" knowledge—contempt for objective knowledge is actually the subjective choice of certain people, certain interest groups and certain cultural groups; the question of "what knowledge is the most powerful" by Young, M. is an upgraded version of "what knowledge is of most worth", reflecting the new ideas of knowledge choice in the information age and knowledge explosion era. Perkins, D., an American scholar, advocates "educating for the unknown, learning for the future", and "knowledge that is meaningful to the learner's future life can have long-term vitality", which echoes Young, M.'s proposition and promotes people's recognition of knowledge choice. For another example, the speech *The Idea of a University* by the British theologian and educator Newman, J. H. 150 years ago is still thought-provoking. The key lies in the three basic questions he raised about universities: what is the nature of university? What knowledge shall be learned in a university? What education should universities provide? The theoretical thinking of higher education is constantly deepening, accompanied by these questions.

The process of education is the process of teaching students to learn through certain methods (means, approaches) with knowledge as the content and teachers as the main body. What to teach and what to learn? Who teaches and who learns? How to teach and learn? How to evaluate the results and effectiveness of learning? How to improve teaching effectiveness? Etc. These constitute the basic context of the development of pedagogy. Content, method, subject and object are the four basic elements of education. As society and education continue to change and develop, and as people continue to deepen their understanding of the nature of education, their understanding of the characteristics of the four and their relationships is also deepening. Teachers and students are no longer a simple relationship between subject and object, no longer a simple relationship between teaching and learning, but a mutual symbiotic relationship between the subject and the subject. The teaching content—the connotation and extension of knowledge are also deepening, from Spencer's "science is the most

valuable knowledge" to the four types of knowledge proposed by OECD[3]; the connotation and extension of teaching methods (means and approaches) have changed more dramatically. Due to the widespread application of disruptive technologies such as the Internet, cloud computing, wearable technology and artificial intelligence, innovation storms have been triggered in all walks of life. Education is no exception. And the changes that will take place may fundamentally change the form of education and will redefine the basic concepts of education such as schools, learning, students, teachers, etc. In short, pedagogy is very concerned about how to teach the most important knowledge (facts, abilities, attitudes, comprehensive literacy) most effectively (at the most appropriate time, most personalized, and most creatively), and obtain the best personal development and the greatest benefits for society. It is undoubtedly worthwhile for pedagogy to work harder and deeper to explore these questions and acquire knowledge at different levels by empirical methods. Of course, this is not a special discussion on the core problems of pedagogy, but a process to show that the development of disciplines is not only a process of digging deep into the core problems, but also a process of constantly expanding the boundaries, innovating fields, and timely transforming the core problems. Another important reason for the slow growth of pedagogic knowledge is the vagueness and inadequate exploration of the core problems. To pursue and deepen the core problems, pedagogy needs to be more conscious.

5 Refining Major Problems

CPC General Secretary Xi (2016) emphasized that "problems are the starting point of innovation and the source of innovation." Only by listening to the voice of the times, responding to the call of the times, and seriously studying and solving major and urgent problems, can we truly grasp the historical context, find the law of development, and promote theoretical innovation. "Refining major issues is not only the driving force for the discipline to make major social contributions but also the practical needs of social development. The significant improvement of the development level and status of any discipline is closely connected with their refinement and answers to major problems. Taking economics as an example, Smith, A.'s theory of enriching both the people and the sovereign clarified the division of labor relationship between the people and the people, the country and the country, and laid the theoretical foundation for the correct thinking of the country's economic management; Marx, K.'s theory of surplus-value reveals the secrets of capitalist production and exploitation, the economic roots of class opposition and struggle between the proletariat and the bourgeoisie; Keynes, J. M.'s theory of effective supply and state intervention

[3]Know-what refers to knowledge about "facts"; Know-why refers to scientific knowledge of the principles and laws of nature; Know-how refers to skills or the capability to do something; Know-who involves information about who knows what and who knows how to do what. For details, see: OECD Annual Report 1996, *The Knowledge-based Economy*.

stimulated production, expanded employment, and saved the economic crisis; etc. It is precise because of the refinement and answers to a series of major problems that economics has gradually become the dominant science and the leading science of the social sciences. Another example is the philosophy of science. Popper regarded the problems as the starting point and ending point of theories. He repeatedly asked: "When is a theory true?" "What is the standard or boundary to distinguish science from pseudoscience?" Continually exploring this problem, his conjecture-rebuttable doctrine of falsification was established.

The development of pedagogy has also experienced the process of expanding from micro research to macro research, from country research to global research, and from tactical research to strategic research. Take the *Harvard Education Review* as an example. From the publication of the magazine in 1931 to 1960, if the topics of educational research are arranged in descending order, the top five are teaching research, curriculum research, educational philosophy research, teacher research, educational psychology Research, accounting for 9.5%, 8.3%, 7.5%, 7.3%, 6.8%, respectively. These five items belong to internal education research. Since 1961, this situation has changed significantly. The top five are education equity research, student research, teaching research, teacher research, and school research, accounting for 17%, 11.1%, 8.9%, 7.8%, 5.3% respectively, the largest of which is education equity research (Du 2007). The focus on education has clearly expanded from inside schools to outside schools. As we all know, the 1950s discussions in the United States about the responsibility of education for failing to launch artificial satellites first contributed to the *National Defense Education Act* and triggered a major change in American education; Coleman, J. S. 1960s' *Educational Opportunity the Education Equity Report* in the 1960s directly stimulated black and white children to study in the same school, and promoted the elimination of the apartheid policies; the human capital theory of Schultz, T. and others in the 1970s changed the view that education is consumer behavior, and promoted the general growth of investment in education in various countries; the research report of *A Nation in Crisis* in the 1980s promoted the return of American education to the basics, taking improving quality as the central task of education; as for the well-known research report of *Learning to Survive*, it has established the concept of lifelong learning and promoted the construction of lifelong education institutions and systems around the world. It can be said that there is no contemporary pedagogy without refining, researching and answering these major problems.

More and more attention has been paid to the role of education. The relationship between education and all aspects of society is becoming more and more complex. Education occupies more and more resources of society and family. People's demands and expectations for education are getting higher and higher. The awareness and ability of pedagogy to refine major problems is becoming more and more urgent.

Marx and Engels (1983) have a famous saying: "The problem is the open, fearless, voice of the times that influences all individuals. The problem is the slogan of the times, the most practical voice of its mental state." It is believed that "Every era always has its own problems. As long as we scientifically understand, accurately grasp and correctly solve these problems, we can continue to advance our society

(Marx and Engels 1983)." Since the reform and opening up, fundamental changes have taken place in China's education. It has grown from a large country in population to a large country in education, and is accelerating its progress towards becoming a powerful country in education. The fundamental contradiction of Chinese education has undergone profound changes. It has entered a new era of educational development from being educated to being well educated, then to enjoying high-quality education. Faced with the dramatic change, people from the government to schools, from society to families, are exposed to new situations, new challenges, and new tasks, which have to be addressed in a creative manner. Not long ago, Gu (2016) put forward eight paradoxes of Chinese education, and put forward some profound problems that cannot be avoided in China today. These phenomena reflect the new characteristics of educational problems, which are beyond the scope of school education and reflect the important orientation of education research today. Combining pedagogy's own characteristics, facing the frontiers of science and technology in the world, facing the major needs of the country, facing the main battlefield of the national economy, and refining major problems, it is not only a practical requirement for pedagogy in the new stage of education but also a new opportunity for education science to step up to a new platform, a new stage and make the leap of quality.

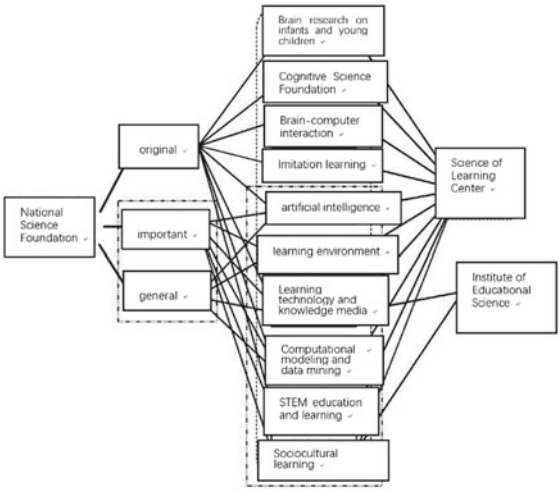
6 Expanding Interdisciplinary Problems

Since the 1960s, "interdisciplinary" has gradually become a keyword for people to explore subject construction and knowledge innovation. New comprehensive disciplines such as energy, materials, oceans, life, aviation, computer, and brain science have become the leading disciplines in the world today. Interdisciplinary integration has become the most powerful driving force for the development of disciplines and the growth of knowledge. Interdisciplinary integration is no stranger to pedagogy. In fact, interdisciplinary integration is an important feature of the development of pedagogy. Pedagogy has evolved from the original pedagogy to education science, and then to later education sciences. It is an important driving force for the development of pedagogy to continuously obtain nourishment from adjacent disciplines and form its own comprehensive characteristics.

The interdisciplinary development of pedagogy has experienced three important stages: the first stage is the end of the nineteenth century and the beginning of the twentieth century. The intersection of pedagogy, psychology and statistics has produced educational psychology, educational evaluation, educational measurement and other disciplines, which makes pedagogy move from speculation to science; the second stage is after the 1960s, the combination of pedagogy with economics, sociology, and public policy, makes pedagogy move from the micro to the macro; the third stage is after the twenty-first century. The ongoing combination of pedagogy and information science, computer science, brain science, artificial intelligence science, etc. results in new disciplines and fields such as learning science, educational neuroscience, etc., which makes pedagogy move from simple social science to

comprehensive science. This process has gone from the inter-disciplinary interchange of concepts and theories to the development of interdisciplinary cooperation to solve problems, to the comprehensive theory of interdisciplinary integration, and then to the development of new areas in the overlapping part among independent disciplines. According to the analysis of the fields and projects supported by the National Science Foundation, the Institute of Education Sciences and Science Learning Center in recent years, the research funding is mainly concentrated in the following ten aspects: brain research on infants and young children, cognitive science foundation, brain-computer interaction, imitation learning, artificial intelligence, learning environment, learning technology and knowledge media, computing modeling and data mining, STEM education and learning, social culture and learning.[4] Judging from these fields of funding, pedagogy is showing a new vision combining natural science and engineering technology, and it is giving birth to new major breakthroughs. (See the Figure below).

[4]There are 65 secondary research directions in ten primary research directions, and the secondary research directions in each primary direction are as follows: 1. There are 8 sub-research directions in the brain research on infants and young children, including learning and memory, attention and brain imaging, mirror nervous system, biology of language expression, biological studies of brain learning, attention and emotion, and the influence of music on the brain, and face and target recognition; 2. There are 8 sub-research directions under the basic research of cognitive science: cognitive-affective interaction, cognitive behavioral assessment, motivation and transfer, educational cognitive neuroscience, relational reasoning, implicit learning, visual and cognitive plasticity, and educational intervention; 3. There are 2 sub-research directions under brain-computer interaction, namely mind-controlled computer and brain-computer interface; 4. 2 sub-research directions under imitation learning are robot imitation learning and children's imitation learning; 5. The five sub-research directions in artificial intelligence are intelligent mentor, machine learning, robotic automatic indexing (foraging), intelligent evaluation and educational robotics; 6. There are 6 sub-research directions in the learning environment: game-based learning environment, computer-based learning environment, virtual reality learning environment, collaborative learning environment, informal learning environment and inquiry learning environment; 7. There are 10 research sub-directions in learning technology and knowledge media: distance learning and learning, game-based learning, mentor learning system, collaborative learning, online learning, computer-supported collaborative learning, distributed learning, social learning, learning partners and service learning; 8. There are 5 research directions in computational modeling and data mining, including educational big data mining, computational thinking, learning algorithms, network security education and data analysis; 9. There are 10 sub-research directions in STEM education and learning, namely mathematics learning, computer science, STEM learning for ethnic minorities and women, spatial thinking ability, spatial cognition and communication, 3D printing, STEM learning for the disabled, STEM cultural construction, STEM future workforce training and STEM teaching; 10. There are 7 sub-research directions in society, culture and study, namely, reading ability training for deaf or hearing-impaired people, language development and bilingual learning, social communication, social and cultural impact on learning, sign language, learning for autistic patients, and citizen participation.



Related education research projects of three major research funding institutions in the United States.

Today, the interaction between education, information science and artificial intelligence science is the first new field worthy of attention and research. Since the popularity of the Internet, its technology has evolved from 2 to 5G, from wired to wireless, and from two-dimensional to three-dimensional. The speed, convenience, clarity, and information modalities of the Internet are constantly changing. The revolution that has taken place, coupled with the holistic breakthroughs in digitalization, cloud computing, wearable computing, and artificial intelligence, are driving school education to ubiquitous education, collective learning to individualized learning, and paper-to-pencil learning to screen learning. The shortcomings of standardized education since the industrial revolution may be completely reversed, and it is truly possible for people to dream of changing from learning based on teaching to teaching based on learning. At the same time, the new high-tech is a double-edged sword for education. How can we use its strengths to improve the efficiency and personalization of teaching, while preventing the risks including "privacy violations" caused by the abuse of monitoring technology and "cocoon deprivation" due to personal information transmission, "potential obliteration" and "trajectory track" due to the accumulation of big data, "functional dependence" due to the use of artificial intelligence? It needs an open mindset in pedagogy to expand vision, update concepts and innovate methods while maintaining humanistic and ethical vigilance so as to make high-tech for our use.

The interaction between education and brain science is another new area worthy of attention and research. Human development is the process of continuous brain construction, and education is the shaping of the learner's brain. In a sense, the law of brain development is the largest and most fundamental law of education. With the breakthrough of brain wave measurement technology and brain imaging technology, the black box of the brain has been opened, and the systematic working

secret of brain function, such as the functional division of the brain, the working principles of brain neurons, synapses, brain chemicals, and even the working characteristics of each brain cell and the working mechanism of their interrelation, are increasingly revealed. What are the differences between human cognitive structure, social-emotional structure, and personality structure—differences; what content can people learn until when—maturity; What is the relationship between learning Chinese characters and Roman characters, using abacus and calculators and forming habits of thinking—culture; which have advantages? individual learning or cooperative learning, active learning or passive learning—sociality; when is the most effective for people to learn what and is hard to compensate when overdue—critical period; how to tread a very fine line of developing human learning potential—the zone of proximal development; why can people's moral emotions be stimulated—empathy; learning throughout the life—a need or a potential; and so on. All of these problems have in the past been stuck at the level of empirical or psychological research. But today, brain science provides more and more evidence and methods for these, which can be thoroughly researched at the level of brain neural mechanisms. Isolated, fuzzy, fragmentary empirical research is moving towards holistic, precise, and systematic scientific research, the secrets of human learning are being continuously revealed, and it is possible to comprehensively improve human brain development and learning capabilities. In the new round of information revolution, artificial intelligence revolution and brain science competition, China stands on the same starting line with those at the world's advanced level. In some aspects, we are even in a leading position. With a keen grasp of the significance and opportunities of this revolution, and merging the resources and strengths of different disciplines, it should be possible for us to accelerate the interdisciplinary development of pedagogy to the forefront of the world.

7 Predicting Future Problems

The formation of the ability to predict the future is a sign of maturity. At that time, Ma Yinchu's construction of the model of population growth and resource consumption in China laid a theoretical foundation for the national policy of family planning. The research report of the Club of Rome on the limits to growth inspired the concept of sustainable development and the development of new energy. As early as the 1950s, future-oriented education research, which was applied systematically and orderly, tried to predict and control the emergence of development trends or future trends with the passage of time by analyzing the key factors that affect future development and their interrelations. The researches on learning society such as "post-industrial society", "electronic technology society" made by techno-optimists represented by Illich, I. and Toffler, A. and the researches on "catastrophic outlook" of resources depletion and population expansion made by the techno-pessimists represented by the Club of Rome are all good examples.

In the educational research and report of government and professional groups, the future orientation has become a very important dimension. For example, in 1985, the American Association for the Advancement of Science (AAAS) organized the preparation of an educational reform report that formulated the American basic education and scientific education program from the late 1980s to the beginning of the twenty-first century, and directly name the report oriented on future—*Project 2061: Science for All*, which fully reflects its emphasis on future educational research. This kind of research is common in western educational research and the research reports based on it in the past dozen years.

In a methodological study of educational futurology made by UNESCO, some scholars distinguished between the two types of problems that people will face in the future, namely social problems and spiritual problems about society. There are also scholars have made many predictions on the future education problems based on the three big bangs (population, knowledge and expectations), three big problems (war and peace, human and environment, culture and technology), and three big conflicts (mind and the outside world, science and belief, personal freedom and social organization). and three major differences (developed and developing countries, knowledge and wisdom, strength and love) (Wang 2001), which has brought a lot of thinking to people. The world today is moving from certainty to uncertainty, which is the greatest feature of the future world. Moreover, the biggest difference between education and other industries is that the biggest feature of educational activities is their delay effect. Its effectiveness and product quality inspection take a long time to realize. On the one hand, science and technology are changing rapidly, society is changing unpredictably, and society's requirements for the number, specification and quality of future talents are constantly changing; on the other hand, it takes ten years to nurture a tree, but a hundred years to train a man. When a 6-year-old child enters the educational age, it needs to wait 12 years, 16 years, or even longer for him to enter the society. Whether today's knowledge, ability and concept are right or not and whether today's education is successful can only be tested after more than ten years. Therefore, forward prediction and planning are especially important for education. Due to many complex factors affecting education, it is really difficult to predict the education problems. So far, there is no breakthrough in the method of education prediction. But we cannot think that a prediction method and prediction ability cannot be formed because pedagogy has not formed prediction methods. In order to study the limits to growth that year, the Club of Rome needed to establish a theory of social dynamics of system dynamics. The research team did not hesitate to wait for two years for MIT professors to work. Education has a long period of human cultivation. It is particularly worthy of attention and requires methodological breakthroughs to study how education can "cultivate people for a society that does not yet exist", and especially what changes might be caused in social structure and social activity modes by the widespread use of artificial intelligence, and what impacts and challenges to modern education by the educational changes therefrom.

8 Other Discussions

Knowledge is the crystallization of human cognition, and it is the wisdom power to understand and transform the world. But positivism and phenomenology of knowledge are divergent. Positivism (empiricalism) emphasizes the objectivity of knowledge and believes that knowledge is observable, measurable, and verifiable; emphasizes the universality of knowledge and believes that the knowledge of natural sciences and social sciences is essentially the same; emphasizes the analysis of knowledge Sex and believes that knowledge can achieve a holistic understanding of things through the accumulation of countless pieces and partial cognition. While phenomenology (hermeneutics, historicism, existentialism, etc.) emphasizes the subjectivity of knowledge and believes that knowledge is the construction of objective phenomena by the subjective world, and the subjective world of human spirit and consciousness is also knowledge; emphasizes the uniqueness of knowledge and believes that social and historical activities are numerous individual events, which are difficult to repeat; emphasizes the integrity of knowledge and believes that human activities and social activities are the unity of the past, the present and the future, and the partial individual cognition may result in the dismemberment of human integrity. There have been three major confrontations in the history of these two disputes (Yuan 2017; Zeng et al. 2018), but now the debate between the two has gradually receded and tends to absorb and merge with each other. In fact, positivism and philosophical speculation have the same emphasis on problems. The history of the development of philosophy is, in a sense, the history of problem research, but the methods of research and interpretation of problems are different. Philosophical speculation is the ideological power of empirical research. Philosophical reflection is always accompanied by empirical research. The interpretation of the significance and impact of empirical research results cannot be separated from philosophical participation. Similarly, the acknowledgment of philosophical speculation is ultimately implemented in empirical research. Today, the reason why we must vigorously advocate and emphasize positivist educational research is that, first, the preset traditions of "chunqiubifa," "the six classics explain me and I explain the six classics" still have a profound influence; Second, the phenomenon of collective monologues with no target and no intersection is still universal; third, research with scientific design, scientific methods, and scientific evidence has not yet become a basic norm. In recent years, a culture of advocating empirical research has gradually formed, and it is necessary to continue to consolidate and strengthen this trend. Educational practice is the richest and most precious resource of educational research. The extensive participation of millions of teachers in education and scientific research is a beautiful scenery line of which China is proud. There are more than 30,000 education and research personnel in China who go deep into the front line of school education and explore effective methods to improve the quality and level of education. They have accumulated a lot of experience and made great contributions. However, most of these experiences are subjective, individual and fragmentary. It is urgent to refine and process them by

further refining and falsification so as to promote and transform them into objective, universal and systematic scientific knowledge.

Only by focusing on scientific issues, strengthening empirical research, revealing the internal relations among various elements of educational activities, making clear the causal relationship (for social science, it is more probability than law) and causal mechanism, and gaining more understanding of the regularity of education, we can provide good and fast development of education, pleasant and efficient learning for people, provide insights, realize the rapid growth of pedagogy, and promote the discipline construction of pedagogyto a new level.

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The Disciplinary Surveillance Over Students from Big Data-Based Measurement and Assessment in Education—A Philosophical Examination into the Instrumentalization of Education

Shenghong Jin

Abstract An important device for modern education is data-based measurement and assessment; it has become a new power dominating and controlling school education and will result in panoramic data-based surveillance over the educational process to monitor quality and behavior. However, by narrowly assessing students' development and education, data-based measurement and assessment in education standardize the educational process and learning behavior, leading to a simple understanding of the value and meaning of education, as well as ignorance of immanence, individuality, and the wholeness of each student as a human being. Ontologically, human beings cannot be reified, with their mind and soul being unquantifiable by data. The value of their life cannot be measured. In fact, data-based measurement and assessment in education is a compulsory mechanism, where students are marked, predicted, predetermined, and separated. Competitions and anxieties in education are exacerbated and educational utilitarianism and instrumentalism are aggravated. It seems that the aim is in achieving the educational goal and promoting educational efficiency, but in fact, it is a non-pedagogical device attached to educational practice, incompatible with real education and its process, and contradictory to existential learning. Therefore, educational risks exist in it.

Keywords Measurement and assessment in education · Dominant force · Immanence of life · Non-pedagogical · Disciplinary surveillance

Data-based measurement and assessment in education have become a dominant way in modern education, as reflected in a digital or data-based education landscape. The objective data of data-based measurement and assessment in education which monitors school education quality and supervises students' learning behavior has been the basis for planning and transforming educational practices. The data-based education measurement and assessment has become a way to evaluate a person's quality, the value of life, and potential of development, and the basic standard for dispatching

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and using talents. Evidence-based education is built on education measurement and assessment. In the era of big data, it will become a reality that educational assessment will be connected with big data. However, there are questions worthy of consideration. Is data-based measurement and assessment in education consistent with the inherent purpose of education? Is it a constituent element in the process of education? Is the assessment the only way for education to be used to cultivate people? Does the educational assessment of human growth respect and recognize people? This paper intends to analyze these questions by using thought experiments and normative methods of educational philosophy and discuss the reasonable limits of data-based measurement and assessment in education.

1 Forms of Data Control in Education

Imagine that the future smart schools and classrooms will be equipped with various data collection and processing technological facilities, and students' emotion, action, behavior, language, thinking, learning process, learning effect and outcomes during the entire education process can be recorded in the form of data and be processed and analyzed. Even data regarding brain activities, mental and physical conditions will be collected, and be processed and displayed in some way. With big data technology in schools, students' entire existence, mental state, moral and emotional behavior, and psychological development can be represented by data. The data, mined and accumulated day by day, will become the objective basis for evaluating students' learning behavior and outcome, development level or literacy level, and their development possibility may be determined by these data. Based on the assessment of these data, these students can get their grades and be selected for further studies according to the objective and fair data-oriented standards. Moreover, university admissions and employers might refer to these data.

Imagine in such a smart education system, all the action or behavior of teachers during the school education process is also monitored by the education monitoring system of big data. Big data not only provides detailed analysis and assessment of each teacher's behavior in school and during class but also serves as a basis for the school to manage and evaluate teachers according to the recording data of the conduct of teachers' educational behavior. Big data-based teacher evaluation also provides objective data basis for teachers' professional development and promotion. Big data can also be used to analyze the educational practices of good teachers and allow other teachers to learn from them.

Actually, such smart education evaluation is not far away from us. Technically, it is not that difficult to implement it. In the near future, the assessment of educated people carried out by school education may be specific, standardized, and big data-based. In the era when data is regarded to reflect facts and to make decisions, and, education will likely enter the era of big data-based measurement and assessment,

which may herald a new state of education with the application of data and AI technologies. A data-based and evidence-based education process and education operation strategy is perceived as a goal of education progress. Macro-policy measures or micro-education institutional arrangement, curriculum, school management and leadership, and teacher's education strategies and measures will be justified by data and determined by data-based evidence.

Although this is just an imaginary thought experiment, it illustrates the possibility of future development of data-based assessment education. Many scholars may contend that this kind of big data-based intelligent education evaluation is a general trend of future education. It is progressive, scientific and fair, and it will improve the efficiency of education because big data will reveal the secrets of a human brain's process of acquiring knowledge, the secrets of human existence and human development. Some scholars may believe that big data-based and intelligent education evaluation is part of education modernization, and the education evaluation based on big-data will be a scientific way to form a new conception about man and education (Foucault 2007). It will provide objective, authentic, credible, and feasible data for educational practice, and evidence-based support for student learning, teaching behavior, school development, and education transformation. The educational administration can also obtain accurate information on the education process and education-related products through such data evaluation, and can accurately and precisely regulate and optimize the education process, and hold schools and teachers accountable.

This thought experiment does not pay attention to whether data-based education evaluation is technically feasible or not It attempts to raise a normative question in an ontological way: is big data-based education evaluation human-friendly? Is it part of the process and the purpose of education? Can it provide schools and teachers with an understanding of human development? Can data point out what truly good education is? Can it truly enrich and be constructive for human development? Can it promote education based on humanity and for the humanity? Can it bring progress and excellence in education? Is education as a human practice determined by big data? Can the data determine what kind of person an educated person is?

In fact, although today's education has not yet fully adopted intelligent big data evaluation, there is an obvious trend of big data-based education evaluation. At present, regardless of the method of educational assessment and its scientific level, it has been already a decisive force that governs how education is carried out, and it becomes the main way to measure education performance. Education policymaking and practice reformation are based on education assessment. Education measurement, monitoring, and data evaluation have become guidance on how education should do, where it should go, and how teachers and students achieve development. It can be said that following this development pattern driven by big data in the intelligent era, education evaluation based on big data will, to a certain extent, become a new way to control education and a new objective structure to manipulate man. Big data will push education assessment to use a higher level of technology and make it panoramic monitoring of the entire education process.

If the objective evaluation of data of education becomes ubiquitous, if the institutional selection of education and the micro-structures of school education go along with data-based education assessment, if different education practices, in reality, are guided by it, education assessment will become a new objective power characterized by data. If data-based education evaluation is intertwined with education mechanisms, and a refined process of observation, recording, scanning, analysis and training is formed around the educated person, big data-based education evaluation will become the means, method, and process of producing people and a disciplinary technology. It will turn school education into a disciplinary institution that controls and trains students to achieve specific operational goals or results through data.

When school education divides the educational qualities of the educated person into standardized evaluable competences, and employs big data to measure or describe these competences, and when school education divides the education process into a series of controllable units to ensure that competences required by social production structure can be produced, an educated person may be someone with standardized competences who is produced in an education factory. If education trains students in the same way factories produce standardized products, data-based measurement, assessment, or quality monitoring in education will become the primary choice for measuring these education products. Education assessment or education quality monitoring mechanism will become the controller of said education factory. Education produces so-called educated people based on the results of education evaluation or quality monitoring, and on the "talent" map according to competence system and demand standards.

In fact, data-based education measurement and assessment have facilitated the industrialization of the education process and the standardization of education products. A quality control method, education measurement or education assessment has been relied on by modern education, and it is also regarded as an indispensable part of the education process. Education has become big-data evaluation and evidence-based, which is the landscape of modern education.

2 Students' Life Cannot Be Measured

The data-based education assessment mechanism is embedded into the school educational structure, making school education itself a structure for estimating people's use value. Education measurement and assessment focus on the standardized ability or competences that can be reflected by data, and it does not pay attention to general human subjectivity. In other words, education measurement and assessment reduce the intellectual growth of people in education to measurable data. An educated person is represented by a set of statistics or a set of evaluation data. That is to say, a person is treated as an object that can be calculated. The richness, complexity, and profound internality of a person are cut off.

With data-based education assessment, it is difficult to explore in-depth the existential essence of human beings in education and to understand the forms, style and

situation of human existence. This is because human life is inestimable and invaluable (Nietzsche 1992). Ontologically, due to its internality and transcendence, no assessment can measure human nature. Or rather it is impossible to describe the way and form of human existence with data. Teleologically, human beings are the highest purpose and should not be regarded as measurable and appraisable instrumental objects. At the same time, the mysterious growth of human life cannot be estimated by data-based assessment methods. The evaluation of human life becoming and personal development in the form of education assessment will make the complicated internality and performance of human nature superficial and simplistic. Education assessment lacks the grasp on human life and its complexity, and isn't aware of the inherent breadth and depth of changes in human intellectual and spiritual being and becoming. Facing with real persons, only values the appearance showed by data and ignores human nature (Macherey 2016).

Measurement and assessment in education fail to explore man's immanence. Immanence means that the subject possesses the deepest identity within itself, and is the center of self and spiritual activities. Immanence explains the inherent nature of humanity. Life has the inherent and absolute immanence (Deleuze 2001, p. 25). Human immanence is essential. Life originates from immanence, and the generated subject spirit is also internal. Immanence reveals hope and possibility (Lan 2017). Man's immanence is different from physical functions and mental phenomena. It is inherent in the whole spiritual self and is itself present. The depth of human nature and self cannot be assessed from the outside, nor can it be represented by data. Therefore, we cannot explain the immanence of human beings by analyzing the phenomenon and use data to describe immanence, because it will be misunderstood or distorted. Data-based measurement and assessment in education often deny a person's immanence since it cannot explore it profoundly. As a result, it leads to the neglect of life experience and the quality of life, and the complexity of the inner spiritual change of a person (Preston 2017, p. 52).

Measurement and assessment of education are not in a position to explain man's intellectual uniqueness, which refers to the individuality of a person, an attribute that can distinguish one from others. This is a feature a person has which can show his unique personality, character and dispositions as a subject of existence and an individual. Uniqueness and individuality indicate the principle of essential difference and that of subjectivity. Human beings have essential differences from non-human beings. As individuals, human beings have individual differences too. From these two perspectives, man is the existential subject with uniqueness. What uniqueness refers to is not a difference in phenomena, but a difference in nature. As a subject of existence, human beings are subjects with unique subjectivity. Such uniqueness does not negate the normative significance of commonality and universality in humanity. In contrast, it means that each person is ontologically unique and cannot be replaced by others, be overwhelmed by universality, and be represented by data. His existence and spirituality cannot be replaced, nor be explained by some numbers or data. Because subjectivity is connected with immanence and integrity, the uniqueness of the subject cannot show its differences through numbers or data. The difference shown by data is only the difference described in appearance. Therefore

educational assessments which apply simplified and unified indicators/standards to measure, assess and evaluate students treated every person who has individuality homogeneously.

Educational assessment cannot understand a person's mental integrity. Integrity refers to the spiritual unity of an individual, that is, indivisibility. Integrity is also the ontological existence attribute of man as the subject of life, indicating that man, in nature, cannot be treated as different parts. Man is also not a part of another being as a whole. Man himself, as a subject, is a whole. The human spirit is a whole. In fact, it cannot and will not be divided into different parts and be measured. Education assessments often focus on certain aspects of man or identify them through incomplete evaluation indicators, which only show some externalized phenomena of man. In fact, education assessment does not respect human integrity if it classifies human spirit or nature into different attributes or facts, and describes them by data. Even if all the evaluation indicators are integrated, we cannot explain the ontological integrity or integrity of human nature or the human spirit.

Measurement and assessment in education cannot predict the spiritual potentiality of man. Potentiality is a wealth of possibilities and uncertainties. The existence of human beings means potentiality, and potentiality always means that man's rich possibilities need to be realized, or that existence is action and process of actualization of potentiality. This so-called potentiality is something real to be actualized, it is inherently in the actualization process (Deleuze 2001, p. 31). Potentiality and actualization are unified, and the potential means the possibility of actualization, and the potentiality is in the actualization. Among the possibilities, the potentiality is made possible through action, that is, the potentiality of action through interaction with the world and the other becomes reality (Aristotle 2003). Therefore, although the potentiality is just potential, it is completely real (Deleuze 1993). The essence of man is latent, and the actualization of a latent factor is the nature of human existence. Existing as life is always in the latent actualization, which means that the growth of man in education is a kind of generation and emergence. It is also a gesture and situation of self-creation. The real possibility of human development lies in the dialectical unity of potentiality and activities of its actualization. Because of the potential uncertainty and the abundance of possibilities, it is immeasurable. Education assessments cannot judge human potential, nor can they predict the realization of human potential. Their simplified assessment of human development cannot grasp the complexity of human beings, nor can they grasp the complex relationship between human potential and the realization activities.

Education assessment cannot grasp the forms and values of human life. Man has spirituality, and humanity and life have essential significance and value, which gives life a right and just way to exist, additionally bringing hope, love, pursuit and creation to life; it can also add height, breadth, and strength to life (Agamben 2016). Human life is not a bare natural life phenomenon, but a spiritual existence with a value form. Education evaluation treats the rich existence of people as a kind of natural and naked life with no difference and no form. It uses objective factual figures or data to understand and distinguish people. The digitization of people translates the rich and complicated life performance of people into measured digital or data issues.

Therefore, education evaluation is blind to the richness or the quality of life and the meaning of life forms. It is blind to how people interact with education to shape themselves and make the transformation of their life forms. It is also impossible to evaluate the performance of human life forms and the expression of life meaning.

Education evaluation attempts to show the educational secrets as unfathomable as human nature all within data which is the instrument to control the process of education. This is the arrogance of instrumental rationality. Education is complex and uncontrollable, and human nature is mysterious and unpredictable. Even if the education assessment is completely intelligent and big data-based, it is impossible to grasp and explain all the secrets of education and of human growth. Education assessment objectifies people, but it forgets about and despises human nature in-depth. It also disregards the integrity of life and its existence. When the existence of human life and human nature are regarded as estimable, valuable, and measurable objects, the richness and freedom of human beings disappear, and human beings lose the real existence of being human and turn to be as data shows. This kind of data-based education evaluation takes education which fosters people as production of standard components. Therefore, education evaluation, despite the fact that it seems to be for education, is actually against humanity. On the contrary, when human beings are regarded as measurable and evaluable objects, they, as the growth of existence, are distorted. In this sense, education assessment poses an existential threat to human education (Preston 2017, p. 55).

The worship of academic performance and evaluation in education reduces the improvement of humanity and substitutes personal character and quality with the training of some using functions. It actually downgrades man's spiritual character and regards humanity and spirituality as tools. In fact, real education explores the soul and intact humanity, which is incalculable. That is to say, the formation, construction, and improvement of the quality of the soul cannot be measured. Man's spiritual growth and experience renewal can only be verified in practices, and cannot be measured and calculated. Man's action, the experience of growth, and the results of spiritual development can only be achieved by one's reflection, and be grasped and judged by subjects themselves.

Educational evaluation can hardly assess and reflect the complexity, significance and transformation of l human life. The subjective spirit of students is constantly transformed and is open to future possibilities. Therefore, standardized data of education assessment cannot be used to describe the students' spiritual growth. In educational assessment, students' complex and rich spiritual changes in education are represented by a set of data. In fact, it will lead to the superficial and reified understanding of education and students and thus to digital distortion of the existence of education. With this, the numbers and data become a mere digital landscape and true human existence is overlooked. The human nature behind the landscape is obscured and forgotten. In this way, the "education" described by educational data is straying farther and farther from true education, and the developments represented by the data is getting farther away from the true growth of students.

No matter what kind of data technology is used, no matter how objective the process and method of evaluation is, the only things that can be evaluated by the

measurement and assessment in education are those measurable phenomena or appearances. As the reality of education is guided by education assessment, representational indicators used by assessment will cause those deeper, richer and more intrinsically immeasurable content to be ignored by educational institutions, and these factors may be the spiritual content that education should cultivate. Under the guidance of education evaluation, school education can only adapt to the index system of education evaluation and become more and more utilitarian and instrumental. Education evaluation regards education as an input–output process, and it measures the output of those designed input-education process contents after output. This result is not to the benefits students acquire in the education process, nor the mental quality of the students' subjective transformation.

The process of education is a unique and complete process of subjective construction for individual students. In fact, education or the benefits one receives during the process of education consists not of the educational results produced by input. Personal intention, experience, realization, construction, expansion, imagination, integration, participation, creation, connection, etc. in education all constitute the experience, interests and benefits obtained through education, which are generative and creative. Therefore, data-based education evaluation can neither evaluate the development of students nor education itself (because students receiving educative benefits are a subjective construction of education meanings) nor can they even fully evaluate the education process and educational activities themselves.

3 Non-Educational Feature of Education Assessment

Is education assessment an integral part of education or a foe? (Black 1998) Those scholars who are in favor of education evaluation believe that data-based education evaluation can objectively and clearly represent the development status of students, and can discover or diagnose and even correct the problems of learners and educators in a timely manner. Therefore, education evaluation is treated as an indispensable component of the education process and education is inseparable from the evaluation of assessment. Some scholars may argue, from the perspective of instrumental effectiveness, that in spite of some negative effects in measurement and assessment in education, it is an indispensable means of educational practice. Both of these views regard education evaluation as a necessary process and element to achieve education goals, and believe that without modern education measurement, educational activities cannot achieve the due actual goals and aims.

This view is one-sided. In fact, educational measurement or evaluation is the product of modern educational institutions. It is a method that modern industrialized or factorized education system used to describe the production process and its products. It is a technical approach that the "input–output" industrial and engineering world thinks in, and is used here as a form of controls for educational practice. Education assessment is not necessarily an integral part of education. From the perspective

of pedagogy and history of education, educational practice or activities do not necessarily depend on assessments. It is a means attached to educational practice, not an element of educational activities themselves.

In light of the essential attributes of educational activities, because educational assessment narrows education practice, it is irrelevant or even unhelpful to create true education that cultivates humanity. This is because the relationship between educational practice and human life development is not built on educational assessment or evaluation, and the evaluation cannot reflect the spiritual growth of people. The educational evaluation itself cannot understand the spiritual growth of human beings or the inherent nature, complexity, integrity and uniqueness of people. It is not a necessary process or means to promote excellence within human nature, and has nothing to do with the process of human spiritual construction transformation.

Teleologically, data-based educational evaluation is not necessarily required for the purposes of education. Educational assessment cannot measure the practice or realization of the essential purpose of education. The educational objective evaluated and promoted by education measurement and assessment is not necessarily the essential purpose or the ultimate purpose of education. From the perspective of the practicality of education, the purpose of education is inherent and embodied in practice itself, and so specific indicators or goals set according to external needs are subordinate to its essential purpose. Educational assessment converts the external instrumental goals into the goals of education, so that the measurable results and processes achieved by the goals are used as the evaluation objects. Data replaces the understanding and practice of the real educational purpose. The intrinsic nature of education determines that its content cannot be expressed by educational assessment, and the specific content of educational assessments is not exactly contained in the goals of education. There is no doubt that when education refers to indicators of education assessment that deviates from the purpose of education, it leads to the focus on indicators and ignorance of the purpose of education, thereby misleading education practice.

Data-based education assessment is an important device for modern education. This kind of education assessment is adverse to education, but it has become a dominant factor attached to educational practice, and in education, it is deployed to capture, regulate, and control school education processes and products. Education is controlled by an external assessment mechanism. It is exo-pedagogical and contrary to education. Education assessment is non-educational and is not an integral part of education. It is fundamentally different from and opposite to real education and its processes. Even in some cases, it is anti-education because it distorts education (Kamenetz 2015).

Data-based education assessment has nothing to do with good education. It cannot identify what good education is, nor put good education into practice. This is because the data education evaluation gives cannot interpret the essence of good education. Good education should improve man's mind and cultivates humanity. This is both an educational ideal and creative practice. Therefore, it cannot be achieved because education assessment focuses on the external educational phenomenons, the instrumental efficiency and effectiveness of the educational process, and it ignores

the normative and purposeful issues of a good education. Education assessment turns education into a technical, procedural, managerial, and instrumental process. It changes the normative issues of good education into results described by data, leading to the issue of good education being forgotten (Biesta 2016). The indicator system of education evaluation is only aimed at certain factors in the measurable educational reality, and cannot involve the essential factors of a good education.

On the surface, education assessment is intended to promote people's learning, but its actual effect is anti-learning. Real learning is existential learning, which is the whole process of spiritual involvement and transformation of the subject. The learner turns the acquired knowledge into his own spiritual power through learning and transforms it into new qualities of the subject itself. Therefore, learning is normative action with values in which the learner uses his own spiritual power to absorb the overall human experience and refine the subject's spirituality. In this sense, learning itself is for the being and becoming of man, and it is towards the integration and transformation of spirituality. It also shows the spiritual progress and improvement of the subject itself. Furthermore, it reflects the subjective construction of educational value and its meaning. In fact, this kind of subjective constructive learning cannot be evaluated or assessed by various popular education measurements and assessments.

Education assessment is aimed at the factual learning behavior of students and their results, leading to narrow learning of knowledge instead of human existential learning in the full sense. Although the procedural assessment seems to evaluate the progress of students, it still focuses on students' factual learning. It measures operational learning behavior and outcomes and then evaluates the changes of students' places in a specific group (class, school, school district, state, etc.) by establishing a database of student performance (Wang et al. 2018). Although it aims to improve teaching and learning, this is superficial, because according to its understanding, learning behavior is that what uses measurable knowledge and skills as an object, which undoubtedly narrows learning. Thus assessment and evaluation methods seem to promote education and learning, but it actually equates certain kinds of learning with education and makes school education adapt to such learning, as a result, learning replaces education (Biesta 2013).

Data-based education assessments not only distort learning activities but also deviate from the learner's position that education should have. It cannot reflect the growth process and nature of students in education; instead, it is compulsory, that is, learners are locked in the cage of the education evaluation system, and their growth is limited to the evaluation system and regulation of education evaluation. Furthermore, education evaluation also becomes solid labeling, recording students' growth, and their development intention and possibility are predicted or predetermined by education evaluation. In fact, the whole growth of students as persons cannot be estimated by evaluation, and any plan or prediction of whole growth or development is anti-growth. This is because students' growth is holistic, internal and unique. The development of the whole person is rich in possibilities. Growth opportunities and methods are uncertain, and the growth process does not follow a continuous pattern. Assessments at any stage of education cannot explain the experience, feelings and processes of student growth, nor can they explain the changes and

transformations of the spirit, soul, or inner world; thus, they cannot comprehensively diagnose students' development problems and predict their development possibilities. Education assessment has simplified, flattened and narrowed the growth process of students.

Education assessment stimulates educational competition and causes anxiety, and damages students' experience of receiving education and experience of living in school. On one hand, education evaluation compares the position of different students in schools and possible social use-value; on the other hand, it arouses individual desire to compete to succeed in evaluation. Whether education assessment and evaluation are formative or summative, it is actually a way of comparing and classifying students. The evaluation highlights the individual's position and the differences in individual learning behavior, learning ability, and learning results. It results in the competition which causes everyone to feel anxious about winning (Steel 2014). Because recognition gained by children from school, home, peers, and society is based on the evaluation results, the assessment puts students under the pressure of being recognized, so they have severe anxiety in schools, and the learning life is disturbed by anxiety or high stress. In fact, education assessment makes school a place where students are truly anxious, and those who are left behind in education assessment may experience marginalization and unfair treatment.

Regardless of the development level of assessment technology, data-based measurement and assessment in education have become an objective means of education and a modern discipline mechanism. Students are measured, regulated, controlled, captured, and constrained by the data of education assessment. Education assessment produces new educational forms and methods aimed at training human instrumental functions rather than the whole person. Data-based education assessment contains huge educational risks. It penetrates the education process and the life growth process of students. It manages human life through data and evolves into continuous monitoring, intervention, adjustment, correction, control and discipline, becoming an objective mechanism for the alienation of education and the process of students' growth.

In modern education, the control of education demonstrated by education assessment technology has become a worldwide fact. It is accepted, embraced and used to achieve goals. The rapid development of intelligent and data-based education assessment seems to become the inevitable foundation for the modernization of education. Though the modern education system welcomes it, education assessment technology is a way to separate students by data and would cause discrimination, and it narrows and mutates education into conditioning and controlling. Education assessment reflects control of education by modern industrial society and technological society.

Modern education is more and more narrow and instrumental. This may be related to the narrow understanding and conception of school education on human nature, and to the standardized and instrumental methods and content of education assessment. Education is increasingly stressing standardized functions and competences that can be displayed and compared in a measurable manner, thus reducing school education to training for these functions and competences. Undoubtedly, in the era of

education with intelligent and smart technology, education evaluation is given much importance. The intelligent technology of education makes it easier to monitor and evaluate, and causes the data of education evaluation to be increasingly based on big data. All aspects of students and education have become a part of big data. Big data-based education evaluation may become a reality in the near future, which will pose a huge challenge to educational practice.

For education practice, the correct and rational use of education assessment has become a top priority in educational reform. Education practice requires not only evidence of data, but also guiding ideas and practical wisdom. In order to support a good education, education assessment technology needs to face the things that are forgotten by education assessments, examine the hidden educational malaises in it, analyze its possible boundaries, study more humane methods, and scientifically evaluate educational aspects and affairs which need to be measured. It should think to recall educational values, aims, goals and ideals that have been forgotten and let them underpin education assessments. Doing so may alleviate the negative effects brought about by big data-based education evaluation, and turn educational practice into a method for cultivating and up-bringing human beings.

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On Relations Between Education and Machines

Fuxing Liu

Abstract In the data era when the Fourth Industrial Revolution is quickly progressing, the pedagogy must consider the relations between education and machines as an intermediary when studying the relationship between education and humanity, as well as the relationship between education and social development. The subject should be based on ontology and axiology, as machines and their evolution have become a part of human and societal development. Machines become integral to teaching and learning; meanwhile, the reform of the educational structure relies on a revolution of artificial intelligence (AI) technologies. Schools are becoming a new type of social organization that connects everything when the development of machines and education limit one another. Such changes entail reforms of pedagogy as well as the promotion of a new concept of education. There should be a theoretical system supported by data and information, and a policy system consisting of artificial intelligence and education.

Keywords Education · Artificial intelligence · Machines · Relations · Subject basis

Human society is moving towards the data era. The Fourth Industrial Revolution is progressing rapidly, ushering in a new round of radical changes. Pedagogy, a discipline that studies educational subjects, is facing new challenges and opportunities when studying new subjects, proposing new theories and debating new policies.

1 Pedagogy Needs to Face a New Theme

The relationship between education and humanity and the relationship between education and social development are the two major themes for pedagogy. Regardless of what philosophies, worldviews or methodologies are employed, the theoretical system of pedagogy is based on two pillar subjects that will never change. In

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a new era when information, the internet, the internet of things, quantum science, 5G telecommunications and artificial intelligence are all blooming, pedagogy has to face, study and respond to a new subject: the relationship between education and machines. In addition, when dealing with the subject, we need to take a variety of elements into consideration, including education and the development of humanity, society and machinery. We even need to take the relationship between education and machines as an intermediary in order to study the relationship between education and human development, as well as the relationship between education and social development.

1.1 The Influence of the Fourth Industrial Revolution

At present, the Fourth Industrial Revolution, featuring artificial intelligence, is bringing human society into the data era. "Artificial intelligence is an important driving force leading a new round of technological and industrial revolution. It is changing the ways of production, people's life and study, which ushers in a new era characterized of the coordination between people and machines, interdisciplinary integration, coordinated creating and sharing" (Xi 2019a). Typical parameters of the era include rapid evolution of artificial intelligence, production of intelligent machines and a wide application of such machines, as well as interactive relations and even high-level coordination between humans and machines. The features are shown in the following aspects.

The first aspect is that the AI technology is entering into a new stage, where deep-learning-based on the neural network has become a reality (Li 2018a, b, pp. 16–20); artificial intelligence is not only evolving from computational intelligence and perceptual intelligence to comprehensive intelligence, but also from Narrow AI to General AI (Li 2018a, b, p. 21).

The second aspect is that intelligent machines have begun to have independent consciousness as well as learning capabilities. Researchers from Columbia University have for the first time, developed a robot that exhibits independent thinking abilities ("American Scientists" 2019). There are also breakthroughs in the development of neutral network learning technologies; the research team of Shi Luping at Tsinghua University has built AI chip circuits that are similar to human neurons. Robots with such circuits can think like humans, and solve problems with independent thinking (Pei et al. 2019).

The third aspect is that the coordination technologies between human brains and computers have had breakthroughs, which allows cooperation and even high-level coordination between human and machines. The connection between human brains and computers is becoming a reality, as Elon Musk, the founder of Tesla and SpaceX, said that Neuralink, a neurotechnology company invested by Musk, would launch the first brain–machine interfaces (BMIs). The BMIs will connect human brains and computers, thus realizing the interactive communications between human brains and machines ("Is the connection" 2019). The research team of Zhejiang University

collects human EEG signals through an "EEG cap" and transmits it to a computer, where it is processed by a specially designed program, encoded into electrical stimulation parameters, and transmitted it to a chip carried by a mouse, thus manipulating the mouse to follow human instructions("Is the connection" 2019).

Intelligent devices are thus integrated into humans. In the future, in addition to the human-machine combination in the biomedical sense, learners can use wearable or implantable devices composed of intelligent machines, making another type of human-machine combination. 5G and more advanced communication technologies, as well as new developments in quantum science, will significantly accelerate this process by greatly promoting the development of artificial intelligence technologies.

Therefore, in the future, intelligent machines will play a crucial role in education and society. These machines would be integral to society as they are capable of independent thinking and independent movements, executing more instructions and even participating in policy-making processes in regards to politics, law-making and ethics. Following this trend, a problem that people and society have to face is that they must learn to coexist and cooperate with intelligent machines.

1.2 Technological Changes Bring the Revolution in Philosophical Theories and Human Behaviors

Technological changes decide social development. The revolutions brought by steam engines, electric motors and the internet have had game-changing effects on people's lives, social development and scientific theories. The intelligent machine revolution marked by artificial intelligence is rapidly changing people's lifestyles and social activities, forming new material and technical structures of human activities, which will inevitably bring about a revolution in philosophy theory and human behavior.

The first aspect is that the dualistic worldview of subject and object, human and inhuman, which modern science relies on, will be broken. The theoretical system and methodology of modern science are based on anthropocentrism and dualism that centers upon the human being, which means that humans are at the center of the world and control everything. Humans are not only the starting points but also the end of truth. Modern science and methodology, as well as the external world, consists of all instruments that are nothing but the result and means for humans to learn about and change the world.

The rapid progression of AI technology, the generation and application of intelligent machines, and the interaction and even integration of humans and intelligent machines will lead to changes in the philosophical ontology. In particular, the learning and thinking abilities of intelligent machines are comparable to, or may exceed, those of human beings produces a human-machine combination, which will inevitably break the boundaries between traditional subjects and objects, subjectivity and objectivity, person and object, human and non-human. "In a world where everything is connected, human beings are not the center, but only a part of them" (Harari

2017, p. 345), and man is no longer "the source and purpose of truth", but "a tool to create the connection" (Harari 2017, p. 345). As "the people-centric worldview moves towards data-centric worldview" (Harari 2017, p. 353), anthropocentrism is subverted, a dataist worldview will gradually replace the humanist worldview, and the development of human society will thus enter the post-human era. Changes in the philosophical ontology will also bring about changes in value theory, epistemology and methodology.

The second aspect is that algorithms have become the basic rules and ways of thinking to explain and understand humans and the wider world. This means that in a data-led world, algorithms are the basic rules of thinking to explain and understand people, society, and everything else. In actuality, the core part of AI technologies is various algorithms with different functions.

Generally, an algorithm is a program of instructions prescribed by an algorithm engineer to solve a specific task. It can produce a valid output in a limited time, for inputs within a limited range. Algorithms are solutions for intelligent machines to process data streams using specific programs. The status and importance of algorithms in the data era are similar to human knowledge, neural networks, and methodologies of thinking.

In the data era, "algorithms are profoundly changing our recognition of life, the universe and everything (Dormehl 2016, Introduction)". In the future, "a creature itself is actually an algorithm, and life is a process where data are processed continuously" (Harari 2017, Front cover), and even "the external environment with big data accumulation knows us better than ourselves" (Harari 2017, Front cover). Freedom of information will become a new belief, and Dataism would be the first movement to truly create new values since the establishment of humanist values in 1789 (Harari 2017, p. 346). Furthermore, information, data and algorithms will become important concepts for understanding the nature of people and society (Li 2004, p. 203).

The third aspect is that the connotation and boundary of human (society) and machinery need to be redefined. It is recorded in the history of modern science that people invented and created machines and machines are merely tools for human and social development. Man is the subject with a subjective initiative, and machines are objects and tools. But in the data era, the lines between subject and object, subjectivity and objectivity, person and object, human and non-human have become blurred. Under the condition that machines have autonomous learning and autonomous thinking capabilities, we need to rethink the relationship between humans (society) and machines, and redefine and explain the connotations of humans (society) and their activities.

Firstly, the relationship between humans and machines is becoming increasingly complex and no longer merely absolute subjects and objects. The relationships between man and machine and society and machine are no longer a unidirectional subject-object relationship, but an interactive, inter-subjective, increasingly integrated relationship. Secondly, the definition of humans and machines have become more complex. This is demonstrated by the data flow becoming one of the solutions which are used to explain the connotation of human nature; human history is actually the process of data processing (Harari 2017, p. 342), while machines change from

an absolute tool to a subject (Li 2004, p. 191). Thirdly, it is possible that humans and machines change the status of subjects and objects. Robots have advantages over humans (King 2017, p. 101), and though man-created algorithms, they face the threat of being eliminated by algorithms (Li 2018a, b, p. 1). "Dataism is a move from people-centered philosophy to one with data as its center, and people are pushed aside during the move (Harari 2017, p. 352)."

1.3 The Internet of Everything: Pedagogy Must Consider the Educational Reform Brought by AI Technologies

We must face up to changes of the world itself and the relationships in the world. Pedagogy, which mission is to study the development of education, the human and society, must consider a time when the nature of people (society), the relationship between people (society) and tools, and even the dominance of human beings changes, and the perception of human beings and the society includes methods of information, data and algorithms.

We must face the changes in education and learning practice under the internet of everything. Just as previous industrial revolutions brought revolutionary changes to education, the fourth industrial revolution will also usher in new forms of education and learning revolutions. One rule of dataism "is to connect everything to a system, even those who don't want to be involved—everything is in reference to not just people, but everything. The internet of everything includes not only humans themselves, but also cars running on the streets, refrigerators in kitchens, chickens in coops, and the trees in the woods. Simply put, everything must be connected to the internet of everything (Harari 2017, p. 345)."

Education is an absolute key link in the connection. With the support of information, networking, digitalization, intelligence, and 5G technologies, education will take on a new form. The internet of everything, including the smart schools, people's learning, machine learning, and human-computer interacted learning, has become the norm in education. IoE, IoT, blockchain, 5G communication technologies and even quantum science, determine the future structural relationship between society and education. As a result, education is facing a structural change in the development paradigm, with the fourth industrial revolution as the grounding basis. Pedagogy that studies educational phenomena cannot ignore the radical and structural changes taking place in the practical activities of education and learning.

In the data era, pedagogy based on the industrialization has to face a new theme. On one hand, the machine revolution marked by artificial intelligence and its corresponding technological changes spawned new topics in pedagogy studies. It needs to explore the relationship between education and machines, and take such a relationship as an intermediary to study the relationship between research education and human

development, as well as the relationship between education and society. Additionally, pedagogy also needs to study the reconstruction of ethical values and thinking methods brought about by artificial intelligence, as the ontology and purpose.

On the other hand, pedagogy needs to re-examine and consider the fundamental issue of human destiny and its future under the new technological structure and in consideration of historical conditions. The controversy between modern humanism and scientism is now becoming the relationship between man and machine in the data era of the 21st century. Will machines gradually replace humans to become the center and dominator of our world? Many scientists and scholars predicted and analyzed this as a possibility.

Handling the relationship between humans and intelligent machines is important for the study of the relationship between education and machines. The more developed machines are, and the more such machines participate in our world, the more we need to take human nature and society into consideration. We need to look at how humans and machines adapt to each other, and think about the proposition of the relationship between education and machines and its internal mechanism, from multiple levels. This question will make humans and our world in more need of pedagogy to study and think about what to teach, what kind of people to cultivate, what the future of humankind holds as well as a series of fundamental issues involving human and social development. In addition, pedagogy's research on information, networking and artificial intelligence technology must urgently go beyond the relationship between education and technology.

All revolutionary technological changes in history brought about fundamental changes to human society, but this time it seems a little different. The technological revolution is no longer just about technics, material, tools and means of promoting human development and social development. The technological revolution is the development of human beings, the development of society, the ontology and reality. It may even cause the reconstruction of the value system. Pedagogy should consider how education faces the new challenges that are brought about by this new round of technological change in human society from a more fundamental, more theoretical, and higher-minded perspective.

2 Basic Points on Relations Between Education and Machines

In the history of education and pedagogy, the application of machines in education and teaching is not new. Most typical, are the programmatic teaching theories and teaching models using teaching machines promoted by American psychologist Burrhus Frederic Skinner in the mid-20th century, as well as the widespread application of contemporary computer-assisted education. However, the philosophy and behavioral theories behind these theories and practices were still confined to the category of human-centered and subject-object dualism, which means behaviorism,

constructivism, and technical philosophy serve as the philosophical basis. The role of machines is only in terms of instrumentalism, and machines are only viewed and used as tools for human education and learning.

In the era of data, the position of anthropocentrism will be challenged, the dual thinking method of subject and object will be broken, and human nature will be given a new meaning. Machines are transformed from tools, technologies, and objects into a part of the purpose, subject, and ontology. Schools, teachers, and students will become part of the internet of everything. This requires us to think beyond the methodological level of behaviorism, technical philosophy, and instrumentalism. It requires us to study the machine-related problems in education and teaching at the level of ontology and axiology.

The emergence of the new ontology will inevitably affect the value system and ethical rules, and, then, the reform of the methodology and evaluation system. Pedagogy should consider and study the proposition of the relations between education and machines from the perspectives of philosophy, pedagogical principles and educational policy.

2.1 Machines Will Become Part of the Essence of Human and Social Development

In the history of philosophy, there are various views on the nature of humans and society. Marxism emphasizes that "the production mode of material life restricts the whole social, political, and spiritual life. It is not people's consciousness that determines existence; rather, it is their social existence that determines their consciousness" (Marx and Engels 2009a, p. 591). "All social life is practical in nature" (Marx and Engels 2009b, p. 501), and "human nature is not an abstraction inherent in a single person. In its reality, the essence of man is the sum of all social relations" (Marx and Engels 2009b, p. 501). The principles of Marxism provide a way of thinking for us to consider and study the nature of intelligent machines as well as the nature of people and society in the data era.

Firstly, intelligent machines are a kind of being, which is demonstrated by Rasmussen S. who used five axioms and three inferences to support the conclusion (Li 2004, pp. 191–194). The large number of human-computer combinations created by the era of enhanced intelligence (King 2017, p. 7–40) is itself a new type of existence. "From the perspective of post-humans, there are no intrinsically different or absolute boundaries between physical existence and computer simulation, between human-machine relationship structures and biological organizations, between robotics and human goals (Hayles 2017)." The coexistence, symbiosis and cooperation of biological humans with intelligent machines and human-machine combinations have become a normal state of social production and social life.

Secondly, intelligent machines have become a part of humans and society. They have been and are constantly improving their social practices. On the one hand,

machines are becoming more and more like a human. Intelligent machines with self-awareness, self-learning capability, and thinking ability become more and more human-like. When the physical structure and functions of the machine reaches or exceeds the structure and functions of the human brain, machines will change from the most important tool of the human being to the human being itself and become ontology. Therefore, the concept of life has been expanded. Natural life and intelligent machines are just different social existences based on different algorithms, such as biochemical algorithms and electrified algorithms. On the other hand, intelligent machines continue to form, develop, and enrich their practical social relationships. We see that Alpha Go defeated the Go champions Lee Sedol and Ke Jie, that accompanist robots are popular in Japan and the United States, that the nearly 400-year-old Kyoto Kodai-ji Temple officially uses the robot Mindar to preach and that intelligent machines are widely applied in the biomedical field to produce a large number of human-machine combinations. These are the social practices in which intelligent machines participate. More importantly, intelligent machines will gradually establish their own social relationships in social practice, thereby forming, developing, and continuously enriching their own intrinsic connotations.

Thirdly, humans and society are beneficiaries of this process. The Marxist theory of the objectification of labor reveals that people with self-awareness realize their own reproduction through "subjective objectification" and "objective objectification" when using tools (Sang 1993). In the data era, this kind of human reproduction is faster, wider, and richer in content. People are more and more like machines. Intelligent wearable devices, implantable devices and enhanced intelligence technologies are becoming more and more complete and advanced; this can enable people to think and act beyond the reach of creatures. The social relationship between human beings and intelligent machines with self-awareness and autonomous learning capabilities has become more complicated, as is the subject, the object and even the integration. Compared to the previous tools as absolute objects, intelligent machines and their development will become an unprecedented driving force in promoting the continuous enrichment and development of humanity and society.

How will all these changes affect our understanding of the nature of education, the nature of human development, and the nature of social development? Although in an age of artificial intelligence machines begun to have a subjective significance, the status of human beings and machines are fundamentally different. Furthermore, the education of machines and humans will also be essentially different. This is the basis of our discussion on the relationship between education and machines.

2.2 Machines as Tools and Carriers of Education Become the Educators and the Educated

Man is the subject and the object of education. This is the basic proposition of modern pedagogy. In the data era and under the internet of things, the proposition needs new

perspectives and new connotations. We need to look at educators, the educated and their relationships from a new perspective.

Machines still perform the basic functions as the carriers and tools of education and learning. Intelligent machines and technical structures are the basic material, technical basis and basic tools of education. Just as we didn't have books, computers, or mobile phones and now we can't live without them, in the era of the internet of everything, humans can't live without intelligent machines. Intelligent machines are the hub and network of the internet of everything. With the continuous improvement of automated machine-learning systems, the basic approach is using intelligent machines for labor, education, and learning. As intelligent machines are irreplaceable in labor, education, and learning, the relationship between education and machine development has become an intermediary and carrier for the study of the relationship between education and human development as well as education and social development. However, machines are no longer just carriers and tools, but also subjects and objects of education.

There will be more robot teachers; such teachers can shoulder some education and teaching tasks. More importantly, intelligent machines operate not only through programs, instructions and algorithms, but also with self-awareness, autonomous learning and autonomous thinking. With the development of artificial intelligence technology, self-awareness, autonomous learning and autonomous thinking capability of intelligent machines they will become stronger and stronger. Databases and algorithms become stronger, more powerful than humans and continue to improve. There remain many possibilities to combine biochemical algorithms that embody human characteristics with electrification algorithms with intelligent machine characteristics. All this will lead to intelligent machines growing more powerful than humans in some specific aspects, as "the tasks performed by algorithms are impossible for humans to complete (Dormehl 2016, p. 203)." Will future robot teachers surpass human teachers? This is true at least in some steps and aspects of education.

Another problem is educational machines and the combination of human and machines. As machines become more and more human, machines become part of social practice and life in general. The cooperation between biomedical technology and artificial intelligence technology will produce more human-machine combinations. The man-machine combination which uses many wearable devices and implanted devices is particularly critical, as the characteristics of such a combination direct the development of people and society in the opposite direction of humanity, meaning people are more and more like machines.

Scientists predict that the singularity is bound to arrive someday in the future. Facing the social, ethical and even legal issues brought by intelligent machines and human-machine combinations, machines and human-machine combinations will inevitably become the object of education. Theorists of post-humanism have raised the question of how one ought to educate machines (Zhu 2018). Though some scholars believe that "computers cannot make value judgments", "computers cannot have morals", and "value systems cannot exist in the form of algorithms (Brabandere 2019, p. 109). Regardless of how artificial intelligence technology is developed and applied, humans need intelligent machines to learn value judgments. Therefore,

the machine must have ethical principles and adhere to basic norms. At the same time, algorithms actually can "change the course of today's public opinion (Dormehl 2016, p. 231)". the existing facts have also shown that big data and algorithms can influence, determine, and even shape value judgments and value systems.

In particular, the education of machines has become a practical and policy issue. The European Union, as well as Japan and China, have all published and presented ethical guidelines. Ethical AI is a global issue, for example, the European Union issued the *AI Ethics Guidelines* in April 2019, Japan issued the *Human-centered Artificial Intelligence Social Principles* in December 2018. The *New Generation Artificial Intelligence Development Plan* issued by the State Council of China in July 2017 clearly raised ethical issues of Artificial Intelligence. UNESCO released the *Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development*, which systematically pays attention to the challenges brought by the application of artificial intelligence technology in education. In the age of artificial intelligence, it remains to be seen where education will eventually go. However, as man-made objects, machines serve the well-being of human beings and coexist in harmony with human beings. This, exactly, is an important mission and destination that humans expect to be completed by educational machines or machine education.

2.3 Educational Structure Needs to Continuously Adapt to the Transformation of Social Structure Based on the AI Technology Revolution

The technological revolution has profoundly changed the social structure. The current educational structure must adapt to these changes within the social structure. This is not only a basic principle of modern sociology and pedagogy, but also a fact that has repeatedly occurred in the history of modern human education. The same is true in the age of data, the age of algorithms and the age of enhanced intelligence. The depth, breadth, and speed of this kind of change are unmatched by any previous industrial revolution. Theorists of post-humanism have raised the question of how to educate machines (King 2017, p. 42).

The combination of artificial intelligence technology with the internet and the internet of things will create a social structure in which everything is connected. In the age of data, "the human world is embedded with computer logic (Dormehl 2016, p. 217)." In other words, algorithms are the basic norms and ways of thinking in regards to controlling human social behavior. Algorithms become "information and social organization methods formed by the collective human intelligence (Dormehl 2016, p. 210)." With the development of the internet, the internet of things and artificial intelligence technology, the elements of human society, human practical activities and their relationships will become increasingly complex.

Regardless of whether the intelligent terminal and its network collection will grow into a subject with personality, human, robot and the combination of human-machine are three basic subjects. They constitute a more complex relationship. The world becomes a special world composed of three real worlds: the real world, the mathematical world and the computing world (Li 2004, pp. 197–198). Some people believe that it is a quaternary space composed of people, the physical world, intelligent machines and the virtual information world (Wu 2018). Their relationship with each other is bound to be more complicated. Compared to the current world of human beings, the way they connect and collaborate will also radically change (King 2017, p. 213). Social occupation types as well as the type, quantity, and standards of labor required by society will also change dramatically. "Human labor will gradually be replaced by machines from low-level thinking to high-level thinking (Li 2018a, b)."

The educational structure system in the data age is bound to change with the change of social structure. The educational structure system in the data era is based on artificial intelligence, the internet, and the internet of things, technology as the material and technical foundation. It is embedded in the social structure of the internet of everything and is an integral part of the internet of everything. The form of education has changed from education in the industrial era to education featuring information and algorithm such as "Internet + education", "Internet of things + education", "AI + education". The educational system was originally a rigid system characterized by tiers and hierarchy in the vertical direction, with a formal system as the main body, and a dual-track system characterized by the general and vocational education in the horizontal direction. In the future, the education system will be transformed into a three-dimensional or even a continuous expansion of the marginal spherical multi-loop, network-based, flexible institutional system consisting of both formal and informal institutions. The subject system, teaching material system, the teaching system and the management system will also change accordingly. Additionally, the identities, connections and collaborations of teachers, students, and managers will also become increasingly complex.

2.4 School Becomes a New Type of Social Organization

In the history of human education, the transition from decentralized individual education to organized school education is an educational organizational reform based on the technical revolution of the first industrial revolution. The second and third industrial revolutions, marked by electric motors, computers and the internet, only enriched the concept of the school, and did not fundamentally change the school's extension within society or its organization. However, in the data age, the rapid development of the internet (especially the mobile Internet), the internet of things, 5G technologies, and, especially, artificial intelligence technology provides possibilities for school reorganization and reconstruction.

Firstly, the school is a social organization that is connected to everything. The internet, the internet of things, 5G technology and AI technology are widely used

in education, thus making schools an integral part of the internet of everything. Virtual teachers, smart desks, smart schools, smart kindergartens and all-connected schools are integrated within smart cities, smart homes and the wider connected world. More importantly, with the advancement of technology, there will be a cycle of technological changes that are constantly embedded in schools, education, and learning systems. Then it will be further embedded into schools, education, and learners. Those who are teachers, students and education managers will be "just a chip in the Internet of Everything (Harari 2017, p. 348)."

Secondly, human-computer interaction has become the norm in education and learning. Based on the current internet and internet of things applications, educational robots will be widely used in education. It is put forward in the *Education Informatization Action Plan 2.0*, "as a representative of robots used in education, educational robots will become an important part of a smart learning environment (Ministry of Education of the People's Republic of China 2018)." Wearable, implantable educational learning devices and even miniature educational robots have become standard equipment for learning. Furthermore, learning to coexist with machines in education will become a basic requirement.

Thirdly, the boundaries of the school concept are broken. Education, teaching, and learning have gradually become Online-Merge-Offline activities (Li 2018a, b, p. 146). Mobile terminals, new communication technologies and augmented intelligence will completely change the way people organize education and learning. The standard traditional school organization, which is like an assembly line will be completely changed. The coexistence of real-world learning and virtual learning, the combination of classroom learning and mobile learning, institutionalized learning and non-institutionalized learning will each equal and have their own characteristics. The requirements, results and effects of practical activities, such as education and learning, will require new standards. That means that we "not only need to teach students science, technology, engineering, and mathematics (STEM subjects), but also teach flexible, creative thinking, rapid learning and adaptation (King 2017, p. 53)". Information literacy, data literacy, lifelong learning, fast learning, learning to choose, higher-order thinking and high emotional intelligence, firm values and beliefs have become basic requirements for learners; some call it the new general education of the 21st century (Wu 2018).

2.5 Machine Development and Educational Development Limit Each Other

In the data era, the development of machines determines the development of education. The development of the internet, the internet of things and artificial intelligence technology will bring us a new social form composed of intelligent machines and virtual worlds (or computing world, data world) outside of traditional society. In traditional society, whoever has the highest quality talents and the most advanced

production tools will lead the world. Similarly, in the data age, those who have the most advanced internet, internet of things and educational robots may have the highest quality education and talent.

From the history of education, there are many factors that determine the quality and level of education. However, in the data age, the level of artificial intelligence technology and the level of educational robots will be revolutionary and decisive factors in the effects of education reform and education quality as a whole. The quality of talents determines the level of artificial intelligence technology and the level of intelligent machines. In accordance with the development of artificial intelligence technology, talents, policy, market and big data are all key elements that affect artificial intelligence technology (Li 2018a, b, p. 105). Talent is the core and policy is the guarantee. Without innovative talents and specialized, high-level artificial intelligence engineers, it would be impossible to have the world's leading artificial intelligence technology and intelligent machines.

Secondly, the research level of education science will also have an important impact on artificial intelligence technology. It is generally believed that artificial intelligence technology is an interdisciplinary field where mathematics, logic and computer science constitute to form the subject basis of artificial intelligence technology (Brabandere 2019, p. 1). After neural network learning methods have been used in artificial intelligence technology, cognitive neuroscience (psychology) has become the subject basis of artificial intelligence technology.

As intelligent machines with independent consciousness and thinking ability are widely used in all aspects of social life, there will be issues, such as robot behavior norms, ethical issues, the value relationship between humans and machines, education and management machine problems, educational robot manufacturing, use and management problems and so on. All of these require the theoretical guidance of pedagogy in the data era. Needless to say, pedagogy is an important theoretical and disciplinary basis for the development of artificial intelligence technology in the future. It can be said that from now on, Chinese pedagogy must establish such concepts and make theoretical preparations for them.

3 Pedagogy and Its Research Need Reform

Education is conservative; it is necessary to continue culture and civilization. However, education is an advanced social undertaking. Education plays a leading and shaping role in social development and human development. Therefore, it bears great social responsibility. Facing the requirements of the data age, the study of pedagogy needs to consider whether education can play this leading and shaping role; it needs to consider whether it has shouldered this great responsibility. History has proven that technological change will not only change people's lives and social structures but also spawn new theoretical systems, value systems, policy systems and even new education systems. These changes will in turn lead to new technological changes; human society will continue to change and progress.

At present, we can basically be confident that in the data age, whoever has the highest level of artificial intelligence technology and who occupies the commanding heights of applied artificial intelligence technology will have the necessary conditions to have the best education in the world. Educational innovation in the data era requires innovation in pedagogy and its research. Pedagogy has the task of advocating and shaping a new educational value system, a new educational policy system and even a new educational structural system. On the basis of a large number of researches in educational technology, the subject of education, and even pedagogy, must pay more attention to the researched relations between education and machines. Educational philosophy, pedagogical principles and educational policy science need to carry out systematic research from the perspective of philosophy, principle and system construction. It needs to give full play to the theoretical navigation role of pedagogy.

3.1 Advocating the Establishment of a New Education Development Concept

To systematically study the new problems brought about by the development and application of intelligent machines, pedagogy needs to promote an establishment of a new educational development concept, taking technological changes into consideration.

People have various views on the concept of educational development, among which educational modernization is popular. However, under educational modernization is often linear thought and social evolution, or even technical determinism. The increasingly rapid development of modern science and technology, as well as the revolutionary effects it brings, continuously strengthen linear thinking and social evolution in modernized developmental concepts.

As mentioned above, in the data era, we will encounter problems that we have never encountered before. Thus, these questions follow in terms of:

- Educating machines: how much and what kind of big data to input to the machine;
- Managing machines: as we face the ethical problems, rule stipulations and moral education for machines, it is necessary to study and establish the rules and evaluation standards of educational activities;
- Determining the roles of humans and machines (Dormehl 2016, p. 200): setting standards for educational machines, a process similar to that of teacher qualification, textbook editing and review, need to become more sophisticated;
- Treating algorithm designed by machines: so far, only algorithm engineers have designed algorithms, but in the future intelligent machines might be able to design new algorithms themselves.

In the face of these problems, if we only think about these problems in terms of linear thinking, social evolution and technical determinism, the future of humanity

and the status of human nature are highly uncertain. With the rapid changes of artificial intelligence technology, pedagogy needs to re-examine the education modernization developmental concept. It needs to re-examine the nature and ultimate purpose of human, social and machine development.

We need to "understand not only what the algorithms are doing, but also the purpose for which these algorithms are designed (Dormehl 2016, p. 225)". We need to adopt humanistic, cultural and civilized means to deal with the impact and challenges of rapid technological changes have upon the future of mankind and upon the status of humanity. We need to use educational humanism to balance the influence of dataism and algorithmism. We need to use the culture of education to solve the problems brought about by education modernization, and we need to use value education to solve the many ethical dilemmas generated when applying intelligent machines. We also need to use culture to educate both humans and machines. The first subject that pedagogy needs to study when dealing with the relations between education and machines is the establishment of a new theoretical system in regards to the nature and ultimate purpose of human, social and machine development. It needs to establish a more traditional and modern educational development concept in order to guarantee that education can continue to modernize and extend. The final goal of this process is the integration of tradition, culture, modernization, and technological evolution and revolution.

3.2 Exploring an Information-Led Theoretical System of Pedagogy

The theoretical system of modern pedagogy is basically established during the industrial age. In the data era, we find that the basic values, concepts, viewpoints, theoretical and methodological structures of this system often fail to respond to new problems brought about by the development of education, machines as well as human and social development. Therefore, we need to establish an information-led basic theoretical system of pedagogy (or algorithmic pedagogy, computational pedagogy).

To this end, we must first prepare pedagogy theories for understanding, enriching and developing the essence of education. With the support of artificial intelligence technology, the time, space and content of educational activities will be richer and more complex. Additionally, the number and quality of educational activities will also expand unprecedentedly. Therefore, pedagogy needs to make new interpretations and judgments on the essence, value, and teleology of education.

Secondly, we must prepare pedagogy theories to deal with the relations between human development, social development and machine development. With the development of artificial intelligence, the technical structure determines the social structure; the social structure determines the educational structure. This requires pedagogy to construct a new theoretical framework for the theory of structure, the system and the function of education.

Thirdly, we must prepare pedagogy theories to describe and explain machines as educators and objects of education. As artificial intelligence technology expands the participants and subjects of educational activities, their relationships become more interactive and intimate. Accordingly, the dualistic thinking model for teachers and students would change. We need pedagogy to construct a new theoretical perspective on the subjectivism, objectivism and subject-object relationship theory of education.

Fourthly, we must prepare educational theories for the application of artificial intelligence technology. Artificial intelligence technology brings education many challenges in regards to its organizational form, subject-object relationship, communication methods,process structure and evaluation standards. As a result, pedagogy needs to draw new research conclusions on curriculum theory, teaching theory and methodology.

Finally, we must prepare pedagogical theories for the development of artificial intelligence technology—for the benefit of mankind. With the continuous advancement of artificial intelligence technology, machines have become a form of reality; they have become the subject and object of education. Therefore, manufacturing machines, using machines, dealing with the independent thinking abilities of machines and designing new algorithms have become issues that education has to face. Thus, pedagogy needs to explore new research fields, such as theories on the nature of machines, machine ethics, and machine specification (Zhu 2018).

3.3 Establishing the "Artificial Intelligence + Education" Policy System

Education policies are the means by which a country and local departments plan, regulate and manage education. The level of education policy determines the development of education. As the fourth industrial revolution has come and artificial intelligence is booming, education is undergoing structural and revolutionary changes. When making educational policies, the relevant authorities need to respond to new developments and problems; thus plan, regulate, and manage educational activities. This is a requirement for realizing educational modernization and a key for equipping China with the best education. It requires us to start our studies immediately.

First of all, we need to carry out systematic education policy research and work to change the traditional thinking mode of educational information policy. The research topics mainly include the structural, systematic and revolutionary changes of education brought about by the internet, the internet of things and artificial intelligence technology. We need to draw up a series of measures to deal with new problems in education policies, in the new systems of "Internet + Education", "Internet of Things + Education" and "Artificial Intelligence + Education".

Secondly, we need to pay close attention to international trends. At present, UNESCO, the European Union, other international organizations, the United States and other developed countries have formulated and implemented policies on the

relationship between artificial intelligence technology and education. This represents the highest level of policies in the field of "AI + education" today. In contrast, China's current policy texts are mainly concentrated in the field of industrial development. Therefore, we need to learn from international trends, to study and formulate specialized education policies on "AI + education".

The third point is that we need to make supporting policies. We need to improve the communication efficiency of various departments, grasp the standard issues, regulatory issues, connectivity issues, and evaluation issues in the field of "AI + Education", promote the standardization and systematization of related policies and lead high-level development in the various new systems: "Internet + Education", "Internet of Things + Education" and "AI + Education". For issues such as the security of network information education and the moral education under conditions of artificial intelligence technology, etc., we need to make plans and conduct research in advance.

The fourth requirement is to focus on building a new talent training system. We must grasp the development trend of global artificial intelligence technology, identify breakthroughs and its main directions and cultivate a large number of high-end artificial intelligence talents with innovative and cooperative abilities. This is the mission of education (Xi 2019b). We must strive to build a comprehensive education system covering education in moral principles, intelligence, physical training, art ability and working skills. We must strive to build a higher-level talent training system, devote ourselves to training innovative talents (AI engineers in particular) and attach importance to the cultivation of interdisciplinary and cross-cultural talents (Xi 2018).

The final requirement is that we must upgrade the education systems in regards to disciplines, teaching materials, teaching methods and management methods. According to the new requirements for talent training within the fourth industrial revolution and AI technologies, we must effectively reform the education systems in primary and secondary schools to cultivate more innovative talents.

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On the Modern Educational Value of Conscience

Wei Gao

1 Issue Raised: The Challenge of Educational Modernity

Modernity is the number one issue within the modern social sciences (Taylor 2014). Academic circles have yet to give a programmatic definition as to what modernity is. From the perspective of genetics, modernity originates from the Western Renaissance, reform of religion, and enlightenment. It is an inevitable consequence of the establishment of capitalist economic order. It introduced a new way of life (Giddens 2000), created a lifestyle and value scale different from the previously classical. It is a historical movement of multidimensional changes in system, culture, and value order; thus, the "overall change" of modernity is a dual phenomenon (Giddens 2000). While creating countless opportunities for human beings to enjoy a safe and prosperous life, it also introduced new risk parameters and fell into a "multitude of concerns." Judging from modernity's historical process, modernity has the dual dimensions of the diachronic and the synchronic. The twists and turns of modernity are both convergent and different, controversial, and intricate. Different from the endogenous nature of Western modernity, Chinese modernity originates from the survival dilemma of the nation's internal and external problems forcing the modernization process in a specific space–time background. This also determines the reflection of China's modernity. From the beginning, it has been given the historical task of planning China's future development and positioning of China within the global system.

There is a collective unconsciousness of critical consciousness and anxiety about Western modernity. Particularly, Chinese modernity has at least two themes: one is how to solve the problem of constructing a reasonable internal social order. The other is how to solve the problem of rediscovering location set within the world system. These two themes are essentially rethinking China's developmental path in the context of sophisticated modernity. This is within the inherent nature of

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Chinese modernity. In order to fulfill this mission, we need to transparently review the cultural and political factors behind modernity and modernity itself, as a process of constructing self-transformation. The complexity of Chinese modernity lies in that, on the one hand, China's development has been a process of passively accepting modernity; on the other hand, China's development has been a process of actively creating modernity. The former refers to the need to accept modern norms actively; the latter refers to the need to reflect self-determination according to local conditions critically. The essence of Chinese modernity is to create Chinese-style modernity based on a critique of existing modernity, and then propose a "Chinese plan" to solve the problem of human modernity. This makes Chinese modernity not only of Chinese significance but also of world value.

How to surpass modernity in adaptation is a serious problem that Chinese modernity has to face. Fundamentally, this issue involves the modernity value of traditional culture. Thorough all-around modernization will lose fundamental culture. Traditional culture will lose its footing if it is not modernized. We need to integrate into world civilization without losing our own soul successfully. Although, according to classical judgments, modernity is characterized by a critique of traditional ideas and lifestyles. In any case, tradition cannot be regarded as a "past tense." It still forms the continuity of life and is shaped in various ways. It is shaping our present life. As for how to transcend modernity and transcend the modernity of education, the academic circles have proposed various plans, all of which constitute to thought resources for rethinking Chinese modernity. However, no matter what kind of program ideas are employed, we must concern two kinds of power: the power of human nature itself and the inherent strength. It is these two forces that shape the mental state of the era. It is only through these two forces that human beings can surpass the value of nothingness and move towards a spiritually well-ordered life. The creative transformation of conscience tradition is based on dual concerns about the two high forces of humanity and culture.

When reconsidering the value of conscience in educational modernity, one will undoubtedly encounter a series of accusations. The intricacies of educational modernity unfold in two ways. One is to understand education as a solution to the needs of modern humans in terms of "useful" value; so, the task of education is to give students useful knowledge and the ability to become a useful person. Another is to link education with traditional morality and believe that the value of education in the reshaping of human morality is essential; so, the task of education is to make students become good people and good citizens. The former will reject conscience, believing that conscience does not help improve people's ability to survive. It is pretentious and mysterious; the latter will partially reject conscience because refined modern epistemology is enough to solve the problem of moral character. It remains to be seen whether the categories discovered in old paper piles are capable of solving the current problems. Both charges are worthy of a response. The first accusation is sharp but unreasonable—survival is the first need of human beings, and conscience is a need of being human. These two kinds of needs are not necessarily contradictory to each other. After all, people must not only live but also live human values, including dignity. The second allegation is reasonable, but not sharp enough. Conscience is not

about making a person a good person but about providing a basis for what a good person is. The modern value of conscience is not self-evident. At present, it is still thought of as a solution. A review of the value of modern education of conscience is based on the following underlying assumptions. Firstly, the problem of conscience is a problem of Chinese modernity; the creative transformation of conscience is based on the "problem consciousness" of Chinese modernity. It is the reconstruction of the modern knowledge system and the personality of Chinese modernity, a possible solution to the system and value system. Secondly, conscience helps to reconstruct the relationship between modern human beings and the world; it has a positive value for constructing a well-ordered society and a harmonious value-concept system. Thirdly, in the era of diverse values, conscience has to contribute to the formation of ethical communities. In the context of educational modernity, rethinking, revisiting, and rebuilding the theory of educational conscience is the basis for the conscience to rebuild education. In the deepest sense, this is based on the recognition of traditional Chinese culture; that is, Chinese traditional thought resources are conducive to the reflection and rescue of educational modernity. Conscience can be regarded as the cultural consciousness of participating in the repair process of educational modernity.

The most acute problem facing the modernity of education is that modernity has ended the foundational self-identity within education. The past is no longer seen as a model, history is no longer considered a revelation, classical authority is destroyed, and self-identity becomes questionable. The ultimate goal becomes a pure value, and new paradigms are constantly being created and rapidly destroyed. The so-called "progress" principle in modern times destroys its spiritual connection with history, the traditional types of authority, and the basic principles that must be followed in the moral life. The paradox of modernity lies precisely in fact, a reborn and reconstructed authority, and its principles are waiting to be destroyed. Since the modern industrial revolution, the traditional thought/ideological framework is no longer reliable. Education has become productive labor, subordinate to the social purpose outside of education; teachers have become subordinate to the benefits of professional workers. In the pedigree of modern value, how to regain the basis of education, how to find a place for teachers to settle down, especially in a culturally diverse and value-rich modernity background, where is the fundamental value of education and the spirit of teachers? Where did it come from? These acute problems are unprecedented, and the solutions are urgently required. What is an appropriate education? That is, education that can do justice; this is an ontological question. Education has its inherent truths; within its essence is inherent regulation, which does not change because its functions may alter during different historical periods. The unique significance of education is precisely not only in its inherent goodness but also in its necessary means to achieve "goodness." Means and ends of educational unity determine the ethical nature of education; such nature determines the moral obligations to be borne to teachers. Only when the teacher heeds the calling of education as "good" is the teacher's educational practice "from duty" rather than "in line with duty." The value of obligation-based moral behavior depends on the principle of will to which the behavior follows; responsibility is the necessity of

the behavior, resulting from respect for the law (Kant 1986). The moral behavior of the teacher is "out of obligation"; therefore, it means following the principles of an innate form of will. This principle of an innate form of will is a conscience in the thought system within Chinese traditional culture.

The conscience tradition has not just historical-cultural value, but also indispensable modern value when solving the problem of educational modernity. Almost all critics of modernity have taken note of the huge change's modernity has brought to human life. Their criticism unfolds either from thought/ideological logic, targeting its essentialism, logocentric, universalism, and other modern propositions. Or, the criticism starts from the logic of value, emphasizing its technical-rational "tyranny" and the barrenness of its spiritual homeland. To affirm the modern value of conscience is to fundamentally examine the theoretical and practical effectiveness of conscience in solving the crisis of modernity. Such effectiveness is concentrated in the conscience's reestablishment of the moral subject and the reintegration of disconnected facts and values in a modern world filled with "disenchantment." Conscience can become an invented tradition, rather than a discovered topic if, and only if, it helps find a place for education and teachers. It is only possible to rejuvenate within modern society if it can build a foundation for education and reconstruct a system of values and meanings for teachers.

2 The Ontology of Conscience: Returning to the True Essence of Education

What is authentic education? That is the primary question of education that educational philosophy strives to answer. Only if this question is answered can all other educational issues can be resolved. In this question, educational philosophy responds to fundamental ideals and ideas in education. No matter how different peoples' understanding of authentic education is, there are always three opposing and unified aspects of authentic education. First, authentic education is the unity of idealism and reality. That is to say, people want to educate in a certain way, and to be able to do it, achieves the possibility of reality. Second, authentic education is the unity of idealism and reality. That is to say, education should look a certain way, and in fact, it has been that way, and it is possible to return to that particular way. Finally, authentic education is the unity of regularity and purposefulness. Education is not only natural but also free. The questioning of what exactly authentic education is, is, in a sense, a metaphor, or an imagination. It means that people always pursue a better education, the education that has existed but has faded away in history. Better education is a kind of "education" that looks more "like" education.

Inquiring about authentic education is essentially inquiring about educational ontology; that is, it is not only a question of educational history (a beautiful imagination of classical education) but also a metaphysical inquiry (a rational exploration of the nature of education). Chinese traditional culture lacks ontology in the Western

philosophical sense. The tradition of Chinese culture is based on "Tao" as the basis of the system. Until the Song and Ming Dynasties, establishing the ontological basis of Confucianism was the fundamental task of the then-new Confucian philosophy. To Song and Ming dynasty Confucianism, the ontological inquiry of traditional Chinese philosophy is the theory of mind and nature. The cosmic order is the order of the human heart, and the order of the human heart is the cosmic order. Zhu Zi said," 'The body is natural', and the heart is the same; 'The rationale is the way', and nature is the same; 'The use is the god', and the feelings are the same" (Li 1986: 2). Although the cosmic order is the order of the human heart, heavenly principles have logical precedence and value priority. Regarding the Zhu and the World's Health prior to treatment, each has its own physical composition; the total processing of all things is the ball. The sum of the prime ministers of all things in this world is the ontology and the Tao. Through the heart of its reasoning, then, or one does not know the spirit of this heart; hence there was no reason for all the poor of the wonderful but need an investigation of things before the extension of knowledge. So heart and reason are rather solid. Xiangshan Lu believes that no more than justice to the people, the heart and reason to Angelica First, the essence goes, everyone is the heart, the heart is Jieju reason, the mind is also a reason (Lu 1980). To Wang Yangming, in replacing a conscience with a conscience, the ontology of psychology is finally complete.

The ontology of traditional Chinese educational philosophy is different from Western philosophy. Its rationale is based on the isomorphic relationship between heavenly principles and human minds; it constructs an educational value order both human and heavenly. In the genetic sense, this tradition of educational ontology is the tradition of Conscience. Li Zehou has an important viewpoint in "On the History of Ancient Chinese Thought," which holds that traditional Chinese philosophy has returned from ontology (natural ontology) to cosmology (world schema) to humanity, epistemology, and ethics. Internal procedures and believe that since the beginning of Zhou Dunyi the logical construction from cosmology to ethics has been realized (Li 2008). From the "head of Song Confucianism," Zhou Dunyi's Taiji schema explains Confucianism to Wang Yangming's Conscience and justice; cosmology is linked with ethics. Wang's Conscience in ontology conscience is the main body; out of heart claims, Kai into service, Zhihanggeyi, the Conscience, cosmology joint Ethics has substantially opened. However, its incompleteness still lies in the Conscience as the moral entity (ethics) and the basis of value (cosmology). How to dialectically develop epistemology, and how to have dialectical development from top to bottom and from inside to outside features is still a question. The only problem is fully resolved, and the Conscience of the body before being presented the true circle full. The task of correcting Wang Xue was mainly accomplished by Mu Zongsan.

In the construction of conscience ontology, "nothing outside the heart" is a key requirement. Nothing outside the heart is the natural principle of "mind" as ontology. However, there are still two things that need to be completed before the mind has nothing: the creative performance of the "heart" proves the creation of the universe, and the creative performance of the "heart" determines the creation of heaven. According to Mou Zongsan, "the mind–body … is not only the essence (base) of our moral practice but also the essence of the biosynthesis of the universe and all beings"

(Mu 2013: 5). The entity of creation, that is, the infiltration of the origin of the mind into the origin of the universe, is of ontological significance for the Conscience to complete. Mu Zongsan distinguished between "moral metaphysics" and the "metaphysics of morals." In Mou Zongsan's view, "moral metaphysics" is a metaphysical study of morality, which focuses on the metaphysical discussion of the basic principles of morality itself. The subject of his research is morality; "moral metaphysics" is based on the metaphysical itself (comprising of the ontology cosmological), from the passage into the ethical, moral to the resistance body when the seen origin (cardiac) penetrates into the origin of the universe (Mu 2013). "Metaphysics of morals" are a present subsumption morality. "Moral metaphysics" as moral subsumption exists, and the moral Han Photo presence would have to justify the "heart" of the creation of the record. The "mind" as a creative entity is, on the one hand, Taoism, or self-purity, due to the fact that human existence contains the infinite and universal universality of the real heart; on the one hand, the metaphysical (the ontology Cosmology) and morality are based on the practice of benevolence. Mu Zongsan concluded that "This is not only human nature, but not just human nature, but the achievement of rigorous and pure moral behavior. It is the meaning of cosmology that goes straight to its metaphysics. The nature of heaven and earth is the physical entity of the universe and the bottom of the universe. It is a sense of silence and the principle of biochemistry" (Mu 2013: 235–236). Since there is nothing but gender, the cosmic order is the moral order, and the moral order is the cosmic order. "The heart and benevolence are inherently unlimited and have their absolute universality. It is not only characterized by the achievement of moral behavior, but also runs all over their body, and the presence of the former is the meaning of its moral practice. What is the significance of its ontological? The former is the creation of its moral, ethical behavior, which the students cited as 'pure nor has', called Mencius' Peiran Mo Zhi Neng Yu'. The latter is its 'biological unpredictability', which triggers the order of the universe. Yi Zhuan's so-called 'if it is far away, it is not'. In short, it is a creative principle" (Mu 2003: 235–236). Mou Tsung-san further pointed out that, "a statement on the matter, according to my Conscience, is a clear perception of the practice of virtue; it was a statement, according to Conscience is clear ontological sense of the universe, therefore subjective to say, by benevolence. The Gantong as a unity, and objectively speaking, the heart of this unity is immediately the principle of the biochemistry of all things" (Mu 1979: 241). The former is the practical meaning of becoming oneself, and the latter realizes the meaning of oneself.

Mu Zongsan believes that the central issue of "moral metaphysics" is a possible prior (or transcendent) basis for moral practice, that is, the problem of mentality. As far as the metaphysical approach to morality is concerned, there are two layers of existential theory. One is the "non-persistent" being theory of "that is being, is active," and the other is the "doing" that is "being existing but not active." In one word: existentialism. The so-called ontological non-attachment means that their ontological community, no executive body that is known Ming feel is the infinite wisdom of the heart; execution of the so-called ontology is a phenomenon of the ontological world. There is the enforcement of a subject of the intellectual "Perseverance of Consciousness." Cheng Zhuxue's theory of nature, being without being active, is

a theory of being that is persistent; Lu Wang's Conscience, being both active and inactive, is a theory of being that is unruly. Being without activity is natural and lonely, although it is absolute, infinite, and unintuitive; being with activity is now leaping everywhere, and this activity can be defined by "intelligent intuition," that is, "consciousness." Conscience is not only the subject of presentation, but also the "object" of intuition of intelligence, and the so-called intuition of intelligence is the so-called conscious body perception. According to Mou Zongsan, the law of morality is not the result of rational reasoning, but it can reach the inherently moral nature of man through the intuition of intellect, which is the "inverse physical experience," that is Conscience. Mou Zongsan even thought, "if we do not recognize the limited existence of human beings, we can have intelligent intuition." According to Kant (I.), the meaning and function of this intuition are not only impossible for all Chinese philosophy, but that is also for Kant himself. All the morals spoken are all empty words (Mu 2003). Wisdom's intuition is the ability to reverse the physical experience "and" seek out when the moment is right, "which is the origin of the heart and benevolence." The original mind is presented when it comes back and shakes to wake up the original mind so that the object itself is a creation of value, and the phenomenon is not the same as the original, but there exists a difference in form. The reason is that ontological cosmology can only be established in terms of moral metaphysics. In other words, it is not metaphysics that makes morals possible, but it is human intuition that makes metaphysics possible.

The construction of the ontology of Conscience is intended to highlight the ontological value of Conscience. The manifestation of the ontological value of Conscience lies in the survival value and meaning of man, which is what Kant referred to as "what is a man." The ontological value of Conscience is fundamental and ultimate value to people. That is to ask what kind of person one is. In this dimension, Conscience actually reflects the unity of internality and transcendence and becomes a transcendent spiritual dimension and value scale.

Generally speaking, a "good" education is an education intended to cultivate "good people." It only aims to develop "good" education called "education," which is the educational value of inherent self-assurance (to this education was different from abetting, even abetting will be under the banner of education). In Eastern philosophy, especially in the field of Conscience, "good people" and "good citizens" have a natural unity. The problem of "good people" is essentially how to create the "real self" within ethical practices. The self who establishes self-identity is one of several identities," but the "True Self." Only the true self can integrate all kinds of self into a complete self. The self is a value, and the self has various sides to it. In Kant's view, the self is divided into "Unification Me," "Induction Me," and "Inner Me," and "Unification Me" is the "cognitive subject" and "cognition me"; "Induction me" "Is" creative, "the self of the thing itself ";" inner sense of me "is" the psychology of me, "is" phenomenon of me. "Cognitive me" is just a pure "thinking," not "intuition"; although "phenomenon I" is an "intuition," it can only recognize phenomena, but not the ontology; "the self of the thing itself" "Is the true" knowledge of the ego "and" metaphysical provisions of the object." "Tongue Me" is the "True Self" as the thing itself. In this regard, Kant pointed out, "In the transcendental synthesis of the

so-called 'general variety of appearances' and in the integration and unification of the origin of consciousness, I realize that I am neither the one who appears in myself, not myself, but only the self is one thing. This 'I' appearance of it is thinking rather than intuitive. For me, it themselves, then' make every possible intuition of heteropoly acids, in unifying system thinking outside activities under a unified vision 'of, it would need to run by heteropoly granted and I of certain intuitive physiognomy; it is, although I really non-existence of the phenomenon (more non-phantom), and I am of the existence of regulations, and shall the way of introspection is the same, that is, the special form taught to me based on the intuitions that I have connected to it can only happen" (Kant 1960, p. 114). Mu Zongsan took a critical position on this. Knowing me is just a fake self. Both the "cognitive self" and the "phenomenal self" are unified in the "real self" of the "thing itself." The "cognitive self" comes from the "self-trap" and "phenomenon of the" real self. " "I" is the "I" that arises when dealing with the "real self" with "perceptual intuition." This "thing in itself" is the real me; it is concrete and real to me. Through enough practice to complete the personality of "moral self," it also revealed that this really is the main body. The "real me" in Western philosophy is not so clear and not necessarily connected to Chinese tradition. "Kang Deshun Western tradition—this name is really my soul, this immortal soul. Therefore, it is only substantive; it contains simplicity, self-identity, and eternal self-existence from foreign objects (including the body), but it is difficult to say its universality. I think this is only limited by tradition, not this true self-image. This is true. I can also be a solitary soul; it can also be a benevolent body, a sexual body, a conscience, or even a free will; it can also be a Xinzhai or a spiritual house; it can also be a pure heart of Conscience. It can monopolize, re, strict and only say the true self with the immortal soul, but the real state of the true self is not reached. This is how it is in Confucianism, in Taoism, and in Buddhism—as long as they look at their system we can understand. One can say that Confucianism is the most honest and raise it to the extreme. If so, I opened this; you can connect a critique of Kant and traditional Chinese." (Mu 2003: 235–236) Mou Tsung-san is the so-called Chinese traditional interpretation that the true "I" is consciousness. Conscience, as the true self, unifies the self of each "face." As Wang Yangming said, Conscience exists "in terms of the cohesion of its rationale; it is called sexuality; in terms of its cohesive master, it is referred to as mind; in terms of its dominating initiative, it is referred to as meaning. As far as consciousness is concerned, it is known as knowledge; as far as its perception is concerned, it is called something" (Wang 1992: 76–77).

The realm of the Confucian "real self" is "sanctification." Sanctification and Greek sanctification are the ultimate value orientation of Confucianism. It is not only the highest state that can be achieved by an individual mind but also the inherent requirement of social and political order for individuals. It is not only the highest example of the moral ideal of self but also the best social and political order construction of a legitimate body. Moreover, this ideal self is not mere imagination, but the unity of absoluteness, perfection, infinity, and presentence and limitation, which is different from the setting of ultimate concern in Western philosophy. If Western

religious philosophy is "incarnation," eastern cultural philosophy is also "incarnation." Regarding the way of Confucian sanctification, it is not difficult to find a self-centered sequence structure, which is based on self-cultivation, cultivating people, self-cultivation, self-reliance, self-respect, and self-respect. As for the Qi, family rules the world. The so-called self-cultivation is to awaken an individual's moral consciousness, mobilize his moral initiative, and practice it. As a result, ethics and politics are assimilated. Mencius believes that everyone has good deeds, and as long as they can activate their hearts, everyone can be sanctified. Saints are people and not divine, but a saint is beyond ordinary people, drawing almost its extraction by. In this way, the pursuit of sainthood will no longer have the mystery of destiny but will have practical reality and possibility.

Wang Yangming believes that "conscience is only one, and when he sees the place, it is sufficient now, and there is no need to ask for it" (Wang 1992: 85). According to Wang Yangming, there is an ambiguous meaning in Conscience. First, there is Conscience, that is, there is a present. Yes, the first is the opinion of Conscience, which appears in the activity. The former refers to the existence of Conscience in the transcendental sense, and the latter refers to the activity of Conscience as an experience. On "see the conscience" and debating "ready Conscience," that a body that is on time, and ready to see in Conscience say to Conscience have different emphases. Man has its essence, but its manifestation must have a process. The essence is congenital, and the process is a possibility. To say that it has an essence is not a prior decision; to say that it has a process, and you cannot "do whatever you want." The essence of Confucian sanctification is precise in the sense that everyone has the necessity and possibility of sanctification. This necessity and possibility are inherently based on the development of human nature and the structure of human nature. In other words, sanctification or Conscience is ideally possible, and it is difficult to realize it fully. The Conscience of the body itself as a transcendental experience at the same time be presented in the event, but the experience is not purely of Conscience also determines the self is not pure. In some sense, the debate between "seeing in conscience" and "ready-made conscience" shows the real dilemma of Confucian sanctification. Without Conscience, people are no longer human, and Conscience is essential, congenital, and ideal. The Conscience or its appearance has obvious contingency and vulnerability. But it is unwise to reject the congenital Conscience without hesitation. This is not a rational epistemological error, but an existential flaw, which means a rejection of an idea. This is also evidence of the necessity and eternity of education. Man has, in any case, an "in education" existence. Education has the same ontological implication as to human existence. Someone has an education, and man is the existence of education. Man exists in the form of education, and the significance of education is to make people truly human.

3 Developing Virtue: Reshaping Educational Ethics

Cultivating people is the nature of education. The kind of people that result from such cultivation is the purpose of education. The purpose is, ultimately, a value concern. China regards Li De Shu Ren—building morality and cultivating persons —'as the fundamental task of education in the new era. This fundamental task cannot be understood merely as the need for national and social development. Li De Shu Ren is the inherent meaning of education and the internal needs of human development. That is to say, people need to build Virtue and cultivate themselves internally. The cultivation of people who can build Virtue is the basic Virtue of education in the new era. At the beginning of classical educational thoughts, those knowledgeable educators and philosophers were keenly aware of the natural relationship between education and politics, education and a better life, and education and political order. Xue Ji expresses the value of education in a concise manner as "turning people into customs." The so-called "turning people into customs" is, in the final analysis, the education of the people and the shaping of their morality. On the path to realizing the value of education, the traditional Chinese philosophy of education is different from Virtue of the way to the West. This is a line of reasoning inherent to awakening the Conscience of people. Conscience is the unity of heaven and human Virtue. That is to say; Virtue is a virtue. Chinese traditional education ethics, therefore, lies in its own destiny. It awakens people's inner Conscience, both shaping and self-education—disciplines morality, and morality is morality, both knowing and doing, uniting knowledge and action.

Virtue in ancient Greek, in addition to containing moral quality, also includes a variety of excellent qualities. According to Aristotle, Virtue is the outstanding realization of those who deserve praise (Aristotle 2003). He also regards Virtue as the quality of the soul, a quality that makes both good and excellent in completing his activities (Aristotle 2003). Because of a moderate virtue characteristic, it is also a virtue of an appropriate selection of the quality required by each Si. Although the essence of Virtue is conceptually modest, as the highest good perspective, it is extreme (Aristotle 2003). After examining the historical development of Virtue as thoroughly as possible, Macintyre points out that even within the relatively consistent ideological traditions he describes, there are many different and incompatible virtues. The concept of sex, so there is no truly unified concept of Virtue, there is no single core concept, no unified history, but it is possible to sort out a unified, core concept of Virtue. He believes that Virtue is a kind of acquired human quality. The possession and practice of this kind of Virtue allow us to obtain the inherent benefits of the practice. Without this Virtue, we cannot obtain these benefits (McIntyre 1995).

Conscience is a virtue that is inherent in human beings and does not need to be sought out from the outside. At this point, the theory of morality in Eastern and Western philosophy can achieve a certain degree of connection. But the Western Virtue Theory Perspective Orient conscience school of thought still persists some kind of "misplaced concreteness fallacy." What are Virtue and all virtues? The Eastern and Western cultures do not segment the "Elements" areas, namely East and West

Germany, headset together. Are the elements the same? However, there are still huge differences between Eastern and Western moral theories. This difference is mainly manifested in two aspects. First, Conscience is not only one Virtue, but it is the basis of Virtue itself. Since Socrates put forward that "knowledge is a virtue," the Western tradition of virtue theory regards knowledge/rationality as the basis of Virtue. This has brought up a very serious question. The question is whether people with knowledge have Virtue? After Socrates, Hume's moral sentiment, and Kant's rationalized will all tried to make up for this theoretical flaw. Into a moral conscience within the school will put the knowledge, the knowledge of so-called honor virtue, the Virtue of the place according to "the Truth," that Wang Yangming said, "my husband's called Shingo's conscience that also" (Wang 1992: 250). The process of self-confirmation of Conscience, that is, the appearance of Conscience is the unfolding and instantiation of the "true self." It is not difficult to see that the theory of morality in Western culture is to know the good and stop the evil, while Eastern culture turns knowledge into Virtue and embarks on a road of good to stop evil. The second is that Conscience, as the basis of Virtue, is not only the knowledge of Virtue but also the nature and direction of moral behavior, in addition to being a virtue. Therefore, Conscience is both a virtue and the basis of Virtue.

First of all, Conscience is both a virtue and an ontological virtue related to human existence. Man can be without Virtue, not without Conscience. A person without Virtue is still a person, and a person without a conscience is no longer a person. According to Aristotle, everything has its own inherent Virtue. That is to say; each Virtue makes both the state of the thing that is its Virtue and the activity of that thing done well. In addition to the "excellent" quality of such things, morality also contains the meaning of moral quality. All virtues are dedicated to expressing part or all of a person's character. According to Aristotle's understanding, this character is both the character of a man and the character of human activity. Virtue is good quality, it is also a characteristic of quality, so it can only be said to be a sign of character. The so-called Virtue presents the good qualities that people must pursue and possess, accumulating in the so-called character.

In Eastern philosophy, Conscience is not "a" character, but the basic character of human existence. It is not a side-by-side virtue like generosity, moderation, and courage in Western moral ethics. It is the source of Virtue and base of basis, but also the virtues of scale. In this regard, Kant gave a very clear definition. He said, "we can also define conscience in this way: it is the judgment of one's own judgment." (Kant 2003: 198) The reason why people can make moral judgments is that people can freely incorporate moral rules into their own values. And the reason why people can incorporate moral rules into themselves is that people have a special personality endowment, that is to say, their own goodwill. For Kant, moral judgment forces are present in everyone's intellect. In its human form, it is the ability to question oneself, to discern whether their actions are done out of obligation or out of respect for the moral law. Conscience is thus a sense of obligation, or it is aware of it as an obligation. Tortured Conscience caused by the "accountability" would have a pleasure, pain, or remorse emotional experience, thereby leveraging the individual's own survival sense in connection with awareness and experience. Wang Yangming

pays special attention to the relationship between moral consciousness and moral Conscience. He believes that if one knows evil and good, one may not be able to stop evil and do good. The key is to use sincerity to recognize the values from evil to Virtue and to transform knowledge. Wang Yangming pointed out that Conscience is heaven. While recognizing dryness, there are all kinds of meanings. This reality has its own selves; that is to say, through self-recognition and personal practice, moral consciousness becomes the inherent Virtue of the subject.

Secondly, Conscience is inherent; however, it needs to be achieved too. Human beings have a conscience. As Mencius said, “The heart of a recluse is shared by everyone; the heart of shame is shared by everyone; the heart of respect is shared by everyone; the heart of right and wrong is shared by everyone. Benevolent; shame, righteousness; respectful of the heart, the ceremony too; Conscience also bearing, Tomoya wisdom, non-from the outside Shuo I also, I inherent also, Firth’s ear carries on.” (Yang 1960: 259) “The people learning and are not capable; it is also Liangneng; do not also consider conceivable, also conscience."(Yang 1960: 307) However, this Conscience of the body is required now. “The mastered state of conscience,” and with the object and the grid, the matter mill needs refining. Wang Yang Ming said, “however, the holiest thing in the world, to have wisdom and old age to see how mysterious and wonderful, now it seems everybody has had Cong ears originally, head out originally, was originally thought wise, sage only. It’s the Conscience that is able to deal with it, and everyone can’t, but it’s just not to know how easy and simple it is!” (Wang 1992: 109–110) According to Wang Yangming, the reason for the sage’s wisdom and wisdom is that the consciousness and Conscience of the sage are unified. Therefore, the effort of Conscience is needed because it is covered by selfish desire, the knowledge is not good, and the behavior is not perfect. The Virtue of the sage comes from the heart, and it should be, as it should be, and the state of Conscience is consciousness. In this sense, Conscience is an acquired virtue. According to Aristotle’s understanding, Virtue is both not in nature, nor breaching the resistance, but the pass is too accustomed to achieving perfection. In the Chinese tradition of Conscience, Conscience has its own, and there is no need to ask for it, but as a practice, Conscience depends on willingness, that is to say, whether people are willing to act according to Conscience and whether they choose to obey Conscience. Violations are either forced or done out of ignorance. Willingness to do so is an act of conscious choice. The choice is made through the will, but its meaning is more profound than the will. In addition to choosing, it means to choose something before others; that is to say, the choice is ideological and valuable. A choice needs to be considered. Sages and ordinary people have consciences, but saints can do what they want, but ordinary people don’t know how to use their Conscience daily, or they can let their conscience slumber. This is the difference between recognition and choice. Sages act rashly, that is to say, the Tao; ordinary people fail to do so, and their behavior is either over or under. What one chooses to do and what kind of person one chooses to be is the most important Virtue of a person. Aristotle even believes that choice is more a judge of a person’s qualities than behavior (Aristotle 2003). Kant believes that transcendental moral laws are universally valid and self-disciplined and that human free will is a practical reason. In this regard, Kant pointed out, “The only the thing

that is rational has the ability to act according to the concept of laws, that is, to follow the principles, or to have the will. Since seeing laws into action necessarily requires reason, will is also to practice reason" (Kant 1986: 63). This free will not only does not feel impulses; it actively refuses to feel the impulse. But Wang Yangming thought that Conscience is not entirely a priori reason; it contains empirical content, emotion, will, and so on, "the impassioned Shun natural pop, are all good knowledge of use" (Wang 1992: 111). Conscience solid congenital have released popular remains to be the acquired experience can only be realized through physical inspection and Conscience. It is not difficult to see that whether it is intentional good or realized good, it is still a question of action and a question of choice.

Finally, Conscience is both episodic and a stable state of mind. A person's natural Conscience may be touched by accidental circumstances, the so-called "conscience discovery" because Conscience is in a state of choice, for Aristotle made this clear. He believes that Virtue is a state of quality that is related to choice, exists in the middle way relative to us, and is determined by the way that rational and practical wisdom determines it. The state of Conscience is contextual, but once formed, it has strong consistency and stability. Because the appearance of Conscience means that people return to their inner goodwill, this return of nature did not happen overnight, nor was it suddenly changeable. If a person makes an excellent choice occasionally, it is hard to say that the person has a certain quality. Only when a person has been able to make good choices in various activities can a person be considered to have Virtue. That is to say, Virtue must be reflected in the totality and integrity of human life, and only in the integrity of human life can Virtue be reflected. Virtue can, therefore, be understood as a valuable quality or intention to act consistently and in a proper way. It is not only the quality of knowing better, but also the overall state of mind, including emotions, desires, attitudes, and feelings. The role of Virtue is different from the externally binding role of planning. It is inherent in human intention and motivation and often affects behavior through unconscious motivation. In a sense, Virtue is a kind of "psychological settling."

The traditional Chinese theory of Conscience opens the joints between heavenly principles and personality, and knowing and acting, and forms a direction of thinking different from Western ethics. It not only transforms knowledge into a virtue in the dimension of heavenly principles and personality but also the relationship between knowledge and practice to transform Virtue into Virtue. Conscience is not only a virtue, but also a virtue achieved in practice, action, and performance. Chinese traditional ethics has been aware of this inherent nature of ethics almost from the beginning and recognized it in concrete ethical practice. The concern about the unity of knowing and doing is a kind of ideological anxiety corresponding to the actual and actual separation. If it is categorically dichotomous, then it is not necessary, but it may not be. Kant and Wang Yangming's concerns are really focused on this. Wang Yangming solved this problem on the basis of ontology. In the West, the value ethics of Scheler (M.) can be mutually referenced and corroborated. Scheler's thinking is the unity of can and should. As for Virtue, Scheler believes that it is not only the ability to be directly aware of a thing that should be experienced as an idea (Scheler 2004) but also the ability to realize the realm of the idea that should be finally distinguished in

the qualitative value (Scheler 2004), as it should be. The carrier of moral value is not only under an obligation but also every possible direction, such as Virtue and vice. If the person's obligations under the acts, will be the only personality as "a (possible) should do X," so that it excludes the open personality, the false consciousness of the human place in the universe. Scheler also emphasized that the over-emphasis on the fundamental role of obligations is actually the "fear of exposure" to the realization of good in the real world (Scheler 2004). For Scheler, "Len Chang always discerns" rather than saying that obligation is the measure of morality. This is quite consistent with Wang Yangming's thinking.

4 Conscience as Ultimate Care: Finding Educational Beliefs

If we do not avoid the suspicion of simplicity, the greatest risk of modernity can be attributed to the destruction of traditional belief structures, or the advent of nihilism. The old belief no longer exists, and the newly born consciousness remains to be questioned. "The real problem of modernism is the problem of belief" (Bell 1989: 74). However, nihilism is not always doomed. Human beings naturally need to be "even" and "able to be" with faith. Education also requires faith. "Without belief, it is not education, but only teaching technology." (Jaspers 1991: 44) But educational beliefs are different from all beliefs. Educational belief is people's extreme conviction and respect for the value of educational activities in the process of individual and social development and the way to achieve it; it is the fundamental norm of educational behavior (Shi 2000). Educational belief is, in the final analysis, a belief in the nature of education. The premise to strip system parts believe that human nature is evil, and their people believe that it is good if not better not to give people the opportunity to be evil; it is the precondition of education is the belief that human nature is good, people can become a "good person" through education. The whole belief in education is to awaken people's conscience and make people a "good man" in the real-real sense.

People have many concerns, but the ultimate concern is the meaning of existence. Every culture must ask a person to respond to finality. In the context of Chinese traditional culture, the external and internal transcendence of a finite individual constitutes a response to the value, meaning, and spirit of Life, or it is put into cultural wisdom, or it is put into the kingdom of the country, or it is put into virtue Sex, or put it into words, or put it into eternal history, so the avenue is so, as Life is settled here, in traditional Chinese philosophical terms, it is a question of "settling down." Chinese culture does not resort to the ultimate concern for religion, but concerns itself with sacred worldly values, especially in the context of "internal transcendence." Conscience serves as the ontological and moral basis of existence, providing the care value for human existence ultimately. This type of ultimate care is different from the ultimate care of converted creators and the ultimate care of returning to the original source. It is a kind of care value or ethics that pursues the values of the world and the perfect moral personality.

Conscience is the ultimate concern because conscience reaches the ultimate realm of existence. Conscience is heaven, the realm of heaven is the realm of conscience, and the realm of heaven and earth is the highest and ultimate realm. This means that man acting with his conscience is the highest moral value, and it is the highest universality of ethics. In the Western philosophical tradition, the universality of ethics is mainly demonstrated using reason. Kant inferred the absolute moral law from the universality of rationality, and the restrictive basis was "to search for the concept of pure rationality innately" (Kant 1986: 37); Hegel (GWF) believes that ethics is "eternal justice" and a "divinity that exists freely" (Hegel 1961: 165). But Eastern philosophy shows very different characteristics, that is to say, its universality is explained from the universality of heavenly principles, the universality of ethics is the infiniteness of heavenly principles, and the realm reached by ethics is "with heaven and earth." The purpose of ethical enlightenment or conscience is this "self-satisfaction" of "joining heaven and earth." As Mencius said: "A gentleman is a man who studies the Tao and wants his contentment to be self-sufficient. If he is contented, he will live in peace; if he is comfortable, he will be rich in the capital; if he is deep in capital, he will take it to his right. It is contented also" (Yang 1960: 189). Conscious conscience and therefore, the final analysis from the world of awareness of sleep. As much as you know the world, you know how many consciences you know; how many consciences you know means how much Life you know. Therefore, Feng Youlan said, "the realm of the same day is incredible. But the gain of man must be due to the deepest understanding. Man must have the deepest understanding and then the highest realm" (Feng 1996: 637). This highest realm, that is to say, the state of mediocrity and mediocrity itself, that is to say, the state of conscience pursued by conscience, or, in Feng Youlan's words, a "great understanding" of the state of heaven and earth (Feng 1996).

Conscience is the ultimate care complex because conscience is not only the ultimate response to the value of Life but also the ultimate response to the value of Life, that is to say, the ultimate answer to the value of Life as a whole. Conscience is the basis of the value of Life. For those who have a conscience, their Life's purpose has a foundation, but it is in me, so it is lively and harmonious, without hindrance. Conscience's continuation of Mencius' "reassurance" is the true wisdom of the Confucian philosophy of Life, and it gives Life a bright light. The so-called conscience means seeking the true value and wisdom of Life. The Shi family also has the meaning of "sending heart." Although the two are different, they are a kind of care for Life. In Liang Shuming's opinion, the Buddhist Toru Toru's beginning of the end is the "heart" and that is "Bodhicitta." It is not only the heart and compassion, and wisdom, and it is above all, is a mechanical beings life, can have a deep understanding, forgiveness, and compassion, and demand an unmechanical life. Confucianism also requires a life that is not life-mechanical, but it is different from Buddhist. Confucianism also has a thorough point and is determined. However, the spiritual meaning of Confucian aspirations is different from that of Buddhism. Buddhists forgive and sympathize, while Confucianism has a straightforward attitude. The two have their own internal connections. So, the ultimate end is a free, lively, and powerful life

(Liang 1989). In the framework of Western thought on philosophy, in general, knowledge of Life and learning about Life in segmentations, knowledge, or concern of Life is not concerned about the living things or concerned about the Life of living things was it to look at Life. Chinese traditional philosophy, especially the unity of knowledge and action of conscience, shows that Life is Life, that is, the whole Life. Life is nothing else. From the perspective of Confucianism, Life is just the "continuity" of Life. Liang Shuming pointed out that the universe is Life, but only Life, but there is no universe at first … Life is a "continuity of things" in a certain range (Liang 1989). Endless creation is, is, therefore, not only the wisdom of Life but also the creation of the universe. Liang Shuming believes that Life is the essence and "the continuation of life"; "living" is the manifestation and "creating upwards." Moreover, Life is the highest form of Life of the people Kuoran up, and the people of the smooth outline of what Life in the universe creators of the machine awakened. This can be the only perception of the universe, physical evidence raw life of the people. Man's "now" is just one with the endless cosmic Life. This Life is a life of conscience. Conscience is the ultimate concern because of the ultimate ontology and body moral personality. Conscience is ready-to-use and should not be separated from one another. Xiong believes that neither Buddhist philosophy, Western philosophy, nor Taoist philosophy has seen the body, the tightest that "natural body article with an individual," or, as the body will be beyond the phenomenal world, or hidden it after this "two the weight of the world "led more than a harming, the most important thing is in really good from wrong, born outside the envy that empties their inner self and absolutely true source (Xiong 2001). According to Xiong's "body with no two" theory, the universe is both beyond the ultimate body, but also the lives and hearts of the people; Life is not only practical but also can be an accessible cosmic body. Cosmic body bona jump, endless, endless Life also, Life and the universe through the heart of who that is, that the heart of the body. This "heart" is the conscience, that is to say, the lively and vivid moral or ethical mind. From Xiong Shili's point of view, the original mind is the ontology, the ontology is the true mind, and the ontology is the popularization of Life. To seek the consciousness of Life in this way is to recognize the universe's ontology, and thus the individual Life and the universe's Life have realized a harmonious unity on the level of ontology and axiology.

It is worth noting that merely seeing conscience as a historical and cultural phenomenon is a simple and rude method, which means refusing to acknowledge that there is always a divine glory in human nature that is difficult to destroy. In fact, at least in the perspective of oriental culture, individuality and absoluteness, history and the present have reached unity in conscience, so that conscience participates in all noble and valuable human activities. Through the absolute certainty of conscience, human beings finally understand the beginning of divinity. All those beliefs and eternal values that are considered sacred are possible only through the conscience of the actor. In other words, without the conscience of the actor, all value education and belief education cannot be within reach. And conscience will resolutely reject this self-consoling utopia. Everyone has a conscience, and everyone can act with a conscience. This is where the true meaning of education lies and the most fundamental value of conscience in the modernity of education. The essence of calling

for conscience is to rebuild the value foundation and belief foundation of teachers' spiritual Life in the modern lifestyle and use this as the true authority of teachers' orders. Although this foundation cannot provide teachers with the legitimacy of their educational lives, it has priority in terms of logic and value. The so-called logical priority means that, in the epistemological sense, conscience is a universal principle that education must understand in order to understand itself. Only when a teacher acts with a conscience can he engages in the cause of education with the integrity of the "people." Conscience is not education itself. The so-called priority of value means that, in a practical sense, conscience is the self-evident basis of all other values of education. Only when teachers are willing to protect the value of conscience with Life can the true meaning of education be revealed. Acting with a conscience is a difficult process that lasts a lifetime. More importantly, awakening conscience is inseparable from the building of institutions. Awakening the conscience is the foundation of social governance. Only when conscience is incorporated into social governance activities and becomes a social governance method can conscience no longer be an abstract concept, but a positive social construction.

Finally, it is necessary to point out that educational conscience is an activity of thought/ideological layout because the thinking of education must be the thinking of culture. Education cannot leave the cultural traditions upon which it is based. More importantly, conscience is a practical activity. It is impractical to try to propose a package of solutions to the problems of modernity through the revival of conscience. It is necessary to clarify the boundaries of conscience, and on this basis, further develop other ideological resources of traditional Chinese culture in order to help the creation of Chinese educational modernity programs. For the treatment of the problems of modernity, thinkers always have an impulse to "return home," thinking that classical thought can be good medicine. This impulse is understandable. However, if a traditional idea does not stop the decline of culture, then it is difficult to hope that it can restore said culture. Classical ideas are not an ideological principle but needed to create resource transformation. This process of thinking layout is essentially the process of creation or discovery. This idea cannot be entrusted to solve all the problems of educational modernity, but this tradition is still indispensable for the salvation of educational modernity.

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History of Chinese Education Study in Forty 40 Years of Reform and Opening-Up—Based on Journal Articles and Doctoral Dissertations

Zhengping Tian and Wenyang Pan

Abstract The journal articles and doctoral dissertations on the history of Chinese education over the past four decades after reform and opening-up are studied from two dimensions: the historical periods and the educational subjects. The number of journal articles has experienced a sluggish period of growth before expanding rapidly. The subjects studied in journal articles are expanding across traditionally focused fields of educational figures, thought and systems; this resulted in widespread attention regarding all kinds of educational forms and problems. The interest in theory of history of education has improved. The research paradigm is characterized by its diversity. However, there are also problems such as subpar quality, trivial and repeated themes, overemphasis on reality, and imbalance in the historical periods of the writings. Changes in the number of doctoral dissertations over the past forty years are mainly affected by the number of doctoral programs. Regarding the historical periods examined in dissertations, there exists a preference for the modern to ancient period, which is generally the same trend found in journal articles. Influenced by the general attention directed at the *Gaokao* reform, the number of educational systems-themed dissertations exceeds those focusing on figures and thought. The dissertations on the themes of educational figures and thought have richer subjects, which avoid the negative side of repeated themes of journal articles. In the future, we should place improvements on research quality and the heightening of academic standards as a foremost priority. We need to strike a balance between seeking truth and attaining practical use when paying attention to reality and formulating positive responses. Moreover, we should remain open to the changes in research paradigms, theory and methods.

Keywords Forty years of reform and opening-up · History of Chinese Education · Journal articles · Doctoral dissertations

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The History of Chinese Education is a basic subject in the discipline of education. With the introduction of educational discipline in the early twentieth century, it firstly became a course for teacher training. Over the past century, important progress has been made in the construction of the history of education; among which forty years of reform and opening-up have witnessed particularly noticeable changes. Many scholars have reviewed and commented on the discipline development of the history of Chinese education since 1978 and some have even written about it as a master's thesis or doctoral dissertation, such as Yi Qin's doctoral dissertation "Knowledge Instruction and Academic Inquiry: the Developing Picture of the Discipline of Chinese Educational History" (2010), Hao Lixia's master's thesis "The Main Progress in the Research of the History of Education since 2000: A Comprehensive Review of Post-graduate Thesis within the Discipline" (2013), and Lou Aofei's "Academic Progress on History of Chinese Education in Recent Years" (2015). The author has also discussed the disciplinary construction of the history of education during the 30 years of reform and opening-up (Tian 2008). Based on these results, this article intends to further discuss the development of the history of Chinese education in the past forty years of reform and opening-up.

This article is based on a statistical analysis of the number and content of research papers (journal articles) and doctoral dissertations regarding the history of Chinese education in the past 40 years. This article intends to make a comprehensive long-term reflection on the course of discipline development from the perspective of research results, review the general trends and issues existing in the research on the history of Chinese education during this period, and put forward discussions on future development.

1 Journal Articles: From the Perspective of Number of Publications[1]

In the past 40 years of reform and opening-up, the number of related papers concerning the history of Chinese education published in various journals in China is shown in Table 1.

It can be seen from Table 1 that from January 1979 to December 2016, a total of 16,846 related papers were published in various journals, with an average of 443.3 papers published each year. This is a considerable number for a second-level discipline, which had a relatively small number of research sites and population, and

[1]The main scope of collecting related data of journal articles comes from "China Academic Journal (Network Edition) Database (CAJ-N)" of CNKI, which combines a variety of search conditions such as "full text", "China library classification number", "topic", "title" and so on. The method was used to search and cover papers on the history of Chinese education in the fields of education, history, and educators. Noting that the papers included in the database from 1979 to 1993 were not comprehensive enough, the author supplemented the papers of important journals that were not included by the database during this period as much as possible. The data sources of the journal articles in this article are all from the same source and will not be noted below.

Table 1 Number of papers of a history of Chinese education published in various journals from January 1979 to December 2016

Year	Number of papers	Year	Number of papers
1979	27	1999	287
1980	49	2000	295
1981	45	2001	431
1982	60	2002	455
1983	49	2003	530
1984	70	2004	614
1985	62	2005	740
1986	60	2006	809
1987	80	2007	859
1988	70	2008	896
1989	103	2009	875
1990	71	2010	921
1991	107	2011	1 041
1992	84	2012	1 159
1993	145	2013	1 301
1994	229	2014	1 239
1995	248	2015	1 190
1996	221	2016	964
1997	212	Total	16 846
1998	248		

was constrained due to its status as basic research. Certainly, in the past 40 years, the number of published papers has shown clear periodical characteristics. Before 1993, more than 100 papers were published only in 1989 and 1991 (103 and 107, respectively), and in the remaining years, the number of publications hovered below 100. Since 1993, the annual number of published papers has increased steadily to more than a hundred. In 1994, more than 200 papers were published. In 2001, the number of papers published was nearly double that in 1994, reaching more than 400. In 2006, the number of papers published was once again nearly double that of 2001, reaching more than 800. After 2011, the annual number of published papers has stabilized at more than 100.

It can be said that in the past 40 years of reform and opening-up, the research results of the history of Chinese education have developed from a downturn to sustained and exponential growth in terms of quantity. In 1979, there were 27 relevant papers about the history of Chinese education published in various journals in China, with an average of only about 2 per month. By 2013, the number of related papers published throughout the year reached 1,301, with an average of 108 papers per month, an increase of about 47 times compared with 1979.

For more than 20 years after 1994, in terms of the number of journal articles published, the year around 2010 witnessed another turning point. It can be seen from

Table 1 that the number of published papers in the whole year of 2011 exceeded the one-thousand mark for the first time, and this momentum has lasted until 2015. During this period, there was the highest number of papers published in 40 years, namely 1301 in 2013.

The diversification of research paradigms may be one of the important factors for the significant increase in the research achievements of the history of education at the end of the first decade of the 21st century. The *Research Series on the Modernization of Chinese Education* published by Guangdong Education Press in 1996 (Zhou 1996; Qian and Jin 1996; Tian 1996; Wang 1996; Dong and Xiong 1996; Zhang 1996; He and Shi 1996) was the first attempt by scholars in the field of educational history to learn from modernization theory to study modern educational development in China under the guidance of Marxist historical materialism. After the publication of the series, it had a great impact in academia. Although the range of study in this series of books is limited to the history of modern Chinese education, it has broken through the constraints of the single research paradigm, and its impact is not limited to the field of modern education history, instead, it has been widely recognized in the field of education history. After entering the 21st century, the consensus among scholars was to promote the diversification of research paradigms or analytical frameworks in the field of Chinese educational history. This profound conceptual change has directly encouraged the transformation of research horizons, the expansion of historical sources, the strengthening of problem awareness, and the breadth of research topics. In December 1996, the Fifth Annual Academic Conference and Member Congress of the Educational History Research Association of the Chinese Society of Education, hosted by the Education Department of Guangxi Normal University and the Guangxi Lei Peihong Educational Thought Research Association, was held at Guangxi Normal University. One of the most important results of the conference was the election of the fourth council of the Educational History Research Association of the Chinese Society of Education. Since then, as an academic exchange platform for scholars of educational history nationwide, as well as an academic community, its activities have been carried out in a variety of forms. It has effectively led to the construction of the discipline and the trend of research of Chinese educational history. It should also be noted that the Cross-Strait Educational History Forum, co-sponsored by Beijing Normal University, East China Normal University, Zhejiang University, Xiamen University, and Taiwan Normal University, the University of Macau, has been convened once a year since 2007. Each university took turns to host. This event in the field of educational history across the Taiwan Strait has injected new vitality into the study of the history of Chinese education. Another important factor is that, as of 2011, twenty-four institutions across the country have been approved to grant doctoral degrees in education as a first-level discipline. This has increased significantly the number of institutions of higher education nationwide to confer doctoral and master's degree in the history of Chinese education, and the number of corresponding research results has increased accordingly. *Journal of Hebei Normal University (Educational Science Edition)* was founded in 1998. From the very beginning of its publication, it has published columns about Chinese and foreign educational history, regarding the papers in this field as the focus of the

publication. According to statistics, as of June 2013, there were nearly 700 papers on the history of Chinese and foreign education published by the journal (Li 2013). Even if we take just half of this number, it should still be a considerable amount.

In the above paragraphs, we have roughly examined the quantitative development trend of the research results of the history of Chinese education in the 40 years of reform and opening-up, and roughly analyzed the reasons for this trend. From the perspective of the development level of a discipline, the number of research results is an important dimension, but it is far from the only measure. In the following, we will further examine the content of these results. In consideration of a long time span and a large number of results, analysis in terms of the research theme may be a better perspective.

2 Journal Articles: From the Perspective of Research Theme

For the sake of convenience, we have still used 1993 as the boundary and divided the entire 40 years of reform and opening-up into two phases. The first phase is from 1979 to 1993 and the second phase is from 1994 to 2016. A longer period would be divided into several shorter periods for further comparison. The overall survey consists of two aspects. One is the historical period at which the article itself aimed at: the other is the educational subject discussed in the article, such as educators and educational thoughts (ethos), education systems, higher education, vocational education (industrial education), teacher education, general education, educational reform, educational history theory, curriculum and teaching, etc. The category of those issues could be finely adjusted at different times.

(I) Investigation on the research themes in journal articles on the history of Chinese education published from 1979 to 1993

Firstly, we made the classification based on the historical period at which the papers aimed.

It can be seen from Table 2 that during these 15 years, among papers on the history of Chinese education published in various journals, the "Republic of China" was the period most discussed, with 342 articles, followed by the "ancient" and "contemporary" periods, with 256 and 207 articles respectively. Furthermore, there were 17 articles focusing on the period of "revolutionary base," the number of which was the lowest. If we examine the publication of those papers over a period of 5 years, this quantitative change will become more apparent.

It can be seen from Table 3 that special attention was paid to the education of the Republic of China from 1989 to 1993. During this period, the number of papers published about "the Republic of China" was almost equal to the sum of the number of papers focusing on "ancient" and "late Qing Dynasty (modern)."

Secondly, we made the classification based on the research content of the papers.

Table 2 Number of published journal papers on history of Chinese education from 1979 to 1993, based on the historical period at which the research aimed

Year	Ancient	Late qing dynasty (Modern)	Republic of China	Revolutionary base	Contemporary
1979	10	0	9	1	7
1980	21	2	16	0	0
1981	13	2	22	0	0
1982	10	5	23	3	16
1983	18	10	13	0	5
1984	23	10	14	4	6
1985	21	10	14	0	2
1986	20	7	17	3	2
1987	20	12	27	1	4
1988	12	5	20	1	5
1989	21	17	41	1	23
1990	18	12	24	2	15
1991	21	16	42	1	27
1992	18	16	24	0	26
1993	10	30	36	0	69
Total	256	154	342	17	207

Table 3 Segmented statistics on the number of published journal papers on history of Chinese education from 1979 to 1993, based on the historical period at which the research aimed

Year	Ancient	Late qing dynasty (Modern)	Republic of China	Revolutionary base	Contemporary
1979–1983	72	19	83	4	28
1984–1988	96	44	92	9	19
1989–1993	88	91	167	4	160
Total	256	154	342	17	207

As can be seen from Table 4, among the papers published during this period, 471 of them included content relating to "educators and educational thoughts (trends)," and the number of this category was far more than that of other issues. In the next place, there were 86 studies focusing on the "education systems." Fifty-six studies on the "educational reform" in history, ranking the third. The lowest number belonged to the studies on "curriculum and teaching," with only 10 studies. It is understandable that the number of studies on "educators and educational thoughts (trends)" is at the top of the list. Figures, thoughts, and systems have always been the main content for the research in the history of education. In addition, during the statistical process, it is difficult to differentiate between the themes of "educators" and "educational thoughts (trends)." Putting the two related subjects together inevitably

Table 4 Number of Published journal papers on history of Chinese education from 1979 to 1993, based on the research content

Year	Educators and educational thoughts (Trends)	Education systems	Educational history theory	Higher education	Vocational education	Teacher education	Educational reform	Curriculum and teaching
1979	10	7	0	2	0	0	0	0
1980	19	0	4	0	0	0	0	0
1981	26	0	2	0	0	0	0	0
1982	38	0	1	0	0	0	0	0
1983	21	0	2	0	0	2	0	0
1984	30	3	2	2	1	3	2	0
1985	21	5	1	0	1	1	4	0
1986	24	5	3	2	4	0	4	2
1987	28	8	2	3	4	1	1	2
1988	21	9	3	4	0	3	3	1
1989	36	5	4	3	0	3	11	2
1990	35	13	0	1	0	0	3	1
1991	42	10	4	6	1	0	10	0
1992	26	10	2	2	1	2	6	0
1993	94	11	2	10	0	3	12	2
Total	471	86	32	35	12	18	56	10

results in a leading quantity. It is worth noting that, as far as the traditional research perspective of educational history is concerned, the research on educational reform is often included in the research of "education systems." In fact, relevant papers rarely highlighted the word "reform." It can be seen from Table 4 that from 1979 to 1983, there was no paper focusing on the theme of "educational reform." Since 1984, the related papers began to appear sporadically. It was not until 1993 that there were 12 related papers. Although the number was still small, on the whole, in the 15 years from 1979 to 1993, the total number of papers in this area ranked third, which should be a phenomenon worth paying attention to. The reason behind the phenomenon is closely related to a series of major educational reform initiatives started by the government in the mid-to-late 1980s, including the "Decision of the Central Committee of the Communist Party of China on the Reform of the Education System" promulgated in May 1985, the "Compulsory Education Law of the People's Republic of China" passed at the Fourth Session of the Sixth National People's Congress in April 1986, and "Several Interim Provisional Regulations on Running of Schools by Non-governmental Sectors" promulgated by the State Education Commission in July 1987, the "Outline of China's Educational Reform and Development" promulgated by the Central Committee of the Communist Party of China and the State Council in February 1993, etc. Each of these important "decisions," "regulations" and "outline" were closely associated with millions of people who were involved in education at different levels, and were closely connected with the daily lives of millions of households. Researchers in the history of education have gained some insights or inspirations from the reform dynamics in real life, which has stimulated interest in corresponding topics in history, and tried to provide some possible references to reality through their own research results. This trend has been intensified and strengthened, which was evidenced by the statistics after 1994.

(II) Investigation on the research themes in journal articles on the history of Chinese education published from 1994 to 2016

Consistent with the previous classification, we firstly took a look at the situation based on the historical period at which the papers aimed.

As shown in Table 5, during this period, the number of research papers on the education of the "Republic of China" continued to climb to 5,999, still ranking first, followed by research papers on education in the "late Qing Dynasty (Modern)," reaching 4,690 papers, rising from fourth place in the previous period (1979-1993) to second place. The number of research papers on "contemporary" education was 1,406, and the overall ranking has dropped from the third to the fourth. Although there has been an increase in terms of absolute amount, the increase in the number of papers was slightly smaller than that of other historical periods. In the previous 15 years, 207 papers were produced, and in these 23 years, 1,406 papers were published, the number of which was less than seven times than that of the previous period, while for other historical periods, such increment could be over ten times. Although the total number of research papers on the history of "ancient" education has increased, the ranking has dropped from second to third, with a total of 3,009 papers, which

Table 5 Number of published journal papers on history of Chinese education from 1994 to 2016, based on the historical period at which the research aimed

Year	Ancient	Late qing dynasty (Modern)	Republic of China	Revolutionary base	Contemporary
1994	47	69	58	8	30
1995	53	50	105	12	24
1996	57	68	65	2	16
1997	48	58	73	4	22
1998	52	71	83	8	27
1999	52	89	76	5	52
2000	93	83	83	2	22
2001	85	142	129	3	43
2002	90	170	121	5	44
2003	103	182	165	7	53
2004	135	191	204	3	64
2005	126	239	290	5	64
2006	159	242	324	16	57
2007	189	278	296	11	65
2008	156	289	342	12	68
2009	144	275	331	8	85
2010	154	257	392	14	84
2011	168	343	407	11	85
2012	218	293	454	25	145
2013	268	357	533	24	98
2014	257	356	480	16	111
2015	183	334	555	14	76
2016	172	254	433	21	71
Total	3009	4690	5999	236	1406

was only about one-half of the number of papers related to the "Republic of China." The number of research papers regarding education in the period of "revolutionary base" was still the last, with 236 papers.

It can be seen from Table 6 that there was another boom for research on education in the "late Qing Dynasty" and the "Republic of China" after entering the 21st century. From 2002 to 2006, the total number of journal articles in the education of the "late Qing Dynasty" and the "Republic of China" exceeded 1,000. For the "Republic of China," there were 1,104 articles from 2002 to 2006, 1,768 articles from 2007 to 2011, and 2,455 articles from 2012 to 2016, and the increase was more than 600 papers in each phase. The research on education in the "Republic of China" continued to grow. In fact, at present, the common view in historical academia is to put the "late Qing Dynasty" and the "Republic of China" together, in this way

Table 6 Segmented statistics on the number of published journal papers on history of chinese education from 1994 to 2016, based on the historical period at which the research aimed

Year	Ancient	Late Qing Dynasty (Modern)	Republic of China	Revolutionary Base	Contemporary
1994–1996	157	187	228	22	70
1997–2001	330	443	444	22	166
2002–2006	613	1024	1104	36	282
2007–2011	811	1442	1768	56	387
2012–2016	1098	1594	2455	100	501
Total	3009	4690	5999	236	1406

these two historical periods are collectively referred to as "Modern China." There are two reasons why scholars paid particular attention to education during this historical period. First, there is a fairly common view in people's cognition, that compared with ancient education, modern education is our "yesterday." The historical circumstances it faced have greater similarity and comparability with those of "today." Therefore, its experience and lessons could provide more referential value for the education of "today." Although not necessarily comprehensive, this view has been dominant for a long time. The second is that the breakthrough of a single research paradigm is of profound significance for the study of modern educational history. For a long time, the research paradigm of Chinese educational history has been restricted by the research paradigm set by scholars in Chinese history and modern Chinese history. The evaluation of historical figures and analysis of educational events were completely based on "class" and "-ism." As a result, in the field of modern educational history, researchers were inclined to rigidly adopt the "paradigm of revolutionary history." For the entire historian community, after the mid-20th century, the single paradigm dominating the whole academia has already been broken, whether on a theoretical or practical level, and some scholars in the field of modern Chinese educational history have called for reconsideration of the discipline system construction. However, as far as the Chinese educational history scholars were concerned, it appears that they still could not avoid the influence of this single research paradigm.

When it comes to the history concerning the development of modern education in China, its writing was constrained by such influence. For example, the icebreaking journey of reforming traditional education during the Self-Strengthening Movement, the first climax of education emancipation during the Reform Movement, the policies of abolishing the imperial examination system, setting up modern schools and sending students to study abroad led by the Qing government in the early 20th century, the education reform after the 1911 Revolution, and the many educational initiatives proposed by the Nationalist government, and so on, most of them were not very fairly expressed. The breakthrough of the rigid paradigm has greatly stimulated people's enthusiasm and interest in exploring the history of "yesterday." Consequently, many results were produced. If the papers on education in the historical period of the "late

Qing Dynasty" and the "Republic of China" in Table 6 were put together, the total number would be 10,689, which is about three times as many as those on "ancient" education during the same phase. This trend is a reasonable one, considering that the situation that modern education has been distorted to a certain extent for a long time. However, it could also be unreasonable, considering the fact that the rich connotation accumulated in the traditional education for more than two thousand years has not received sufficient attention. History presents strange paradoxes here. Although the enthusiasm for studying contemporary education has increased, compared with other historical periods, the number of researches has not increased very much. One convincing reason is that in the discipline system of Chinese educational history, the history of contemporary Chinese education has not yet become a relatively stable research direction, and this direction has been short of a stable research team, so it is easily interfered by various uncertain factors, and thus the number of related research results has increased relatively slowly.

Next, we continued the investigation by classifying based on the research content of the papers.

As can be seen from Table 7, the distribution of papers on research topics during this period has undergone many significant changes compared with 1979–1993.

The first is the increase in the number of new topics. For example, research papers on "general education" and "social education" have entered the valid statistical scope, with 842 and 321, respectively. Certainly, this phenomenon does not mean that the two types of research did not produce any single article in the previous phase, but it does indicate that the number of research results for both types had not reached double-digit numbers and entered a valid statistical range before. The number of 842 papers related to "general education" was a big change, which was likely to be related to the "Decision of the CPC Central Committee and the State Council on Deepening Education Reform and Comprehensively Promoting Quality Education" (CCCPC & State Council 1999), "The Decision of the State Council on Basic Education Reform and Development" (State Council 2001) and the new round of basic education curriculum reform subsequently launched by the Ministry of Education. The number of 321 papers related to "social education" was directly related to the proposal of building "a society in which every citizen is committed to learning and pursues lifelong learning" by the Chinese government during the first decade of the 21st century (Jiang 2002; see also Hu 2007; CCCPC & State Council 2010), as well as the emphasis on the development of education as a major administration content to improve people's livelihood by the authority.

The second is the change in the ranking of various topics. During this period, the number of research papers on the history of "higher education" exceeded "educators and educational thoughts (trends)" by 3,369 articles, rising from third place in the previous phase to the first. The number of research papers on "educators and educational thoughts (trends)" numbered 3,323. Although ranked second, it still maintained a great advantage over the "education systems," with the number of 1,811. If we exclude those two topics, the top five in this phase in terms of the number of related articles published are higher education (3,369), education reform (2,030), vocational education (914), general education (842), educational history theory (561). The sharp

Table 7 Number of published journal papers on history of Chinese education from 1994 to 2016, based on the research content

Year	Educators and educational thoughts (Trends)	Education systems	Educational history theory	Higher education	Vocational education	Teacher education	General education	Social education	Educational reform	Curriculum and teaching
1994	48	28	9	29	5	5	19	11	21	8
1995	50	23	6	43	13	8	7	3	16	7
1996	40	34	10	41	6	9	14	1	19	8
1997	45	23	12	53	9	4	9	2	24	3
1998	53	33	9	40	6	11	15	4	21	8
1999	60	40	12	61	14	1	12	1	39	7
2000	50	46	10	76	13	5	7	4	37	7
2001	94	64	21	88	7	7	20	5	53	15
2002	88	61	18	123	18	6	24	8	63	16
2003	120	72	24	120	14	6	23	13	61	18
2004	159	84	16	134	18	13	23	15	66	13
2005	160	78	48	164	34	16	29	9	66	21
2006	198	91	26	171	84	19	39	22	125	16
2007	179	99	39	146	66	14	42	11	132	25
2008	188	93	33	152	84	22	32	18	104	21
2009	199	81	49	155	64	25	41	18	109	21
2010	186	93	29	178	70	25	33	19	116	32
2011	209	87	41	185	70	20	52	28	143	36

(continued)

Table 7 (continued)

Year	Educators and educational thoughts (Trends)	Education systems	Educational history theory	Higher education	Vocational education	Teacher education	General education	Social education	Educational reform	Curriculum and teaching
2012	240	125	35	288	62	44	74	28	146	50
2013	323	157	33	322	53	39	107	27	198	51
2014	293	156	27	265	78	34	61	32	173	43
2015	181	139	30	298	70	47	80	20	189	51
2016	160	104	24	237	56	40	79	22	109	39
Total	3323	1811	561	3369	914	420	842	321	2030	516

increase in research papers on the history of higher education and the history of vocational education, especially the soaring number of papers on the history of higher education is completely understandable. Since the end of the 20th century, terms such as "Project 211," "Project 985," and "Double First-Class" have almost become popular discourses in the field of education and even in a society as a whole, naturally attracting great attention from the academic community. The surge in the number of papers related to the topics of the history of higher education and vocational education echoes the before mentioned discussions about the dramatic increase in papers regarding education during the Republic of China and late Qing Dynasty because modern Chinese higher education and vocational education were all stemmed from those two historical periods. The number of research papers on "education reform" was 2,030, which was close to two-thirds of the number of "higher education." There were many papers that focused on the successes and failures of educational reforms over the ages, which is indeed unexpected from the perspective of traditional educational history research. This is not only a natural continuation of the trend in the previous period but also a historical response to the frequent introduction of major measures for contemporary education reform in China at the turn of the century. This includes the promulgation of "Education Law of the People's Republic of China" (NPC 1995), "Higher Education Law of the People's Republic of China" (NPC 1998), "Law of the People's Republic of China on Promotion of Non-government Funded Education" (NPC 2002), "Outline of the National Medium and Long-term Education Reform and Development Plan (2010-2020)" (CCCPC & State Council 2010), "Plan for the Construction of a Modern Vocational Education System (2014-2020)" (MOE, NDRC, MOF, MOHRSS, MOA & CPAD 2014) and other major statutes, policies, and regulations. Since the beginning of the 21st century, the word "reform" has become the loudest voice in the entire education field, and it has become the strongest driving force for promoting various types of research in the entire education discipline. There were 561 articles discussing the "educational history theory" in this period, compared with the 32 in the previous period, an increase of nearly 17 fold, which is a very prominent change. In all fairness, research and discussion on disciplinary theory in the field of Chinese history of education have been relatively weak for a long time. Yet research in this area has been strengthened since the 21st century, and it is inseparable from the awareness and pursuit of my colleagues in the field of the history of Chinese education, who have worked hard to get rid of their theoretical dependence on other subjects and try to build their own academic foundation.

Generally speaking, due to the short publishing cycle of academic journals, the wide range of authors and readers, and convenient circulation, journal articles often reflect the latest research results in the academic field, the development trend of the academic field, and also show academic focus and social concern in different periods. Based on the preliminary examination of the number and theme of papers in the field of Chinese educational history published from 1979 to 2016, the following conclusions may appear. First, in the past 40 years of reform and opening-up, the study of the history of Chinese education has gone through a process of the downturn, wandering, breaking through bottlenecks, and continuing rapid development. In the

first 15 years from 1979 to 1993, a total of 1,082 related papers were published, with an average annual rate of about 72 papers each year. Since 1994, the growth rate has accelerated, and it took 8 years, 5 years, and 5 years, respectively, to have the output of the papers go beyond 400, 800 and 1,000 each year. This trend for rapid growth is obvious and stable. Secondly, in the past 40 years, the research theme of the history of Chinese education has expanded from the relatively concentrated and traditional topics about educators, educational thoughts, and education systems, to the general attention to various educational forms and educational issues. As can be seen from Table 4, in the first 15 years from 1979 to 1993, there were 557 papers focusing on the topics of educators, educational thoughts (trends), and the education systems. There were only 163 papers on other topics altogether. The ratio of the two was 3.4:1. In the 23 years from 1994 to 2016, there were 5,134 papers discussing educators, educational thoughts (trends), and the education systems, and the total number of papers on all other topics reached 8,973 papers, the ratio of the two became 1:1.7. Other themes have gradually become a stable focus of education history research, including higher education, vocational education, teacher education, general education, social education, educational history theory, education reform, curriculum and teaching and other fields. Thirdly, the diversified research paradigms, the interest in the theory of educational history and the promotion of such interest are also major features of this period. Fourth, the biggest feature of the history of Chinese education in the past 40 years might be the continuous attention to the realities of educational reform in contemporary China. As mentioned earlier, whether in terms of the rapid increase in the number of research results, or the large change in the number of papers on each research topic, it can be said that they have been significantly influenced by China's education reform in different periods, without exception.

However, some obvious problems can be found through the general survey of the research papers on the history of Chinese education published in various journals in the past 40 years.

The first is that the improvement in the quality of the papers was not consistent with the substantial increase in the number of papers. This point is mainly manifested in a large number of repeated and trivial topics, including educators, educational events and various educational issues. In terms of educator research, when it came to pre-Qin education thoughts, attention was focused on Confucius, Mencius, Xun Kuang and Mozi. When it came to modern educators, attention was largely focused on Cai Yuanpei, Tao Xingzhi, Huang Yanpei, Chen Heqin. Researches on new educators were rarely discovered, and researchers on the educators who had been discussed repeatedly were less likely to produce comprehensive, systematic, and in-depth results. No matter the topic selection, research method, or even framework design, many articles carried a common thread of familiarity. These repeated and detailed studies did not provide new knowledge and were of little value to academic innovation.

The second problem lies in the excessive attention to reality. The word "excessive" is used here specifically to show that we are not generally opposed to paying attention to realistic educational issues, nor are we advocating that education history

researchers should confine themselves in an "ivory tower." Instead, the argument here is researchers should not blindly follow a trend, which could lead to the loss of direction and pursuit in the discipline of educational history. This may cause researchers to completely follow their gut feeling, thereby putting the research results at the risk of becoming redundant for realistic educational issues. Excellent historical research results should provide inspiration for people to understand the future, grasp the present, and properly maintain a balance between "seeking the truth" and "attaining practical use."

The third problem points to the imbalance in the historical periods of the writings. This mainly refers to the fact that since the 21st century, academia has concentrated a lot on modern Chinese education, but failed to give the necessary attention to traditional education, which is of deep accumulation and rich connotation.

3 Doctoral Dissertations: From the Perspective of Research Quantity and Research Theme[2]

A dissertation often carries the academic reputation of the applicant, the supervisor, and even the degree-awarding institution. It contains the hard work of both teachers and students. In a sense, the work of a dissertation itself is an academic contribution and innovation. Henceforth, it is relevant to investigate the doctoral dissertations produced over the past decades in order to deepen our understanding of the research status of the history of Chinese education since the reform and opening-up.

The first PhD degree in the history of Chinese education in higher education institutions in China was awarded by Beijing Normal University in 1986. According to statistics, by 2016, a total of 415 scholars nationwide had obtained doctorates in the history of Chinese education. Further details were shown in Table 8.

It can be observed from Table 8 that up to the year 2000, the number of scholars who received a doctorate in the history of Chinese education each year numbered fewer than 10 persons. This is because until 2000, among the institutions of higher education nationwide, only Beijing Normal University, East China Normal University and Zhejiang University (formerly Hangzhou University) had the right to confer doctoral degrees in history of Chinese education, and had started to train doctoral students in the history of Chinese education.

In 2000, Central China Normal University was awarded the right to confer a doctoral degree in the history of Chinese education. Three years later, South China

[2]The relevant data of the doctoral dissertation mainly refers to the "Appendix: List of Doctoral Dissertation Titles in the History of Chinese Education" in Yi Qin's doctoral dissertation "*Knowledge Instruction and Academic Inquiry: The Developing Picture of the Discipline of Chinese Educational History*", and "Catalogues and Abstracts of National Doctoral Dissertation of Educational History" in the first to fourth volumes of *History of Education: Research and Review*. We also retrieved the full-text database of Outstanding Doctoral Dissertations and Master Thesis of CNKI, the catalog of National Library of China, libraries of Beijing Normal University, Zhejiang University, Xiamen University, and other libraries.

Table 8 Number of PhDs in the history of Chinese education from 1986 to 2016

Year	Number	Year	Number
1986	1	2002	6
1987	0	2003	10
1988	6	2004	15
1989	4	2005	19
1990	2	2006	28
1991	3	2007	26
1992	3	2008	26
1993	1	2009	32
1994	2	2010	38
1995	3	2011	30
1996	3	2012	32
1997	3	2013	39
1998	8	2014	14
1999	5	2015	18
2000	9	2016	19
2001	10	Total	415

Normal University and Southwest Normal University (now Southwestern University) were awarded the right to confer the doctoral degree in the first-level discipline of education, and Fujian Normal University was awarded the right to grant a doctoral degree in the second-level discipline of educational history. In 2006, Xiamen University, Northeast Normal University, Northwest Normal University and other universities have successively obtained the right to confer PhD degrees in the history of Chinese education. In 2011, approved by the Academic Degrees Office of the State Council, fourteen institutions of higher education have the right to grant doctoral degrees in the first-level discipline of education, which means more colleges and universities can set up doctoral programs on the history of Chinese education according to their own circumstances. Since then, there have been more than 10 institutions in China that have obtained the right to confer doctoral degrees in the history of Chinese education and started to train doctoral students in the history of Chinese education.[3]

Different from the complexity of reasons for the increase or decrease in the number of journal articles, the main reason for the increase or decrease in the number of doctoral dissertations is the change in the number of doctoral degree programs. The output of doctoral dissertations reached its peak in 2011-2013, and the highest year was 39 dissertations in 2013. This precisely reflects the sudden increase in the

[3] Some higher institutions, such as Nanjing Normal University, have long been awarded the right to confer doctoral degree in first-level discipline of education, but for various reasons, they have not been able to quickly recruit doctoral students in history of Chinese education.

number of institutions that obtained the right to confer doctoral degrees in the history of Chinese education from 2011.

Next, we examined the specific historical period aimed at by the doctoral dissertation on the history of Chinese education from 1986 to 2016.

> It can be seen from Table 9 that from 1986 to 2016, the statistical results of the doctoral dissertation on the history of Chinese education based on the research historical period are: 163 dissertations focusing on the "late Qing Dynasty (modern)," 94 on the "Republic of China," 92 on "ancient," and 51 on "contemporary," 4 on "revolutionary base." Additionally, there were 11 dissertations that did not show a specific orientation towards any specific periods.

As shown in Table 10, from 1986 to 1996, there were 22 doctoral dissertations that concerned themselves with "ancient" education. In the same period, studies on education in the "late Qing (modern)" and "Republic of China" numbered only 4 in total. The ratio of the two was 5.5: 1. In contrast, the ratio of the two periods changed to 1: 4.4 in 2012-2016. That is to say, it was after the mid-1990s that we found the decrease in the number of doctoral dissertations studying the history of ancient education and the increase in doctoral dissertations studying modern education history (including the late Qing Dynasty and the Republic of China). This tendency is similar to the situation in the journal articles discussed above. The number of journal articles on ancient Chinese education was 1,098 between 2012 and 2016 (see Table 6), while the number of journal articles on modern Chinese education during the same period was 4,049 (see Table 6). The ratio of the two is 1: 3.7. The emergence of this phenomenon is inseparable from the social environment and academic atmosphere of the humanities and social sciences, in which great importance was attached to the study of "Western-related" issues. The discussion of modern Chinese education has the closest connection to such emphasis; "Western-related" issues became a topic that cannot be bypassed in any way.

From 1986 to 2016, there were 51 doctoral dissertations that examined "contemporary" Chinese education from a historical perspective, accounting for about 12% of the total 415. As can be seen from Table 9, before 2000, no doctoral dissertation focused on the history of contemporary Chinese education. Doctoral dissertations on contemporary Chinese education have sporadically appeared since 2000, and reached a peak of 8 in 2013. Comparing the number of journal articles studying contemporary Chinese education in Table 5, we discover that the year of significant increase in the number of journal articles was around 1999. Considering the relatively long completion period and the limited number of doctoral dissertations, it can be said that for contemporary Chinese education, the trend about the journal article and the doctoral dissertation was generally consistent. The growth of research interest on this topic is inseparable from the urgent need for education reform, whether it serves for purpose of historical summary or realistic concern.

In the following, we will discuss the situation regarding doctoral dissertations on the history of Chinese education based on research subject.

As shown in Table 11, we discussed the situation about the doctoral dissertation in the history of Chinese education from 1986 to 2016, based on the research content. The descending order is 80 dissertations on "education systems," 76 on "educators

Table 9 Number of doctoral dissertations in the history of Chinese education from 1986 to 2016, based on the historical period at which the research aimed

Year	Ancient	Late Qing Dynasty (Modern)	Republic of China	Revolutionary Base	Contemporary	Other	Total
1986	1	0	0	0	0	0	1
1987	0	0	0	0	0	0	0
1988	5	1	0	0	0	0	6
1989	3	1	0	0	0	0	4
1990	1	1	0	0	0	0	2
1991	2	0	0	0	0	1	3
1992	3	0	0	0	0	0	3
1993	1	0	0	0	0	0	1
1994	2	0	0	0	0	0	2
1995	2	0	0	0	0	1	3
1996	2	1	0	0	0	0	3
1997	1	2	0	0	0	0	3
1998	2	4	2	0	0	0	8
1999	4	1	0	0	0	0	5
2000	0	6	1	0	2	0	9
2001	2	5	3	0	0	0	10
2002	3	2	0	0	1	0	6
2003	5	1	2	1	1	0	10
2004	3	8	2	0	2	0	15
2005	3	9	4	1	2	0	19
2006	1	14	5	1	7	0	28
2007	4	12	8	0	2	0	26
2008	2	12	6	0	5	1	26
2009	5	17	6	0	4	0	32
2010	7	14	10	0	7	0	38
2011	9	10	4	0	4	3	30
2012	5	15	8	0	3	1	32
2013	4	11	13	1	8	2	39
2014	3	4	5	0	1	1	14
2015	3	4	9	0	1	1	18
2016	4	8	6	0	1	0	19
Total	92	163	94	4	51	11	415

Table 10 Segmented statistics on the number of doctoral dissertations in the history of chinese education from 1986 to 2016, based on the historical period at which the research aimed

Year	Ancient	Late qing dynasty (Modern)	Republic of China	Revolutionary base	Contemporary	Other	Total
1986–1991	12	3	0	0	0	1	16
1992–1996	10	1	0	0	0	1	12
1997–2001	9	18	6	0	2	0	35
2002–2006	15	34	13	3	13	0	78
2007–2011	27	65	34	0	22	4	152
2012–2016	19	42	41	1	14	5	122
Total	92	163	94	4	51	11	415

and educational thoughts (trends)," 69 on "higher education," 48 on "educational reform," 35 on "general education," 30 on "curriculum and teaching," 23 on "educational history theory." The number of doctoral dissertations focusing on "education systems" ranked first, which is quite different from the statistics we had for journal articles. As mentioned earlier, from 1979 to 1993, the number of journal articles on the education system ranked second, and from 1994 to 2016, it ranked fourth. The main reason leading to this situation may be that some doctoral degree programs in the history of Chinese education have given long-term attention to the Chinese imperial examination system and the *Shuyuan* system. Taking the study of the imperial examination system as an example, Xiamen University and Beijing Normal University provided about 15 doctoral dissertations on the systematic study of the various aspects of the imperial examination system. The emergence of this phenomenon should be related to the whole society's high attention to the *Gaokao* reform since the 1990s. What can be corroborated is that Xiamen University Education Research Institute, where the Xiamen University Examination Research Center was located, has produced the greatest output of doctoral dissertations on the subject of imperial examination system research. The subject of "educators and educational thoughts (trends)" ranks second in the doctoral dissertation on the history of Chinese education. As mentioned earlier, among the articles on the history of Chinese education published in various journals from 1979 to 1993, there were 471 papers on the subject of "educators and educational thoughts (trends)," and 3,323 papers on the same subject between 1994 and 2016. In other words, when it came to journal articles, this topic took a great advantage when compared to the number of journal papers that studied the "education systems." But why did the topic of "educators and educational thoughts (trends)" rank the second in the selection of doctoral dissertations? After a careful analysis of doctoral dissertations for 30 years, we can find the answer. Earlier, we pointed out that, for journal articles on the study of Chinese educators and educational thoughts, "repeated themes" is the biggest drawback for researchers. This meant that the same educator was chosen as the subject of multiple studies, with repeated historical data, similar views, increased number of articles, yet containing

Table 11 Number of doctoral dissertations in the history of Chinese education from 1986 to 2016, based on the research content

Year	Educators and educational thoughts (Trends)	Education systems	Higher education	Educational reform	General education	Curriculum and teaching	Educational history theory
1986	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0
1988	4	0	0	0	1	0	0
1989	3	0	1	0	0	0	0
1990	1	0	0	1	0	0	0
1991	1	1	0	0	0	0	0
1992	2	1	0	1	0	0	0
1993	1	0	0	0	0	0	0
1994	0	1	0	0	0	0	0
1995	0	2	0	0	0	0	0
1996	3	0	0	0	0	0	0
1997	1	2	0	0	0	0	0
1998	0	2	0	1	0	2	3
1999	3	1	0	3	0	0	0
2000	3	2	0	2	1	0	3
2001	2	1	0	1	1	0	1
2002	1	2	0	0	0	0	0
2003	4	1	1	1	1	0	0
2004	4	0	4	4	1	2	1
2005	3	3	3	3	1	2	1
2006	3	3	4	5	0	0	1
2007	4	4	2	5	2	3	3
2008	4	3	8	3	2	5	1
2009	4	6	6	1	4	4	0
2010	5	6	8	7	4	3	3
2011	4	9	5	3	2	0	1
2012	7	7	8	4	4	1	3
2013	5	12	6	2	6	3	2
2014	1	4	3	0	1	1	0
2015	2	4	6	1	3	2	0
2016	1	3	4	0	1	2	0
Total	76	80	69	48	35	30	23

no innovative knowledge and insights. This phenomenon rarely occurs in the topic selection of doctoral dissertations. As far as ancient educators are concerned, Zhu Xi is the figure featured most prominently. There were three dissertations choosing Zhu Xi as the research subject, but the perspectives were different. In modern education, the problem of "repeated themes" is even rarer. There were only two studies on Tao Xingzhi, who was the most selected educators in modern education. Even educators like Cai Yuanpei had become the research subject of only one doctoral dissertation.

Meanwhile, the list of ancient and modern educators becoming the topic of study in doctoral dissertation has been expanded greatly. Figures such as Zixia, Lv Kun, Li Zhi, Yinguang, Hu Shih, Feng Zikai, Qian Mu, Lin Fengmian, Du Yaquan, Wang Yunwu, Li Hongzhang, Yuan Shih-kai, Yan Xiu, Sheng Xuanhuai, Lei Peihong, Xu Chongqing, Lu Zuofu, Yan Xishan, etc., appeared. It would be difficult for figures like Yuan Shih-kai, Li Hongzhang, Yan Xishan, Lu Zuofu and others, to be chosen as the subject of doctoral dissertation discussions in the 1980s and 1990s. Moreover, even as Hu Shih, Du Yaquan, Wang Yunwu, etc., have only received attention at the beginning of the 21st century. The reason is the same as earlier; a combination of deepening of reform and opening-up and the gradual diversification of research paradigms. The segmented statistics in Table 12 show that after 2002, the number of doctoral dissertations on "educators and educational thoughts (trends)" has increased significantly, which was also rooted from this. Excluding the two themes mentioned above, that is "educators and educational thoughts (trends)" and "education systems," doctoral dissertations on the subject of "higher education" and "educational reform" ranked first and second, which is consistent with the order of publications in various journals. The reason is roughly the same as what we pointed out earlier. It is worth noting that there were 30 doctoral dissertations on the subject of "curriculum and teaching." Although ranked relatively on a low level, it has entered the statistical scope. The research in this field includes "The Study of Teaching Method of History during the Late Qing Dynasty and the Republic of China" (Zhang 2007), "Construction of the Knowledge System in the Discipline of Education of People's Republic

Table 12 Segmented statistics on the number of doctoral dissertations in the history of Chinese education from 1986 to 2016, based on the research content

Year	Educators and educational thoughts (Trends)	Education systems	Higher education	Educational reform	General education	Curriculum and teaching	Educational history theory
1986–1991	9	1	1	1	1	0	0
1992–1996	6	4	0	1	0	0	0
1997–2001	9	8	0	7	2	2	7
2002–2006	15	9	12	13	3	4	3
2007–2011	21	28	29	19	14	15	8
2012–2016	16	30	27	7	15	9	5
Total	76	80	69	48	35	30	23

of China (1949-1963)" (Bao 2013), "By the Way of Tradition Against Tradition: A Research on the Early Chinese Curriculum Modernization" (Wang 2013), "A Study on the University Teaching Material Construction in Modern China—Focusing on the *University Collection* by the Commercial Press, etc." (Wu 2015), etc. The increase in the number of related dissertations is linked to the booming of researches on disciplinary history and academic history at the beginning of the century. The more important reason may be the renewal of the knowledge structure and the expansion of the research horizon of scholars in the field of educational history.

4 Reflections on the Study of History of Chinese Education

In the above, we used the articles on Chinese educational history published in various journals from 1979-2016 and the doctoral dissertations of Chinese educational history approved from 1986-2016 as the basic materials and conducted investigation and analysis from two dimensions: historical period and research subject. Below are some points for reflection.

Firstly, it is of paramount importance to improve the quality and academic standard of research results. As a relatively small branch of the education discipline, scholars in the history of Chinese education have published more than a thousand papers and completed about 20 doctoral dissertations each year. It should be noted that the number is increasing rapidly. Compared with this rapid increase in quantity, the influence of our results in and out of the discipline may be disproportionate and insufficient. Few papers have gone into sufficient depth regarding the framework, main arguments, adopting new methods and new historical data mining. Therefore, the influence on other disciplines of education and other disciplines in humanities and social sciences was limited. In contrast, researchers in the history of Chinese education are always inspired by and gain wisdom from the writings of scholars in history, social history, and cultural history, etc. This tells us that on a whole, there is still room for improvement in the research concerning the history of Chinese education. Focusing on quality, we must first make up our minds to abandon the so-called "research themes" that are repetitive, fragmentary and do not generate any new insights. The choice of a research topic, no matter on a macro or micro level, should be based on a thorough review of the previous research results of the predecessors, starting with finding the missing links and weak links in the academic chain, rather than doing what single individuals regard as the correct direction. Researchers are supposed to provide new content on the basis of previous achievements, even if the new content provides tiny innovation. Although this is a somewhat idealized goal, it is indeed the first step in our research. The first step is always the hardest; however, if the first step is done correctly, our final goal for academic innovation is attainable.

Secondly, education historians are responsible for paying attention to reality and making positive responses. It is also an important way to promote the development of the discipline and the research. In particular, education reform in China is currently getting deeper and deeper. In the face of many deep-seated problems,

researchers are confronted with bigger challenges regarding how to learn valuable lessons from the history of Chinese education, which was full of variety and hardship. As mentioned earlier, some scholars of educational history are particularly sensitive to realistic educational issues. They often turn back to some examples from the history of education in order to compare and describe the phenomenon in reality. However, such descriptions or comparisons are prone to a lack of in-depth analysis of the phenomenon, fail to provide theoretical explanations, and are less likely to trigger any enlightening ideas for academia. This is certainly a response, but it can only be evaluated as a shallow or more utilitarian response. As pointed out by some scholars, these achievements are limited to "specific descriptions and mechanical reduction of a certain historical phenomenon, only to use historical empirical methods to describe and restore the original appearance of social phenomena, and to feel satisfied at the level of 'storytelling'. The absence of explanation and analysis of social theory and lacking the level of 'reasoning' will lead to the deficiency of depth in research results" (Li 2017, p. 139). Such responses are likely to fail to provide meaningful inspiration for solving practical educational problems. We must discard the habitual thinking that the simple statement of facts as the sole task of the study of educational history, and strive to integrate storytelling with reasoning, and correct the academic atmosphere. We must not only restore historical facts clearly and accurately but also search for the roots fairly and reasonably, which requires improvement in theoretical thinking, historical data mining and storytelling. Such an approach will answer the dual challenges of insufficient knowledge innovation and inadequate realistic concern.

Third, in terms of research paradigms, theories and methods, researchers must maintain an open mind, since both attitudes of being dogmatic and trend-chasing are inadvisable. An old question that has puzzled researchers in the history of education for many years is whether the discipline of education history needs to build its own independent theoretical system and unique methodological system. Both advocates and opponents express differing opinions and cannot reach an agreement. Our view is that as a branch of education and a specialized field of history, the history of education is neither necessary nor possible to build a set of "specified" or "customized" paradigms, theories, and methods. In today's academic environment, academic disciplines are increasingly infiltrated and intersected, and Internet big data and massive data sharing are sprouting. If we must insist on doing so, it is likely to be an act of restricting ourselves and regressing. An open academic mentality should be advocated. On the basis of adhering to the basic requirements of historical research, we should strive to absorb, learn from, and integrate theories and methods from other related disciplines to study our own educational issues. What needs to be emphasized is that the absorption, reference and integration here is not the mechanical application of any theory, the intended persistence on innovation, nor the deliberate move to catch up with the trend; it calls for the genuine understanding and authentic suitableness for one's own research object.

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Understanding People's Literacy Through a Connection to Their Activities: A Methodology to Grasp Students' Literacy

Youqing Chen

Abstract Owing to the inherent, general and abstract nature of people's literacy, it is easy for people to have a complicated understanding of such key problems as the essence of literacy, the structure of literacy, and the process of developing literacy. Therefore, it is necessary to find a scientific and clear way to understand these problems. Since people's literacy is formed, developed and shown in their activities, and is inherently related with their activities, we can have a scientific and clear understanding of these problems by connecting them with people's activities. An internal factor that plays a decisive role in people's activities and their quality, literacy in essence indicates people's internal, general and stable physical and mental features. According to the different functions of literacy for people's activities, we can understand the structure of literacy based on the literacy for the side of a certain activity, the overall literacy for a single activity, the literacy for compound activities, and a person's overall literacy. Since the mechanism for students' literacy learning or development lies in their active activities, teachers' instructions can promote the development of their students' literacy only by their being used in their students' dynamic activities.

Keywords Students' activities · Nature of literacy · Structure of literacy · The mechanism for literacy-oriented teaching and learning

The development of student's literacy is the core of talent training. The fundamental questions such as "what kind of people to cultivate" and "how to train people" can only be fully understood from the development of student's literacy ultimately. Since the problem of literacy was brought up, the literature studying on the training of students' literacy in China has dramatically increased in recent years. But they have a complicated understanding of the key problems, including the definition of literacy, the structure of literacy that students should have in a new phase and the mechanism for literacy-oriented teaching and learning. This is probably because of the internal, general and abstract nature of people's literacy. Therefore, it is necessary to find a scientific and clear way to understand the relevant problems of students'

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literacy development. Since people's literacy is formed, developed and shown in people's activities, it is rather a good way to understand literacy by connecting it with students' activities.

1 The Inherit Relationship Between People's Literacy and Their Activities

The method of understanding people's nature, development or literacy by their activities was created in Marxist philosophy, and was then introduced into the study of psychology and pedagogy by psychologists in the Soviet Union. In addition, Dewey, J. also stressed that it is necessary to understand student's development problems from their activities based on his views of empirical educational philosophy.

What makes Marxist philosophy differentiable from the old philosophies is that it is "practical materialism" (Xiao et al. 2012, p. 1). It takes people's dynamic real activities, namely practice, as the primary and basic start on observing and understanding people's world, their real-life and self-development. For instance, Marx, K. takes people's dynamic activities as the basic living way and the nature of people: "The overall feature of a species and the feature of a kind of species lie in the nature of activities while human being's nature is just the free and voluntary activities" (Marx et al. 1979, p. 96). He takes people's dynamic activities as the basis for transforming nature, forming and development of human society, as well as the basis for the forming and development of human being's nature. Marx once said "how one lives his life shows how he is. Therefore, what he acts is in line with his production—both what he produces and how he produces" (Marx et al. 1960, p. 24). In Marx's view, people's feeling, mind, etc. are all developed through their dynamic activities. "People's feeling and the humanity of feeling are produced by the existing objects or the humanized nature. The five senses of human are products of the histories in the past world" (Marx et al. 1979, p. 126). "The essence and the basis of people's mind is the alter of the nature world that human brought, rather than the nature itself only; human's intelligence develops as they learn how to change the nature" (Marx et al. 1960, p. 551). In light of the above, from the aspect of Marx's practical materialism, the dynamic and real activities of people are the main foundation to observe and understand the essence, the development and the literacy of human being.

In psychology and pedagogy, it is the psychologists in the Soviet Union who explicitly and firstly studied mental development and the formation of literacy from their connection with people's activities. In the 1930s, Vygotsky, L. S., Rubinshtein, S. and others, avoiding the shortcomings of idealist psychology (introspective psychology) and behavior psychology, arbitrarily used the dialectical materialism and historical materialism of Marxism to understand the essence of psychology and brought up with three basic principles to observe for Soviet psychologists (Petrovskiy 1981, pp. 52–54). The first one is the principle of determinism. This principle stresses that people's consciousness or psychology is determined by their living in society

or their way of life, and people's consciousness or psychology has social–historical features. The second is the principle of unification of consciousness and activities. This principle holds that consciousness and activities are unified, rather than opposite; consciousness is an internal part of activities and an internal adjustment mechanism for promoting smooth activities. As Rubinshtein stated, psychology or consciousness is developed in the activities and shown in the activities or behaviors. The unification of consciousness and activities makes it possible to know one's internal mind, his experience and his consciousness through his external expression, i.e. his individual behaviors (Zankov, 1985, p9). The third is the principle that psychology is developed in activities. It emphasizes that people's psychology or consciousness is developed within the activities they participate. The core of these principles is to highlight the connectivity between the internal psychology or consciousness and the external activities and to stress the need to understand people's psychology or consciousness through the actual activities they take part in. These principles turned to be the fundamental concepts of "Cultural-Historical Activity Theory" ("Activity Theory" for short) founded by the School of Vygotsky-Leontiev-Luria (also known as the Vygotsky Circle).

The "Activity Theory" of the Vygotsky Circle has been brought into the sight of western psychology since the 1980s and helped the forming of important learning theories, such as constructive learning, cooperative learning, community-based activity learning, etc. Particularly, the third generation of activity theory in the west was developed on the basis of the activity theory founded by Vygotsky and Leontyev, A. N., the representative is Engestrom, Y. from Finland. The third generation expanded the individual activities for development into an "activity system with social characteristics", which is composed of subject, object, community, tools, rules and division of labor. It analyzes human's development from the conflictual nature of this system. The third generation of activity theory pays more attention to the social and contextual features of activities and the analysis is more specific and subtle. But the core concept is still the basic views in the "activity theory" of the Vygotsky Circle, which holds that the development of humans is realized through people's actual activities.

Dewey, based on his experimental education philosophy, supported utterly to study the students' mentality and their development through experience or activities. He raised three viewpoints on understanding people's mentality by comparison with the old psychology. First, the presence and development of individual's psychology are greatly connected with society. Dewey pointed out the old psychology tends to regard the individual's mentality as his own matter. For example, they think psychology is inherited. While the latest trend is to relate the individual's mentality to the function of society, which is not operated or developed by himself but is continuously stimulated by media and nourished by society—the main difference between barbarism and civilization is not the bare nature that everyone faces, but the social legacy and social media. Second, mentality evolves from the need for action and is led by action. Dewey denounced that the old psychology is the psychology of knowledge and intelligence, which mainly concerns about feelings, with emotions and efforts playing a necessary and derived role, and seldom talks about action. The old psychology ignores

the possibility that the roots of mentality lie in and originate from the requirement of action and the only fundamental function that mentality has, which is defining the direction of activities at the moment or in the long run. Here reflects the functional psychology of Dewey: Mentality serves for people's behavior or activities and the study of psychology should start from its function to behavior or activities. Third, mentality keeps growing and developing. The old psychology holds that people's mentality is consistent, while Dewey takes that now we start to believe mentality keeps growing and is variational in essence, and will present different abilities and interests in different periods (Dewey, 1994, p74-77). As a matter of fact, these three aspects of thoughts are unified in the theory of Dewey. His understanding of people's mentality and its development is greatly affected by evolution. In his view, human beings survive and develop with the interaction with the environment while the interaction is realized through people's activities; mentality (intelligence) refers to a factor that an individual, in need of reaching the goal of an activity, regulates and controls the process of an activity (procedure, means, method, etc.) in such activities (Dewey 2001, pp. 144–145). When talking about the relationship between the mind and experience, Dewey takes mind (reflection) and activities (experience) as two existences, which in fact expresses the same view (Dewey 2001, pp. 153–160). Therefore, as Dewey emphasizes the sociality of individual's social development, the connection between human's mentality and activities, and the development of people's mentality in the activities, his views on people's mentality and its development are much like that of Vygotsky Circle.

From the propositions of Maxis philosophy, the Vygotsky Circle and Dewey, the essence, development and literacy of people have connectivity with people's activities. Knowing the connectivity between literacy and activities contributes to understand the complicated problems of people's literacy. It provides a methodology to know and understand people's literacy from their activities. If we study literacy by literacy, it is easy to have different opinions, on the ground that: (1) People's literacy is an internal, general and abstract existence within the physical and mental structure of people, which is invisible though real; (2) there are many elements of literacy and a complicated structure of literacy for a person in whole. By comparison, people's activities are concrete and appreciable, so it is easy to grasp people's literacy by observing and analyzing people's activities in an objective and clear way.

2 Understanding the Definition and Features of Literacy by Connecting with Activities

The basic question to understand literacy is to know its definition and features. Due to the internal, general and abstract nature of literacy in the physical and mental structure of human, it is difficult to define literacy or find its features without making the connection with people's activities.

"Literacy" is a general concept (generic concept) representing the common features of various specific elements of literacy. The kinds or elements of literacy are various, such as morality, intelligence, capacity, creativity, emotions, will, ideal, belief, world outlook, etc. There are already many studies on the specific elements of literacy in pedagogy and psychology. By inducting and summarizing the common and key features of these elements of literacy, we can find the definition of "literacy": It is the internal, general and stable physical and mental features in human body and an internal factor that plays a decisive role in people's behaviors (activities) and their qualities. In other words, literacy refers to those internal, general and stable features within people's body and mentality which play a decisive role in people's behaviors (activities) and their quality.

As a physical and mental feature of human beings, literacy is featured by internality, generality and relative stability which can only be fully understood by connecting literacy with activities. First of all, literacy is internal. It manifests that literacy is within the physical and mental structure of people which is implicit and underlying. Different from people's appearance features, the literacy of a person cannot be directly felt by others and we can only infer the being of literacy indirectly by observing people's activities or behaviors. Besides, literacy is closely related to one's activities in life and cannot exist independently without the human body alive. This is different from knowledge, which can exist in certain objects such as books or disks. Second, literacy is general. People's literacy is generalized and simplified in the long-term and various social activities; meanwhile, once a certain literacy is formed, it will usually be decisive in people's various activities which differs from knowledge in a certain subject. Knowledge in a certain subject can only work in its own field. For instance, chemical knowledge can only work in understanding the chemical phenomena and dealing with chemical problems and has no value in human communication. By contrast, as a generalized physical and mental feature, literacy has an influence on all of the people's activities or one kind of activity, such as, people's intelligence will influence all people's activities. Third, literacy is comparably stable. Once literacy is formed, it will have a lasting impact on people's behaviors and shows in people's life. Literacy is not easy to be forgotten or change, which is dissimilar to the knowledge that people grasp. In fact, those comparably stable physical or mental features in humans can be characterized as literacy, rather than those temporary and unstable features brought by disease, fatigue or drugs. By the way, after literacy is formed, the so-called "relative stability of literacy" also indicates that people's literacy, when the living context changes or by efforts, can change in a comparatively slow way.

Literacy is an internal factor that affects one's activities and their quality, and also the most important factor. That's why literacy is important to people. This reflects that there is a close connection between people's literacy and their activities and it is an important aspect to fully understand the definition of literacy. From the behaviors a person acts in various kinds of actual activities for a long time, we can observe and infer the development of his physical and mental literacy. For instance, it is hard for us to tell whether one person has the literacy of honesty from just one accidental behavior, but through observance of his various behaviors in his life, we can tell.

Therefore, the status and quality of one's behavior or activities is the "indicator" to observe and know one's literacy state. In general, one's internal physical and mental literacy is consistent with one's outside behaviors. In life, each person has different behaviors and this is due to their different efforts and conditions. Apart from that, literacy variation is the main factor in determining one's activity conditions and their quality. What activities one tends to participate in, how to carry out these activities and what is the quality of these activities are all directly related to one's physical and mental literacy. From the view of structure–function, people's literacy is their physical and mental features and their structure, while the outside performance is their activity status and quality. For example, one's interests, need and value orientation determine the scope of activities that he tends to initially take part in and the values he pursues; one's capacity, creativity and aesthetic judgment directly determine the effect of the activities in aspects of the standard, efficiency, creativity and aesthetic perception.

3 Understanding the Structure of Literacy Based on Its Functions to Activities

The most specific and fundamental answer to what kind of people that education should cultivate can be given only from the level of literacy structures that they should have. However, there are different views on the literacy structure that one should have, and this is reflected in the educational policies. Regarding these questions, most ordinary people simply list out the contents and structure of literacy for student's development based on their experience or feelings. On the whole, we have an inadequate theoretical basis and strict classification standard for literacy structure that education needs in China. The kinds of literacy are various and the words to describe one kind of literacy are colorful, such as we may use brightness, flexibility, wisdom, intelligence, intellectual ability, the ability of thinking, creativity, etc. to express one kind of literacy. Therefore, if there is no proper angle to study or no standard of classification, the understanding of the category and structure of students' literacy tends to be various and unable to reach unanimity.

In the author's view, only by relating with people's activities can we have a moderately scientific and clear understanding of the structure of literacy. As there is relative correspondence between people's literacy and activities, and such correspondence also exists between the internal literacy structure and external functional performance, the method of structure–function analysis can be used to study the structure of literacy, namely, deducting the category of literacy and the structural connection of literacies by observing the different functions or effects of literacy in one's activities. But due to the variance of the category and complexity of the structure of activities and literacy, layering and classification are required to have a clear understanding of the category and the structure of literacy. Accordingly, we can understand the category of literacy based on an aspect of a certain activity, the

overall of a certain activity (including the overall of a single activity and the overall of compound activities), and a person's overall activities according to the different functions of literacy for people's activities, and analyze the literacy and its structure corresponding to different levels of activities based on literacy's functions in each level of activities. The unit of literacy in each level is different in size and degree of comprehensiveness as well as its structure.

For the first level, the literacy shown in one aspect of an activity can be called "the literacy for the side of a certain activity". It observes the existence of literacy from the functions of literacy for one aspect of an activity and is a literacy that affects the function of one aspect of an activity. The literacy for the side of a certain activity is the minimum unit of people's literacy and the basis for understanding various comprehensive literacies and their structure. And thus, it is also the basic literacy among all literacies of people. The elements of literacy we used to talk about, such as skills, capacities, creativity, emotions, attitude, value, virtues, etc. are in fact all literacies that reflect the status and quality of one in a certain activity. For example, skills reflect how well a person knows the actions of a certain activity; capacities reflect how good and efficiently one acts in an activity; creativity shows how one performs in novelty and uniqueness. Emotions, attitude, values and other kinds of literacy reflect one's tendency to a certain activity and his understanding and pursue of the meaning of such activity. Virtues reflect how a person handles the relationship with other's interest in an activity.

In the past, people learned the basic literacies (the literacy for the side of a certain activity) by reference from the analysis of the structure of people's mind in psychology. But as modern psychology in the west tends to study the process of mentality from the cognitive level in a scientific way, the discovery of the structure of psychology focuses on the cognitive aspect, and there is not a theory on the structure of psychology which includes all components of psychology. Education has the mission to cultivate people in a whole way and pedagogy requires establishing a psychological structure for a person as a whole. As the features and structure of people's activities are determined by the functions and structure of people's literacy, the internal psychological structure is in line with the external structure of the features of activities (Chen 2000, p. 64). Therefore, we can analyze and learn the literacies for a certain activity based on the structure of the features of activities. Based on the features and its structure of the activities the different functions of literacies in a certain activity, the author once divided the structure of psychological structure in a certain activity for an individual into the following aspects:

First, it is the literacy that affects the purpose or tendency of activity (the tendency literacy). Its core is a need and its form of expression, such as interests, ideal, value, belief, etc. This kind of literacy determines the enthusiasm of the subject in activities, the tendency, category and scope of the activities that the subject participates, and the value and meaning of activities for the subject.

Second, it is the literacy that regulates and controls the process of activities (regulated literacy). This mainly refers to the cognition, emotions and willfulness shown in object-consciousness and self-awareness, such as intelligence (including knowledge, intellectual skills and cognition strategy), literacy of emotion, literacy of willfulness,

and literacies of self-awareness, namely self-acknowledge, self-independency, self-reliance, self-confidence, self-improvement, self-esteem and self-discipline. This category of literacy determines in what way that the subject engages in activities and how to regulate and control the relationship and interaction between himself and the world.

Third, it is the literacy that affects the quality and effect of the subject's activities (effect literacy). This category of literacy includes the ability to determine the level and efficiency of activities (including operating skills), the creativity to determine the novelty and uniqueness of the subject's activities, the aesthetic judgment to determine the aesthetics of the activities, and the literacy which determines the social balance. This category of literacy makes the subject to act under certain social norms (moral, legislative and political norms), including virtues, quality of observing laws and regulations, quality of politics, communication skills, etc. (Chen 2002).

For the second level, the literacy needed or shown in engaging in one single activity can be simply called the overall literacy for a single activity, or literacy for a single activity. Single activity refers to an activity that has one object and one single process. Single activity is a term compared to compound activity; the latter is a comprehensive activity comprised of many single activities. The literacy for single activity corresponds to a certain overall single activity (in other words, a single activity is a unit to observe literacy). It, in fact, reflects the literacy one needs for a single activity carried out in a smooth and effective way.

Literacy for single activity is overall or comprehensive literacy that is composed of the literacies for all sides of a certain activity which affect the overall quality and effect. It is in fact a structure of literacy, rather than pure components of literacy. The composing unit is literacy for the side of a certain activity. From the analysis of the contents and its structure of the literacy for the side of a certain activity in which people participated, the structure of literacy for any single activity is an organic whole of literacy for a certain activity composed of three aspects: the tendency literacy, the regulated literacy and the effect literacy.

As the literacy for a single activity corresponds to a certain single activity, different types of single activity may have different kinds of literacy for a single activity. To understand what literacies for a single activity that people should have, we need to classify the types of a single activity. Due to the diversity of the types of activities, we cannot make a classification for all activities. But through comparison, summarization and abstraction of people's many activities, we can find some fundamental types of a single activity, and figure out the complicated types of activities in human life based on the former. After comparison of various standards of classification, it is found that as the purpose or social function of activities is greatly influenced by people's value orientation or proactive pursuit, the specific processes (tools, methods, procedures) of people's activities are various. Therefore, differentiating the types of activities in accordance with the purposes or social functions can lead to complicated results. Yet by the objects or fields of activity, we can find five basic single activities in people's life: operating activity, interaction activity, symbolic activity, observation activity and reflection activity (Chen 2011, pp. 111–114). Through these five kinds of activities, people have a connection with nature, others (society), cultural and

scientific knowledge and themselves, which actually include all fields of human life. These five kinds of activities thus become the basic types of people's activities. This classification is similar to the classification of students' study by UNESCO, which is "learning how to acquire knowledge, how to do things, how to live together and how to make a living" (UNESCO 1996, p. 75). Corresponding to these five basic activities, five basic literacies for a single activity can be classified as literacy for operating activities, literacy for interactive activities, literacy for symbolic activities, literacy for observation activities and literacy for reflection activities.

For the third level, the literacy required or shown when people are engaging in a compound activity can be called the literacy for compound activities. Compound activities refer to many single activities are combined together to achieve one purpose or function. Based on the different purposes or functions to be achieved, compound activities can be divided into different groups, such as role activities (activities are taken part in to play some social roles), profession activities (activities in a certain profession), project activities (activities carried out to complete a certain project), etc. Taking role activities to analyze its structure of literacies, the literacies needed or shown in the role activities can be called literacies for role activities, or literacies for roles. Literacies for roles are actually a comprehensive structure of literacies composed of literacies for many kinds of activities in their social roles. The unit for it is literacy for an activity, for example, the literacies for being parents, the literacies for being a teacher, the literacies for being a lawyer, etc. Specifically, the role activities for an outstanding teacher include teaching, cultivating students, contacting work with parents, involving in work of school management, etc. So the literacies for being a teacher is a comprehensive structure of literacies integrated by literacies for teaching, literacies for cultivating students, literacies for contacting parents and literacies for involving in the work of school management. Among them, literacy for each activity is composed of literacies for all sides of a certain activity. For example, the literacy for teaching is a comprehensive literacy including the attitude, knowledge, skills, capacities, creativity and aesthetic judgment of teaching; the literacy for cultivating students is a comprehensive literacy composing of such literacy elements as responsibility, compassion, knowledge, skills, creativity and capacity.

According to the relevant research of the Organization for Economic Co-operation and Development (OECD), core literacy is the literacy for some complicated activities in the backdrop of information-based society and globalization (Zhang 2013). Therefore, the core literacy is not a literacy for the side of a certain activity, rather a comprehensive, overall literacy that is needed to complete an activity, which is composed of many literacies for the side of a certain activity such as knowledge, skills, attitudes, creativities, etc. This shows by connecting with activities, we can better understand the definition of core literacy.

For the fourth level, the overall literacy shown in all the activities that one takes part in his life can be called a person's overall literacy or a person's literacy. It corresponds to a person as a whole and his overall living status and refers to the comprehensive literacy or literacy for overall development as a whole person. It in fact is a structure of literacy that is integrated by various activities that a person has to

participate in as a whole person and the unit is the literacy for various single activities and compound activities. A person's life is in fact the aggregation of all the activities that he participates in his living and development. Suppose a person's life is a whole composed of professional activities, activities of earning for basic necessities of life, leisure activities and learning and self-development, then the structure of overall literacy of a person is a structure composed of literacies for those activities. This level of literacy is the most comprehensive literacy compared with the previous three levels of literacy. This kind of literacy which can reflect one's overall literacy can be expressed in characters, personality, etc. Leontyev, A. N. brought up with a methodology principle of understanding one's mentality from the whole aspect, namely the principle of unifying activities, consciousness and personalities on the basis of activities. Leontyev treats one's need or motivation as directly connected with the activities and uses this to specify the structure of a person's mentality as a whole—the forming of personality. He takes the view that the forming of one's personality is attributed to the coordinated and subordinative relations that are formed among different needs or motivations in one's life. "The structure of personality is layered in the internal side and has a relatively steady route of motives". The steady relationship among the needs or motivations leads to the "overall 'outline of psychology' of personality" (Leontyev 1980, p. 158). According to the views of Leontyev, the facts that the needs and motivations in life have formed coordinate and subordinative relations actually indicate that there is some structure formed among the different activities in life, which is to say, that a person has developed his characters or personality.

Clearly, the relationship between those four levels of literacy is progressive or inclusive. The lower level of literacy is the unit of a higher level of literacy; conversely, the higher level of literacy is a comprehensive structure composed of a lower level of literacy. For example, "the literacy for the side of a certain activity" is the composing unit of "the literacy for a single activity"; "the literacy for a single activity" is the composing unit of the literacy for compound activities; "a person's overall literacy" is a structure of literacy that is composed of all literacies for all activities that a person participates. At different levels of activities, the unit of literacy and its structure are different. In light of this, the analysis of the unit of literacy and the structure of literacy should be associated with different levels of activities.

4 The Mechanism of the Development and Teaching of Students' Literacy Based on Their Activities

From the middle of the 1980s when quality-oriented education was recommended in China, and there were discussions on how to apply quality-oriented education into the teaching and learning process. In recent years, the problem of the process of development of literacy has caused attention again with the "core literacy" being put forward. But till now, there is no thorough research and consensus on the rules

of the teaching process on the cultivating of students' literacy, especially the rules of cultivating process based on the mechanism for the development of literacy. Many people still, intentionally or unintentionally, take the way of teaching only knowledge or promoted the way of teaching knowledge as the way of teaching literacy. But the teaching process with the goal of pure acquiring of knowledge can use the method of "teacher teaching and students receiving," for knowledge is transmissible; while literacy itself cannot be fully represented by symbols (that is to say, to be described or expressed with symbols as languages or mathematical logic), it is thus not transmissible. Therefore, the development of students' literacy is clearly not a process of "teacher teaching and students receiving", and it rather needs a special mechanism. According to the researches of the Vygotsky Circle, Dewey, and Piaget, J., the mechanism for forming and developing students' literacy can be found through their activities.

Based on the practice or activity view of Maxim, the Vygotsky Circle presented the idea that we should understand the process of psychology and the development of psychological function (i.e. literacy) through external and physical activities. In the Vygotsky Circle, researchers' understandings of the types of activities that promote the development of people are not exactly the same. Vygotsky pointed out that the development of one's psychology is originated in the collective activities that he participates and the interaction with others. In the children's development, advanced psychological function "comes to stage" twice: The first one is the function of interpsychology, namely that of collective activities or social activities; the second one is the internal psychological function in individual activities and in the internal way of thinking of children (Vygotsky 1994, p. 403). Leontyev summed up the theory of Vygotsky as: The main mechanism for the development of people's psychology is the mechanism of transforming the various kinds of activities in society and history into the internal psychology (Leontyev et al. 1962, p. 6). He thinks that the psychological activities are the internalization of the external activities: The internal activities originate from the external practical activities and are inseparable with them; the former is not formed above the latter but remains a fundamental and ambilateral relationship with the latter. Internalization refers to a transition, due to which, the process of handling external material objects turns to the process carried out with wisdom and consciousness; under such circumstances, they have undergone the special transition—generalization, words and simplification. And most importantly, internalization can further develop beyond the limit of possibilities of external activities (Leontyev 1980, pp. 60–67).

Dewey's understanding of the mechanism of children's development has typically reflected his educational philosophy proposition on empiricism. In Dewey's opinion, the basic unity of his educational philosophy can be found in such view: The practical experience and education have a close and necessary connection (Dewey 1997, p. 20). Dewey repeatedly stated that the children's development is achieved in the process of interaction with the environment. He said that "to change one's psychology, the only way is to make use of the natural or artificial material conditions so as to let him involve in a responsive activity" (Dewey 2001, p. 41). All education can cultivate one's intelligence and morality, but this cultivation is mainly about selecting and

regulating activities of the young's talents. And it is not only about the cultivation of congenital activities but also about cultivating through activities. This is a process of transform and reorganization (Dewey 2001, p. 81). On the basis of this, Dewey put forward that "teaching is about searching materials to have one engages in a special activity" (Dewey 2001, p. 146). Piaget's theory of cognitive development deals with how children acquire knowledge based on their activities. He said, "cognition is not developed from a subject with self-consciousness, nor from an object that is developed (from the aspect of the subject) and placed over the subject; cognition is acquired from the interaction of the subject and the object, which appears in the process and thus has included both the subject and the object." The state of activities, intermediary of the interaction of the subject and the object, alters with the growth of children's age. Before the acquiring of figurative concepts and languages, the activity as the intermediary is perception—exercise activity (external activity), while after the acquiring of languages and figurative concepts, the activity is "conceptual thinking activities" (internal activities) (Piaget 1985, pp. 21–22).

By learning from the fruits of the above foreign researches, China has gradually spread the idea of understanding a student's development through his activities since the 1980s. For example, some scholars put forward a new theory on the factors affecting one's physical and mental development in 1986 and classified the factors into two groups. The first is possible factors, namely the state of the subject itself and the conditions of the environment; the second is realistic factors, namely the activities of the subject. Possible factors provide all kinds of possibilities for people's development, but to make these possibilities come true, one needs to reply on these individual activities. As it were, the individual's activities are decisive factors for the individual's development and without the activities of the individual, there is no development (Ye 1986). What's more, the researches on the curriculum of activities, activity teaching since the 1990s have promoted the understanding of students' development from student's activities.

At present, researchers at home and broad have reached a consensus on the mechanism for the development of student's literacy, which is students' dynamic activities are the mechanisms for the development of their literacy. In other words, a student actively participates in an activity, experiences by himself and completes the whole process, and this is the mechanism for the development of a student's literacy. To figure out why students' activities can promote the development of their literacy, we can have a more specific analysis from the two-way objects or mutual transition of the subject and object that existed in the dynamic activities (Chen 2000, pp 98–109).

The knowledge of the mechanism for the development of students' literacy has provided important theoretical guidance for understanding how teachers' instruction has promoted the development of students' literacy (Chen 2011, pp. 300–303). Since students' literacy is developed through their own dynamic activities, the mechanism on how teachers' instruction promotes the development of students' literacy is as follows: indirectly affect the development of literacy through influence on students' activities, namely, the function of instruction → students' activities → students' development. The function of instruction to students' literacy can only be realized when the instruction is on the students' activities. Any expectation, influence and

strength of education, did not act on students' activities or transform to the factors of students' activities, would not be meaningful to students' development. This is as Dewey put: "Education becomes an external pressure unless the efforts of the educator are linked to some activities which the child undertakes on his own initiative without depending on the educators." "Education is about taking charge of activities and providing guidance on these activities" (Dewey 1994, p. 4).

With this mechanism for students' development by teaching, we will have a new understanding of the key questions of how to teach, such as the object, purpose and method of the teaching. The roles of teachers to students are not to directly influence or remold the students' physical and mental structures, but through the influence to the students' dynamic activities to indirectly remold them (students' physical and mental structures are remolded by their dynamic activities). Therefore, the direct object of instruction is "the students' activities", rather than the still life "students" (for instance, treating students as containers to take in knowledge), or the "knowledge on books" which students learn. As educator Tao Xingzhi once said "what a good teacher teaches is not knowledge or a student, but to let them know how to study" (CERI 1981, p. 5). The intention of instruction on students' activities is to make them actively join in the activities of learning and efficiently complete the activities of learning. The ways of instruction on students' activities are to facilitate their motivations, provide guidance, demonstrate the process, give feedback and evaluations, answer their questions, etc. Therefore, it is necessary to have a right understanding of the roles of teachers' instruction to the development of students. Instruction is only the condition to let students actively join in the activities of learning and effectively complete the process, but it cannot substitute students in the process of dynamic learning, and should not be done using the time and space which the students need for independent and initial study. This is due to the fact that the development of student's literacy is achieved by their own active activities, and the activities of learning must be experienced and done by themselves, not being substituted by any other person.

According to the mechanism of instruction on students' development, the role of teachers to students is not mainly direct teaching or giving. In modern education, many teachers mainly focus on passing on knowledge on books. In fact, passing on knowledge on books is simply providing an object for the activities of learning, which is not a more important aspect of teachers' role that for many occasions can be replaced by student's reading by themselves; besides, in cramming education, what teachers teach is only conclusions and the time and space of students' independent activities in class are fully taken by teachers. The roles of teachers should be to stimulate the motivation of learning and guide and help students to actively and effectively carrying on learning. Real teaching is not simply to teach, give or infuse, but to stimulate, guide and help students gaining knowledge through their activities; the effective process of teaching and learning is to let students actively learn by teachers' instruction. As Suhomlinskii, V. A. said "it is only those which can stimulate the self-education of students are real education" (Sukhomlinskii 1984, p. 350).

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A National Empirical Study of Students' and Parents' Satisfaction with Basic Education

The Research Group

Abstract A survey of 47,562 kindergarten parents, primary and secondary school students from 31 provinces and municipalities indicates the following results: in general, the students and their parents were satisfied with the educational services provided by the government; their educational expectations and their perception of educational equity and perception of educational quality had a positive effect on their overall satisfaction with their education; their overall satisfaction with education, educational expectations and perception of educational equity and quality all increased to varying degrees; among the observed indicators, they showed greater satisfaction with the school environment and school conditions; and they showed the least satisfaction with the equity in educational opportunities, the curriculum and teaching, and students' learning and development. To increase their educational satisfaction, the government is supposed to promote equity in educational opportunities by reforming the supply of high-quality educational resources, improve the quality of education by deepening the reform of basic education, and resolve the difficult problems within education in order to promote healthy development of education.

Keywords Basic education · Satisfaction index · Educational expectations · Perception of educational equity · Perception of educational quality

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1 Introduction

Satisfaction with basic education is fundamental to "running the education for people's satisfaction." With the gradual establishment of a socialist social governance system with Chinese characteristics, evaluation has been playing an increasingly important role in improving government work. The survey of satisfaction of education is a basic descriptor of China's basic education development, an important indicator of people's perception of education, their demands upon education, an important means to evaluate the performance of the government and its education department and diagnose the weak link of work and thus pinpoint the direction of future efforts (Ji 2015).

Students and parents, who are the recipients of the government's educational service, have a direct perception of the educational service process and the quality of education. Surveys of educational service satisfaction can serve as a reference for the government in order to improve educational service performance. Therefore, this study, based on data from a survey about satisfaction with basic education, conducted by the National Institute of Education Sciences in 2015 and 2017, aims to analyze the satisfaction status and explore the influencing variables from the perspective of students and parents—the service recipients—to find the means necessary to raise satisfaction, compare the trend of satisfaction changes in order to gauge the effectiveness of policy implementation, analyze the most satisfactory and most unsatisfactory facets in order to diagnose the strengths and shortcomings of government's education work and thus provide a general reference for improving work in education.

2 Literature Review

Some countries regard the measurement of satisfaction in education as an important measure within education management. The United States is one of the earliest countries to conduct basic education satisfaction surveys. From 1969 onwards, Gallup Inc. conducted basic education surveys in public schools across the United States every year. Based on the survey results, education policy makers, researchers and teachers made responses and adjusted the direction and strategies of education reform accordingly (Fan et al. 2009). The 2017 Gallup Inc. survey results showed that 47% of the public were "totally satisfied" or "relatively satisfied" with their K-12 public school education, whilst 79% of the parents felt "relatively satisfied" or "very satisfied" with their children's education (Swift 2017). Alberta, a province in Canada, made the education satisfaction assessment a form policy means for the government to evaluate school work; they released the education satisfaction data collected from students, parents, employers and other sectors of the society annually (Cui 2016).

In China, the surveys of education satisfaction started relatively late; there is a scarcity of research concerning the field of basic education. From 2006 to 2013, the 21st Century Education Research Institute conducted satisfaction surveys. Their

2013 results showed that the public had a low overall satisfaction level; the public's satisfaction with education equity ranked the lowest amongst the four indicators ranging from education quality, education process, education equity and education fees (Yang 2014). From 2011, the Academy of Marxism of Chinese Academy of Social Sciences started to conduct annual surveys in 38 major cities across China, investigating people's satisfaction with basic public service, including basic education. They found that the urban dwellers' satisfaction with education fluctuated and that education equity received close attention from urban dwellers (Zhong et al. 2017). From 2014 onwards, the Development Research Center of the State Council started to conduct annual surveys of livelihood, including satisfaction with education, indicating the overall satisfaction with education amongst urban dwellers and rural residents stayed at a high level (China Livelihood Survey Project Group of Development Research Center of the State Council, 2018). In addition, some local research institutes also started to conduct surveys on people's satisfaction with local education development. From 2009 onwards, the Beijing Academy of Educational Sciences started annual household surveys of satisfaction with education work at district and county levels in Beijing. They found that the parents had high satisfaction with educational work done at district and county levels, and that their satisfaction increases annually (Lu and Wang 2017). The Shanghai Academy of Educational Sciences also conducted basic education satisfaction surveys in Shanghai. The 2009 results showed that the overall rating of basic education reform and development by the parents had reached a "relatively satisfied" level (Tang et al. 2010). Previous surveys accumulated rich practical experiences; however, they mainly used descriptive statistics and thus lacked the causal inferences of satisfaction and an analysis of the relationship between various variables. The reliability and relevance of their policy recommendation need improvement. In addition, some surveys had inadequate samples, low instrument reliability and validity; thus inviting doubts in regards to their results (Wen 2014).

In order to accurately reflect people's calls and appeals concerning education and to assess the effectiveness of the government's education work, the National Institute of Education Sciences conducted two rounds of national surveys on basic education satisfaction, probing into the current satisfaction levels of basic education and analyzing its evolution trend and contributing variables, in order to provide scientific suggestions for educational policy making (National Institute of Education Sciences 2015, 2018).

3 Research Design

3.1 Theoretical Model

Satisfaction with education is a subjective feeling in principle, resulting from one's comparison of their comprehensive perception of the provided education service and

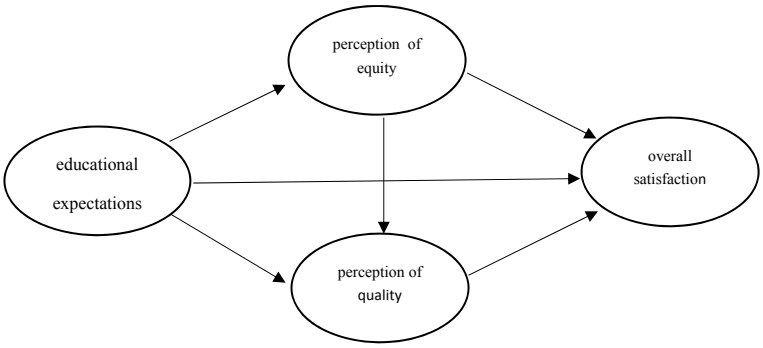

Fig. 1 Model of satisfaction with basic educational service

their expectations. Therefore, it is affected by the students' and parents' educational expectations before enrollment. Basic education is a special basic service and its satisfaction is affected not only by the results of educational service, but also by the education process, which includes equal access to educational services and access to high quality educational services. This study adopted the theoretical model of the 2015 survey of basic education satisfaction conducted by the National Institute of Education Sciences, which includes four variables, namely educational expectations, perception of educational equity, perception of education quality and overall satisfaction. The perception of educational equity and quality positively affects overall satisfaction. In addition, the model also hypothesizes that the perception of educational equity positively affects their perception of educational quality, as shown in Fig. 1 (National Education Satisfaction Evaluation Research Team 2016).

3.2 Instruments

The four variables in the model of satisfaction of basic educational services are latent variables that need to be transformed into directly observable indicators. We designed four questionnaires corresponding to the characteristics of kindergarten, primary school, junior middle school, and senior middle school education, each including overall satisfaction, educational expectations, perception of educational equity and the perception of educational quality, as well as students' background information. The overall satisfaction was gauged with three questions from three aspects; namely overall perception of their schools, their satisfaction as compared to their expectations and their confidence in their schools. The questions adopted the seven-point Likert scale, 1 stands for "very dissatisfied" and 7 stands for "very satisfied."

Educational expectations are measured using three questions from three aspects; namely their overall expectation of the local schools, their expectation for their own

school, and whether their own school meets their individual demands. The perception of educational equity involved two secondary indicators, opportunity equity and process equity. The perception of educational quality has four secondary indicators; namely, school philosophy and culture, school environment and conditions, curriculum and instruction, and learning and development. For each stage of education, five to seven questions were designed to measure the perception of educational equity; 17 to 20 questions were designed to measure the perception of educational quality. The educational expectations, perception of educational equity and perception of quality all used the 7-point Likert scale respectively. The options are set according to the definite content of the questions.

The coefficients of overall internal consistency (reliability) of the questionnaires were all above 0.9; those of internal consistency (reliability) by dimension were all above 0.7, indicating the good reliability of questionnaires, as shown in Table 1.

The results of confirmatory factor analysis revealed that the model was a good fit for the data of different educational stages, the RMSEA values being all below 0.08, the NFI and CFI values being all above 0.90 and the GFI values all above 0.88, as shown in Table 2.

The factor loadings of the four observed variables for educational equity perception at the kindergarten were below 0.4 while all other factor loadings for observed variables were above 0.4, as shown in Table 3.

The goodness-of-fit and factor loadings show that the questionnaires were of good construct validity. The item-total correlations were all above 0.4, showing good discrimination of items, as shown in Table 4.

Table 1 Internal consistency (reliability) of questionnaires for participants of different educational stages

	Kindergarten	Primary school	Junior middle school	Senior middle school
Overall reliability	0.959	0.967	0.973	0.972
Reliability by dimension	0.777–0.959	0.837–0.863	0.868–0.960	0.857–0.955

Table 2 The goodness-of-fit of confirmatory factor analysis for models in different educational stages

	$\chi 2$	df	χ^2/df	RMSEA	NFI	CFI	GFI
Kindergarten	15,595.224	392	39.784	0.057	0.940	0.941	0.903
Primary school	17,180.805	424	40.52	0.057	0.935	0.937	0.902
Junior middle school	19,811.840	484	40.93	0.059	0.935	0.936	0.889
Senior middle school	14,919.476	366	40.764	0.058	0.948	0.949	0.910

Table 3 Factor loading of observed variables for different educational stages

	Educational expectations	Perception of educational equity	Perception of educational quality	Overall satisfaction
kindergarten	0.732–0.829	0.283–0.875	0.633–0.815	0.816–0.855
Primary school	0.794–0.851	0.419–0.798	0.608–0.801	0.791–0.868
Junior middle school	0.806–0.882	0.468–0.842	0.622–0.823	0.813–0.905
Senior middle school	0.822–0.894	0.596–0.824	0.454–0.843	0.796–0.902

Table 4 Discrimination of the questionnaires for different educational stages

	Parents of kindergarten students	Primary school students and their parents	Junior high school students	Senior high school students
Item -total correlation coefficients	0.669–0.714	0.641–0.897	0.642–0.917	0.496–0.924

3.3 Participants

The survey used stratified multistage sampling with unequal probabilities in 31 provinces (including municipalities and autonomous regions). Considering the weight of the population of different provinces within a total population of China and the weight of county-level administrative units in the country as a whole, for every province, 4 to 22 counties were sampled. In order to ensure the representativeness of the sample counties, we sampled at three levels, namely economically developed counties, economically moderately developed counties and economically underdeveloped counties. The schools were sampled with consideration of their location and their types. In 2017, a total of 4,894 schools in 307 counties of 31 provinces, including kindergartens, primary schools, middle schools, participated in the survey. Taking the students' literacy level into consideration, the kindergarten questionnaires were answered by the parents, the primary school questionnaires were answered by students with their parents' help, and junior middle school and senior middle school questionnaires were answered by students themselves. All questionnaires were conducted online, involving more than 50,000 students and parents. Finally, 47,562 valid questionnaires were retrieved, as shown in Table 5.

Table 5 Number of questionnaires retrieved

	Parents of kindergarten students	Primary school students and their parents	Junior high school students	Senior high school students
Retrieved	13,041	15,241	12,720	13,225
Valid	11,950	12,249	11,602	11,761
Ratio of valid questionnaires (%)	91.63	80.37	91.21	88.93

3.4 Data Analysis

The data analysis process included four steps. First, we calculated the factor loadings of the observed variables in their corresponding latent variables by using structural equation modeling, calculated the weight of each observed variable based on factor loadings, and then determined the values of the latent variables (overall satisfaction, educational expectations, perception of educational equity and perception of educational quality) using the weight of the manifested variables and the original ratings. The values of latent variables were expressed in a hundred-mark system, values around 66.67 were regarded as "relatively satisfied" and values around 83.33 were regarded as "satisfied." At the same time, we used structural equation modeling to examine the influence of educational expectations, perception of educational equity and perception of educational quality upon overall satisfaction. Second, we gauged the changes in students' and parents' satisfaction by comparing the ratings of the satisfaction index, the perceptions of educational equity and the perceptions of educational quality in the 2017 and 2015 surveys. Third, by comparing their perception ratings of educational equity and educational quality, we found which aspects of educational work the students and parents are most satisfied with and which they are least satisfied with. Fourth, we analyzed the students' and parents' attitudes towards major issues relating to education. Throughout the data analysis process, we exclusively used SPSS17.0 and AMOS17.0.

4 Results and Discussion

4.1 Students' and Parents' Satisfaction and Influencing Factors

The overall satisfaction index for the students and parents at the basic education level was 81.41, which was between "relatively satisfied" and "satisfied," but closer to "satisfied." Among educational expectations, perception of educational quality and perception of educational equity, the index of educational expectations was 81.03,

ranking the highest. After which ranked the index of perception of educational quality, which was at 80.95. The index of perceived educational equity was 78.99, ranking the lowest.

Taking the differences among the different educational stages and the observed indicators into consideration, this study confirms the model of satisfaction of basic education at different educational stages respectively. The results of structural equation modeling revealed that educational expectations directly affected overall satisfaction; it indirectly influenced the overall satisfaction via the perception of educational equity and perception of educational quality. Within the context of controlling the perception of educational equity and the perception of educational quality, the direct effect of educational expectations of different educational stages on the overall satisfaction was between 0.079 and 0.262; the total effect was between 0.795 and 0.847. Educational expectations had a positive influence on the perception of educational equity, the direct effect sizes of different educational stages being between 0.728 and 0.795. In addition, educational expectations directly influence the perception of educational quality, and indirectly influence the perception of educational quality via the perception of educational equity, the total effect sizes being between 0.867 and 0.871, respectively, as shown in Table 6.

These results have revealed that the students and parents who have higher expectations for their school and government education work, in general, may be more likely to acknowledge educational equity and educational quality, and more likely to have higher satisfaction levels. According to expectation theory, students and parents who have higher expectations of government and their school's education work have more confidence in the positive effects of education; students were more willing to participate in the educational and instructional activities and their parents were more willing to support and cooperate with the school. When their efforts produced positive educational effects, they were more likely to be satisfied with the educational process and the educational results (Yang 1989).

The perception of educational equity directly and positively influenced the overall satisfaction; it also indirectly influenced the overall satisfaction via the perception of educational quality. Within the context of controlled educational expectations and the perception of educational quality, the direct effect of perception of quality at different educational stages upon overall satisfaction was between 0.489 and 0.714; the total effect size was between 0.697 and 0.793. The relationship between the perception of equity and the overall satisfaction can be explained using the Equity Theory from American psychologist John S. Adams. From the perspective of social comparison, people not only care about the absolute values of their benefits, but would also like to learn the relative amount of their benefits, so as to determine whether they have been fairly granted the benefits (Adams 1965). In the comparison processes, people's emotion, cognition and behavior will be affected. Compared with others, when students and parents experience equal educational service, they will experience positive emotion and higher satisfaction. The perception of educational equity positively influenced the perception of education quality, the effect's size being 0.535 and 0.707, as shown in Fig. 2.

Table 6 Standardized direct, indirect and total effects of predictor variables on outcome variables in four models

	Predictor variable	Educational expectations			Perception of equity		Perception of quality
	Outcome variable	Perception of equity	Perception of quality	Overall satisfaction	Perception of quality	Overall satisfaction	Overall satisfaction
Kindergarten	direct effect	0.728	0.478	0.079	0.535	0.489	0.415
	indirect effect	–	0.389	0.716	–	0.222	–
	total effect	0.728	0.867	0.795	0.535	0.711	0.415
Primary school	direct effect	0.784	0.329	0.187	0.676	0.691	0.096
	indirect effect	–	0.542	0.614	–	0.066	–
	total effect	0.784	0.871	0.801	0.676	0.742	0.096
Junior middle school	direct effect	0.795	0.307	0.142	0.707	0.714	0.112
	indirect effect	–	0.562	0.665	–	0.079	–
	total effect	0.795	0.87	0.807	0.707	0.793	0.112
Senior high school	direct effect	0.772	0.405	0.262	0.603	0.524	0.207
	indirect effect	–	0.466	0.585	–	0.125	–
	total effect	0.772	0.871	0.847	0.603	0.697	0.207

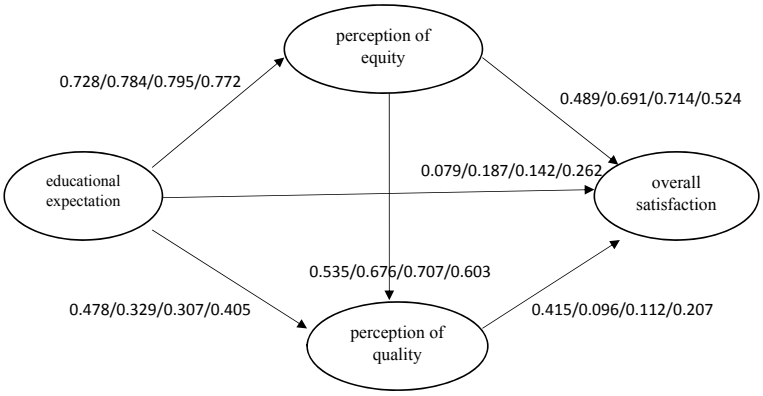

Fig. 2 Educational satisfaction paths for different educational stages. *Note* 1. All path coefficients being significant at 0.001 level. 2. The four coefficients on each path are coefficients for kindergarten, primary school, junior middle school, and senior middle school respectively

The ultimate purpose of the government in boosting educational equity is to raise the quality of education. In recent years, the Chinese government sought to develop high-quality equity by measures such as balanced development and integrated development of the urban and suburban economies. The results of the study also demonstrated that improving educational equity is an effective means for raising satisfaction within educational quality. When students and their parents have higher satisfaction with education equity, they have higher satisfaction with education quality.

Perception of education quality directly and positively influenced overall satisfaction. Within the context of controlled educational expectations and education equity perception, the influence coefficient of education quality perception on overall satisfaction was between 0.096 and 0.415. This result demonstrated that, those students and parents who had a higher approval of school education quality were more satisfied with government education work. Under the influence of the "student-centric" idea, as a service, education increasingly took hold in people's hearts and education quality became an important factor in influencing students' satisfaction. Other studies also found that the perception of quality positively influenced the students' satisfaction with education (Liu 2011; Zheng 2015).

The results above showed that educational expectations, perception of education equity and perception of education quality are all important factors in influencing the students' and parents' overall satisfaction. They showed that the government set two correct development strategies regarding education equity and quality as the two major themes of basic education. In comparison to the perception of education quality, the perception of education equity has a larger total effect on overall satisfaction, which suggests that we should prioritize education equity in our efforts to run the education system for the satisfaction of the people.

4.2 Comparison with the 2015 Survey Results

Compared with the 2015 survey results, the overall satisfaction, the perception of education quality and the education expectations of the students and parents raised by 2.25 points, 2.65 points, 5.68 points and 4.35 points. Amongst the four, the perception of education quality had the largest increase, suggesting that the government's shift from focusing on schooling conditions to education development strategies featuring quality improvement showed initial achievements.

After we compared the perception of education equity and the changes in the perception of education quality by the different stages, we found that in regards to kindergartens, the access to kindergarten has improved the most, with the parents' satisfaction increasing by 7.13 points; next to it is the improvement of facilities, toys and books, etc. In regards to primary schools, the development of students' interests and talents improved the most, the students' and parents' satisfaction increased by 8.72 points. After which follows the improvement of books at school, the arrangement of extracurricular school activities and the management of the surrounding security environment. In regards to junior middle schools, the importance placed on books as equipment in junior middle schools improved most dramatically, the students' satisfaction increasing by 12.82 points. Next to it is the arrangement of extracurricular activities, and the increase of sleeping time, etc. In regards to senior middle schools, under the influence of the new college entrance examination, students' satisfaction with selective courses changed the most, raising by 12.2 points. After which follows the improvement of book collection, channels of ideas and suggestions, management of surrounding security environment, etc. These results suggested that (1) under the influence of the policies, such as increasing pre-school education resources, balanced development of compulsory education, and popularization of senior middle school education, the government's investment has had dramatic achievements; (2) the idea of quality education was further implemented in different education stages, from various aspects, such as resource allocation, curriculum, student activities and student sleeping time; (3) democratic political construction was emphasized at school and students' comments in the feedback passage improved greatly, suggesting progress in the internal democratic management of schools. Overall, among the indicators, students of different stages and their parents were much more satisfied with their school's environment and conditions; this relates to the efforts in improving the schooling facilities for basic education, as shown in Table 7.

4.3 Most Satisfied Aspects and Least Dissatisfied Aspects

After we analyzed the most satisfied and least satisfied indicators of education equity and education quality by students of different educational stages and their parents, we found that at the kindergarten stage, parents were more satisfied with the teachers' conscientiousness, the atmosphere of the kindergarten, and the kids' habits.

Table 7 Five aspects with greatest improvements at different educational stages

Indicators	Dimensions		2015	2017	Score increased
	Primary	Secondary			
Kindergarten					
Increased access to kindergartens	Perception of equity	Opportunity equity	63.69	70.82	7.13
Improvements in facilities	Perception of quality	Environment and condition	79.12	85.09	5.97
Toys, training aid and books	Perception of quality	Environment and condition	76.98	82.93	5.95
Narrowing gaps among kindergarten quality	Perception of equity	Opportunity equity	50.61	55.79	5.18
Kids' friendship at kindergarten	Perception of quality	Learning and development	79.15	84.08	4.93
Primary school					
Development of kids' interest and talent	Perception of quality	Learning and development	72.83	81.55	8.72
Improvement of book collection at school library	Perception of quality	Environment and condition	76.83	85.46	8.63
Arrangement of extracurricular activities	Perception of quality	Curriculum and instruction	70.67	77.59	6.92
Improvement of security of the surrounding area	Perception of quality	Environment and condition	79.67	86.37	6.70
Communication between teachers and parents	Perception of quality	Environment and condition	76.17	82.06	5.89
Junior middle school					
Improvement of book collection at school library	Perception of quality	Environment and condition	66.51	79.33	12.82
Arrangement of extracurricular activities	Perception of quality	Curriculum and instruction	59.94	70.84	10.90
Increase of sleeping time	Perception of quality	Learning and development	58.82	68.02	9.20
Improvement of security of the surrounding area	Perception of quality	Environment and condition	73.36	81.78	8.42

(continued)

Table 7 (continued)

Indicators	Dimensions		2015	2017	Score increased
	Primary	Secondary			
Improvement of learning atmosphere at school	Perception of quality	Idea and culture	74.09	81.89	7.80
Senior middle school					
Offering selective courses	Perception of quality	Curriculum and instruction	57.98	70.18	12.20
Improvement of book collection at school library	Perception of quality	Environment and condition	60.06	68.12	8.06
Channel for complaints and suggestions	Perception of quality	Environment and condition	62.66	70.03	7.37
Surrounding security environment	Perception of quality	Environment and condition	68.60	75.73	7.13
Diversified means of assessment	Perception of quality	Curriculum and instruction	63.25	69.72	6.47

Compared to the 2015 survey, parents were still less satisfied with access to kindergartens and gaps in the quality of different kindergartens, although these aspects had been improved greatly. Preschool education is a weak link in basic education in China. After two rounds of 3-year pre-school education initiatives, preschool education has had significant achievements. However, due to a lack of investment, huge demand, the variety of organizers, and the uneven quality of preschool education, parents still have low satisfaction due to the quality gaps amongst kindergartens, the lack of access to kindergartens and the fees of kindergartens (Gao 2018).

At the primary and junior middle school stage, students and parents were in unison on the most satisfying aspects and the least satisfying aspects. They were more satisfied with their relationship with their fellow students, the teacher-student relationship, the campus security, etc. They were less satisfied with gaps between the school quality, the lack of access to good schools, the lack of extracurricular activities, the lack of sleeping time, and their academic achievements. In recent years, the government took many measures to boost a balanced development of compulsory education. However, the school quality gap still existed, due to the lasting urban-suburban gap. In addition, the students' heavy schoolwork and their lack of sleep persisted, due to the unscientific orientations of education assessment such as "test score as the sole criteria for enrollment" and "enrollment as the sole criteria for academic achievement."

At the senior middle school stage, students were most satisfied with their relationship with their fellow students, the student-teacher relationship, the campus security,

etc. They were least satisfied with the lack of social practice activities, the variations in the quality of school education, the heavy load of schoolwork, etc. Due to the pressure of the college entrance examination, some senior middle schools prioritized the subjects for the college entrance examination at the cost of the students' development in other aspects. As a result, the students had a heavy load of schoolwork, a lack of sleeping time, and a lack of physical exercise. Overall, students and parents of different educational stages do not totally agree on the most satisfied aspects; their least satisfied aspects centered on education opportunity equity, curriculum and instruction, and students' learning and development, as shown in Table 8.

4.4 Major Issues of Different Educational Stages

In order to increase the explanatory power of the results from the satisfaction survey and the relevant policy recommendations, the 2017 survey of basic education satisfaction was supplemented with investigations of major issues within different educational stages.

4.4.1 Preschool Education Issues

Kindergarten survey involves major issues such as teaching primary-school-level courses in kindergartens, parent-kindergarten relationships, teacher-student relationships, etc. Survey results revealed that although 54.82% of parents would not like kindergartens to teach primary school courses, some parents still attached importance to knowledge learning and neglected kids' physiological and psychological development, due to their own lack of correct knowledge of preschool education. Therefore, kindergarten teachers should have good communication with parents and help them establish correct ideas for childcare and education.

Parent-kindergarten cooperation and teacher-student relationships are the key to raising preschool education. The survey results revealed that the overall performance of parent-kindergarten cooperation and teacher-student relationship is good; without widespread conflicting emotion, 97.92% of parents believed that teachers seldom or completely did not employ corporal punishment, 89.79% of teachers often or very often communicated with the parents about their kids' learning, and, 96.91% of parents believed that their kids "fairly liked their teachers" or "liked their teachers very much." Although kindergartens and parents were found to be in good cooperation, the government should continue to strengthen their regulation of kindergartens and continue to prevent undesirable events.

Table 8 Most satisfied and least satisfied aspects rated by students of different educational stages and their parents

Most satisfied aspects				Least satisfied aspects			
Indicators	Scores	Dimension		Indicators	Scores	Dimension	
		Primary	Secondary			Primary	Secondary
Kindergarten							
Conscientious and responsible teachers	90.03	Perception of quality	Care and education	Great variation in quality of local kindergartens	55.79	Perception of equity	Opportunity equity
Good atmosphere in kindergarten	89.92	Perception of quality	Idea and culture	Kindergartens charge high fees	65.34	Perception of equity	Opportunity equity
Improvement in kids' habits	89.08	Perception of quality	Learning and development	Limited access to kindergartens	70.82	Perception of equity	Opportunity equity
Good health service	87.92	Perception of quality	Environment and condition	Kindergartens far from home	72.00	Perception of equity	Opportunity equity
Kids like going to the kindergarten	87.77	Perception of quality	Learning and development	Instruction according to kids' characteristics	81.46	Perception of equity	Process equity
Primary school							
Get along well with fellow students	90.39	Perception of quality	Learning and development	Great variation in quality of local schools	75.61	Perception of equity	Opportunity equity
Feel safe at school	90.18	Perception of quality	Environment and condition	Many cases of relying on examination, contest, award certificates to enter good schools	76.61	Perception of equity	Opportunity equity
Clear instruction of teachers	89.85	Perception of quality	Curriculum and instruction	Not satisfied with one's own academic achievements	76.78	Perception of quality	Learning and development

(continued)

Table 8 (continued)

Most satisfied aspects				Least satisfied aspects			
Indicators	Scores	Dimension		Indicators	Scores	Dimension	
		Primary	Secondary			Primary	Secondary
Get along well with teachers	89.75	Perception of quality	Learning and development	No enough extracurricular activities at school	77.59	Perception of quality	Curriculum and instruction
Equity and fairness of awards at school	88.57	Perception of equity	Process equity	Not enough sleeping time	78.81	Perception of quality	Learning and development
Junior middle school							
Get along well with fellow students	88.13	Perception of quality	Learning and development	Not satisfied with one's own academic achievements	67.97	Perception of quality	Learning and development
Teachers encourage students to voice different opinion	85.02	Perception of equity	Process equity	Sleeping time less than 9 h	68.02	Perception of quality	Learning and development
Feel safe at school	84.88	Perception of quality	Environment and condition	Great variation in quality of local schools	70.72	Perception of equity	Opportunity equity
Get along well with teachers	84.77	Perception of quality	Learning and development	No enough extracurricular activities at school	70.84	Perception of quality	Curriculum and instruction

(continued)

Table 8 (continued)

Most satisfied aspects				Least satisfied aspects			
Indicators	Scores	Dimension		Indicators	Scores	Dimension	
		Primary	Secondary			Primary	Secondary
Equity and fairness of awards at school	84.52	Perception of equity	Process equity	Many cases of relying on examination, contest, award certificates to enter good colleges	72.74	Perception of equity	Opportunity equity
Senior middle school							
Get along well with fellow students	85.17	Perception of quality	Learning and development	No enough social practice activities sponsored by schools	62.23	Perception of quality	Curriculum and instruction
When students have difficulties in study, they have teachers' help	82.10	Perception of quality	Curriculum and instruction	Local senior middle schools' educational quality is much lower than that of neighboring counties	62.33	Perception of equity	Opportunity equity
Equity and fairness of awards at school	78.15	Perception of equity	Process equity	Heavy load of school work	64.84	Perception of quality	Learning and development
Teachers encourage students to voice different opinions	77.53	Perception of equity	Process equity	Book collection does not meet needs	68.12	Perception of quality	Environment and condition

(continued)

Table 8 (continued)

Most satisfied aspects				Least satisfied aspects			
Indicators	Scores	Dimension		Indicators	Scores	Dimension	
		Primary	Secondary			Primary	Secondary
Enough security measures	77.15	Perception of quality	Environment and condition	Physical exercise less than 1 h every day	68.32	Perception of quality	Curriculum and instruction

4.4.2 Major Issues in Compulsory Education

In compulsory education, three major issues were investigated, namely psychological health education, prevention of campus bullying and extracurricular activities. Psychological health education is a key component of quality education. The survey results revealed that 90.60% of primary schools offered psychological health education courses, but only 67.7% of junior middle schools offered such courses. Junior middle school students have a greater demand for psychological health education because they are in early adolescence, experiencing dramatic physiological and psychological changes and more psychological pressure. However, test-oriented education has caused a low proportion of schools to offer psychological health courses.

Campus bullying causes harm to both the perpetrators and the victims. Survey results revealed that more than half of the students have experienced campus bullying, but some such incidents had not been timely resolved by schools; 51.52% of primary school students had experienced campus bullying and only 47.91% of the incidents had been timely resolved by the schools; 63.53% of junior school students had experienced campus bullying and only 57.04% of the incidents had been timely resolved by the schools. Possible factors underlying the schools' failure to timely treat such bullying incidents included the school's lack of a mechanism to deal with bullying incidents, the teachers' failure to identify bullying incidents and a lack of capacity and experience to cope with bullying, etc.

Extracurricular activities constitute an important means to promote quality education and students' individual development. We studied extracurricular activities by investigating students' participation in interest groups. Results revealed that 91.96% of primary school students joined interest groups (including school-based curricular activities and club activities) every week, whilst 82.76% of the junior middle school students joined such activities. For the sake of the all-round development of all students', extracurricular activities deserve special attention; although, it can be said that, overall, the proportion of compulsory education schools offering extracurricular activities and the proportion of students joining such activities are satisfactory. There are few compulsory education schools not offering such activities.

4.4.3 Major Issues in Senior Middle School Education

For senior middle schools, we mainly investigated how they coped with the new college entrance examination reform. The new examination, through reforms in assessment, aims to reform the method of education, diversify courses of examination, give students more autonomy to choose and boost individual students' development. The reform is a complicated and systematic process, requiring the optimization of teacher allocation, improvement of facilities and management, implementation of curricular development, etc. The survey results revealed that 92.48% of senior middle school students believed that their schools have adopted a variety of measures to cope with the new college entrance examination. The most popular practice is sending

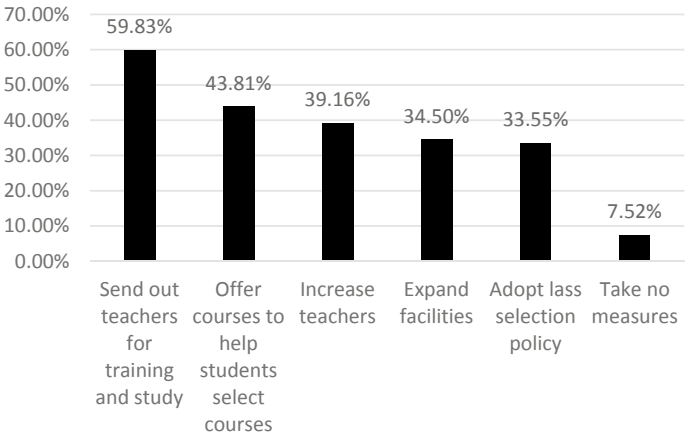

Fig. 3 Senior middle schools' measures to cope with new college entrance exam reform

teachers out for training and study. About 61.0% of the public schools sent out their teachers for training and study, higher than the proportion data for private schools and other schools, which were 48.75% and 33.33%, respectively. Although some schools offered students courses on how to select courses for the upcoming college entrance examination to maximize their strengths and minimize their weaknesses, there exist huge gaps amongst schools in different areas of China. The proportions of schools offering such courses in the eastern, middle and western part of China were 49.42%, 38.69% and 42.16% respectively. The regional gap was also found in the implementation of other measures such as class selection. The proportions of schools implementing class selection policy in the eastern, middle and western part of China, as reported by the students in the survey, were 42.66%, 25.56% and 30.65%. The data above demonstrated that some schools, especially in the middle and western regions, were not ready for the new college entrance examination and needed further efforts in the supply of courses, teachers and facilities, as shown in Fig. 3.

5 Conclusion and Suggestions

The analysis of the survey data revealed that the recipients of basic education in China were generally satisfied with the government's education work; their educational expectations, perception of educational equity and perception of educational quality positively influenced the overall satisfaction of students and parents; compared to the past, the students' and parents' overall satisfaction, educational expectations, perception of equity and perception of quality were all raised by different degrees; amongst the indicators, the biggest improvement happened in the satisfaction with the school environment and conditions by students of different educational stages and

their parents. Based on the above findings, we conclude that four measures should be taken to raise the level of satisfaction of basic education services.

5.1 Optimize High-Quality Education Resource Supply to Boost Education Equity

The survey results revealed that, compared with educational expectations and the perception of educational quality, the perception of education equity by students and parents is relatively low, the huge education quality gap is one of the least satisfying aspects, according to the students of different educational stages and their parents. The issues, such as difficult access to kindergartens, high cost of access to kindergartens, distance from home to kindergartens, still existed, although improvements have been made. The reliance on examination scores, competition awards and certificates to enter good schools was still common. The main factor leading to such reliance is the scant supply of high-quality education resources. There are not enough government-funded quality kindergartens to meet parents' demands. The uneven supply of primary school and middle school resources causes the "school choice fever" and heavy loads of schoolwork. The government still has to expand inclusive preschool educational resources by strengthening overall planning, increasing fiscal investment, expanding existing government-funded kindergartens, supporting the private kindergartens and setting up corollary kindergartens in urban residential quarters. At the same time, the government should continue to improve the conditions of the schools in under-developed areas. In addition, the government should expand high quality education resources by furthering the school system reform and diversifying the types of schools available.

5.2 Deepen Basic Education Reform and Raise Education Quality

Education quality is the lifeline of education development and an important factor in influencing people's satisfaction with education. Compared to the 2015 survey, the index of education quality perception has increased by 5.68 points, suggesting that the quality of basic education in China has risen significantly. However, the least satisfying aspects rated by the students and parents are still the heavy load of school work, the lack of physical exercise time, the lack of extracurricular activities and social practice activities. First, in order to solve these problems, the government should establish a scientific orientation for education assessment and promote school education reform. In order to dissolve the tendency to regard papers, titles, certificates, diplomas, awards as sole criteria, we should strengthen the research on talent

evaluation technology and methods, strengthen the international exchange of evaluation research, and provide support for the implementation of evaluation reform ideas. Second, the allocation of teacher resources should be optimized and the supply of school courses should be increased. The lack of extracurricular activities and social practice activities was due to the lack of professional teachers, especially in the central and western regions where there is a structural scarcity of music, physical education and arts teachers. Therefore, teacher structure should be optimized, provide students with a rich selection of courses and diversified education experiences, and meet students' expectations of receiving a high-quality education. Third, the class instruction revolution should be ushered, in order to raise class instruction quality. The parents hoped teachers can care and instruct their kids according to their characteristics; middle school students and primary school students hoped that they could have better academic achievements. Schools in different regions should further class reforms, innovate pedagogy and instruction mode, so as to provide students with suitable and individualized academic guidance.

5.3 Solve Major Education Problems to Boost Healthy Development of Education

The solutions to the major problems not only promote the healthy growth of students and the healthy development of the education cause on a whole, but also raises the satisfaction level of education. Firstly, parents of kindergarten kids should be guided to establish a scientific education conviction. Some parents did not share education convictions with kindergartens and demanded primary school courses be delivered in kindergartens. The differences in education convictions may lead to conflicts between kindergartens and parents; this may harm the physiological and psychological growth of kids. Kindergartens, the government and society should guide the parents to change their convictions, create an atmosphere conductive to the joint care and education between parents and kindergartens and promote healthy growth for kids. Secondly, preventative and coping mechanisms against campus bullying should be established. Once bullying happens, schools should investigate and cope with it in a timely manner following an appropriate process, educate and punish the perpetrators according to the severity of the bullying incident and provide the victims with help and psychological instruction. Timely intervention by the schools can help protect the psychological health of the victims. Thirdly, psychological health education should be strengthened for primary school students and middle school students. Middle school students are in the most important growth period during middle school and are also in the period in which they may have the most problems. However, as the survey found, the psychological health courses offered by junior middle schools were far from

enough. Principals and teachers should know the importance of psychological health education, be aware of individual differences and be able to provide psychological health education and counseling according to the characteristics and needs of students of various age groups. Fourthly, the education system should be improved to meet the requirements of the new college entrance examination reform. Although schools in different regions have taken various different measures, they were not well prepared in terms of course supply, teacher allocation, etc. Educational departments of different levels should strengthen their overall planning, organize teacher training, improve facilities, improve teaching management, ultimately, establishing an education mode that suits the new college entrance examination reform, as the examination involves the interest of thousands of families and the close attention of society.

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Theory and Practice of a Chinese Pre-primary Education Indicator System

Liyan Huo, Qiangqiang Sun, and Hengbo Hu

Abstract It is an urgent and significant matter to build a Chinese pre-primary education indicator system. This system is expected to have both Chinese standpoints and international perspectives, and to be used to systematically guide and scientifically evaluate pre-primary education in China. This study, based on the internationally popular CIPP evaluation model, describes, explains, juxtaposes, and compares the pre-primary education indicator systems from the OECD, the UNESCO, the US, the UK, and other major international organizations and countries. The authors propose the theoretical framework of a Chinese pre-primary education indicator system, which includes factors such as background, input, process and output, the 10 first-level indicators (demographic characteristics, social welfare, the management system, resource allocation, curricular activities, kindergarten management, the teaching force, family support, the popularization of education, and child development), and 63 second-level indicators. In conclusion, the theoretical framework offers a value-oriented instrument for establishing the development goal of pre-primary education development in China, a structural instrument for a complete understanding of the current situation of China's pre-primary education, a methodological instrument for the scientific supervision and evaluation of China's pre-primary education, and a universal instrument for China's international exchanges and cooperation in the field of pre-primary education.

Keywords CIPP evaluation model · Pre-primary education · Education indicators

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A pre-primary education indicator system is a fundamental instrument for scientifically guiding and systematically assessing pre-primary education development using standardized and systematic impact factors. Within the current background of "ensuring people's access to childcare" and "improving pre-primary education," the development of the Chinese pre-primary education indicator system with Chinese standpoints, international perspectives and adhering to internal regularity of education, has become a major problem to be resolved. This paper attempts to employ the internationally recognized CIPP evaluation model as the theoretical framework, compare pre-primary education indicators of major international organization and countries, and establish the theoretical construct to guide the development of a systematic and sustainable pre-primary education indicator system with theoretical support, systematic analysis, process monitoring, development-orientation and driving force from reforms. This indicator system, with Chinese standpoints and Chinese discourse, is expected to serve the need of policies, promote reforms, facilitate international exchanges and tell Chinese stories to the world.

1 CIPP Evaluation Model and Development of the Pre-primary Education Indicator System

The theoretical framework informing the development of a pre-primary education indicator system must be internationally recognized and be suitable for its designated country. Although scholars have different ideas concerning the theoretical framework of the educational indicator system, currently most subscribe to the CIPP evaluation model formulated by the famous American scholar D. Stufflebeam in the 1960s; it is a comprehensive and dynamic system including context evaluation, input evaluation, process evaluation, and product evaluation. Stufflebeam pointed out that the ultimate purpose of education 'evaluation is not to demonstrate the attainment of educational goals but to improve education plans and education quality through evaluation (Huo 2000, p. 290).

The CIPP model informs the development of the indicator system in four ways. First, it further develops people's understanding regarding educational background, namely the relation between education and society, politics, economics, culture, and population; it expounds on the relation between education and society, and constitutes the examination of the decisive factors influencing education development, finding that the factors deciding education development exist not on campus, but off-campus. Second, it deepens people's understanding of education investment, namely the conditions of education implementation, education budget, and equipment. It analyzes the condition and factors that guarantee education development, and constitutes the examination of condition and factors that guarantee education development, finding that resource allotment and teacher team are the basic conditions for education quality. Third, it develops people's understanding of the education process, namely the efforts of schools, teachers, and parents in the education

process. It considers the qualitative factors that guarantee education development, and constitutes the examination of the inclusive factors affecting education development: process quality is the core of education quality and the sustained pursuit of education quality via improvement of the education plan. Fourth, it deepens people's understanding of education product, namely the education popularization level and child development level. It can evaluate the effectiveness of education development and constitutes the structural and developmental examination of education product, which is high-quality equity and quality with equity are eternal themes of education reform and development.

At the same time, it can be seen that the CIPP evaluation model guides us to view pre-primary education as an important part of social development, particularly as an important part of the social public service system. Thus pre-primary education evaluation should investigate the systematic impact of social, political, economic and cultural factors on pre-primary education, and investigate whether and how pre-primary education meets the demand of socio-political, economic and cultural development. It also guides us to view the pre-primary education resources offered by the government as the precondition of pre-primary education development. For this reason, pre-primary education evaluation should investigate the investment for school facilities and teachers as well as student expenditure per capita, and investigate whether and how the government resources are effectively being utilized, guide us to regard rationality, feasibility, and suitability as the core elements in pre-primary education quality. Therefore, pre-primary education evaluation should attach importance to curriculum plans and teaching plans, and sustained improvement of curriculum plans and teaching plans. It should guide us to regard the product evaluation of pre-primary education as an instrument for process improvement rather than an accreditation system. For this reason, the pre-primary education evaluation should focus on providing large amounts of rich, directional and practical information for national educational policy-making departments, educational management institutions, schools, as well as education evaluation institutions, and through this improve education process (Poliandri et al. 2010). The pre-primary education evaluation system guides countries to regard pre-primary education evaluation as a form of continuous feedback of pre-primary education results rather than a final report. Pre-primary education evaluation should make timely use of the information obtained from the continuous evaluation results to make suggestions for pre-primary education programs.

As demonstrated above, the CIPP evaluation model can help us understand, analyze and reformulate the factors in and out of the pre-primary education system as well as their impact on pre-primary education development, and it may become the most influential construct model to guide the development of our pre-primary education indicator system (Nuttall 1990).

2 Comparison of International Pre-primary Education Indicator Systems Using CIPP Evaluation Model

The studies concerned with indicator systems mainly include comparative studies, such as Education at a Glance, supervisory frameworks, Proposal for Key Principles of a Quality Framework for Early Childhood Education and Care, in addition to other development reports, such as Report of Education Development from Pre-primary to College 2015. Although these indicator systems have different goals, they can all be used to evaluate the development of pre-primary education development.

In recent years, many influential international organization and countries established pre-primary education indicator systems that incorporate common principles and their own characteristics (Scheerens 1990). They do that by combining diagnostic, formative and summative evaluation organically (Stufflebeam and Kellaghan 2003). These indicator systems have a positive and far-reaching impact on the education strategic planning and research of the current situation in different countries in the world, which lead these countries to set reasonable education development goals, scale, quality, and speed, and provide the education policymakers in these countries with value guide, as well as indicator introduction and data support.

This research adopts the CIPP evaluation as the basic framework of comparative analysis. It further adopts educational background, educational input, educational process, and educational product as the main dimensions. It compares and analyzes the pre-primary education indicator systems of international organizations and countries with international influence, so as to inform the construction of the Chinese pre-primary education indicator system. We chose 12 international indicator systems[1] with authority and representativeness, used the MAXQDA (MAX Qualitative Data Analysis) to conduct open coding and relational coding of the four dimensions of the CIPP; this is education background, education input, education process and education product, juxtaposed and compared the pre-primary education indicators of major international organizations and countries while exploring and perfecting the categories. The research used the "line-by-line analysis" method to analyze the pre-primary education indicators in the 12 samples, conceptually sorts all the indicators and gave each an independent code, and generated 203 independent codes at the open coding stage. After the open coding process, we conducted the first

[1](1) *Education at Glance*, published by OECD in 2015, coded O1; (2) *Starting Strong II: Early Childhood Education and Care* published by OECD, coded O2; (3) *Starting Strong IV: Monitoring Quality in Early Childhood Education and Care*, published by OECD, coded O3; (4) *Holistic Early Childhood Development Index*, published by UNESCO, coded U; (5) *Proposal for Key Principles of a Quality Framework for Early Childhood Education and Care*, published by EU, coded EU; (6) *Starting Well: Benchmarking Early Education across the World*, published by Economist Intelligence Unit, coded I; (7) *The State of Preschool—Preschool Yearbook 2015*, coded Al; (8) *Using the Early Years Evaluation Schedule*, coded E; (9) *International Comparison of Education Indicators*, published in Japan in 2013, coded J; (10) *National Plan of Action for Children*, published in India by Department of Women and Child Development, coded D; (11) *Education and Training Indicators*, published in Australia, coded AU; (12) *Development Report of Education from Pre-primary to College 2015 (Coûts, activités, résultats. Synthèses statistiques)*, published in France, coded F.

round of relational coding. This consisted of clustering the concepts generated in open coding. In this process, the researchers classified all materials, consolidated similar materials in the coding system, contrasted and compared the codes generated in the open coding phase, and grouped codes into categories, so that these categories have the biggest inner homogeneity and external heterogeneity. The researchers extracted 25 subcategories, such as a number of population, population structure, child protection, mother benefits, government management, government evaluation, from the 203 indicators. For example, "quality of indoor and outdoor learning environment," "promotion of equality and diversity," "inclusive environment" are classified into "curriculum environment." Later, the second round of relational coding generated 10 primary categories out of the 25 subcategories, such as "demographic characteristics," "social welfare," "government management," "resource allocation," "curriculum activities," "kindergarten management," "teacher team," "family support," "education popularization" and "child development." Finally, the third round of relational coding clustered four dimensions out of the 10 primary categories, including background, input, process, and product. The details are listed below.

2.1 Categories and Indicators of Education Background Dimension

According to the coding results, there are 32 occurrences in the indicator "education background" dimension. This can be categorized into "demographic characteristics" and "social welfare." The "demographic characteristics" category includes "population number" and "population structure." The "social welfare" category includes "child protection" and "mother benefits," as shown in Table 1.

2.2 Categories and Indicators of Educational Input Dimension

According to the coding results, there are 50 occurrences in the indicators of "education input" This can be divided into two categories. These are "government management" and "resource allocation." The "government management" category includes "explicit government management" and "government supervision and evaluation." The "resource allocation" category includes "expenditure input" and "material input," as shown in Table 2.

Table 1 Categories and indicators of educational background dimension

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
D1 Background dimension	D1-1 Demographic characteristic	Number of population	7	Birth rate (O2); total population of the country (O2); birth certificate (U); birth registration (U); under-five mortality (F); rural population development (F); child number and family condition (EU)
		Population structure	4	Adult literacy (F); poor child ratio (O2); female labor participation (O2); under-six population (O2)
	D1-2 Social welfare	Child protection	14	Comprehensive prevention and medical service (O2); gender equality (O2); prevention of malnutrition (F); vaccination rate (F); monitor and feedback of growth and nutrition (U); compliance with the *United Nations Convention on the Rights of the Child* (U); child health (D); fight against illegal child transaction (D); protect disadvantaged children (D); fight against child labor (D); nutrition, water, and health (D); safeguard poor children (O3); children's freedom from domestic violence (O3); support for dropout and minority language children (A)

(continued)

Table 1 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
		Mother benefits	7	Mother benefits (O3); formal education of mothers (O3); policies to help poor families (O3); pregnant and maternal leave (D); pregnancy and delivery services (U); mother's health (D); work participation rate of mothers of children aged below 6 (O2)

2.3 Categories and Indicators of Educational Process Dimension

According to coding results, there are 84 occurrences of "education process" indicators, which included four categories. These include "curriculum activity," "kindergarten management," "teacher team" and "family support." The "curriculum activity" category includes "curriculum environment," "curriculum content" and "curriculum methodology." The "kindergarten management" category includes "management leadership" and "evaluation of improvement." The "teacher team" category includes "number of teachers," "teacher structure," "teacher benefits," "teacher training," and "teacher capability." The "family support" category includes "parent-kindergarten communication" and "parent-kindergarten cooperation," as shown in Table 3.

2.4 Categories and Indicators of Educational Product Dimension

According to coding results, there are 37 occurrences of "educational product," which can be divided into "education popularization" and "child development." The "education popularization" category includes "kindergarten enrollment rate" and "popularization of service." The "child development" category includes "academic achievement," "physical and mental health," and "learning quality." This is shown in Table 4.

Table 2 Categories and indicators of educational input dimension

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
D2 Investment dimension	D2-1 Government management	Explicit government management	3	Clear stake-holder role (EU); access to kindergarten education as legal rights of children (EU); strategies of pre-primary children development by government (F)
		Government supervision and evaluation	3	Supervision and evaluation maximize children's rights and interest (EU); provide information of local, regional and national levels via supervision and evaluation (EU); establish universal pre-primary education funded by public fiscal support via supervision and evaluation as well as funding support

(continued)

Table 2 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
	D2-2 Resource allocation	Expenditure input	35	Total pre-primary education funding (O1); average pre-primary education funding per capita (O1); proportion of fiscal expenditure for pre-primary education in GDP (O1); proportions of public and private expenditure for pre-primary education (O1); total expenditure of the country and types of expenditure (F); education expenditure per capita (F); proportion of pre-primary education expenditure in GDP (F); average pre-primary education funding per capita (J); proportion of pre-primary education funding in fiscal expenditure (J); purposes of education expenditure (J); GDP and the proportion of school education expenditure (J); government expenditure and proportion of pre-primary education in public fiscal funding (J); proportions of public and private expenditure (J); average public fiscal expenditure for education per capita (E); total expenditure of pre-primary education and its proportion in GDP (E); average education expenditure for child per capita (E); total public expenditure for pre-primary education (E); proportion of education funding in GDP (E); investment in pre-primary education service (O2); service investment for children aged under 3 who are not enrolled in kindergarten (O2); social expenditure of pre-primary education (O2); average expenditure of parents (O2); average unit cost of pre-primary children (O2); social expenditure of pre-primary education (O2); government investment in pre-primary education (I); fees charged by private kindergartens (I); subsidies for underprivileged families (I); fiscal management of pre-primary education (O3); government investment in pre-primary education (EU); family investment in pre-primary education (EU); pre-primary education investment (EU); cost of preliminary projects of states (A); number of states whose projects require the providers' funding match that of donors for the projects (A); average expenditure of state budget for enrolled children per capita (A); total pre-primary education expenditure in all states (A)
		Material input	9	Indoor and outdoor space (U); health, hygiene, safety, learning and game materials (U); improved drinking water and hygiene equipment (U); work condition (U); food service and monitoring (D); maximum class scale (3 and 4 years old) (D); school facility (D); environment inclusion can facilitates the raise of child learning ability (AU); teaching condition (F)

Table 3 Categories and indicators of educational process dimensions

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
D2 Process dimension	D2-1 Curriculum activity	Curriculum environment	4	Quality of indoor and outdoor learning environment (E); promote equity and diversity (E); environment inclusion can facilitate the improvement of child learning ability (AU); teaching condition (F)
		Curriculum content	8	Curriculum orientation (I); health and safety guide (I); early learning standard (A); realize potential through overall development (EU); create a curriculum based on education goals, value, and methods (EU); promote child health (AU); curriculum includes healthy food and body movement (AU); integrated learning framework that promotes child learning and development (AU)

(continued)

Table 3 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
		Curriculum methodology	18	Create an environment for child participation (D); create child game opportunity (D); protect child safety (AU); degree to which caregivers support children learning (AU); attentive attitude and reflection of educators in designing and implementing curriculum (AU); respect and equality between teachers and children (AU); facilitate children's autonomous learning (E); degree of safeguarding and promoting children's benefits (E); extra learning for children based on their need (E); the degree to which care-givers help children learn and develop (E); encourage children to develop actions that satisfy their own needs and those of others (E); create plans for each child (E); linkage between kindergarten and primary school (E); curriculum implementation (O3); response to children's individual need (O3); practice appropriate to children's age (O3); teaching (O3), the curriculum encourages cooperation among teachers, children and colleagues, and parents (EU)

(continued)

Table 3 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
	D2-2 Kindergarten management	Management leadership	10	Effective management system (AU); effective kindergarten leadership (AU); teachers possess ethics (AU); kindergarten management and leadership (E); the average amount of time at pre-primary education organization (E); main modes of a pre-primary education organization (E); the degree to which the organization meets children's needs (E); kindergarten planning (O3); human resources management (O3); leaders create opportunities for teachers' observation, reflection, teamwork and parent-kindergarten cooperation (EU)
		Evaluation improvement	3	Self-evaluation by organizations (O3); data collection mechanism (O3); continued improvement of organizations (E)
	Teacher team	Number of teachers	5	Teacher-child ratio (O1); teacher-child ratio (U); teacher-child ratio (I); teacher-child ratio (A); teacher-child ratio (J)

(continued)

Table 3 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
		Teacher structure	6	Distribution of teachers' age and sex (O1); the proportion of female teachers (EU); a number of children in each class (J); diploma of teachers (A); teacher certificate (U); recruit qualified staff (EU)
		Teacher benefits	6	Teacher salary (O1); create supportive environment (EU); paid maternal leave (EU); teacher salary (O3); average kindergarten teacher salary (I); proportion of part-time teachers (F)
		Teacher training	7	Continuous pre-service and in-service training (EU); the proportion of training (EU); teacher training (F); in-service training requirement (A); minimum time of compulsory professional training (U); minimum length of pre-service teacher training (U); kindergarten teacher training (I)

(continued)

Table 3 (continued)

Dimensions	Primary category	Secondary category	Occurrence	Secondary indicators
		Teacher capability	7	Ability to use information technology (O1); education and teaching time (O1); teaching sensitivity (O1); teacher-child interaction and relationship (O3); colleague cooperation (O3); teacher incentive (A); characteristics of teaching staff (F)
	Family support	Parent-kindergarten communication	4	Influence of family education on children (O1); expectation of parents who choose kindergartens (A); organization respect family's view of child-rearing and belief (AU); efficacy of communication between teachers and parents (E)
		Parent-kindergarten cooperation	6	Family expectations of early child development; teacher participation in family education (A); organizations respect families and keep supportive relationship with them (AU); cooperation between organization and other organizations (AU); parent participation in caring and education program (O3); cooperation between teachers and parents (O3)

Table 4 Categories and indicators of educational product dimension

Dimension	Primary category	Secondary category	Occurrence	Secondary indicators
D2 Product dimension	D2-1 Education popularization	Enrollment rate	14	Popularization rate of one-year pre-primary education (I); popularization rate of three-year pre-primary education (I); enrollment rate of children with disability (D); enrollment opportunities for children of appropriate age (D); enrollment rate of children aged 4 (J); enrollment of children aged 3–5 to pre-primary education (J); gross enrollment of pre-primary education (J); popularization rate of one-year pre-primary education (F); gross enrollment of pre-primary education in two years (F); enrollment rate (O1); enrollment rate of children aged 3 (U); children have had pre-primary education before Grade 1 (U); numbers of disabled children aged 3 and 4 admitted in kindergartens (A); a number of children admitted in kindergartens in preliminary projects (A)
		Popularization of service	3	Pre-primary education service that encourages participation, social integration and inclusive diversity (EU); provide all families and children with accessible and affordable pre-primary education (EU); provide children aged 3–5 with care and education (D)

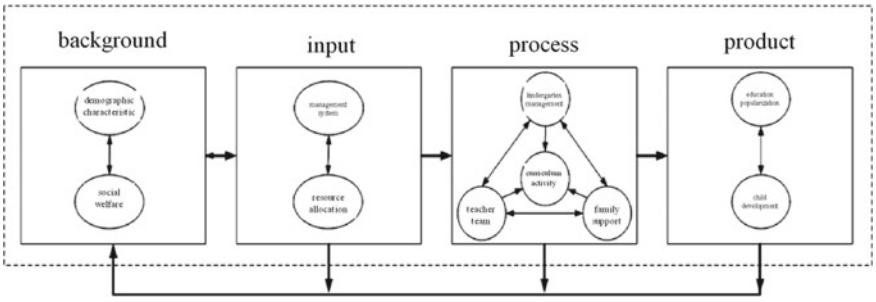
(continued)

Table 4 (continued)

Dimension	Primary category	Secondary category	Occurrence	Secondary indicators
	D2-2 Child development	Academic achievement	8	Academic achievement (O2); language, reading and writing (E); extent of active contribution (E); child development product (E); math (O3); science and information technology capacity (O3); Grade 1 repetition (U); connect to the world and make contribution (AU)
		Physical and mental health	8	Social affection (O3); practice capability (O3); body movement, health development (O3); development of healthy lifestyle; basic capability (E); the extent to which one feels safe (E); strong self-identification (AU); strong happiness (AU)
		Learning quality	4	Creativity (O3); autonomy (O3); confident and active learner and effective communicator (AU); children enjoy learning and progress (E)

3 Theoretical Construct of the Chinese Pre-primary Education Indicator System Based on the CIPP Model

As an important basis for the construction of a pre-primary education indicator system, theoretical frameworks play an important role in informing the value orientation and structural dimensions of indicator systems. As an evaluative theoretical framework of international influence and with wide applicability, the CIPP model can help reflect the changes in demand and supply, inner drive, development process and development product of pre-primary education in specific cultural backgrounds. Informed by the CIPP evaluation model and comparing its use by major international organization and countries, we developed the Chinese pre-primary education indicator system that includes explicit value orientation, complete structure, clear inner logic for specific analysis and consolidation, from the background of education, education input, education process, and education product dimensions. It does so by incorporating theoretical models, international experience, the real-life situation of the pre-primary education development in China, as shown in Fig. 1.



background	demographic characteristics
	social welfare
input	management system
	resource allocation
process	kindergarten management
	curriculum activity
	teacher team
	family support
product	education popularization
	child development

Fig. 1 Basic dimensions of Chinese pre-primary education indicator system and primary indicators

As shown in Fig. 1, the Chinese pre-primary education indicator system includes four dimensions, which are further classified into independent indicator systems for goal setting, condition evaluation, process evaluation, and product evaluation. The primary indicators include 10 indicators. These include demographic characteristics, social welfare, management system, resource allocation, curriculum activity, kindergarten management, teacher team, family support, education popularization, and child development. Demographic characteristics and social welfare are background indicators. Management system and resource allocation are input indicators. Curriculum activities, kindergarten management, teacher team, and family support are process indicators. Education popularization and child development are product indicators.

3.1 Theoretical Construct of Pre-primary Education Development Background Indicators

Regarding background indicators, research revealed that the current Chinese education yearbooks or education development statistical bulletins do not have information related to demographic characteristics and social welfare. Based on the needs of Chinese social development and international pre-primary education indicators informed by the CIPP evaluation model, the Chinese pre-primary education indicator system should increase indicators reflecting the background of education, primarily focusing on "demographic characteristics" and "social welfare."

Demographic characteristics and social welfare are important indicators reflecting the levels of socio-political development, economic development, and cultural development. They play decisive roles in pre-primary education development in a country, and are important indicators of pre-primary education development levels. Based on the Chinese condition and international experience, this research puts five items, such as "birth rate," "mortality rate" and "children aged below 6," under the secondary indicator of "demographic characteristic"; eight items, such as "gender equality," "mother benefits," "subsidies for poor children" are under the secondary indicator of "social welfare."

3.2 Theoretical Construct of Pre-primary Education Development Input Indicators

By combining the needs of Chinese society development and the international pre-primary education indicators informed by the CIPP evaluation model, we developed the Chinese pre-primary education indicator systems that focus on two primary indicators. These are "management system" and "resource allocation." The former is the basic guarantee of the latter and the latter is the main carrier of the former.

Regarding the management system, the current Chinese pre-primary education has problems, such as unclear division of responsibilities among different government departments, unreasonable allocation of rights and responsibilities among governments of different levels and a lack of overall coordination and fiscal guarantee due to the low level of responsible management subjects (Pang and Fan 2012). In order to implement the Outline of the National Program for Medium and Long Term Educational Ref*orm and Development (2010–2020)* and *Several Opinions on the Current Development of Pre-school Education by the State Council* (hereafter referred to as "*Several Opinions*"), which emphasized "government leadership" and "local responsibility and hierarchy management," the indicator system set "clear role and responsibility-sharing mechanism among the Central Government and the local governments," and the "relationship between education authority and government of the same level" as secondary indicators for the management system.

Regarding resource allocation, expenditure allocation should focus on the combination of absolute indicators and relative indicators. Absolute indicators are the basic indicators displaying overall numerical characteristics. Relative indicators are calculated by comparing two statistics, and their values are expressed in multiples and percentages. Generally speaking, the relative indicators of education funds are "the two proportions" required by the *Outline of National Medium and Long Term Education Reform and Development Plan (2010–2020).* They are the proportion of education expenditure in GDP and the proportion of pre-school education in GDP. Besides these, the "proportion of fiscal pre-primary education funds in fiscal education expenditure" and the "proportions of public and private expenditure" are relatively universal relative indicators in international literature. The commonly used absolute indicators include "public funding per capita" and "average expenditure of parents." The above relative and absolute indicators were included as development indicators of funding input. Besides funding input, we should include material input indicators, including "indoor activity space," "outdoor activity space" and "library resource."

3.3 Theoretical Construct of Pre-primary Education Development Process Indicators

Regarding the process indicators, based on the current situation of the Chinese pre-primary education development, which involves not only access to kindergartens but also access to quality kindergartens, combining the international pre-primary education indicators informed by the CIPP evaluation model, the Chinese pre-primary education indicator system should focus on the process indicators such as education plans, implementation of plans, team guarantees, parent-kindergarten interaction, which connect education input and education product. They also include "curriculum activity," "kindergarten management," "teacher team," and "family support" as four primary indicators under the education process indicator. Among them,

curriculum activities constitute the core factors. Kindergartens, teachers, and families are the participants of curriculum activities who play the management, leadership and support functions. These three participants interact with each other to ensure the continuous improvement of the design, implementation, and quality of curriculum activities.

Curriculum activities mainly include static structural elements and dynamic process elements. Structural elements include "curriculum orientation," "learning environment," and "teaching condition." Dynamic process elements include "teacher-child interaction," "facilitate autonomous learning" and "colleague cooperation."

Kindergarten management mainly includes kindergarten leadership and kindergarten improvement. Informed by international experience, the Chinese pre-primary education indicator system adopts "effective kindergarten leadership," the "degree to which the organization satisfies children's needs," "organization's self-evaluation and improvement" and "data collection mechanism" as the secondary indicators for "kindergarten management."

The adequacy and quality efficacy are two characteristics of the teacher team. The current Chinese indicators for kindergarten teacher team mainly include staff size, diplomas and professional titles of kindergarten heads and teachers (Department of Development Planning of Ministry of Education 2006). This only reflects the size of the kindergarten teacher team and basic information, and lacks indicators to substantially reflect the quality of kindergartens. International indicators involve the "qualification requirement of kindergarten teachers," "education and training," etc., comprehensively reflecting the quality of kindergarten teachers. Combining international experience and the Chinese indicator data, researchers will adopt the "teacher-child ratio" as an indicator for adequacy, and adopt "teacher salary and benefits," "ratio of certified teachers" and "ratio of trained teachers" as an indicator for efficacy.

Family support is an important element influencing young child development. As demonstrated by research literature, parents' participation in pre-primary education can ensure the consistency of young children's acquisition experience in different environments, and help develop young children's cognition and social affection, as well as prepare them for entry to schools (Desforges and Abouchaar 2003). According to the *Guideline to the Learning and Development of Children Aged 3–6*, teachers and parents should establish a cooperative and mutually supplementary relation between parents and kindergartens through a variety of effective means. Therefore, "effectiveness of communication between teacher and parents" and "teacher participation in family education" are designated as a secondary indicator of "joint education by parents and kindergarten."

3.4 Theoretical Construct of Pre-primary Education Development Product Indicators

Regarding the product indicators, research revealed that some pre-primary education indicator systems lacked the product indicators such as child development level. The *Report at 19th National Congress of the Communist Party of China* put forward the strategic plan of "ensuring people's access to childcare" and "improving pre-primary education," both pointing to fair and high-quality pre-primary education. Based on this, the indicator system should further focus on the fairness and quality of pre-primary education development. Fair pre-primary education refers to equity and public welfare, mainly reflected in the degree of popularization. High-quality pre-primary education refers to efficiency and quality, mainly reflected in the level of child development. This research combines the international pre-primary education indicators informed by the CIPP evaluation model and the reality of Chinese pre-primary education development and uses "popularization of education" and "child development" to reflect the product of education development. "Popularization" refers to the accessibility of pre-primary education, reflecting the solution of difficult access to kindergartens. "Child development" refers to children's development in five areas and the quality of learning, with children being the subjects and ultimate beneficiaries of pre-primary education.

Regarding education popularization, the *Outline of National Medium and Long Term Education Reform and Development Plan* stipulated that pre-primary education should be popularized by 2020. A one-year pre-primary education will have been popularized across the country; two-year pre-primary education will have been basically popularized, and three-year pre-primary education will have been popularized in areas where the conditions for it are available. Therefore, gross enrollment rates of one-year pre-primary education, two-year pre-primary education, and three-year pre-primary education, as well as gross enrollment of kindergartens for disabled children, are included in the pre-primary education indicator system as secondary indicators for pre-primary education popularization.

Regarding child development, informed by international indicators and the requirements of child development stipulated by the *Guideline to the Learning and Development of Children Aged 3–6*, the Chinese pre-primary education indicator system lists developments in health, language, society, science, and art as the secondary indicators of "child development." As an important internationally recognized domain of early learning, learning quality is one of the core components of pre-primary child learning and development (Copple and Bredekamp 2009). The promotion of children's development in the five areas should direct attention to the evaluation and development of their learning quality. The developments in five major areas interact with learning quality. The development of learning quality facilitates the development in five major areas. The development in five major areas can stimulate children's learning enthusiasm and interest and support the development of their learning quality.

International comparison and domestic analysis based on the CIPP evaluation model generated the Chinese pre-primary education indicator system, which includes 4 dimensions, 10 primary indicators, and 63 secondary indicators, as shown in Table 5.

4 The Applicability of the Theoretical Construct of the Chinese Pre-primary Education Indicator System

In the new era of the pre-primary education reform and standard development, the theory of pre-primary education indicator system will be of great relevance to (1) planning the pre-primary education development goals in China, especially the medium-term and long-term goals, (2) measuring the current situation of pre-primary education in China, especially the equity and quality of pre-primary education, (3) implementing the evaluation of pre-primary education development, especially the education improvement evaluation, (4) boosting pre-primary education international exchange, especially "Chinese storytelling." The expected applicability of the Chinese pre-primary education indicator system is reflected in the following four aspects.

4.1 Provide Value-Oriented Instrument Support for the Establishment of the Goal of the Pre-primary Education Development in China

The goal of pre-primary education development is the compass guiding further reform and standardization of pre-primary education. The goal is the expected results or conclusion. Indicators are the units or methodology used to measure goals. Without goals, indicators are meaningless. Without indicators, the goals cannot be realized. The theoretical construct of the Chinese pre-primary education indicator system, which contains Chinese perspectives and has an international horizon, can provide instrument support for setting the development goals of pre-primary education. The development of the indicator system is not to set goals and determine whether the goals have been achieved, but to guide the value orientation of the further reform of pre-primary education and its standardized development, and evaluate the appropriateness of reform and development plan and support the improvement of education quality. In this sense, the theoretical construct of the Chinese pre-primary education indicator system emphasizes that we should switch from the evaluation of pre-primary education itself to the evaluation of the social system, from input monitoring to input improvement, from process demonstration to process incentive, and from product accreditation to product-orientation.

Table 5 Theoretical construct of Chinese pre-primary education indicators

A Education background		B Education input		C Education process		D Education product	
Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators
A1 Demographic characteristics	A1-1 Birth rate	B1 Management system	B1-1 Clear role and responsibility of the Central Government	C1 Curriculum activity	C1-1 Curriculum orientation	D1 Child development	D1-1 Health development
			B1-2 Relationship between education authority and government of the same level		C1-2 Learning environment		
	A1-2 Mortality rate		B1-3 Government supervision and evaluation		C1-3 Teaching condition		
			B1-4 Pre-primary education sponsored by the local education authority		C1-4 Teacher-child interaction		D1-2 Language development
	A1-3 Number of children under six		B1-5 Access to kindergarten education as legal rights of children		C1-5 Facilitate autonomous learning		
	A1-4 Adult literacy	B2 Resource allocation	B2-1 Proportion of pre-primary education expenditure in GDP		C1-6 Linkage between kindergarten to primary school		

(continued)

Table 5 (continued)

A Education background		B Education input		C Education process		D Education product	
Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators
					C1-7 Teacher reflection		D1-3 Social development
	A1-5 Ratio of poor children		B2-2 Proportion of pre-primary education expenditure in government fiscal expenditure		C1-8 Colleague cooperation		
				C2 Kindergarten management	C2-1 Effective kindergarten leadership		
A2 Social welfare	A2-1 Gender equality		B2-3 Proportion of fiscal expenditure for pre-primary education in education		C2-2 Degree to which the organization meets children's need		D1-4 Science development
					C2-3 Self-evaluation and improvement by organizations		
	A2-2 Compliance with the *United Nations Convention on the Rights of the Child* by the state government		B2-4 Fiscal allotment for pre-primary education by governments		C2-4 Data collection mechanism		
				C3 Teacher team	C3-1 Teacher-child ratio		D1-5 Child art development

(continued)

Table 5 (continued)

A Education background		B Education input		C Education process		D Education product	
Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators
	A2-3 Comprehensive medical service		B2-5 Public funding allotted to each student		C3-2 Teacher salary and benefits		
	A2-4 Policies and projects that help poor family out of poverty				C3-3 Teacher age distribution		
			B2-6 Proportions of public and private expenditure		C3-4 Sex ratio of teachers		D1-6 Child learning quality
	A2-5 Mother benefits				C3-5 Ratio of certified teachers		
			B2-7 Average expenditure of parents		C3-6 Proportion of teachers with professional titles	D2 Education popularization	D2-1 Gross enrollment rate of one-year pre-primary education
	A2-6 Mother's formal education				C3-7 Ratio of trained teachers		
			B2-8 Indoor activity space		C3-8 length of teacher training		D2-2 Gross enrollment of two-year pre-primary education
	A2-7 Subsidies for poor children			C4 Family support	C4-1 Parent-kindergarten cooperation		

(continued)

Table 5 (continued)

A Education background		B Education input		C Education process		D Education product	
Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators	Primary indicators	Secondary indicators
			B2-9 Outdoor activity space		C4-2 Parents' participation in pre-primary education		D2-3 Gross enrollment of three-year pre-primary education
	A2-8 Young children's social, political and cultural background				C4-3 Effectiveness of communication between teacher and parents		
			B2-10 Library resources		C4-4 Teacher participation in family education		D2-4 Enrollment rate of disabled children

These four value-related turns have important value leading function for the setting of Chinese pre-primary education goals, especially the medium and long-term development goals, and will be helpful for determining the development direction, development route and support strategies for the Chinese pre-primary education cause. They will help further adjust the policy system that regulates the development of pre-primary education as part of the government public service system, as well as systematically planning and leading the comprehensive and sustained development of the Chinese pre-primary education.

When one examines the current reports such as the *National Statistical Bulletin of Education Development* and *National Education Statistics*, they can find that some reports in China do not pay due attention to the background of education. In other words, they do not give enough attention to the social nature of education or pre-primary education, which constitute an important component of the public service system. Focusing on the background of education or social development and evolutionary factors is an important value-orientation of the Chinese pre-primary education indicator system, and is the embodiment of the political, economic and cultural background of the new era. It is a truthful and collective reflection of Chinese values, Chinese perspectives and actual conditions of China. Given the introduction of the universal two-child policy, the Chinese pre-primary education indicator system should pay more attention to the social development background of pre-primary education, especially the birth rate, mortality rate, number of children under six, etc., which have an important influence on the systematic planning of Chinese pre-primary education development goals, especially medium term and long term development goals, as well as systematic guidance of the direction, scale and quality of pre-primary education development. At the same time, with the increasing popularization of pre-primary education in China, raising the quality of pre-primary education should be an important goal of Chinese pre-primary education development. However, when we used the theoretical construct of the Chinese pre-primary education indicator system introduced in this paper to examine the existing reports, we found that they did not pay due attention to curricular activities, family support in education process, and child development in education product, although these indicators are key to measuring pre-primary education quality. As shown above, the indicator system constructed in this paper can effectively supplement the current indicator systems, scientifically set the Chinese pre-primary education development goals and indicator system, and lead the further reform of pre-primary education in the new era and standardize its development.

4.2 Provide a Structural Instrument for a Complete Understanding of the Current Situation of Pre-primary Education in China

The current situation of pre-primary education development is the original level on which pre-primary education is further reformed and developed in a standardized manner. After the value-orienting goals of pre-primary education development or such an indicator system are set, the structural prescription of the indicator system will be helpful for the comprehensive and systematic understanding of pre-primary education development. The Chinese pre-primary education indicator system, which has a comprehensive list of dimensions and clear indicators, can provide structural instrumental support for comprehensively understanding the Chinese pre-primary education development. The basic dimensions of the indicator system should cover not only internal aspects of pre-primary education, but also external aspects of pre-primary education. It should cover not only the input in pre-primary education, but also the process of pre-primary education and the quality of pre-primary education. In this sense, the theoretical construct of the indicator system emphasizes that the understanding of pre-primary education development should structurally include the education background dimension. This includes social factors, education input dimension, namely the resource factor, education process dimension, namely process quality factor, and education product dimension, namely product quality factor. In other words, the four dimensions or main factors, are independent of each other and related to each other, constituting an organic unity. They constitute a structural instrumental framework for collecting and analyzing current information of pre-primary education, and also a reference with which we construct a package of solutions to pre-primary education reform and development.

In recent years, with the development of society and the promulgation of papers such as *Outline of the National Program for Medium and Long Term Educational Reform and Development (2010–2020)* and *Several Opinions on the Current Development of Pre-school Education by the State Council*, the state government pays increasing attention to pre-primary education. The pre-primary education cause is developing quickly. Changes in pre-primary education in many aspects call for a comprehensive understanding. We used the indicator system constructed in this research to investigate the currently existing statistical reports, and found that some important indicators are missing. For example, the demographic characteristics and social welfare in the education background dimension, curriculum activities, family support, teacher training the in education process dimension, as well as child development in the education product dimension are missing, although the current reports have statistics of pre-primary education popularization, resource allocation, and teacher team. The absence of some important indicators or the lack of attention to certain indicators reflects the structural inadequacy of the indicator system.

In the new era of improving pre-primary education, the Chinese pre-primary education indicator system should pay more attention to the irreplaceability and interdependence of the structural indicators of pre-primary education, their systematic

description of goals, background, condition, strategies, and product of the "improving pre-primary education" strategic plan, which is of great importance for the comprehensive and systematic understanding of Chinese pre-primary education evaluation development, and the systematic planning of the routes and strategies leading to pre-primary education goals.

As shown above, the Chinese pre-primary education indicator system is of positive significance to constructing or reconstructing the structural instrument to understand and analyze pre-primary education development, and realizing the comprehensive and systematic understanding of the current development of the Chinese pre-primary education.

4.3 Provide a Methodological Instrument for the Scientific Supervision and Evaluation of Pre-primary Education in China

Strengthening the supervision and evaluation of pre-primary education guarantees the further and standardized reform of pre-primary education. This highlights the function of indicator systems' methodological guidance, which is based on value leading and structure prescription. Combining qualitative and quantitative indicators, as well as dynamic and static indicators, the theoretical construct developed by this research can provide a methodological instrument for the scientific supervision and evaluation of pre-primary education in China. The Chinese pre-primary education indicator system supports the position that supervision and evaluation should pay attention to not only the development of quantitative indicators, but also that of qualitative indicators. It should focus not only on the final report but also the continuous feedback on education development, so as to propose better suggestions. It is in this sense that the theoretical construct of the Chinese pre-primary education indicator system emphasizes that the focus of supervision and evaluation should switch from the accreditation result to improvement process, from criteria consistency to characteristics, from static presupposition to dynamic generation, from material structure to site status.

When one uses the theoretical construct of the indicator system constructed in this research to examine the current supervision and evaluation methodology, for example, *Interim Measures for Supervision and Evaluation of Pre-primary Education,* and other criteria for pre-primary education supervision and evaluation, they can find that the current Chinese pre-primary education supervision and evaluation, which are based on Tyler's goal-oriented model, are conducted by education administrative departments and supervisory departments. These top-down accreditation evaluations do not have the full play of improvement function, because the supervisory evaluation indicators pay more attention to input indicators than background indicators, process indicators, and product indicators. For example, the *Evaluation Standard of Kindergarten Grade in Zhejiang Province* has more than 70% of total

content devoted to the static input indicators, such as environment and texts. The lack of attention given to the background dimension may cause supervision and evaluation to neglect the reality of development. The lack of attention given to the process and product indicators, such as curriculum activities, family support, and child development may cause supervision and evaluation to neglect the quality of pre-primary education quality. The supervision and evaluation of pre-primary education in the new era should focus on individuality, pay more attention to the attitude of character and quality of children and teachers, as well as the characteristics of pre-primary education and innovations; it should focus on relationships, namely pay more attention to peer relation, teacher-child relation, parent-kindergarten relation, kindergarten-community relation; the focus should be placed on process, namely the everyday life of children, so as to evaluate and improve pre-primary education practice in the dynamic environment in reality.

As discussed above, this research will supplement the existing supervision and evaluation indicators, and promote the appropriate supervision and evaluation of pre-primary education in China.

4.4 Provide a Universal Instrument for International Exchanges and Cooperation in the Field of Pre-primary Education

International exchanges and cooperation in the field of pre-primary education are important means to raise the pre-primary education quality and increase the international influence of pre-primary education. As an important instrument for measuring the developments of pre-primary education, the indicator system can comprehensively present the overall condition of the pre-primary education in a country, so that different countries can learn about the pre-primary education development in other countries, learn about the successful practices of pre-primary education in other countries, and promote the excellent experience of their own pre-primary education. This is important to the enhancement of international exchanges and cooperation in the field of pre-primary education.

The theoretical construct of the pre-primary education indicator system proposed by this paper is based on international models, and comprehensively covers a wide range of indicators. This construct can provide universal and instrumental support for international exchanges and cooperation in the field of pre-primary education. The development of the indicator system not only solves the local pre-primary education development problem, but also includes connection with the international pre-primary education, which facilitates the comparison, analysis, reference, and sharing of pre-primary education indicators in other countries. For this reason, the theoretical construct of the Chinese pre-primary education indicator system emphasizes that, in order to support international exchanges and cooperation in the Chinese pre-primary education field, the development of the pre-primary education indicator

system should have a universal theoretical framework, logical rigorous indicator dimensions, comprehensive coverage of indicators of different levels, and the combination of qualitative and quantitative indicators. In other words, these four characteristics constitute the key to ensure that pre-primary education indicator system has international applicability, allow comparative analysis frameworks to be set up based on the pre-primary education indicator systems across different countries, so as to have mutual understanding, borrowing and sharing of pre-primary education development among different countries. The indicator system can be the universal instrument for China to connect its pre-primary education policy discourse, theory discourse and practice discourse to the world in the efforts to tell Chinese stories to the world in the new era.

Recently, the Chinese government attaches more and more importance to international exchanges and cooperation in the field of education. For example, the General Office of the CPC Central Committee and the State Council promulgated the *Opinions on the Opening up of Education in the New Era* in 2016, which explicitly required expansion of opening-up, strengthening of China's education, promotion of humanistic exchange, continuous improvement of China's education quality, and strengthening China's soft power and international influence (General Office of CPC Central Committee 2010). As pre-primary education is an important part of the education cause, international exchange and cooperation should be part of its mission, and the pre-primary education indicator system should play its role. However, the surveys of the existing statistical reports using the Chinese pre-primary education indicator system constructed by this paper have already made some findings. For example, the statistical indicators in these statistical reports are largely classified according to education objects, education investment, team, etc., describing the basic information such as scale and achievement of education in China"(Pang and Xiong 2013). Compared with the CIPP evaluation model, the indicator systems used in the existing reports lack clear theoretical frameworks. Their logic of indicator dimensions is not rigorous and lacks the educational background aspect. Their indicators are not comprehensive and lack process indicators such as curricular activities and family support; they focus more on quantitative indicators and ignore some qualitative indicators such as child development. As discussed above, the Chinese pre-primary education indicator system constructed in this paper provides a universal instrument for international exchanges and cooperation in the field of pre-primary education, and meets the needs of intercultural comparison, dialogue, and substantially strengthens the international influence of Chinese pre-primary education.

In conclusion, based on the CIPP model, this paper developed the Chinese pre-primary education indicator system from four dimensions, namely education background, educational input, education process and education product, which can reflect the external context, condition, internal drive and output performance of pre-primary education development. It provides scientific guidance and a systematic evaluation for pre-primary education development because it transforms the evaluation of education into the evaluation of the social system in which evaluation of education occurs.

It transforms the monitoring function into an input improvement function, transforms the process demonstration function to process stimulation function, and transforms from product assessment function to product guidance function.

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The Dual Economy Policy and the Dilemma of Vocational Education Development in China——From the Perspective of Economic Sociology

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Abstract Currently, the development of vocational education in China is in a dilemma, where the national demands are incompatible with the demands of enterprises and individuals. According to a comparative analysis of the relationship between the forms of industry, the development of vocational education, and the modes of economic operation in the United States, Germany, Japan and the UK, in the countries which do not choose high-end manufacturing industries as the major forms of industry, there is no necessary connection between the economic growth and the development of vocational education; those countries which choose high-end manufacturing industries as the major forms of industry must be supported by high-level vocational education. These forms of industry and high-level vocational education need support from a corresponding mode of economic operation, namely the mode of market economy, which imposes proper coordination and restrictions on enterprises. In China, the extremely loose mode of the market economy is incompatible with the government-led direction of industrial development, which is called the dual economic policy. As a result, it is difficult to encourage enterprises to upgrade industrial technology; enterprises have no enthusiasm for participation in vocational education, and individuals lack enthusiasm for skill learning, thus creating a dilemma of the development of vocational education. Therefore, it is necessary for China to learn from Germany, Japan and other post-Fordist countries, offer reflections on the mode of market economy, and relocate the roles of enterprises in the market.

Keywords Dual economy policy · Vocational education · Dilemma · Economic sociology

In order to develop Chinese vocational education in the new era, we must solve the conflicts among the demands of the state, enterprises and individuals. On the

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one hand, the state government attaches great importance to vocational education, on the other hand, however, the enterprises do not want to participate in vocational education, and neither do the individual learners. This dilemma has been affecting Chinese vocational education for a long time and has not been effectively solved. Only after the solution of such dilemma can Chinese vocational education step on a new historical starting point and provide education support for the economic and social development goals. The reason why this dilemma remains unsolved is that policies were made only to stimulate enterprises' interest in participating in vocational education or individuals' interests in joining vocational education. However, what is special about vocational education research is that its research questions are not only educational questions but also economic questions. Specific forms of vocational education are embedded into specific economic systems. Only by analyzing the relationship between the elements of the economic system can we understand the essence of vocational education problems and come up with solutions. The compatibility between forms of industry and modes of economic operation is key to the development of vocational education. When one refers to this relationship model, they will find that the mismatch of demands is but a phenomenon. The underlying reason is the incompatibility between China's forms of industry and its modes of economic operation, namely the dual economy policy.

1 The Support Relation Model Among Forms of Industry, The Modes of Economic Operation and Vocational Education

Economic sociology is a discipline that came into being in the 1990s in America. It is a result of reflection and challenge on neoclassical economics. It advocates that sociological perspectives be used to observe and explain the economic phenomenon and economic system, as it believes that economic phenomenon is embedded into the social structure or social network. The research of vocational education needs the economic sociology perspectives and ways of reasoning because enterprises' demand of vocational education and individuals' demand for vocational education is social behavior caused by economic behavior.

1.1 Support Relation Between Forms of Industry and Vocational Education

About the necessity of vocational education, most studies have the assumption that economic development must be supported by high-quality vocational education. However, there are two challenges to this assumption. First, in countries such as

Germany and Japan, one indeed can see the important support of vocational education for economic development, but not all economically developed countries have high-quality vocational education. For example, America's vocational education lags far behind that of Germany. In terms of professional skill development, American vocational education is not as good as Chinese vocational education, although its economy is much bigger and stronger. Even after the 2008 financial crisis, the American economy has been moderately recovering in the past years. From the American case, one may ask: why isn't the development level of vocational education necessarily connected with the economy? Second, if the development of vocational education has no necessary connection with economic development, why the British economy was impacted by the poor vocational education system (as weak as that of the US) and lost its leadership in the European economy to the German economy?

Based on the two cases above, we put forward the following hypothesis concerning the economy and vocational education: The forms of the economy determine whether the economic development of a country needs the support of vocational education and the kind of support it needs from vocational education. The sources of wealth of a country are varied. Some countries mainly rely on raw materials, some on agriculture, some on innovative research and financial hegemony, etc. Only those countries relying on high-end manufacturing need the support of high-level vocational education. If a country's forms of industry center on high-end manufacturing and does not have high-level vocational education, its development will not last, as can be seen from the development of economy and vocational education in the major developed countries in the twentieth century. Below are the comparative study of the American, German, Japanese and British cases.

1.1.1 Relationship Between American Forms of Industry and Development Level of Vocational Education

America differs drastically from Germany in its goals of vocational education. John Dewey made the following judgment on the goals of American vocational education: "The problem with our country is an education problem, unlike commercial or technological problems in Germany" (Dewey 2012, p. 70). The problem facing America at that time was what faces China today: "When Germans acquire skills and succeed in implementing this policy, we can but express admiration, because their policy can hardly be feasible in America. We do not have this historical background, neither do we have the practical perspectives" (Dewey 2012, p. 71–72). The development status of American vocational education lasts through until today. The basic goal of American vocational education remains the same as it was one hundred years ago, namely. the education of people, not the needs of industrial development, although its scale and quality have expanded greatly. Therefore, vocational education in America is called career education, which well reflects the function positioning of American vocational education. The support for industries from American vocational education is very weak and their courses do not match industry positions. For example, cluster curriculum is very popular in American vocational education, which is designed to

raise the adaptability of individuals in the employment market, at the cost of compatibility between courses and positions. The technical workers needed by American industries are mainly trained by the human resources departments of enterprises, which stimulates the development of human resources discipline in America.

How does the American economy keep its global leadership while their industries do not have the support from vocational education? The reason is that American economic growth is not driven by manufacturing, but by Silicon Valley and Wall Street, namely technological innovation and financial hegemony.

American manufacturing does not play an important role in its economy, although it was very strong and took the biggest share in the world throughout the twentieth century. However, American manufacturing is characterized by the wide use of mass production mode featuring assembly line invented by Ford Motor Company, which was designed to reduce the reliance on the sophistication of workers' skills. "In America, the goal of the enterprises is to realize rationalization of the production process and reduction of reliance on skilled workers, via technological innovation, work reform and standardized production" (Thelen 2010, p. 248). This mode of production greatly lowered the cost, increased competitiveness, and reduced the demand for vocational education by minimizing the reliance on skilled workers. This is why America, without the advanced vocational education of Germany, was able to develop a powerful manufacturing industry. However, after the 1980s, American goods, due to their modes of production, lost to German and Japanese goods. In addition, American goods gradually lost their competitive edge in the low-end market because the cheap Chinese labor counterbalanced the low cost brought about by the American mass production mode.

1.1.2 Relationship Between German and Japanese Forms of Industry and Vocational Education

Both Germany and Japan have very well-developed vocational education, characterized by a high degree of participation by enterprises in vocational education. The Japanese enterprises have an even higher degree of participation than their German counterparts because the vocational education features internal training of enterprises, namely the big corporations are responsible for all the skill training tasks of their workers. Different from American vocational education, German and Japanese vocational education still have many apprenticeship elements. The much-discussed craftsman's spirit is mainly found in Germany and Japan because the goal of their vocational education is to meet industries' demands for skilled workers.

The German and Japanese vocational education substantially support their economic development, because their development of vocational education is compatible with their forms of industry. These two countries adopt strategies that are different from the American ones in their industrial development, but they are no rival to America in terms of technological innovation because they cannot control the intellectual properties of the majority of original technology. Although Germany and Japan have very strong technological capacity, especially Japan who adopted the

national strategy of technology for its economic development after the Second World War, their technological inventions are largely limited to the concrete techniques of manufacturing. Their originality of technology lags far behind that of America. For example, although German and Japanese cars are more sophisticated than American cars, cars were invented by Americans. In the financial sector, their competitiveness is much weaker than that of America, because America has been the global financial center since the end of the Second World War. Therefore, German and Japan chose high-end manufacturing as an alternative route of industrial development, that is, raising the technical level of products, producing high-quality and individualized products, to establish the leadership of its manufacturing industry, as skills constitute an important source of wealth in these two countries.

In the manufacturing sector, Germany and Japan adopt different modes of production from the American standardized production. Although they also adopt the latest production technology, Germany and Japan adhere to the modes of production that require skills and their products are more diverse and more sophisticated. Just as an economic sociologist remarked after learning the problems faced by American standardized production, "Following the Second World War, various European and Japanese manufacturers adopted the latest technology in industry after industry at a time when transportation costs were declining and markets for high-quality consumer goods–as distinct from standardized products–were expanding. Moreover, manufacturers in Japan, Germany, and several other countries had never become as committed to the hierarchical form of standardized mass production as had manufacturers in many sectors of the American economy" (Campbell 2009, pp. 45–46). For example, in the organizational mode of automobile production, Honda greatly raised the quality of car assembly and lowered the rate of spoiled products, by adapting the Ford assembly line into manufacturing islands.

1.1.3 Relationship Between British Forms of Industry and Development Level of Vocational Education

In the UK, one can find another story. Their forms of the industry are typically not compatible with their vocational education, which ultimately led to their economic recession.

The UK was the cradle of the Industrial Revolution, because the steam engine, which was the core technology driving the first industrial revolution, was invented in the UK. With the rise of their economic power, the UK quickly expanded its influence around the world and established a lot of colonies, which brought a huge amount of wealth for the UK and wore away their impetus for technological innovations. From the early twentieth century, few original technological innovations happened in the UK. By contrast, the American economy began to be driven by technological innovations after the Civil War and the abolition of slavery in the south. The UK was just the opposite. After the Second World War, the UK lost its leadership of technological innovation and financial hegemony, with the independence of colonies.

The UK cannot but choose high-end manufacturing, and it indeed chose such a road of economic development.

The forms of the industry having high-end manufacturing as its main body must be supported by well-developed vocational education. After the first industrial revolution, Germany well kept its traditional apprenticeship and developed it into a dual system. However, the traditional apprenticeship in the UK disappeared due to a variety of factors, such as enclosure movement, worker strikes, and laissez-faire market economy. Afterwards, the UK established a vocational education that was market-oriented and had strong characteristics of schools, which meant their forms of industry lacked the support of vocational education. The UK government must have realized this problem, as they introduced a lot of projects to develop vocational education from the 1980s. Many new concepts of vocational education were coined in the UK, such as new vocationalism, core skills, national qualification framework, and modern apprenticeship, etc. However, vocational education in the UK progressed slowly, without substantial achievement, in spite of the multitude of new concepts.

The UK has been trying to revitalize its economy since the 1980s, but it has not succeeded, due to the loss of innovation and financial hegemony, as well as the difficulty in establishing high-quality vocational education compatible with their high-end manufacturing.

1.2 The Support of Economic Operation Modes for the Forms of Industry and Vocational Education

Why did the vocational education of the UK develop like this? How were vocational education systems set up in Germany and Japan? After analyzing the vocational education systems in the UK, Germany and France, scholars believe that these systems are closely related to their work cultures. As regards industrial relations and labor laws, the UK prioritizes economy, Germany prioritizes society and France prioritizes politics(Greinert 2004, p. 19). From the perspective of economic sociology, a major theoretical issue is involved here: only certain modes of economic operation can give rise to high-end manufacturing and vocational education that provide highly skilled talents for it. Economic sociologists often divide the modes of economic operation in different countries today into neo-Fordist and Post-Fordist. The former is represented by America, the UK and other countries. The latter is represented by countries like Germany and Japan.

The neo-Fordist forms of industry are characterized by low skills, low wages, low welfare, raising profit by cutting wages and management costs, increasing competitiveness with standardized mass production. Related to these forms of industry, followers of the neo-Fordist mode of economic operation worship competitive individualism and the role of a free market. They advocate the increase of market freedom by lowering the social cost of labor, reduction of trade union power, reduction of enterprise taxes, in order to attract investment. The passage of *Tax Cuts and Jobs*

Act of Donald Trump was such an attempt to increase the competitiveness of American products. In the last 30 years, America and the UK strengthened the role of the market, their government created opportunities to ensure the free operation of the market, no longer mediated the compromise between employers and employees. Such neo-Fordist proposals are reflected in many aspects in these two countries. For example, in America, "the annual work time has increased by one month since the 1970s. Every year, Americans work 320 more hours than Germans but they make less money, at least from the 1990s. From 1973, their average salary dropped by 10%" (Albritton 2001, p. 23).

The basic characteristics of post-Fordist forms of industry are high skills, high wages, and high welfare, attributing wealth growth to skill development and regarding skill development as a national strategy. Their followers realized that economic growth relies on the quality of products and service, rather than the mere price wars. They emphasize accurate market positioning, flexible production system, batch production, which is the high-end manufacturing industry mode analyzed above. Accordingly, the followers of post-Fordism call for the establishment of a flat type of labor organization via the cooperation among the government, employers and trade union, high degree of trust between employers and employees, offer good work condition and high wages, encourage employees' participation in management, in order to increase the quality of products and service as well as enterprise competitiveness. "For example, as early as the 1920s, the Japanese workers' wages were closely connected to their qualification, especially their work experience. Enterprises were thus motivated to invest in worker skill training, which was one of the factors behind the continuous increase of wages. For workers, this system allowed them to learn special skills needed by enterprises" (Thelen 2010, p. 181). A striking characteristic of a post-Fordist country is the substantial proportion of skilled workers among the middle class.

However, the forms of industry advocated by new-Fordists are much easier to develop. As long as the government eases its control of the economic operation process, the profit-driven enterprises are very likely to follow the road of low skill, low wages, and low welfare. In the 20 years after the introduction of the reform and open-up policy, China gave enterprises more market freedom, unleashed their vigor, achieved huge economic development success, but at the same time, the industry form featuring low skills, low wages and low welfare naturally took hold. Most enterprises still say that they do not need highly skilled students graduating from vocational schools, they prefer those obedient and hard-working labors, reflecting the low level of the technological level of enterprises.

By contrast, the post-Fordist form of the industry featuring high skills, high wages and high welfare cannot grow autonomously. Its formation requires two conditions and the two conditions call for government guidance, exterior pressure and system constraints. The first condition is that enterprises should be willing to invest in long-term technological research and improvement, and increase profit by raising product quality. However, enterprises will not be willing to adopt this form of industry, as long as they can increase their profit via other means, because this form of industry

calls for hard work and accumulation over a long period of time. The second condition is that technical workers should be willing to study technology and hone their operation skills. However, this will not happen automatically. They will not be motivated to learn skills and spend enough time honing their skills, unless (1) their wages are connected with their skills; (2) their wages and welfare are improved; (3) they are offered opportunities to participate in enterprise management; (4) their employment stability is raised. Therefore, the post-Fordist counties all adopt the coordinated market mode of economic operation. Their government, trade unions and other organizations constrain and coordinate the behaviors of enterprises and individuals in the market, to promote the formation of this form of industry. From this perspective, the economic governance of China during its industry upgrade stage is far more complex than it was during the extensive development stage.

The support relationship among modes of economic operation, forms of industry and vocational education go as follows. The forms of industry are closely connected to vocational education development. The form of the industry featuring high-end manufacturing has the highest requirement of vocational education. Its formation requires high-level vocational education. The form of the industry featuring high-end manufacturing also needs a coordinated market mode of economic operation. In a laissez-faire economy, this form of the industry can barely exist. The development of high-quality vocational education needs coordinated market modes of economic operation because it requires this system to promote enterprises' participation in vocational education. The absence of any of the above factors will cause the destruction of the triangle. The comparison of neo-Fordist and post-Fordist modes of economic operation reveals that, whether it is laissez-faire or coordinated economy, the modes of economic operation involves two aspects, namely (1) the behavior of enterprises in the market, such as their selection of product positioning and profit pattern, etc. (2) the patterns of relationship between management and employers, such as hierarchical type or flat type.

2 The Duality of China's form of Industry and Mode of Economic Operation

Below is the analysis of the compatibility between China's form of industry and mode of economic operation.

2.1 The Choice of Industry Form Featuring High-End Manufacturing

Currently, a basic direction of the Chinese economy is industrial upgrading, namely the transition from labor-intensive and resource-intensive industries to technology-intensive industries and the development of high-end manufacturing industry by upgrading enterprise technology. This is a difficult and lasting process. As early as 1989, the *Decision of the State Council on Key Points of Current Industrial Policy* made the following observation on the industrial structure at that time: "Nowadays, the total demand of Chinese society is bigger than the total supply, there are also serious problems with industrial structure. There is an excess of manufacturing capacity of manufacturing and inadequate production capacity of agriculture, energy, raw materials and transportation; there is an excess of low-end manufacturing capacity and shortage of high-end manufacturing capacity. The structural level of export products runs low. The export of some undersupplied goods affects their supply in domestic market."

In the twenty-first century, industrial structure adjustment became the core content of China's industrial policy. In 2005, the *Interim Provisions for Promotion of Industry Structure Adjustment,* a key document on China's industry structure adjustment, was promulgated. This document set the goals of China's industry structure adjustment as follows: We shall propel industrial structure optimization and upgrading, promote the healthy and coordinated development of primary, secondary and tertiary industries, gradually form the industry pattern with agriculture as the base, the hi-tech industry as the forerunner, and basic industry and manufacturing industry as the support, under which the service industry develops on an all-round basis. We shall also adhere to conservation-conscious development, clean development and safe development, and realize sustainable development. In 2015, the State Council of China promulgated the *Made in China (2025)*, which stipulated as follows: We should pursue structural adjustment as the key facilitator of manufacturing power, support the development of advanced manufacturing, upgrade traditional industries, and transform production-oriented manufacturing into service-oriented manufacturing, optimize the industrial structure, cultivate industrial clusters, and follow the path of improving system and organization performance. The *Report at 19thNational Congress of the Communist Party of China* continued to point out the future industrial development as follows: We will work faster to build China into a manufacturer of quality and develop advanced manufacturing.

The construction of a manufacturer of quality and hi-end manufacturing is China's strategic choice of her industrial mode for the next stage of development, after experiencing 30 years of labor-intensive and resource-intensive development mode. What deserves attention is that China did not choose the American style of manufacturing that solely relies on the advanced production line. Instead, China chose to pursue a manufacturing industry that is based on the advanced production line and at the same time relies on skills, which is the manufacturing industry of Germany and Japan. The failure of the American mode has provided China with important lessons. China's

choice proved very wise: Unless China upgrades industries, their industrial products will lose their competitiveness due to rising labor cost and the Chinese economy will fall into the middle-income country trap; on the other hand, China cannot choose the innovation-based form of industry, because China cannot realize the monopoly of intellectual properties in the near future. Although the Chinese government encourages innovation and has achieved breakthroughs in many technological fields and some breakthroughs have reached the original level, China is not likely to reach the innovation level of America that can realize absolute monopoly of intellectual properties, and most of the technological innovations in China remain at the production innovation level. As a most populous country, China cannot direct so many surplus laborers to the service industry, including the modern service industry. In a word, China must pursue a manufacturing industry that relies on skills, in order to create jobs.

2.2 The Incompatibility Between China's Forms of Industry and Its Modes of Economic Operation

Currently, China's form of industry is not compatible with its mode of economic operation. China chooses high-end manufacturing as its form of industry, but it implements extremely loose market mode, which constitutes the dual economy policy, just as a scholar observed, "Chinese economy does not have the non-market governance mode of Japan. Although the market has already become the most important mechanism governing the Chinese economy, the administrative intervention caused by the planned economy still exists to different degrees" (Gao 2008, p. 4). The scholar further stated that "China's mode of development has transformed the Chinese economy into a highly open market economy" (Gao 2008, p. 7). As a new market economy, in order to stimulate market vigor, China needs to spend time to perfect many aspects of its system. As a result, some aspects of economic operation remain highly unmonitored. The major decisions in enterprise management, such as the product types, means of production and location of production, are generally controlled by a few high-ranking leaders of enterprises, without the coordination of the internal balance mechanism or restraints from external systems. As regards employment, external systems almost have no substantial constraints on the determination of wages, employing and firing workers. There are huge gaps between management and workers in wages, work environment, job stability, promotion opportunities, etc.

The dual economic policy makes it difficult for China to upgrade its industries. The *Report at 19th National Congress of the Communist Party of China* pointed out: As socialism with Chinese characteristics has entered a new era, the principal contradiction facing Chinese society has evolved. What we now face is the contradiction between unbalanced and inadequate development and the people's ever-growing needs for a better life. The unbalanced development is partly reflected in the gaps

between different industries, i.e. overall backwardness in spite of partial leadership. On the one hand, China has the most advanced aerospace technology and high-speed railway technology. On the other hand, the Chinese people are buying high-quality consumer goods from abroad. Advanced technology exists but in state-owned enterprises because it is produced under government investment and guidance. Except for a few enterprises like Huawei that attach great importance to product quality, most of the private enterprises are not motivated to improve their product quality and their technological levels are generally low because the extremely free-market environment gives them other easy means of increasing profit, such as lowering wages, selling products to less developed areas, and financing by getting listed after mergers and acquisitions.

However, as analyzed above, in order to realize the economic development goals set by the *Report at 19thNational Congress of the Communist Party of China*, the only way is to upgrade industries by following the new industrialization road. In the Chinese economy, there are already many elements to force enterprises to upgrade themselves, for example, the ever-increasing market competition, the increasing demand for product quality, rising cost of labor and land. In response, many enterprises have adopted strategies to raise product quality voluntarily. The workers' work environment has also been improved. Recently, Shanghai Municipal Human Resources and Social Security Bureau published a survey of skilled worker wages in Shanghai enterprises that involved more than 100,000 people. Their data revealed that in 2016, for 10% of the skilled workers, the annual income was more than 174,500 *yuan*; for 50% of the skilled workers, the annual salary was more than 95,100 *yuan*; and that the skilled workers' salary rose quickly in recent years (Luo 2017). Still, we should be wakeful of the complexity of this transition, and we should realize that its final completion needs the state government to establish the industrial ideology that encourages enterprises to raise product quality, design and introduce new governance modes for enterprises that promote industry upgrading.

3 The Dilemma of Chinese Vocational Education Under Dual Economy Policy and Solutions

3.1 Raising the Development Level of Vocational Education Under the New Form of Industry

The form of the industry featuring high-end manufacturing must be supported by advanced, industry-oriented vocational education, otherwise, manufacturing will suffer due to the lack of highly skilled talents, just as what happened in the UK case.

China's vocational education development has been actively serving the needs of skilled workers, as required by the economic development. Since the Reform and Open-up in 1978, the demand for skilled workers by the fast-developing economy has

been contributing to the vocational education system. However, although the overall direction is correct, the vocational education in practice is more like that of the UK, rather than Germany or Japan. First, vocational education has a low level of enterprise involvement and has no system basis. High-level skill training requires an apprenticeship, but the teachers of vocational schools cannot undertake this task. Since the beginning of the twenty-first century, China has been promoting school-enterprise cooperation, but little has been achieved. In 2014, China introduced pilot projects of modern apprenticeship, but the project's development proved very difficult, due to the lack of enterprise support and funds. Second, practical skill training is much less than theoretical knowledge. Although China has been introducing competency-based curriculum reform since the 1990s, and such reform has been popularized and deepened since the beginning of the twenty-first century, actual vocational education is still dominated by theoretical courses and work skill training is far from enough. Third, the motivation of learners runs very low. Even if we have established so many vocational schools and vocational colleges, recruited many students with effective measures, we have not solved the problem of their motivation to learn skills. Few vocational school students are willing to be workers. What happened in the UK in vocational education is repeating itself in China. Although the two countries have different cultural backgrounds, this difference only affects the condition and roads to solve the problem while the nature of the problems in the two countries is comparable.

3.2 The Economic Root of China's Vocational Education Development Problem

China chose high-end manufacturing as its direction of industry form of development, and has realized the support of vocational education for high-end manufacturing, and attached great importance to vocational education. At the state level, China's industrial development policy is compatible with the policy of vocational education development. The 1985 education structure reform set the goal of recruiting roughly the same amount of secondary vocational school students as that of regular senior middle schools. The expansion of secondary vocational education provided a rich supply of labor for the fast-growing economy in the 20 years after the introduction of Reform and Open-up policy. In the twenty-first century, together with the promulgation of the industry upgrading goals, the Chinese government ranked vocational education among national strategies and put forward concrete goals such as promote the intensive development of vocational education, establishing a modern vocational education system, etc. The earliest document to rank vocational education among national strategies was the *Advice to Further Strengthen Vocational Education* promulgated in 2004, which stipulated as follows: It is a mission of strategic significance to change the relative backward situation of vocational education so that it can play its fundamental role in economic and social development.

However, under China's extremely loose market economic operation mode, most enterprises do not have the inner drive to realize industry upgrading; they are not willing to participate in vocational education due to their production mode. Such enterprises do not have appealing jobs for highly skilled workers and individuals do not have enough motivation to receive vocational training in order to enter posts requiring skills, because these enterprises have not set up governance systems suitable for high-end manufacturing. This situation caused contradictions between the needs of the state, enterprises and individuals. If these contradictions go unsolved, industry upgrading will be difficult due to the lack of the highly skilled workers needed by high-end manufacturing, the goals cannot be realized, and the economy will ultimately decline.

3.3 Repositioning of Enterprises' Role is Key to the Solution of the Vocational Education Dilemma

Now that the form of the industry featuring high-end manufacturing and the vocational education that provides human resource support can only be realized in an economic operation environment that has certain constraints on enterprises' market behaviors, we must reconsider the modes of market economic operation in China. The most important is to reposition enterprises' role in the market, adjust market rules, under the condition of ensuring enterprises' autonomous development enthusiasm, guide more enterprises to increase their profits by improving their technique, management expertise and worker' skills, transform enterprises from mere profit-pursuing market players into contributors to social welfare under the balance of various parties.

How can enterprises realize the change of their role? A key part in reshaping the inner governance of enterprises. Of the two kinds of behaviors in enterprises that need to be coordinated by Post-Fordism, the more fundamental and complex is the relationship between enterprise leadership and workers, i.e. breaking the hierarchical structure between leadership and workers, so that workers can participate in decision making, changing the situation where a few leaders decide the governance of all major issues. For example, in Germany, laws require that workers take up one-third of the enterprise board of directors. This system was once questioned in Germany because it can indeed affect the decision flexibility of the enterprises in the market. But this system finally proved worthwhile, because it greatly increased the workers' work enthusiasm, forwarded the market information from production to enterprise decision making, and supported high skill and high-quality industry development. The increasingly excellent performance of the German industries in the twenty-first century has demonstrated the advantage of this enterprise system.

During the Chinese planned economy era, enterprises' lack of market autonomy caused so many serious problems for the development of industries that its elements were later totally discarded in the market economic reform. Actually, some of the

governance means in enterprises during the planned economy era are very valuable. For example, at that time, workers had high status in enterprises and could participate in enterprise decision making, unlike what is happening in enterprises nowadays when workers are merely fluid labor or appendage of machines. The post-Fordist enterprise system is not unfamiliar to China, which constitutes an important basis for enterprises to realize the transition of their market roles.

As regards economic institutions, China implements a socialist market economy with Chinese characteristics. Although China emphasizes the decisive role of the market in economic operation, a decisive role is not an absolute role. Control and mediation is the inner element of Chinese modes of economic operation. This is the institutional basis of enterprise system reform. Of course, this reform process must be very difficult, but it is inevitable.

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The Educational Value of the Body: A Perspective of Phenomenology

Haosheng Ye

Abstract A human being is one who unifies the body and the mind. Phenomenology, which implies "returning to things themselves," suggests that we should "return to nature." Husserl's classic phenomenology stressed conscious experience, while Merleau-Ponty replaced it with the perceptual experience of the body, and transformed the phenomenology of consciousness into the phenomenology of the body. The theory of embodied mind, strongly influenced by phenomenology, stresses the construction of cognition by the body and claims that the body, which is not an "object" but a "subject" in the production and reproduction of knowledge, "constructs" knowledge. Cognition, which originated from the recurring mode of consciousness-action of the body, results from the movement of the body and is in essence a sort of experience of the body. The embodied education and teaching emphasizes the unity of the body and the mind and advocates the transformation from the representational view of knowledge to the view of embodied knowledge by using the principle of embodied learning in education and teaching to further the change of the views of education.

Keywords Enactivist view of embodiment · Embodied mind · Phenomenology · Phenomenology of the body · View of education

In education, the body has always been suppressed or disciplined (Fan and Gao 2018). Although the Roman poet Juvenal advocated the maxim, "*Mens sana in corpore sano* (a sound mind in a healthy body)," the dualism tradition which was started by Plato and promoted by Descartes put mind and body into a dichotomy, lowering the body to the servant or carrier of mind. "It is not difficult to see the influences of this tradition on most models of schooling and their disembodied conceptions of human beings, in which the mind is both the subject and object of education, and the body is a service and transport role that is separate and inferior" (Bailey 2017).

But a human being is one who unifies the body and the mind, and "there is deep continuity of life and mind" (Thompson 2007, p. 157). This suggests that

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education, as a human activity, faces the whole person, not merely the mind above one's neck. Phenomenology, which implies "returning to things themselves" suggests that we should "return to nature," return to the original logos, i.e. the lived, present experiences, and sublate the disembodied education mode that seeks the essence of mind behind the surface of the body. French phenomenologist M. Merleau-Ponty inherited and reconstructed the methodology of classic phenomenology, developing Husserl's phenomenology of consciousness into the phenomenology of the body, stressing the epistemological value of the body and bringing about the birth of the embodied view of education. Education and teaching are entering the embodied era.

1 From Phenomenology of Consciousness to Phenomenology of the Body

The phenomenology was set up by Husserl in the early 20th century, as opposed to the positivism philosophy. Positivism, the basis of Descartes' dualism, proposes that scientific knowledge is the truthful description of an object by the subject. True science should exclude the consciousness experience of the knower, without any subjective bias. Scientists seem to hold the "mirror of nature," which describes facts and reflects nature. However, Husserl believed that positivism can only get the explanation of the experience in nature, and it cannot be equated with things themselves. With the conviction of "phenomenon being essence," Husserl believed that essence did not hide behind the phenomenon, instead, it was expressed in the phenomenon, so the phenomenon is the essence. Here, the "phenomenon" used by Husserl refers to the object of consciousness, the so-called "things." "Returning to things themselves" means returning to the initial appearance of things in consciousness, focusing on the way the object appears in the consciousness and our "initial experience" of it, rather than seeking various external interpretations. This is because those external hypotheses and interpretations can only hide and distort the understanding process and hinder understanding. Phenomenology seeks the lived experience that appears in consciousness. "[T]he phenomenological term 'lived experience' does not refer to any kind of deep experience, fundamental event, or hidden source of meaning—On the contrary, lived experience is just the name for ordinary life experience as it carries us on in its lived everyday current….The point is that we do not think about, or phenomenologically reflect on our experiences while we 'live' them" (Van Manen 2017). Husserl's goal was to challenge the positivism view of knowledge and used the clarification of consciousness experienced as the Archimedes point to pry scientific knowledge, overcome "objective thinking," and restore the legitimacy of subject consciousness in epistemology.

Husserl's phenomenology is the phenomenology of consciousness, discussing the relation between object and consciousness, that is, the so-called "intentionality question." The implication of phenomenology of consciousness for education is that

educators should shake off the prejudice of various education theories and preconceptions, suspend those preconceived theoretical hypotheses, directly face the learners' life world and consciousness experience, and return to the original education activities themselves. However, Husserl's classic phenomenology did not realize the epistemological function of the body. In his early works, Husserl mentioned the reliance of perception and cognition on the body. In *Thing and Space Lectures of 1907* (Husserl 2013). Husserl discussed the role of muscular kinesthetic consciousness in the formation of visual perception. According to traditional views, visual perception results from external objects' stimulating the retina and the formation of visual perception is dependent on the retina, having nothing to do with the body movement system. However, Husserl believed that the movement of extraocular muscle controlled the direction of visual perception, the kinesthetic consciousness feedback coming from this movement will inevitably be involved in the formation of visual perception. Therefore, the formation of visual perception is usually accompanied by the activation of body kinesthetic sensory mode, and the position and shape of the object and the potential body movement mode configured the content of visual perception. This analysis of the formation of visual perception emphasized the role played by the motor system and is echoed by the contemporary analysis of mirror neuron mechanism (Ye 2016).

As regards the body, Husserl discussed the difference between the body as the object and the body as the subject. The body as the object is the body to be understood, and there is many so-called "scientific knowledge" about this body. In other words, this body is "Körper (the material body)," namely the objective and passive body, the object of knowledge and reflection. By contrast, the body as the subject is the body that generates understanding, different from the material body: we do not view the body as a thing among many things. Rather, the body as the subject is the phenomenological body that is motile and pre-reflective. It generates understanding and experience. At the same time, although the body as the subject is pre-reflective, this does not mean that we do not have any conscious perception. In fact, the position and movement of the body are always in the field of intentionality. This intentionality is pre-reflective and is a phenomenological experience. Husserl's distinction between the body as an object and the body as subject anticipated Merleau-Ponty's phenomenology of the body. Merleau-Ponty furthered Husserl's "phenomenological body theory" by spiritualizing the body and vice versa. The body is no longer the "objective object," but the body-subject that is united with consciousness, realizing the shift from "phenomenal body" to the "phenomenology of the body."

Fundamentally, Husserl's phenomenology is the phenomenology of consciousness, not the phenomenology of the body. Phenomenology of consciousness discusses intentionality of consciousness, in order to solve the puzzle of the source of cognition, namely "how can we be certain of the correspondence between cognition and the object cognized? How can knowledge transcend itself and reach its objects reliably?" (Husserl 1986). Husserl emphasized the construction of objects via conscious experience, in order to achieve an understanding of the things external to consciousness. According to Husserl, the object world does not exist outside consciousness, rather it exists in consciousness via intentionality and has the so-called "inner objectivity."

An object gains particular meaning only when consciousness is directed towards it in various directions. Before being intentionally grasped, the object world is chaotic and meaningless, and it is the construction of the world by the consciousness that gives meaning to the world. So cognition starts from consciousness experience, and "returning to things themselves" means returning to "pure consciousness," and returning to the initial appearance of the object in consciousness. Merleau-Ponty's phenomenology of the body replaced "consciousness experience" with "body experience," replaced "conscious intentionality" with corporeal intentionality, and shifted the focus of phenomenology from the relation between consciousness and object to the relation between body perception and perception objects. Thus the body has the significance of "constructing knowledge," displaying the epistemological value of the body.

Merleau-Ponty's phenomenology of the body both inherited and developed Husserl's classic phenomenology. Husserl insisted on "returning to things themselves." As Merleau-Ponty asserted, "Phenomenology is the study of essences…. But phenomenology is also a philosophy that puts essences back into existence, and does not expect to arrive at an understanding of man and the world from any starting point other than that of their 'facticity' …. It tries to give a direct description of our experience as it is without taking account of its psychological origin and the causal explanations which the scientist, the historian or the sociologist may be able to provide" (Merleau-Ponty 2001). What Merleau-Ponty needed to do is also "returning to things themselves," but the "things" understood by him were different from Husserl's "things." Husserl's "things" are "pure consciousness" and "transcendental ego" while Merleau-Ponty's "things" are the body experience obtained from perception. According to Merleau-Ponty, all rational forms of human beings are built on the experience from body perception. The body perceptual experience is the basis of all reason and is the most original and truthful experience. "Returning to things themselves" is to go back to this vague, pre-reflective body experience.

The core of Husserl phenomenology is "consciousness" while the core of Merleau-Ponty's phenomenology is "body," which takes up the central position in Merleau-Ponty's philosophical system. But Merleau-Ponty's "body" concept differs from the traditional dualism understanding of the "body." In the dualism perspective, the body is a physical entity, having extensions, and is the counterpart of the mind. However, Merleau-Ponty believed that the body understood in this way is no longer our body, but the object of biology and medicine. The body without consciousness and spirit is practically a machine with mechanical and biological nature, only a carrier of consciousness. According to Merleau-Ponty, the body is the unity of material and spirit. Just as Merleau-Ponty (2004) said, "rather than a mind and a body, man is a mind with a body, a being who can only get to the truth of things because its body is, as it were, embedded in those things." The body is neither a purely material, mechanic existence, nor a purely spiritual and conscious existence. It is both the object and the subject, and it is a body-subject. It is both the first-person "I," and the third person "it." It can both perceive and be perceived. "The body that sees everything is able to see itself, and recognize the 'other side' of its observation in the objects it sees" (Zhu and Lu 2000). The body brings us into the world in this

entangled way. This body is a physical subject, different from Husserl's "conscious subject," which gazes and overlooks the world. The physical subject can contact and understand the world via things that one can see, things that can be seen, touch and perception. For example, when my right-hand touches my left hand, the right hand seems to be the subject and the left hand the object. But the left hand is also touching the right hand and the right hand is object. The relationship between the body and the world is such an entangled one. Heidegger's "being-in-the-world defines the style of the body's understanding of the world. Merleau-Ponty pointed out, "The body is our general medium for having a world" (Merleau-Ponty 2001), and is the medium through which we are connected to the world.

As a medium, the body opens up to the world. The intentional activities of understanding the world are not the connection between consciousness and the world, but the connection between perception and the object of perception, namely the so-called "corporeal intentionality." Merleau-Ponty believed that this corporeal intentionality is closely related to physical perception. The object of consciousness activities is the object of body perception. The initial appearance of "things" does not happen in consciousness, but in the body's perception of the world. So the relationship between the body and the perceived world is the most original. The start of cognition is not the construction of the consciousness object by the consciousness, but the merge and infiltration of body perception and the perception objects. Body, as the medium through which we are connected to the world, does not need to start from the construction of consciousness to understand intentionality.

The corporeal intentionality and the conscious intentionality have the same formal structure. Husserl believed that meaning is constructed by the intentionality of consciousness and everything in the world get their meaning because they are connected to consciousness, becoming the objects of consciousness. Merleau-Ponty believed that in the initial body experience, the body is a Gestalt of life, the focus and center of meaning. Everything in the world has stable meaning only after they have become connected to the body and become its perception objects. Therefore, compared with consciousness intentionality, corporeal intentionality is more original and more fundamental. The intentional activity of the body does not need the "*cogito* (I think)" element, as it is vague, pre-conceptual and pre-reflective, and it is the body understanding of space and visual perception characteristics of things. It represents "I can," which is a more fundamental intentional activity. In the process of the body's opening up to the world via perception, the perception objects gain meaning because of their connection with the body movement capability, which "suggests that for a normal person, every movement is both movement and moving consciousness. In the requirement of normal living, intentionality and body movement are connected. Through the projecting of the body, the normal person establishes a meaning relation between perception and perception world" (Ji 2010). Therefore, the body is the center of meaning, and the basis of all changes of meaning.

Merleau-Ponty's phenomenology of the body highlighted the foundational role of the body in cognizing the world, questioned and criticized the consciousness philosophy tradition from Descartes that "suppressed the body and promoted the mind," and changed the view of knowledge. Traditionally, knowledge is the result of

consciousness construction, independent of the body. But the phenomenology of the body tells us that man is the unity of the body and consciousness, the unity of flesh and spirit, sensibility and reason, object and subject, as well as that of nature and value. In this perspective, the mind, the body and the environment are inseparable from each other. The "embodied mind" is formed in this intellectual background. The embodied mind reflects the idea of the phenomenology of the body, places the "body-subject" which has the mind-body duality, in the center of cognition, not only influencing the development of cognition science but also bringing forceful impacts on the traditional education mode that features "shaping the heart" (Ye 2015).

2 The Value and Significance of the Body in Education and Teaching

Under the influence of dualism thinking, mainstream Western philosophy has been engaged in the exploration of reason, will and wisdom while the body becomes the sacrifice of reason and soul. This philosophical belief extends to the education domain, where education and teaching are viewed as "the shaping of souls" and "the discipline of the body." The "emphasis on mind" and "disembodiment" became the typical catchphrases of this education theory. But the initial form of education is the instruction between the elders and the young children, which involved personal examples and verbal instruction. In this process, the body plays a key role, especially before the emergence of words when the body movement of educators and the educated, as well as the body experience thus generated, constituted the main channel of learning. However, in today's education, the voice of the body is waning, as if education and teaching are unrelated to the body. Merleau-Ponty's phenomenology of the body suggests that we must return to the experience domain of body activity, and focus on the value and meaning of the body in education and teaching.

The body is not the object to be cognized in the production and reproduction of knowledge, but the subject of cognition which plays the role of constructing knowledge. For teachers' instruction and students' learning, the body plays the role of the subject of cognition. Traditional education is deeply influenced by philosophy. Both R. Descartes' "*Cogito Ergo Sum* (I think, therefore I am)" and I. Kant's idea of "reason prescribes laws to nature" reflect the dominance of consciousness. In consciousness philosophy, the subject consciousness was promoted to the criterion of knowledge and the subject prescribing everything. The body was degraded to be its servant or attendant. In a word, there is an insurmountable gap between knowledge and the body. When the view of mind prioritizing mind is implemented in education, the mind becomes a process happening in the central nervous system of the brain, unrelated to the body. The school thus becomes a spiritual training camp that develops the mind and disciplines the body.

But is the body a mere carrier or vessel of the mind? Varela and other scholars pointed out the motility of the body profoundly: "By using the term 'embodied'

we mean to highlight two points: first, that cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities, and second, that these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context…(1) perception consists in perceptually guided action and (2) cognitive structures emerge from the recurrent sensorimotor patterns that enable action to be perceptually guided…" (Varela et al. 2016). The message of this passage is that cognition is not unrelated to the body, but comes from the bodily movement experience. Essentially, cognition is a body experience, which comes from the body with certain physical construct and motor ability. Cognition is impossible without this body. As a cognition process, the perception as cognition process is not detached from the body, but exists in the action directed by perception, and is united with body movement. In other words, it is an embodied action. The previously conceived sacred cognition is by no means mysterious. It is neither the result of Kant's a priori categories, nor the strengthened coupling developed by the environment. The cognition structure is formed in the sensorimotor mode that repeatedly occurs in body activities, and it is the internalization of the body actions. It is not unrelated to the body that has a certain sensorimotor capability. Therefore cognition is the body's cognition, the body is the subject of cognition. The subject's construction of knowledge is not done by consciousness, but by the embodied action, in the repeatedly and frequently occurring sensorimotor mode.

Varela's embodied mind emphasized the direct connection between cognition and body experience, explicitly reflecting the influence of Merleau-Ponty's phenomenology of the body. The phenomenology of the body replaces the "*cogito* (I think)" with the "I can" of the body, and establishes the cognition of the world on the foundation of the corporeal intentionality. Such a phenomenology is reflected in Varela's embodied mind theory. The embodied mind is neither "pure consciousness" nor "purely corporeal." On the contrary, it blends consciousness and the body, sensibility and reason, material and spirit, and is the physical mind, reflecting the nature of "body-subject." The construction of knowledge is completed by the embodied mind of the "body-subject."

Similarly, G. Lakoff and M. Johnson's image schema theory reflects the influence of the phenomenology of the body (Lakoff and Johnson 1999). Image schema is the knowledge structure developed via body action experience and can be applied to understanding experience and metaphorical inference. In the process of adapting to the environment, man interacts with the environment with various body movements. The body exists in the contacts and interactions with the objective world, such as walking upright, passing barriers, entering the room, drinking water when one is thirsty, eating when one is hungry, etc., which seem to be irrelevant body activities but entails a stable structure. Through these activities, we form the patterns such as up-down, left-right, front-back, entrance, exit, entailment, crossing, jumping out, etc. The cognitive representation formed by these activity patterns constitutes the so-called "image schema," such as space schema, vessel schema, movement schema, balance schema, force schema, etc. Image schemata constitute the basic way in which man cognizes the world. The originally chaotic natural world becomes ordered

and meaningful via the projection of image schemata. But the formation of image schemata relies on the body activity experience working on the environment. It perfectly matches the embodiment belief that "cognition structure comes from the repeatedly occurring sensorimotor mode." The most familiar body activity to man is "eating." Through the body experience of "three dinners a day," we developed the image schema of eating. As we cognize the world using the image schemata shaped by body movement, we developed the Chinese interpersonal and social understanding such as "eating soft rice (usually a man relying on his wife or female partner), "eat a pitfall and increase a portion of wit (A fall into the pit, a gain in your wit)," "eat bitter (have a tough time)," and "eat flavor (be jealous)." Man has two hands to push things forward. The body movement of frequently and repeatedly pushing things develops into the image schema of "force." Using this image schema to understand the society, we have the abstract metaphor of "pushing" social progress. Can the development of being "pushed" manually? But via the metaphorical mapping of image schemata, we can "push" society. Here, the action of the "push" shapes our way of thinking to cognize the society. These examples demonstrate the value and meaning of the body in knowledge construction. Image schemata result from physical activities, not from rational thinking, not from conscious reflection. The formation of image schemata is non-conscious, and has the experience characteristics of pre-reflective phenomenology, and complies with the basic principles of the phenomenology of the body.

The body not only constructs knowledge but also plays an irreplaceable role in the knowledge learning process. Especially in the learning process of grasping the meaning, the intervention of the body is the key to the success of learning. In education history, learning theory once constituted a fad. This theory establishes learning on the basis of observation and experiments, emphasizes the objectivity of the learning process, and believes that learning is a conditioned reflex and a change of behavior. Just like the dogs in Pavlov's laboratory, the learning process is one in which learners establish a stable connection between environment stimulus and behavior reaction. This connection is mechanic, and its mechanism is causal and can be explained using natural science, not involving any subjective consciousness and values. The learning theory believes that only the knowledge thus obtained is objective and scientific. However, this objective way of learning does not explain the learners' subjective experience. Due to the detachment from the first person "I" experience, this objective way of learning can only explain learning on the observable level, and it is unable to explore the "meaning" plane of learning and unable to help explain the learning of meaning.

Cognitivism or constructivism are just answers to this problem of learning theory, attempting to resolve the problem of meaning learning through learners' subjective construction. This theoretical perspective has Kant's a priori categories as its blueprint, which advocates that knowledge does not come from the external world, but from the inner mechanism of the learner or the construction of thinking categories. Environment stimuli do not impose the content of learning mechanically on us. Education and teaching do not stuff knowledge into the learners' brain. Knowledge is constructed actively through learners' inner mechanisms. This construction

process is the process of meaning generation. However, the cognitivism or constructivism views of meaning learning face the same problem as the traditional view of learning does: Where is the role of the body? Can meaning be generated simply through the construction of consciousness? If knowledge and meaning are the results of certain cognition mechanisms or the result of processing stimuli by thinking categories, how can we prove the existence of such a mechanism or categories? Can it be like a dwarf living in a certain part of our brain? Here the dualism dilemma of Descartes became an insurmountable gap for the cognitivism or constructivism views of meaning learning.

There are many forms of knowledge learning and meaning grasping, not all forms are objective, experiential and rational. The phenomenological "returning to things themselves" lets us return to the vague and pre-reflective experience. They are the sources of meaning and the main channels of meaning learning. "Merleau-Ponty's philosophy seems to be a very suitable theory to explain the important role of perceptual experience and body in knowledge understanding. For the knowledge learning from the grasping of meaning, Merleau-Ponty's philosophy is cannot be more relevant" (Stolz 2015).

Embodied learning is the Merleau-Ponty style of learning. It is a kind of learning through bodily experience. In this learning process, the body and the perception experience of its activity are in the central position. Embodied learning is not about the acquisition of conceptual knowledge, but an understanding obtained via body experience. Its key lies in the fact that we gain understanding from our own body experience, i.e. the first person "I," which is a phenomenological way of cognizing. The world is meaningful to us. The world of our perception is not elemental, objective and cold existence, but a coherent meaningful consortium, which has the body as its center. In the perspective of phenomenology, the world appears in our perceptual experience in an integrated form. We do not construct the meaning of the world in perceptual stimulus. Rather, meaning is an inseparable part of the world of perception, and is determined by the relation between the body and the world. Take the example of a table, its meaning is not constructed by us and is not reflected by the perceptual elements, such as its shape and color. Just as Merleau-Ponty (2004) pointed out, the way of appearing of a table in our world of perception is a way of appearing of meaning: its size and height provide us with a device to support our body, which is its practical meaning. This meaning comes from our body. If it is a table left to me by my parents, it has affection meaning, as it is related to my parents' caring and my fond memories of them. If the table has a good shape and makes my room beautiful, it has aesthetic meaning. These are all determined by my body and life experience. Without the body, the table has no meaning. This demonstrates one point: The grasp of meaning is inseparable from the body.

Emotional learning is more closely related to the body. One century ago, American psychologist William James, the founder of pragmatism, discussed the physical nature of emotions. He believed that emotions were not caused by cognition, but body reaction. When we meet bears in the wild, we do not flee because we panic. Instead, we panic because we flee. The fleeing body reaction causes panic. The key to this emotion theory is that the body reaction anticipates emotional experience;

environmental stimulus causes body reaction, the feeling of the body reaction is emotion.

Due to its difference from common sense, William James' emotion theory was dismissed by many as ridiculous. The follow-up emotional cognition theories paid more attention to the consciousness and evaluation elements in emotions and believed that emotions came from the cognitive evaluation of environmental stimuli. Here the body experience of emotion is downgraded as a secondary phenomenon. It is more an accompaniment of emotions than its cause, and it is the physiological clue to the ongoing emotions. But people soon find the drawbacks of emotional cognition theory, namely, it cannot explain the consciousness experience of emotion as a phenomenon. The evaluation of stimuli can lead to emotions. But what is the nature of emotion, namely what is our feeling under certain emotional states? These questions cannot be answered without reference to body experience. If we do not consider various body factors, such as accelerating heartbeat, muscular tension, short breath, and flush, we cannot determine the intensity of emotions. All of these require reference to body experience. This experience is not the product of conscious reflection, but the product of the first-person experience of "phenomenon." Without the body, the road leading to this phenomenon experience is totally blocked.

The difficulties of the cognitive theory of emotion brought people back to James' theory. An early experiment revealed that nodding and shaking heads indeed can change a person's emotional experience. In an experiment, those subjects making the vertical movement of the head (nodding) like the presents in front of them better while those subjects making the horizontal movement of the head (shaking) like other presents. Unconsciously, the nodding movement and shaking influenced the subjects' emotional experience of the things in front of them. (Wells and Petty 1980). Recent research had the same conclusion. In this research, those participants who performed the gestures of extending their hands to approach or receive had more positive emotion towards the target object than those who performed the gesture of dodging with their hands (Koch 2014). These experiments demonstrated one point: body movements can change one's emotional experience. James' "body reaction anticipates emotional experience" does not seem to be ungrounded. In the perspective of the phenomenology of the body, the experience caused by body movement must affect the emotional experience, because the mind is a physical experience. Then in emotional learning, it is necessary to make full use of the body, form different body experiences so as to develop appropriate emotions.

Education and teaching experiments also confirmed the facilitative role of the body in learning. In a young child language learning study, researchers divided the young children aged between 4 and 5 into two groups. One group listens to stories while doing activities related to the stories. The other group listened to the stories and watched the pictures related to the stories. The results revealed that the first group not only outperformed the second in the follow-up retelling of the plot sequence but also recognized more new words and idioms (Ionescu and Ilie 2018). The involvement of the body leads to differences in learning achievements. Another research found that the smooth physical experience of hands can facilitate students' creative thinking. Those required to perform smooth movement of hands outdid those required to

perform rigid hand movement in creative enactment, cognitive flexibility and long-distance association (Slepian and Ambady 2012). In addition, research also demonstrated that body gestures not only have a communication function but also facilitate students' acquisition of concepts and the change of mindset. In learning mathematical concepts, if the teachers can make full use of gestures, students will have better memory retention and more effective inductive reasoning. Why is this the case? "[G]esture may be effective simply because it involves the body" (Congdon et al. 2017). Mathematics has been long since regarded as irrelevant to the body, because mathematical concepts are abstract, involving numbers and symbols. However, even the abstract disciplines, such as mathematics, cannot do without the body.

3 Education and Teaching Striding Towards Embodiment

Phenomenology asks us to "return to things themselves," asking us to focus on the original, lived, first experiences in education and the teaching process. According to Husserl, this experience is a pure consciousness experience. In Merleau-Ponty's terms, it is the perceptual experience of the body, which comes from bodily activities in the environment and the basis of all human reason. This thought, after being condensed by Francisco Varela and others, developed into the heat wave of embodied mind research. The embodied mind examines the value and status of the body in knowledge, changes the denigration of the body by educators, and drives education and teaching towards embodiment.

Psychology has been regarded as the scientific basis of education. The behaviorist learning theory, Piaget's theory, cognitive psychology theory, and humanistic psychology have all impacted education and teaching. The view of the mind in psychology, i.e. how to view the influence of consciousness and psychology on education and teaching, determines the curriculum setting, selection of pedagogy and determination of teaching strategies. From this point of view, the appearance of "embodied mind" inevitably challenged traditional education and teaching, which is used to "shape one's heart."

The traditional disembodied education mode, which emphasizes shaping one's heart, has the following characteristics. First, the dualism view of mind and body believes that the mind is different from the body. Second, human intelligence is rational: it involves the use of language and/or other kinds of symbols. Third, human intelligence is abstract: it involves concepts that are less closely or less obviously tied to concrete experience. Fourth, thinking is conscious, involving analysis, induction and inference. Fifth, thinking is reflective, likely to feel effortful, rather than smooth and automatic. "The key question is: how much can we attribute these more intellectual abilities to the workings of the body? The Cartesian answer was: not at all" (Claxton 2015). The traditional pedagogy is built on the basis of this understanding of the mind.

The embodied mind under the influence of phenomenology puts the body in the center of cognition and asserts that "perception, thinking, feelings, and desires—the

way we behave, experience, and live the world—are contextualized by our being active agents with this particular kind of body. In other words, the kind of body we have is a constitutive precondition for having the kind of behaviors, experiences, and meanings that we have" (Overton 2013). This means the body has gained unprecedented importance in the embodied mind, become the cognition subject that unites flesh and spirits, determined the way we experience the world and construct meaning. These body-subjects set the ontological foundation for embodied education and teaching.

The embodied education and teaching is based on the enactivist view of the embodiment, which regards cognition or mind as "enacted." In other words, cognition is generated in the body activity that is imposed on the environment, and its aim is to instruct the organism to act effectively. Cognition is closely related to body movement. Its basic views are listed as follows.

First, cognition is enactive. In other words, cognition is not the impression or representation of the objective world by a ghostly subject. Rather, cognition is the result of body movement and is the action of the body imposed on the environment. Its aim is to guide this activity. Just as the Chinese proverb goes, "roads are made by travelers." There is no road in the first place. A road is formed when more and more people travel by it. Using this metaphor to understand cognition, we will find that cognition is not the representation of the world following a fixed route. On the contrary, cognition is generated in the action of the body on the environment, in order to make the organism adapt to the environment. It is "enacted" by body movements, not "represented" in the brain.

Second, the body is the subject of cognition and is in the central position of cognition. The body is neither the object of cognition nor the servant of the central nervous system. On the contrary, cognition is the cognition of the body and the body is the cognition subject. Just as Merleau-Ponty put it, we do not own our bodies; we are our bodies, and our bodies constitute the way we own the world. "[I]t is the body which 'understands' in the acquisition of habit….To understand is to experience the harmony between what we aim at and what is given, between the intention and the performance—and the body is our anchorage in a world" (Merleau-Ponty 2001, p. 190). Different bodies have a different experience of the world. The different types of bodies have different ways of knowing the world. The way and scope of interaction between organisms and the environment depend on their forms of bodies and capacity of action.

Third, lived experience is the focus of cognition research. Influenced by phenomenology, the enactivist view of embodiment emphasizes the lived experience of the first person, which is human experience examined in a direct and live situation. Fundamentally, cognition is the body experience generated in the interactive process of the actor and the world, which is lived, vague and pre-reflective, and is the body experience of the organism in the life world. Due to its first-person nature, lived experience has always been rejected in cognition science. However, the research of learning, memory, feelings, motivation and will has been wandering among the observables and unable to tap the real experience of the actor, due to

the rejection of the actor's experience. Therefore, the enactivist view of embodiment emphasizes the direct perception phenomenology, and grasps the first person experience directly. Fourth, cognition, body and environment constitute a dynamic whole, the parts of which interact and couple nonlinearly. There are no clear-cut boundaries among them. According to the enactivist view of embodiment, the body plays a constitutive role in cognition; cognition does not happen at a particular place, it happens in the interaction among brain, body, and the environment. The ego and the world are not subject and object. They are entangled, just as Merleau-Ponty put it: "The world is inseparable from the subject, but from a subject which is nothing but a project of the world, and the subject is inseparable from the world, but from a world which the subject itself projects." (Varela et al. 2016, pp. 4–5).

The summary above is not the total of the enactivist view of embodiment and it is a summary of theories related to education and teaching. Embodiment education and teaching are based on such an understanding of mind. Its emphases are reflected in the following points.

First, it emphasizes the unity of body and mind and adheres to the principle of mind-body unity. Traditional education theories view body and mind as a dichotomy. Based on this dualism, traditional education and teaching prioritizes mind and downplays the body. School education focuses on the transmission of ideas and the cultivation of spirits. Learning is viewed as spiritual training, not related to the physical body and its movement capacity. Under the guidance of this thought, the school curriculum obviously inclines towards content related to the mind. Abstract courses such as math, physics and language are given the most attention. Courses related to the body, such as physical education, art, and humanistic courses, are subject to auxiliary or unimportant status in the hierarchy of curriculum. Embodied education and teaching accepts Merleau-Ponty's phenomenology of the body, views mind and body as inseparable from each other: Mind is the mind of the body; the body is the mentalized body; the mind is "body-subject" and is the incarnation of the subject that combines spirit and flesh. The implication of this mind-body unity principle for school education and teaching is that school curriculum should not only focus on courses related to abstract thinking, but also break through the limits of pedagogy and combine the embodied knowledge with curricular knowledge, and train learners' thinking and innovative ability through body movement. John Dewey emphasized "learn from doing" and had children obtain an understanding of the world through body movement. He also emphasized the combination of bodily movement with reflective thinking practice, through bodily practice. Knowledge learning is not a purely mental process, but the product of body and mind activity. Regrettably, Dewey's embodied "learning from doing" was forgotten among the waves of the rationalism of education, and replaced by the focus on the so-called "internal mechanism." In school education, "mathematics has been firmly entrenched at the top of the curriculum hierarchy …, while physical and vocational subjects have languished at the bottom" (Bailey 2018). Embodied education and teaching starts from the body-mind unity principle, reexamines the role of the body in knowledge construction and knowledge learning, attaches the same importance to "learning and understanding via body" in curricular learning as math, physics and language courses, integrates

the teaching and learning of bodily knowledge and abstract knowledge, to promote the healthy development of students.

Next, embodied education and teaching require the transformation of view of curricular knowledge. Traditional education adheres to the representational view of knowledge, according to which knowledge is independent of the subject and cognition is the subject's true reflection or an accurate representation of objective knowledge. In other words, there exists an object of knowledge and the subject has this object as its object. Knowledge comes from the correspondence between the subject and the object. This view of knowledge is based on Descartes' dualism, adhering to the dichotomy of subject and object, and the image theory of the relationship between knowledge and the world. Its limitations are reflected as follows. This objectivism view of knowledge ignores the influence of individual body perception-movement experience and subject value beliefs, only adhere to the accurate representation of objective knowledge by the mind, separates knowledge from the living world of the knower, making knowledge an abstract system that transcends time and life. The implementation of this view of knowledge in education and teaching results in the separation of curricular knowledge and student individual life experience, and the separation of the teaching process and students' practice activities. Teachers become the porters of knowledge, and students become the receivers of knowledge. Teachers have to have a pail of water to fill students' cups. Education and teaching nearly become stuffing and linear filling. Students' manual skills and innovative thinking are generally suppressed. In contrast, embodied education and teaching centers around the body, emphasizes embodied knowledge, and reconstructs the view of curricular knowledge. According to the enactivist view of the embodiment, cognition is an embodied activity. "Cognition is not something happening inside us or to us, but it's something we *do*, something we achieve" (Merritt 2015). This means that knowledge is closely related to the body movement of an individual's body. From the relationship between knowledge and body, knowledge is not the objective reality independent of the body. Due to the differences in the body structure, kinesthetic ability, and the interaction and relationship with the environment, the world facing an organism varies greatly. There is no such thing as objective knowledge world detached from the organic world. Knowledge is constructed, the construction process is embodied, and is the result of organic body movement. Considering the curricular teaching from the embodied view of knowledge, the teachers and students are the actors of the knowledge production process, not passively waiting and receiving. Instead, they do use the body to practice and create. This is the direction of exploration for the embodied education and learning.

In addition, embodied education and instruction require us to switch learning styles, establishing the learning of abstract knowledge on the basis of body experience, and making embodied learning the basis of the learning process. Traditional education and teaching establish the learning process on the basis of rationalism or empiricism. The rationalistic view of learning regards knowledge as the highest attainment of cognition, regards the propositional, abstract and universal knowledge as the main aim of learning. This view of learning believes that there is an insurmountable gap between the things happening in the mind and those existing in the

objective world, and that learning is a process in which learners use their rational ability. Rational ability comes from the brain, playing the role of collecting, storing and applying knowledge. This view of learning pays more attention to the cultivation of rational thinking and the acquisition of abstract and universal knowledge. Opposite to the rationalistic view of learning is the empiricist view of learning, which views knowledge as objective, external and permanent, and views learning as the absorption of objective knowledge, as if the learner is a "*tabula rosa* (blank slate)." Perceptual experience carves various marks on this blank slate. The learning process is passive and inactive. Both rationalism and empiricism neglect the key role played by the body in the learning process.

The embodiment view of learning puts body and the perceptual experience acquired via body movement on the key positions in learning. It focuses on the "phenomenon world" presented to us via body perception, the knowledge of which is vague, pre-reflective and is fundamentally a body experience. This experience is the basis of all rational forms of the human being. The embodied learning grasps this first-person body experience, focuses on situatedness, embodiment, interaction, and enactiveness. It requires us to start from the "life world" of learners in education and teaching, focuses on the body activity experience of learners. The learning of knowledge cannot solely rely on the abstract understanding of causal relations. It requires the learners' perceptual understanding and experience, requires the learners to experience and feel, in order to grasp the meaning of things. At the same time, embodied learning happens in social contexts. In this learning, others are both subjects and objects. Others' behavior shapes ours, makes our behavior adapt to the requirements of the contexts. Being in a learning context is being in a relation. The social nature of embodied learning makes learning no longer a "solipsism" process, but a participatory sense-making, reflecting the characteristics of intersubjectivity.

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How to Promote Preschoolers' Healthy Personality: An Empirical Study Based on a Field Experiment in Education Across China

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Abstract Preschoolers' healthy personality indicates stable and balanced personality traits that are universal and positively adaptable in their personality structure. Personality training should start in early childhood. This study utilized games as a medium to cultivate preschoolers' nine positive personality traits, including self-motivated spirit. The cultivation program included 108 detailed games with Chinese cultural characteristics. A one-year field experiment in education across China showed the following results: The field experiment produced a significantly satisfactory effect, with the preschoolers in the experimental classes which implemented game programs gaining significantly higher scores than those in control classes. After a year of training, the proportion of under-controlled and over-controlled types of preschoolers have decreased, while the proportion of resilient preschoolers have increased in the experimental class. The study concludes that the Chinese game program for the cultivation of preschoolers' healthy personality can effectively promote the development of Chinese preschoolers' healthy personality.

Keywords Preschooler · Healthy personality · Chinese game programs · Mode of cultivation

1 Introduction

The development of preschoolers' personality has been gradually gained great importance in recent years. The Chinese National Education Conference stated the goal for educational work—uniting people's hearts, perfecting people's personality, and developing human resources, cultivate talents and benefit the people. It also noted that preschoolers and adolescents nowadays should work hard to gain pure spirits, healthy personalities and noble characters. These have shown how significant preschoolers' healthy personalities are for individuals, families and the whole country (Guangming Daily 2016).

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Preschoolers are the hope and future of a country. Early childhood is critical for developing one's personality, and it has a great influence on a person's whole life. Nowadays, waywardness, inattention, etc., are some bad habits that are popular among Chinese preschoolers. According to a survey that interviewed 10,409 preschoolers in 15 provinces in China, Chinese preschoolers have some personality problems. These problems include poor emotional stability, creativity and integrity. The result also showed that the under-controlled preschoolers accounted for 18.6% of the total number. Meanwhile, the over-controlled types of preschoolers accounted for 56.2% of the total number. There were only 25.2% of the preschoolers with a resilient personality. Furthermore, previous research cases have also confirmed that 13.9% of children aged between 4 and 16 in China had mental and behavior problems. Besides, the detection rate of mental problems among 4727 preschoolers aged between 4 and 5 in the sample was 13.6 ± 2.01% (Tang 1993). Meanwhile, the detection rate of preschoolers' social adaptation problems among the sample was even higher, reaching 23.46% (Xi and Zhang 1992). Researches by other foreign countries showed that it was more difficult to develop preschoolers' agreeableness and emotional stability as the subject ages (Laidra et al. 2017). Also, researches at home and abroad have both shown that preschoolers' personalities in early childhood influence their life direction. For instance, a person with a sense of responsibility in early childhood can gain more happiness and higher quality of friendship in his or her adulthood (Hampson 2008). Also, a person with extroversion and emotional stability in early childhood tends to achieve higher social status in adulthood (Staff et al. 2017). In addition, a person with extroversion, self-control capability and better intellectual development in early childhood tend to have a healthier body in adulthood (Hampson et al. 2007). A person with self-delayed gratification in early childhood tends to have stronger communication skills in adulthood (Yang and Wang 2007). As the educator, Cai Yuanpei said, "it is not the learning that determines the life of a child, but a healthy personality." (Cai 2012).

Personality refers to an integrated system that contains various psychological characteristics. They are formed with biological basis as well as social living conditions. Those characteristics, with a tendency and dynamic property, are unique, stable and have the capability to adjust and control (Yang 1993). Many theories and genres are used to study personality. They are a school of psychoanalysis, social learning theory, humanistic genre, cognitive genre, school of trait theory, among others. According to the school of trait theory, which is the mainly adopted method to study personality, traits determine the basic characteristics of a person's behavior. It is the effective factor and component of an individual's personality. It is also a frequently used basic unit to assess personality (Huang 2017). From the 1930s, Allport (GW) (Allport 1955), Carter (Cattell, RB) (Cattell 1946), Eysenck, H. J. (Eysenck 1987), McRae (McCrae, the RR) and Costa (Costa, PT) (Costa and Mccrae 1990) and others put forward the theory of personality model. High Park (Goldberg, LR) in 1992 proposed five big factor models, including extraversion, agreeableness, conscientiousness, emotional stability and intelligence (Mccrae and John-Akinola 2010). Furthermore, Lexicology notes that language is an important tool for a human being to survive and develop, and it also contains a human being's

vital personality structure. Those individual differences, which are closely related to people's social life, will be encoded and represented by a human being's natural language (Eysenck 2000). Theoretical construction of preschoolers' personality is developed on the basis of the school of trait theory and lexicology. With the two theories mentioned above and modern measurement statistics tools, our institute has worked out the preschoolers' personality structure. This personality theory has similarities with the existing personality trait theory, however, they are not identical. The differences reflect China's unique cultural connotation. First of all, the prosociality dimension and agreeableness in the five big factors model are not the same. In the prosociality dimension theory, cooperation is a vital part of agreeableness. It reflects collectivism, which is a value emphasized by Chinese culture. Secondly, the connotation of "intelligence" contains more than "wisdom" in the five big factor model. The former one also includes the spirit of being independent and progressiveness. Thirdly, in Chinese preschoolers' personality assessment, "extraversion" is not dominant, nor is any desire to get excitement and stimulation. However, the three elements are all included in the five big factor model.

Researches in China on Preschoolers' personality mainly focused on personality theory (Yan and Liu 2005), personality intervention (Hou 2015), the relationship between personality and other influential factors (Yang 2006), etc. Meanwhile, research in foreign countries also focuses on the intervention and influence of personality problems. The problem includes bad habits, addiction (Lister et al. 2015), interpersonal communication disorder (Meulemester et al. 2017), depression (Harty et al. 2010), etc. Most of the existing studies focused on intervening in a child's personality. However, studies on the cultivation of preschoolers' personality are relatively lesser in number. Among the few studies of personality cultivation, the contents mainly focus on character education (Burton 2008), cultivation methods, cultivation for disabled preschoolers (Brickell 2018). Some researchers said that preschoolers' specific character and personality can be improved by drama education (Aleksandrova 2017), sports (Zhu et al. 2018), storytelling (Agbenyega et al. 2017) and other methods. However, it is lacking in regards to the overall cultivation of preschoolers' personality.

Due to the cultural differences, studies on the cultivation of preschoolers' personality is based on local research. Only by adopting the cultivation plan tailored for Chinese preschoolers can we better improve Chinese preschoolers' personality. In addition, the cultivation should focus on all straits in order to encourage preschoolers to develop an all-rounded healthy personality. Because preschoolers' various kinds of physical and psychological functions are continuously developing, the personality development of children aged between 3 to 15 is dynamic and unique. Preschoolers' healthy personality refers to a healthy, stable and balanced manner to develop preschoolers' traits, which are universal and positively adaptive in their personality structure. First of all, a healthy personality should show stability in preschoolers' trait development. In another word, it should show persistence, stability and consistency in preschoolers' behavioral tendencies. Once a personality has been formed, it is not easy to change. Studies show that preschoolers' personality traits will show typical characteristics at age of 5. Then it will keep at the same level of development

for a certain period (Yang et al. 2012). After the formation of the typical characteristics, the personality will develop steadily. Secondly, from the perspective of positive psychology, we should recognize that this process is very healthy. By cultivating positive personality traits, preschoolers gain a healthy personality, which has a lasting impact on the rest of their lives (Carl 2013). Thirdly, we should emphasize the comprehensive development of personality traits. In another word, all dimensions of personality and different characteristics should be developed equally. Only through this method can preschoolers positively adapt to society. Based on these, this study believes that the healthy personality of preschoolers is the most universal and positively adaptable character of preschoolers' personality structure. It reflects the stable, healthy and balanced development in 15 characteristics. These are responsibility, resistance and attack, persistence and self-control, intelligence, exploration and innovation, artistic interests, self-motivation, sympathy and altruism, affiliation and politeness, honesty and shame-awareness, sociable ability, full of energy, optimism, irritation, sensitiveness and anxiety, etc.

Based on preschoolers' personality structure, assessment tools, development characteristics and influential factors, this study has explored the cultivation program by using games to promote Chinese preschoolers' personality development. This study has explored the feasible cultivation model as well.

2 Research Methods

2.1 Research Targets

Due to China's vast territory and uneven development, this study used stratified random sampling methods to verify the universality of the cultivation program. The first layer of the sample considered the development level of different regions, while the second layer of the sample considered different cities and different types of kindergartens. We referred to the China Development Index (RCDI), which consists of four single index structures. This includes the health index, education index, living standard index and social environment index to measure development level in each of the regions.

The first ranking region, which was picked randomly, was Beijing. The second-ranking regions which picked randomly were Jiangsu, Shandong, Liaoning. The third-ranking regions were picked randomly: Fujian, Heilongjiang, Hebei, Shaanxi, Hunan, Chongqing, Henan, Gansu, Guangxi. The fourth-ranking regions were also picked randomly: Yunnan, Qinghai. The reason why we picked the above regions was that it had representation in both economic development and regional culture. For each of the categories we picked two cities, (one provincial capital, or vice-provincial capital city, and an ordinary city) and we picked two kindergartens (one public park, one private park) in each of the city. We finally selected 53 kindergartens. From each of the kindergartens, we picked two students in each of the three grades (junior, middle

and senior class) who had essentially the same level of personality development to participate in the one-year "healthy personality cultivation game program" (Dong 2016) experiment. Meanwhile, 168 teachers were selected to participate in the design of the game program. A total of 7920 preschoolers were selected, of which 3955 preschoolers were in the experimental class, and 3965 preschoolers were in the control class. After one year, according to the preschoolers' turnover, there were in total 7260 test preschoolers, among which 3639 belonged to the experimental class while 3630 belonged to the control class. The post-test effective subjects accounted for about 92% of the selected preschoolers.

2.2 Research Tools

This study used the "teacher's evaluation questionnaire for preschoolers personality development (aged between 3 and 6 years old)" (Yang et al. 2012). Chinese scholars edited the questionnaire three times in fifteen years. During the first edit, it used the teacher-free description coding and theoretical research methods to obtain the personality structure of preschoolers. During the second edit, scholars attained samples nationwide, and the analytical method included confirmatory factor analysis. The third round of edit was based on the second edit edition. Meanwhile, Lexical and multi-quality multi-method tests were added at this stage to determine the personality structure of Chinese preschoolers (Yang 2014). The questionnaire has 60 questions. It includes five dimensions, which are intelligence features, self-control, extraversion, pro-sociality and emotional stability. The intelligence features include intelligence, exploration and innovation, self-motivation, artistic interest. Self-control includes persistence and self-control, earnest responsibility, resistance and the attack factor. Extraversion includes sociable ability, full of energy, optimism. Pro-sociality includes empathy and altruism, affiliation and politeness, honesty and shame-awareness. Emotional stability includes irritability, sensitiveness and anxiety. The questionnaire uses *Likert* five-point scoring. 1 point means strongly disagree; 5 points mean totally agree. The level gradually increases from 1 to 5 points. The process shows a preschooler's personality moving towards a healthier way. When a child scores 4 points or more in all aspects, it means he or she is closer to become a person with a healthy personality.

The result of the reliability test shows that the coefficient of the internal consistency of the questionnaire (The Cronbach's the Alpha) is 0.952. The raters' reliability is 0.88. Furthermore, the internal consistency of 5 dimensions and 15 traits are analyzed and the average Alpha coefficient is above 0.95. Thus, we can believe that the questionnaire has good reliability. Additionally, we used *AMOS*21.0 to construct a structural equation in order to further analyze the structural validity of the questionnaire. The *CFI* result is 0.95 while the *GFI* result is 0.89 and the NNFI result is 0.94. Thus, we can believe that the hypothetical model has good coherence with the research data. This means the questionnaire had good validity.

The author team has also developed a nationwide standard for teachers' assessment on Chinese preschoolers' personality development. According to the previous researches on development features of five dimensions, we found that there were significant gender and grade differences in preschoolers' personality development. The personality of preschoolers was developed significantly with grade growth. Meanwhile, girls had a significantly higher level of personality development than that of boys. Thus, the standard divides preschoolers into six groups by grades (junior, middle, senior class) and gender. It sets the necessary reference scores.

2.3 Research Design and Procedures

2.3.1 Establishment of Goals for Cultivation of Preschoolers' Healthy Personality

The cultivation of preschoolers' healthy personality must first set a goal. Chinese preschoolers' personality structure, which is built by trait theory and lexical theory, shows that Chinese preschoolers' personality consists of five dimensions and fifteen traits. We invited 187 teachers from kindergartens to order the importance of the fifteen traits in the evaluation questionnaire. As a result, they screened out the traits they want to cultivate. Meanwhile, we researched the contents of two materials related to preschoolers' personality and social development. They were Japan's "Young Preschoolers Kindergarten Essentials" (Ministry of Education 1989), and the US' Arizona's "Early Learning Standards for Preschoolers Aged Between 3 and 5" (Neuman and Roskos 2005).

Based on these two materials and the traits that 187 teachers provided for us, we generated nine core traits as the goals that the cultivation program wanted to achieve. They were optimism, honesty and shame-awareness, self-motivation, responsibility, affiliation and politeness, affiliation and politeness, persistence and self-control, sociable ability, exploration and innovation, sympathy and altruism, emotional stability (Yang etc. 2014).

When we compared those with the preschoolers' personality structure, we found that the nine traits covered five dimensions of preschoolers' personality. Readers can refer to Table 1 to have a glimpse of the nine traits' definition and their relations with the five dimensions of preschoolers' personality.

As mentioned above, we can find that the cultivation of preschoolers' personality with the nine traits can effectively improve the five dimensions of preschoolers' personality. Meanwhile, we inductively integrated teachers' descriptive sentences by the encoding method. Besides, according to the results of the existing literature, we analyzed the development feature of each trait at different ages, and referred to the contents related to personality in "Learning and Development Guide of preschoolers aged between 3 and 6 years old" (Wang 2013). We finally put forward the stage goal

Table 1 Connotation of personality training objectives and its correspondence to five dimensions of personality structure

Five dimensions of personality structure	Objectives	Connotation
Intelligent features	Self-motivation	Reflecting a kind of psychological tendency that preschoolers can rely on their own strength to do things. They aim high and do not rely on others
	Exploration and innovation	Reflecting a kind of psychological tendency that preschoolers show curiosity and spirit of active exploration. They dare to create new things
Self-control	Responsibility	Reflecting a kind of psychological tendency that preschoolers are responsible for themselves and others and they strive to be perfect
	Self-control	Reflecting a kind of psychological tendency that preschoolers can adjust their behavior according to the environment. They can overcome difficulties without giving up
Extroversion	Cooperation and communication	Reflecting a kind of psychological tendency that preschoolers like community life, and are willing to communicate with others. They can get along with others in harmony
	Self-esteem	Reflecting a kind of psychological tendency that preschoolers can affirm themselves, believe in their abilities. They are willing to perform in order to win approval from others
Pro-sociality	Honesty and politeness	Reflecting a kind of psychological tendency that preschoolers can use polite languages and behaviors during interpersonal communication. They can respect others and never lie
	Sympathy and altruism	Reflecting a kind of psychological tendency that preschoolers are concerned about the misfortunes of others and are able to make altruistic expressions. (Sharing or assistance)

(continued)

Table 1 (continued)

Five dimensions of personality structure	Objectives	Connotation
Emotional stability	Emotional adaption	Reflecting a kind of psychological tendency that preschoolers can keep stable emotion, with appropriate emotional expression. They can maintain a good emotional state in a new environment

for preschoolers' personality development. In addition, we designed a game activity program to implement targeted cultivation for preschoolers at different ages (Table 2).

2.3.2 Select Games as Carriers

The choice of the carrier must be based on preschoolers' learning characteristics and their development rules. Thus, games are the most suitable choice to meet the need of preschoolers' learning characteristics and their development rules (Dong 2016). "Learning and development guidance for preschoolers aged between 3 to 6 years old" (Wang 2013) issued by the Ministry of Education states clearly that "education practitioners should cherish the unique value of game and life, in order to meet preschoolers' need which is to gain experience through direct perception, practical operation and personal experience" (Ministry of Education of the People's Republic of China 2012). Vygotzsky's game concept, the concept of personality in positive psychology and development of the critical period theory, have provided the theoretical foundation of using games as an effective carrier to cultivate preschoolers' healthy personality. Vygotzsky thinks games can help preschoolers create a zone of proximal development, thus their personality can be developed effectively. Meanwhile, the concept of personality in positive psychology thinks that the education of preschoolers' healthy personality helps preschoolers develop positive traits. In addition, the development of the critical period theory thinks the design of educational game activities must grasp the critical moment of the development of preschoolers' personality. Games can provide preschoolers with direct experience and practical chances. It also respects preschoolers' differences (Chunliang and Li 2017). Using games as carriers can better improve preschooler's personality (Zhao 2018).

2.3.3 Design the Cultivation Program

We designed the Chinese preschoolers' healthy personality cultivation game program using the theory of positive psychology, overall goal and stage goals of preschoolers'

Table 2 A list of goals of cultivation of preschoolers' healthy personality in different ages

Objective projects	Grades	Educational goals
Self-motivation	Junior class	– Do things by themselves. Such as eating by themselves, dressing or undressing by themselves – Willing to try to solve some simple life issues through their own efforts – Can choose games following their own interests
	Middle class	– Ability to take responsibility and complete tasks independently – Can play games following their own ideas. Perform positively when playing games
	Senior class	– Can make their own decision and stick to their correct decision – Desire for other's approval. Behave positively in every activity and strive to perform the best
Exploration and innovation	Junior class	– Have an interest in new things. Like to move back and forth – Like to ask questions – Can imitate and imagine during games
	Middle class	– Explore things which they are interested in and enjoy the process – Ask questions frequently to satisfy their needs – Can explore different ways to play games or do simple creation
	Senior class	– Like new things and can explore fearlessly – Tend to get the root of the matter. Can imagine on purpose and create things fearlessly with novelty
Responsibility	Junior class	– Responsible for own life, study and games. Such as can put own things in order, can pack and put away toys after playing with them -Can undertake some small tasks
	Middle class	-Try hard to complete tasks -Initially develop a sense of collective responsibility – Can actively participate in group activities. Like the class, they are participating

(continued)

Table 2 (continued)

Objective projects	Grades	Educational goals
	Senior class	– Can take the initiative and complete tasks seriously – Trustworthy. Blame themselves for their own faults – Willing to work for collective. Have a strong sense of collective honor
Self-control	Junior class	– Can obey the rules at the request of others – Can concentrate on something, with adults' encouragement
	Middle class	– Have rule consciousness, and can basically follow rules consciously – Able to overcome obstacles consciously and insist on what they are doing – Have a certain degree of sense to resist temptation and be able to restrain their impulse
	Senior class	– Self-control. They can obey rules in any activity – Not easy to be disturbed by external temptations. Can actively control emotions and actions, and can concentrate on doing an activity for a long time
Cooperation and communication	Junior class	– Enjoy being with friends. Willing to play with friends – Take other's advice after conflicts with others and can continue playing with them
	Middle class	– Enjoying playing with friends and have relatively fixed friends – Can use simple techniques such as rotation and exchange to join peer games and maintain relationships with others – Can solve conflicts with peers with the help of others
	Senior class	– Have good friends and willing to make new friends – Can use appropriate skills of interpersonal communication to launch a game. Like to cooperate with friends and specialize tasks when playing a game – Can resolve conflicts with peers independently
Self-esteem	Junior class	– Willing to show their abilities and can feel the happiness of success
	Middle class	– Initially understand their abilities and believe in their own abilities

(continued)

Table 2 (continued)

Objective projects	Grades	Educational goals
	Senior class	– Dare to try challenging activities. Have sense of satisfactory after success
Honesty and politeness	Junior class	– Can use common polite phrases with adults' reminder – Don't take other people's things casually. Return things they borrowed
	Middle class	– Have the habit of using polite languages, such as thank, greet or apologize – Understand it's not good to lie, never lie intentionally
	Senior class	– Use polite language appropriately. Respect others. Do not deliberately disturb others – Generally speaking, do not lie and can admit own faults
Sympathy and altruism	Junior class	– Under adults' guidance, they can feel sympathetic with other's misfortunes and can take actions – Willing to share at the request of other people
	Middle class	– Can realize or feel others' misfortune and can show care and concern – Can actively share things that everyone likes
	Senior class	– Can express sympathy for the misfortunes of others, and can provide help within their capabilities – Can actively share things he or she like
Emotional adaption	Junior class	– Can recognize some common emotions. Can adapt to changed environment with the help from others. Emotion can become stable relatively quickly – When have strong negative emotions, can ask for help instead of crying and yelling
	Middle class	– Can keep emotion stable and can adapt to changed environment relatively quickly – When have some negative emotions, can control the emotions and recover relatively quickly with others' reminder
	Senior class	– Can adapt to changed environment quickly and keep positive emotion frequently – Know the reason that lead to a particular emotion and can adjust emotion according to the need – Can express negative emotion

healthy personality development, and the features of preschoolers' personality development as well as the critical period of preschoolers' personality. The overall goal is to help the positive and universal personality traits of preschoolers develop stably, healthily and evenly. In other words, the overall goal is to cultivate preschoolers' healthy personality (Yang 2018). According to the overall goal, the nine traits' typical features, and stage goals for preschoolers at different ages, are designed with different game activity programs to match their personality development and critical development moment. We selected 168 teachers from junior, middle, senior classes in 53 kindergartens in China to participate in the design process. Different levels of teachers collaborated with each other to ensure that there were at least 10 game activities under each of the traits. In total, they designed 318 game activity programs. Early childhood experts were invited to assess and evaluate each of the game activities. They selected 4 game activities that gained higher scores in each of the traits. As a result, a game activity library containing 108 games had been created. Then, Chinese culture was integrated into the 108 games. Finally, we forecasted the programs approved by experts and made some adjustments. Finally, we created the Chinese preschoolers' healthy personality cultivation game program.

2.3.4 Educational Field Experiments

We used the cultivation program as the independent variable. And we conducted a one-year educational field experiment in 53 kindergartens in fifteen provinces in China.

Early training phase: We trained teachers and the person in charge of the kindergarten. The training contents included the overall goal of the cultivation program and the stage goals. The assessment methods include the "teachers' questionnaire for preschoolers (aged between 3 and 6 years old)'s personality development" (Yang et al. 2012) (the questionnaire's five-point scores correspond to preschoolers' daily performance); the methods to design game activities (they should follow Chinese culture); the methods to conduct the experiment (the method includes how to launch game activities and notice of conducing the games).

Pre and post-test phase: We chose a head teacher and a deputy head teacher in each class to evaluate the personality development of all the preschoolers in the class, using the "teacher's questionnaire for preschoolers (aged between 3 to 6 years old)'s personality development" (Yang et al. 2012). The selected two teachers cannot talk to each other during the process. After the cultivation, the evaluation measure was the same as the methods mentioned above.

Field experimental phase: we implemented personality cultivation game activities with experimental class' students one or two times a week. The duration each time lasted 15–30 min. The time to conduct the games was 30 min after the lunch break. The training had continued for a whole year, including two semesters. Each grade had completed 36 personality cultivation game activities.

The experimental design of this research was a quasi-experimental design. We took the following measures without the control of the independent variable. Firstly,

we tested the homogeneity of the pre-test data. If two classes were homogeneous at the personality level, the experiment can be conducted according to the predetermined experimental class and control class. If two classes were not homogeneous at the personality level, the class that had lower scores should be regarded as the experimental class. Secondly, while the experimental class was conducting the game activities, preschoolers in the control class should play freely. Meanwhile, other activities in the two classes remain the same. Thirdly, we held parent meetings and told them that they should limit other educational activities at home. Fourthly, we regulated that two teachers who were familiar with him or her at kindergarten should jointly assess each child's personality development level. During the process, they should not discuss with each other. In addition, a reliability test should be conducted on the two teachers in order to ensure the objectivity of the assessment. Fifthly, teachers in both the experimental class and the control class should have at least three years' worth of experience in the teaching industry. We had to ensure that their capabilities were at the same level. Finally, we regulated that during the experiment, teachers should not be changed.

3 Research Result

3.1 A Cultivation Program with Chinese Characteristic

Chinese preschoolers' healthy personality cultivation game program includes 108 games. Firstly, the program aims to convey positive psychology theory and promote preschoolers' positive and healthy personality development through games. For instance, the self-motivation game "brave little soldier," which is conducted in junior class aims to encourage preschoolers to solve obstacles and achieve success, is designed so that they gradually can develop a positive personality. Secondly, with oriental and western culture, we summarized nine types of cultural elements that are in accordance with the needs of Chinese preschoolers' healthy personality development. The nine elements correspond to the game activities that are developed according to the nine personality traits. For instance, "cooperation and communication" reflects collective spirit. "Self-control" reflects the spirit to rectify the mind. Finally, the program accords with the overall goal and stage goals of preschoolers' healthy personality development. The program in accordance with the features found during the critical period of preschoolers' personality development. For instance, the exploration and innovation game "changing of colors" which is conducted in the middle class, encourages preschoolers to mix colors through exploration. It accords with a stage goal of "exploration" for preschoolers in the middle class, which is "exploring things which they are interested in and hence enjoy the process. They can explore different ways to play with games or doing "simple creation." The pretest result shows that the program can effectively promote preschoolers to develop a healthy personality. It can be adopted to conduct an officially filed experiment.

3.2 *Game Program Can Effectively Promote Preschoolers' Healthy Personality Development*

3.2.1 Significant Differences Exist in Experimental and Control Class, Regarding the Overall Development Level of Preschoolers' Personality

Research showed that scores of 5 dimensions and fifteen personality traits in experimental class (all grades) during the pretest phase were all higher than those in the post-test phase. After the experiment, the scores of the intelligent features, self-control ability, extroversion and pro-sociality in the experimental senior class were all above four points. This means that preschoolers' personalities were very close to a healthy standard. Specifically, experimental middle-class preschoolers' scores in seven aspects including self-motivation, intelligent features, and responsibility were all above 4 points. Meanwhile, experimental senior class' preschoolers' scores in thirteen aspects, excluding irritation, sensitiveness and anxiety, which were all above 4 points. We compared the differences of the five dimensions and fifteen traits between experiment class and control class (after conducting the experiment) in order to clarify whether the progress mentioned above was due to the cultivation program or the growth of age (Tables 3 and 4).

Table 3 Average value (standard deviation) and deference test of five dimensions of personality traits after the experiment

Grades	Personality five dimensions	Experiment class	Control class	*t*
Junior class	Intelligent features	3.74 (0.74)	3.30 (0.72)	18.22^{***}
	Self-control	3.74 (0.75)	3.22 (0.72)	15.72^{***}
	Extraversion	3.94 (0.75)	3.34 (0.70)	14.94^{***}
	Pro-sociality	3.72 (0.72)	3.29 (0.70)	18.54^{***}
	Emotional stability	3.57 (0.89)	3.48 (0.83)	3.53^{**}
Middle class	Intelligent features	3.96 (0.68)	3.50 (0.62)	21.02^{***}
	Self-control	3.94 (0.73)	3.43 (0.69)	18.62^{***}
	Extraversion	3.98 (0.73)	3.47 (0.64)	21.99^{***}
	Pro-sociality	3.99 (0.70)	3.49 (0.61)	22.65^{***}
	Emotional stability	3.63 (0.77)	3.42 (0.90)	5.93^{***}
Senior class	Intelligent features	4.13 (0.66)	3.75 (0.84)	14.58^{***}
	Self-control	4.17 (0.67)	3.60 (0.76)	15.37^{***}
	Extraversion	4.13 (0.73)	3.70 (0.85)	14.88^{***}
	Pro-sociality	4.17 (0.66)	3.75 (0.77)	15.58^{***}
	Emotional stability	3.94 (1.04)	3.83 (0.95)	2.08^{*}

$^{***}p < 0.001$, $^{**}p < 0.01$. $^{*}p < 0.05$

Table 4 Average value (standard deviation) and deference test of personality fifteen traits after the experiment

Grades	Personality five dimensions	fifteen traits	Experiment class	Control class	*t*
Junior class	Intelligent features	Artistic talent	3.66 (0.91)	3.08 (0.84)	16.35***
		Self-motivation	3.88 (0.68)	3.37 (0.78)	17.22***
		Intelligence	3.91 (0.77)	3.43 (0.79)	15.14***
		Exploration and Innovation	3.75 (0.75)	3.22 (0.76)	17.41***
	Self-control	Responsibility	3.83 (0.74)	3.33 (0.85)	15.65***
		Resistance and Attack	3.82 (0.76)	3.45 (0.70)	12.66***
		Persistence and Self-Control	3.81 (0.77)	3.29 (0.79)	16.31***
	Extraversion	Sociable Ability	3.70 (0.86)	3.27 (0.76)	13.26***
		Full of Energy	3.83 (0.93)	3.40 (0.78)	12.27***
		Optimism	3.81 (0.77)	3.35 (0.78)	14.73***
	Pro-sociality	Sympathy and Altruism	3.86 (0.67)	3.28 (0.67)	21.00***
		Affiliation and Politeness	3.86 (0.74)	3.39 (0.76)	15.38***
		Honesty and Shame-Awareness	3.59 (0.95)	3.20 (0.95)	10.47***
	Emotional stability	Irritability	3.56 (0.97)	3.51 (0.89)	1.13
		Sensitiveness and Anxiety	3.59 (0.95)	3.45 (0.86)	3.67***
Middle Class	Intelligent features	Artistic Talent	3.85 (0.83)	3.38 (0.73)	15.29***
		Self-motivation	4.09 (0.76)	3.54 (0.69)	19.46***
		Intelligence	4.13 (0.70)	3.61 (0.73)	18.49***
		Exploration and Innovation	3.99 (0.76)	3.45 (0.65)	19.46***
	Self-control	Responsibility	4.03 (0.78)	3.54 (0.90)	14.89***

(continued)

Table 4 (continued)

Grades	Personality five dimensions	fifteen traits	Experiment class	Control class	*t*
		Resistance and Attack	3.87 (0.73)	3.60 (0.69)	9.65***
		Persistence and Self-Control	4.07 (0.88)	3.53 (0.81)	16.42***
	Extraversion	Sociable Ability	3.98 (0.70)	3.42 (0.70)	20.29***
		Full of Energy	4.01 (0.74)	3.60 (0.79)	17.69***
		Optimism	3.81 (0.77)	3.40 (0.72)	21.11***
	Pro-sociality	Sympathy and Altruism	4.09 (0.71)	3.50 (0.63)	22.14***
		Affiliation and Politeness	4.18 (0.70)	3.60 (0.77)	20.01***
		Honesty and Shame-Awareness	3.89 (0.85)	3.32 (0.67)	18.98***
	Emotional stability	Irritability	3.66 (0.97)	3.54 (0.97)	4.45***
		Sensitiveness and Anxiety	3.59 (0.95)	3.49 (0.98)	2.94*
Senior Class	Intelligent features	Artistic Talent	4.08 (0.77)	3.63 (0.96)	12.53***
		Self-motivation	4.24 (0.68)	3.78 (0.85)	14.88***
		Intelligence	4.25 (0.68)	3.82 (0.95)	12.53***
		Exploration and Innovation	4.15 (0.65)	3.69 (0.85)	14.73***
	Self-control	Responsibility	4.25 (0.69)	3.76 (0.97)	14.10***
		Resistance and Attack	4.18 (0.88)	3.82 (0.81)	10.25***
		Persistence and Self-Control	4.20 (0.77)	3.73 (0.84)	14.69***
	Extraversion	Sociable Ability	4.11 (0.86)	3.62 (0.90)	13.66***
		Full of Energy	4.19 (0.74)	3.74 (0.91)	13.24***
		Optimism	4.22 (0.85)	3.74 (0.97)	12.76***

(continued)

Table 4 (continued)

Grades	Personality five dimensions	fifteen traits	Experiment class	Control class	*t*
	Pro-sociality	Sympathy and Altruism	4.24 (0.65)	3.77 (0.79)	15.65***
		Affiliation and Politeness	4.29 (0.66)	3.84 (0.86)	14.19***
		Honesty and Shame-Awareness	4.01 (0.82)	3.56 (0.87)	12.83***
	Emotional stability	Irritability	3.92 (0.97)	3.76 (0.97)	6.18***
		Sensitiveness and Anxiety	3.92 (0.95)	3.79 (0.95)	2.80**

***$p < 0.001$, **$p < 0.01$. *$p < 0.05$

According to Table 2, scores of the experimental class were obviously higher than that of the control class during the post-test phase. Thus, this proves that the change of preschoolers' personality was due to the cultivation program. Hence, we can get the conclusion that the game program can help preschoolers develop a healthy personality and it can be very effective for preschoolers at all grades (Junior, Middle, Senior class).

When we conducted further comparison between the experimental class and the control class (post-experiment) on preschoolers' 15 trait development, and we found the average scores of preschoolers in the experiment class were obviously higher than the scores in the controlled class. However, an irritable personality in regards to the emotional stability dimension in junior class was an exception. In another word, the game program can work at all grades, except the irritation trait in junior class.

3.2.2 Educational Field Experiment Increased the Number of Resilient Type of Preschoolers, While Decreased the Number of Under Controlled Type and Over-Control Type of Preschoolers

Discussion on the measuring result of preschoolers' personality changes can be divided into two perspectives. They are trait-based and individual-based respectively. The previous paragraphs' discussion on preschoolers' personality changes is trait-based. Meanwhile, the discussion on preschoolers' personality types is individual-based. The two methods are complementary to each other. This study uses Mplus as a data processing tool to analyze preschoolers' personality types. It divides personality types (Fruyt et al. 2002) by using potential category analysis, coupled with the theory of self-control (Wang 2000) and self-adaptation (Tangney et al. 2010). Potential category analysis currently is the best way to study the personality types of preschoolers. Compared with the Q-factor method and clustering analysis, it can not only effectively dig out variable data information, but also can make up for the

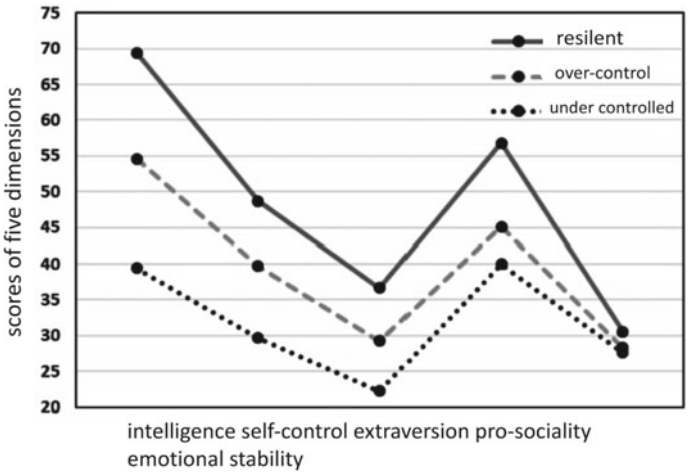

Fig. 1 Potential category of preschoolers' personality traits

shortcomings of other methods which cannot deal with the categorical variables. It can reveal the inner nature of psychological research more comprehensively (Zhang et al. 2010). Potential category analysis has the advantage in analyzing categorical variables, hence currently more and more researchers adopt this method in their work. Belgian scholar De Clercq (DeClercq et al. 2012) and the Dutch scholar Meeus (Meeus et al. 2011). both used the method to analyze preschoolers' and teenagers' personality types. This study also uses the potential category analysis method. The result divides the types into three categories. We present the telegram showing the potential category of preschoolers' personality traits. (Fig. 1).

The three categories of preschoolers' personality types are under the controlled type, over-control type and resilient type. The pro-sociability dimension, intelligent features dimension and self-control dimension under the controlled type preschoolers are all below than those dimensions in the other two types of preschoolers. However the extroversion dimension is moderate and the emotional stability dimension is moderate or relatively low (Robins et al. 1996). That is to say, they show a low capability to control themselves, and they tend to be impulsive and can are easily excited. Furthermore, they frequently behave in a risk-taking manner. What's more, their delayed gratification capacity is weak. They are prone to offensive behavior and disruptive to rules. They are lacking in perseverance and are prone to procrastination in some occasions. Also, their interpersonal skills are poor and they only have few friends in kindergartens. Meanwhile, over-control types of preschoolers tend to have a middle to a high level of prosocial ability. The level of intelligent features and self-control ability is also middling to high. However, due to the inflexibility in self-control, they lack the ability to express their emotions flexibly in real-life situations. Hence, they feature weak emotional stability and weak extraversion. These types of preschoolers tend to over-control themselves. When they play with other kids,

they tend to obey the rules and can help others. Their learning ability is adequate, however, due to excessive control by parents or teachers, they are self-stressed. They do not have the flexibility to express themselves and are unsociable. They tend to cry about minor things. Sometimes they are also accompanied by anxiety, depression and withdrawal behaviors. Resilient types of preschoolers have a higher level of development in five dimensions including intelligent features, self-control ability, emotional stability, extraversion, and pro-sociality. Resilient types of preschoolers tend to be independent and love exploring fresh things. They like participating in their kindergarten activities and have the initiative to create new things. They are responsible and have sufficient self-control capability. They have a strong ability to delay gratification. They can be positive when met with difficulties and setbacks. They are energetic, warm-hearted and like cooperating with others to play games. They interact with other kids actively in daily life and they are adaptive to a new environment. For example, when preschoolers are waiting for teachers to allocate fruits in kindergarten, under-controlled preschoolers will likely leave their seats and step towards the teacher in order to take fruits. Over-control type preschoolers will sit and wait, but they might experience mood swings during the period. They might complain with other kids, saying that why it needs such a long time to get fruits. The resilient type of preschoolers will sit still and comfort other kids.

Statistics show that after the experiment, the number of resilient types of preschoolers increases in the experimental class, indicating that the game program can improve preschoolers' personality effectively. At the same time, the number of resilient type of preschoolers decreases in the control class (junior, middle and senior class), indicating that uncontrolled problems increase with age. Preschoolers' personality tends to develop unstably and cannot adapt to a new environment without any game program (Table 5).

When we further conducted the double ratio test to experimental and control class during the pre-test and post-test phase, we found differences as well (Table 6).

Table 5 shows that after the experiment, the number of resilient types of preschoolers in the junior experimental class is obviously higher than the number in the control class. However, the numbers of under-controlled and over-controlled types of preschoolers are obviously lower than those in the control class. The number of under-controlled preschoolers in the middle class is clearly lower than that in the control class. The number of resilient preschoolers is higher than that in the control class. The number of over-controlled types of preschoolers is obviously lower than that in the control class. However, the number of resilient types of preschoolers is obviously higher than that in the control class.

Table 5 Distributed situation of preschoolers' personality type in experimental class and control class (pre- and post-test phase)

Time	Class type	Grade	Personality type		
			Under-controlled	Over-control type	Resilient
Before experi-ment	Experimental class	Junior class	201 (15.5%)	754 (58.3%)	339 (26.2%)
		Middle class	170 (12.0%)	953 (67.3%)	293 (20.7%)
		Senior class	195 (15.7%)	493 (39.6%)	557 (44.7%)
	Control class	Junior class	215 (16.7%)	758 (59.0%)	312 (24.3%)
		Middle class	225 (15.9%)	672 (47.4%)	520 (36.7%)
		Senior class	176 (13.1%)	732 (54.4%)	438 (32.5%)
After experi-ment	Experimental class	Junior class	80 (6.5%)	685 (55.6%)	467 (37.9%)
		Middle class	157 (11.6%)	668 (49.5%)	525 (38.8%)
		Senior class	140 (13.2%)	404 (38.2%)	513 (48.5%)
	Control class	Junior class	268 (21.9%)	746 (61.0%)	209 (17.1%)
		Middle class	267 (19.8%)	703 (52.2%)	377 (28.0%)
		Senior class	160 (15.1%)	602 (56.8%)	298 (28.1%)

Table 6 Different Situations of Preschoolers' Personality Types in Experimental Class and Control Class (post-test phase)

Grades	Personality type	Class type		*p*
		Experimental class	Control class	
Junior class	Under controlled	80 (6.5%)	268 (21.9%)	0
	Over control	685 (55.6%)	746 (61.0%)	0.009
	Resilient	467 (37.9%)	209 (17.1%)	0
Middle class	Under controlled	157 (11.6%)	267 (19.8%)	0
	Over control	668 (49.5%)	703 (52.2%)	0.159
	Resilient	525 (38.8%)	377 (28.0%)	0
Senior class	Under controlled	140 (13.2%)	160 (15.1%)	0.223
	Over control	668 (49.5%)	602 (56.8%)	0.003
	Resilient	513 (48.5%)	298 (28.1%)	0

4 Discussion and Conclusion

4.1 Clarifying the Appropriate Target System is the Basic Premise of the Cultivation Program

The target system can influence the whole cultivation program. Due to the natural and cultural differences of various countries, they have their own unique expectations of a preschooler's personality development. For instance, the US focuses more on preschoolers' independent spirit, while Chinese parents tend to hope their kids can belong to a certain group and have a sense of collective honor. Thus, we should set the target system following each country's characteristics.

This study created the Chinese preschoolers' personality structure, including five dimensions and fifteen traits by analysis on fifteen-year-research in ten provinces and cities in China. We have conducted three instances of research during this period. Also, we have nine traits that covered preschooler's personality structure's five dimensions from the teachers' assessment. With the help of the elements above, we gained the overall goal of the game program. The overall goal is, with the help of kindergarten's system and conscious personality development education, for preschoolers to gain a better self-understanding ability. They are confident, self-motivated, independent, assertive, creative and curious. They are willing to cooperate and socialize with others. They are honest and polite. They are sympathetic and show concern for other's misfortune. They are willing to help others. They are responsible and have a certain degree of self-control ability. They are calm and possess a certain degree of emotional expressiveness. Last but not the least, they are adaptive. According to the overall goal, we set stage goals for preschoolers at different ages. We also set suitable games for preschoolers at different ages. Take the "self-control" trait for example; the stage goal for junior class preschoolers is "obeying rules at the request of the outside world. Can they focus on a certain thing with the encouragement from an adult." The stage goal of middle-class preschoolers is "having rule awareness. Can they follow the rules consciously? Can deal with difficulties consciously? Can they persevere in what they are doing? Can they have a certain degree of resistance to temptation? Can restrain their impulse?" The stage goal of senior class preschoolers is "having self-control ability, ability to obey rules in various activities, not easily disturbed by others, can actively control their own emotion and behavior, can focus on a particular activity for a long time." Thus, we can see that the cultivation of "self-control" trait is the process from an external requirement into an inward requirement. Middle class (4 years old) is a demarcation point, which means that from then on, preschoolers' focus time increases with age. The stage goal not only meets preschoolers' cognition rule, but also meets the theory which believes that four-year-old is a critical age for preschoolers to develop their self-control ability. All in all, this study thinks that the cultivation target system is the basic foundation for creating games. It can ensure the process follows the overall goal and stage goals.

4.2 Games Are the Best Carriers to Cultivate Preschoolers' Healthy Personality

As mentioned above, games can help to a cultivate preschooler's personality. This theory not only conforms to the requirement of "the learning and development guide for preschoolers aged between 3 and 6 years old" (Wang 2013), but also is the best way to meet preschoolers' physical and mental needs. These can be certified through the teaching cases in the educational field experiment (Haidong 2015).

First of all, games can stimulate preschoolers' autonomy and can teach students in accordance with their aptitude. Furthermore, it can also stimulate preschoolers' interests and internal motivation. According to feedbacks from teachers who participated in the educational field experiments, the game cultivation program can encourage preschoolers to complete tasks on their own initiative. Preschoolers can choose different games in accordance with their abilities. For example, the self-control game "happy robot" requires preschoolers to walk when the music starts and halt when the music stops. During the game process, preschoolers can choose to make different robot-like actions, different motionless movements and different time periods to stand still. Thus, this game meets the needs of preschoolers' autonomy. Besides, it also realizes the goal of teaching students in accordance with their aptitudes.

Secondly, games provide preschoolers with direct perception and practical experience. When they are playing games, they can learn how to solve problems and they can also gain useful knowledge from the first-hand experience. According to feedback from teachers who participated in educational field experiments, preschoolers can solve their own problems through direct experience. For instance, a kindergarten teacher mentioned that a child in junior class kept crying when he went to class. When they played the game "making a smiling face doll" at the beginning, he cannot stop crying and looking for his mother. But after practicing the game, which needed to present a crying face in front of a mirror, he gradually understood that this expression was not a nice gesture. When he heard giggling voices on tapes, he laughed with the happy sounds. The teacher noted that this child gradually became proactive when playing games with other kids and can better adapt to kindergarten life.

Thirdly, games can help develop preschoolers' proactive and exploration traits. According to feedbacks from teachers who participated in educational field experiments, preschoolers love playing games, and every time when they conducted the personality game program, preschoolers were enthusiastic to attend. For instance, some teachers wrote that when they implemented the self-control game called "paper cup doesn't fall," teachers didn't rush to begin the game. Instead, based on preschoolers' nature of the desire to play and be curious about new things, they first put paper cups into the construction zone and allowed them to explore freely. They found that some preschoolers used paper cups to draw and cut, while some others used paper cups as toy bricks and constructed various types of architectural modeling. After preschoolers fully interacted with paper cups and gained some experience playing with cups, teachers began to conduct the game of "paper cup doesn't fall." Because putting paper cups onto preschoolers' heads made them feel fresh,

it simulated their sense of participation and exploration and ensured the efficiency and quality of the game time. When the time was up, preschoolers even asked for an extension of playtime. Thus, teachers put paper cups into the zone so that kids can play freely. It further verifies that game is a form of activity that preschoolers can accept with pleasure.

Finally, games can stimulate preschoolers' internal needs so that they can digest the personality cultivation's contents intuitively. In another word, it can transfer educator's behavior rules into preschoolers' own subject consciousness. Because preschoolers accept games easily, it can influence preschoolers' personality unconsciously, especially in the senior class. For instance, in the senior class, teachers used "the little match girl" story to introduce the game "wall of kindness" under the personality trait of "sympathy for others." Preschoolers tended to feel sympathy for the people in need and come up with the idea of sending blessings and donating clothes to them. Preschoolers gradually became caring for others and this trait was transferred into their internal spirit. Finally, this spirit became their habit.

4.3 It's Vital to Develop a Cultivation Program with Chinese Cultural Characteristic

After making clear the general goal and the carrier for the cultivation program, we found another element that was of great importance as well. It was how to reflect Chinese characteristics and how to convey socialist core values through the program. Our plans should show the principle: "don't forget the origins, absorb the foreign culture and look into the future." (Xi 2017) Our plan should inherit Chinese outstanding traditional culture while absorbing western's distinguished culture.

According to research, China's outstanding traditional culture values ethnics and pursues the world view of harmony and stability. It has strong vitality and inclusiveness. Furthermore, Chinese culture also penetrates multiple schools of thought (Deng 2007). Meanwhile, Western culture values innovation and exploration, independence and equality (Zhu 2001). Thus, we extracted the essence of Chinese traditional culture which are harmony, stability, self-control, honesty, self-improvement, caring others, responsibility, and the essence of Western culture, which are innovation and equality. Based on those qualities, we generated nine cultural elements, which contained outstanding cultures from both the west and the east and can go along with Chinese development. These nine cultural elements correspond with 9 personality traits. For instance, the personality trait of "cooperation and communication" reflects the cultivation of preschoolers' collectivism and cooperation spirit. It is in accordance with Chinese traditional culture "the spirit of harmony and collectivism." The personality trait "self-control" reflects the cultivation of preschoolers' self-discipline ability. It teaches preschoolers to restrain the current desire to a certain degree in order to achieve a long-term goal. It is in accordance with the

Chinese traditional cultural value of a "rectifying mind." The personality trait "honesty and politeness" teaches preschoolers to be honest and keep their promises, and be polite to others. It is in accordance with the Chinese traditional cultural value of "being honest and trustworthy." The personality trait "emotional stability" helps preschoolers ease their anxiety and sensitivity. It also helps preschoolers to keep their emotions stable and pleasant. It is in accordance with the Chinese traditional cultural value to pursue "the attitude of harmony and stability." Furthermore, "self-motivation" hopes preschoolers can improve by themselves, it is in accordance with the culture of "self-improvement and national inclusiveness." The personality trait of "sympathy and altruism" hopes to cultivate preschoolers' spirit of sympathy for the needed." It is in accordance with the culture of "dedication and altruism." The personality trait of "responsibility" aims to cultivate preschoolers' responsibility for others and the responsibility for their own life, work and study. It is in accordance with the culture of "the dedication to national mission." The personality trait of "exploration and innovation" hopes to cultivate preschoolers to explore new things and to be innovative. It is in accordance with "an innovative spirit of breaking new ground." The personality trait of having "self-esteem and confidence" aims for preschoolers to possess self-awareness, and furthermore aims to form their national self-confidence. It is in accordance with the culture of "equal inheritance and self-confidence." Games in the cultivation program can develop the nine personality traits that are in accordance with Chinese culture. For instance, in junior class, the cooperation game called "monkeys transport fruits" promotes collective cooperation spirit by demanding preschoolers in class to stand on a "bridge" to transport "fruits." It integrates the Chinese spirit of collectivism and cooperation into the dribbling game, helping preschoolers to understand the great importance of cooperation. This way, we integrated the Chinese culture into 108 games at different grades (junior, middle, senior classes). Thus, we can ensure that the cultivation program is developed with the characteristic of Chinese culture. It provides the premise and foundation of the educational field experiment. It is also a key point to be implemented in the program.

4.4 Educational Field Experiment is an Effective Way to Cultivate Preschoolers' Healthy Personality

We should conduct an education field experiment in order to test whether the cultivation program is successful in developing Chinese preschoolers' personality. We should analyze the result in order to ensure that preschoolers have healthier personalities after the experiment. This study considers a healthy personality to be reflected in two things. They are reflected in the trait level and at the individual level. If a child can score above four points in trait level, it means he or she develops well in the particular trait. The five-point standard of preschoolers' traits is made based on observations of preschoolers' actual performance, policies, structural goals and theories and studies. When preschoolers score above 4 points or close to 5 points, it

means they are close to the healthy standard. Meanwhile, speaking of the individual level, in this study, a healthy personality equals a resilient type of personality. In another word, the resilient type is closer to the standard of a healthy personality. The norm result also shows that resilient preschoolers' personality development is close to the standard of a healthy personality.

First of all, from the overall effect of personality cultivation, the five-dimensional personality scores of preschoolers at three grades in an experimental class all increased. There were four dimensions of preschoolers' personality in senior class scoring above 4 points. Seven students in the middle class scored above 4 points. And 13 preschoolers in senior class scored above 4 points. It means that preschoolers' behaviors in daily life have changed tremendously. For instance, in the topic of "taking rice bowl or cup lightly" under the "self-control dimension," "generally fit" ($M = 3$) means that preschoolers can basically obey the rules, taking care of toys and other items. "Relatively match" ($M = 4$) means that preschoolers can follow the rules intuitively, and can take care of other's items as well. The increase of the score reflects the improvement of preschoolers' personality development level. When we further analyzed the fifteen traits of the experiment class and control class after the experiment, we found that the cultivation program can work for all classes except the "anxiety and irritability" trait in junior class. The anxiety trait reflects whether preschoolers are irritated when facing setbacks and whether they can be pacified after losing their temper. It is the brain structure of the junior class' preschoolers that causes the cultivation program to not function efficiently. They are too young, and hence the ability of the cerebral cortex to regulate the subcutaneous center is relatively weak (Li 2015). Thus, the development of inhibition is poor and the self-control ability is weak. When external things stimulate them, their emotions tend to become extremely unstable and explosive. In addition, their brains are not yet mature, thus their ability to recognize and regulate negative emotions is weak (Paulussen-Hoogeboom et al. 2008). The game program is mainly based on cognition and regulation of negative emotions. It does not work effectively in junior class in relation to the anxiety and irritability trait (Eisenberg et al. 2005). This can be improved when preschoolers enter the middle class. Furthermore, the score difference between the experimental class and control class after the experiment can also reflect the effect and result of the cultivation program. After the experiment in junior class, we found that there were five traits with large score differences between the two types of classes. They were artistic talent, self-motivation, exploration and innovation, perseverance and self-control, sympathy and altruism. In the middle class, we found that there were six traits with large score differences between the two classes. They were self-motivation, social ability, sympathy and altruism, cooperation and politeness, exploration and innovation, perseverance and self-control (the last two traits have the same score differences). In the senior class, there were five traits with large score differences between the two types of classes. These are responsibility, perseverance and self-control, social ability, optimism, sympathy and altruism. This shows that the program can help improve preschoolers' personality at different ages, but the situation and progress are different with different ages. The cultivation of the intelligent feature can work better in junior class. The cultivation of the intelligent feature,

pro-sociality can work better in the middle class, while the cultivation of self-control ability and extroversion spirit can work better in the senior class.

Secondly, from the perspective of personality types, the development of preschoolers in experiment class was better than those in the control class. By comparing the proportion of the number of personality types in experimental class and control class after the experiment, the proportion of the population of resilient preschoolers in junior class increased tremendously, while the proportion of the population of under-control and over-control preschoolers decreased. In the middle class, some under-control preschoolers transferred into resilient preschoolers while over-control preschoolers can improve into resilient preschoolers. In the senior class, over-control preschoolers transferred into resilient preschoolers, while there was no difference between the under-control preschoolers in experiment class and control class. Thus, we found that the personality type can be transferred much easier into the resilient type in junior class. The improvement is unclear with the ages. This reminds teachers and parents that the cultivation of preschoolers' healthy personality should be conducted as early as possible to gain better results. Generally speaking, there is an obvious increase of resilient types of preschoolers by implementing the educational field experiment with the game cultivation program. Thus, we find that the cultivation program provides preparation and guidance for the development of preschoolers' personality.

Finally, the educational field experiment testifies that the game activity plan is suitable for different areas and regions in China. The experiment fields in our study were representative. Thus, to a large extent, the conclusion can represent the situation of preschooler's cultivation in our country.

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Does Education Expansion Affect the Returns to Education in Urban China?

Changchun Fang

Abstract Educational expansion has become a global trend over the past decades, and its negative impact on the returns to education has been found in developed countries. However, an opposite conclusion is drawn in some developing countries. An analysis of China indicates that different from what has been found in developed countries and some developing countries, education expansion in China has neither a positive impact nor a negative impact on the returns to education. As far as the countries in the period of market transition are concerned, with the maturity of the market and the growth of the economy, the impact of education expansion on the returns to education will pass three periods: the rising period, the period of no significant impact, and the falling period. Compared with developed countries and some developing countries, China is now in the middle period. This indicates that with the maturity of the market economy and the growth of economy, continuous and excessive education expansion in China is likely to result in a decrease in the returns to education.

Keywords Education expansion · Returns to education · Developing country · Urban China

1 Introduction

Since the World War II, educational expansion has become a global trend, the proportion of graduates in the work force has risen dramatically in almost all developed countries over the last 20–40 years (Dolton and Vignoles 2000), and since 1960, the average developing country (gross) primary enrollments have risen from 66 to 100% and (gross) secondary enrollments from 14 to 40% (Pritchett 2001).

With the development and expansion of education, over-education or credential inflation has been the hot topic to study. Some researches in developed countries show that educational expansion alters the structure of supply and demand in labor market

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and then results in a decrease in the returns to education. By contrast, the researches in developing countries (especially those in the period of market transition) show that, with educational expansion, the returns to education still present a lasting and obviously increasing momentum over the past decade. It seems that educational expansion has a rather positive impact on the returns to education than negative one in developing countries.

Educational expansion and obvious increase in the returns to education co-existed in China in the past decades. Therefore, it will be a typical case to discuss the relationship between educational expansion and returns to education in developing countries. The main questions of our study are as follows: Does the educational expansion change the returns to education in urban China?

2 Educational Expansion and the Returns to Education in Developed and Developing Countries

The Human capital theory takes that receiving an education is an investment to human capital (Becker 1994) since education is associated with labor force outcomes, such as occupational status and earning (Bell 1973; Blau and Duncan 1967; Treiman 1970). However, the human capital theory does not well predict how the returns to education will change along with the educational expansion (Bol 2015). The popular view is that educational expansion will result in over-education or credential inflation and a further decrease in the returns to education. One of the perspectives on credential inflation as Štefánik (2014, p. 246) discussed based on Walrasian classical economic theory principle, "If we think of education as a good and of wage as the price of the good, we should be expecting the wage of workers with tertiary education to be declining relative to the average as a consequence of the TE expansion. This relative decline should be a reaction to the situation of increase in the supply of tertiary-educated workers caused by the TE expansion." Freeman (1976), is nearly the first person who study on over-education and his study indicated that excess supply of graduates resulted in a significant decline of return to education in the US in the 1970s. Recently, decreasing in returns to education caused by education expansion has been found by a large number of empirical studies across many developed countries (Bernardi and Ballarino 2014; Dolton and Vignoles 2000; Fersterer and Winter-Ebmer 2003; Murillo et al. 2012; Wanner 2000). Another view of education inflation is developed from the "positional good" or "screening/signaling theory." Different from the view that education is able to improve the work capacities of education receivers in the Human capital theory, this view holds that the educational level (credentials) does not necessarily reflect people's productivity or actual skill; instead, it is a signal to employers to show their potential talents or capacities (Arrow 1973; Spence 1973, 1981). Because of this, employers will tend to hire receivers with a higher level of education under the circumstances of educational expansion and an increasing number of such receivers, and this determines the positions of different

credential holders when entering the labor market. According to this view, with the educational expansion, some credential holders enter into a comparatively lower position in the labor market and the corresponding returns to education are hence decreased. This conclusion is also proved by some recent researches, such as Van de Werfhorst (2009, 2011).

Most of those studies mentioned above concern developed countries. In terms of developing countries and post-socialist countries, there are some different findings. As Pritchett (2001) summarized, several studies from developing countries found that signaling effects of education are small. And the returns to education keep rising in many market transformation countries, which has been found in many market transforming countries, such as Russia (Brainerd 1998), Czech Republic (Chase 1998), Poland (Rutkowski 1996), Hungary (Kertesi and Köllő 2002). One popular explanation is, as Wu and Xie (2003) summarized, the transition of socialism has made the market instead of the state the mechanism to determine social stratification and further made the market competence (such as education) instead of political attribute the important factor to determine income.

Combing the researches in developed countries and some developing countries (in the period of transition), such conclusion can be drawn: In the preliminary stage of economic transition and the initial period of economic takeoff, the transition of a social system and thriving of the market have made the returns to education increase under the backdrop of educational expansion, due to lack of human capital. When the market economy becomes mature, the educational expansion will inevitably change the structure of supply and demand in the labor market as the economy develops, and over-expansion will inevitably result in the decrease of the returns to education. China's economy develops in a period between the above two stages, then what impact does China's educational expansion have on the returns to education?

3 The Changes of Returns to Education in China

As with other countries which went through market transition, China has low returns to education before market transition. In the phase of the planned economy, education levels do not have much influence on earnings; the raise of income is determined by seniority rather than work performance (Zhang et al. 2005). In the 1950s, China's returns to education were ranging from 5 to 6%; at the end of the "cultural revolution" (1966–1976), the returns to education were nearly 0; until 1994, the lower level of the returns to education did not show signs of rising (Fleisher and Wang 2005). Between the 1980s and the 1990s, urban China still adopted the planned economy, therefore, China's marginal returns to education before the 1990s were far below that of the United States, European countries and other developed countries and regions (Fang et al. 2012). For instance, in 1981, each additional year of education produced an increase of 2.5% in people's income in China; in 1987, 2.7% (Meng and Kidd 1997); in 1988, returns to education using the Mincer equation in the rural areas was 4.02% and urban areas 3.29% (Johnson and Chow 1997).

Since the 1990s, with the rapid growth of the market economy, people's earnings have been more affected by the market and the returns to education in China have been on the rise at a rapid rate (Heckman and Li 2004). From 1988 to 1995, net returns to education doubled for man and woman (Hauser and Xie 2005). The returns to education in China increased from 4.0% in 1988 to 10.2% in 2001 (Zhang et al. 2005). A recent research shows that in 1978, each additional year of education produced 2% raise of earnings, while in 1985, the number is 3.5%, 1990, 4.5%, 1995, 5.5%, 2000, 6.6% and 2005, 7.7% (Jansen and Wu 2012). As stated above, in the period of system transition and the initial period of economic development, the increase of returns to education can be viewed as the result of market transition and economic development. A similar conclusion is drawn in many developing countries (in the transition period) as mentioned above. This is because when a market-oriented system was adopted in determining earnings by the state, various potential factors, such as labor market, technological revolution emphasizing skills, an increase of trade, etc. have all resulted in the increasing demand for laborers with a special technique, and further resulted in the increase of the returns to education (Zhang et al. 2005).

In the meantime, China's education has expanded at a fast speed since the 1990s. For instance, in 1991, the gross enrollment rate of elementary schooling is 109.5%, primary schooling is 69.7%, secondary schooling (pre-occupational) is 23.9% and tertiary education is 3.5%; in 2000, the rates are respectively 104.6%, 88.6%, 38.2% and 12.5%; while in 2011, they are respectively 104.6%, 100.1%, 82.5% (full aperture) and 26.5%.[1] In the above discussion about the developed countries and in the mature market, expansion of education will alter the relationship between supply and demand of educated labor force in the labor market, and it, in turn, drives the returns to education in developed countries down. As such, what about China as it has rapid growth and forms a relatively mature market?

Notably, the individual wage, especially the wage of urban employees has increased at a rapid speed as China's economy develops (Fang and Yang 2011; Ge and Yang 2011; Meiyan 2010; Meng et al. 2013; Yang et al. 2010). It could be explained as Xin Meng et al. (2013) mentioned, when an economy shifts from an administratively determined wage system to a market-oriented one, rewards to both observed and unobserved skills increase. However, the increase in income is accompanied by the inequalities of income, which is determined by different systems of ownership, labor sectors and regions (Démurger et al. 2012; Fan et al. 2011; Ge and Yang 2014; Gustafsson and Shi 2002; Li et al. 2013; Shi and Renwei 2011; Yang et al. 2010). And some researchers attribute the uneven growth of income to the difference in access to markets (Kamal et al. 2012). The increase in wages and the differences in sectors and regions will also affect the returns to the skills of laborers. That is to say, the increase in wage and the differences in sectors and regions, as a result of market transition and economic development, can be viewed as the macro factors to affect the returns to education. Therefore, this study will include not only

[1] Source of the data: Statistics by the Ministry of Education of the PRC over the years. (https://old.moe.gov.cn/publicfiles/business/htmlfiles/moe/s8492/list.html).

the educational expansion but also the increase of wage and its differences in sectors and regions as macro factors to be considered for the returns to education.

Based on the above, the returns to education may be influenced by the educational expansion, the marketization degree and economic development level. The impact of educational expansion on the returns to education is regulated by marketization degree and economic development level. The marketization degree and economic development level of China lies between that of the developed countries and some developing countries. Accordingly, the features of the impact of educational expansion on the returns to education should be different from that of the developed countries as well as that of some developing countries whose economy develops slower than China.

4 Data, Variables and Methods

The expansion of education presents in two ways: The rate of enrollment is improved at all stages, and the educational level of laborers has generally increased. The key of this study is the impact of educational expansion on returns to education, or in other words, the possible impact of educational expansion on the labor market. Therefore, the result of educational expansion can be indicated by laborers' average educational level in different periods. Similar to this, the increase of wages can also be measured by the average wages in different periods. As such, the issue of this study turns to the impact of two macro factors—educational expansion and increase of average wages—on individual earnings. The data in this study comes from five mass social surveys, including China Household Income Project (CHIP 1995, 2002) and China General Social Survey (CGSS 2005, 2008 and 2010).[2] The urban data of these five surveys are chosen for statistics analysis.

Hierarchical linear modeling (HLM) is a comparatively ideal tool for analysis of macro factors' impact on individual behaviors, for individuals embedded in macrostructures. HLM involves macro and minor factors at the same time. Due to the inadequacy of data in different periods containing both individual and macro information, the macro factors are usually lacking data, therefore, it is hard to observe the impact of macro factors on individual behaviors. As the data in this study only concern five periods of time, it is hard to observe the change of macro factors. But as average education level and average wage can be taken as the measure of change of macro factors, which alter with time as well as labor sectors and regions, we may therefore use time, sector and region to establish "macrostructure." Specifically, the data of these five surveys will be integrated together and each individual is classified

[2]China Household Income Project (CHIP) is a long-term survey conducted by China Institute for Income Distribution at Beijing Normal University. For its introduction and the data, please refer to: www.ciidbnu.org/chip/index.asp; China General Social Survey (CGSS) is a research project organized and conducted by Renmin University of China. For the introduction, please refer to: https://www.chinagss.org/.

through time, labor sector and region. Then we have 69 groups of "region-sector-time." Though the word "establishing" the structure is used, the macrostructure with these groups is true and real, and the individual laborers are embedded in this "macro structure." By this way, the average level of education and average income in these groups can reflect the changes at a macro level, so as to solve the inadequacy of observing data at the macro level. This helps to study the impact of macro factors (educational expansion and increase of average income) on individual behaviors (returns to education).

With respect to the analysis method, first, the Mincer equation (Mincer 1958) in linear regression is used to estimate the returns to education in urban China between 1995 and 2010. The model is shown in Eqs. (1) and (2).

$$\text{LNWAGE} = \beta_0 + \beta_1 * EDUY + \beta_2 * EXP + \beta_3 * EXP^2 + \varepsilon \tag{1}$$

$$\text{LNWAGE} = \beta_0 + \beta_1 * EDUY + \beta_2 * EXP + \beta_3 * EXP^2 + \sum \beta_i * X_i + \varepsilon \tag{2}$$

Equation (1) is the basic model of the Mincer Equation. LNWAGE refers to the natural logarithm of respondent's monthly wages (changing to currency in 2010 by Consumer Price Index, $\text{CPI}_{1978} = 100$); EDUY and EXP refer to education years and working experience of the respondent. Equation (2) is an extended model including control variables. It has 5 dichotomous variables: FEMAL (female = 1, male = 0), ETHNIC (ethic groups, minorities = 1, others = 0), PARTY (Party members, member of Communist Party of China = 1), FULLTIME (full time job = 1, others = 0), STATEOWN (state-owned sectors = 1, others = 0).

Second, recording the changing average educational level and average wages of laborers in different periods, regions and labor sectors. The labor sectors are classified as party and government bodies and institutions, state-owned enterprises, collective enterprises, private enterprises and self-employed enterprises. The regions are classified as developed regions, moderately-developed regions and less developed regions according to the GDP per capita in each province in 2010. In this study, tertiary education enrollment rate will be taken as an example to show the alter of returns to education. By the way, the tertiary education enrollment rate is obtained from the almanac of statistics on education in China over the years and returns to education is the result calculated by the Mincer equation (results with and without control variables).

Last, Hierarchical Linear Model (HLM) will be used to analyze the impact of macro factors on returns to education. As stated above, the data of the five surveys will be integrated together and be classified in accordance with time, region and labor sector.[3] The variables at the individual level and macro-level are shown in Table 1, among which, MEDU refers to the average year of schooling in each group aimed at

[3]Theoretically, we can have 75 (5 periods × 5 labor sectors × 3 regions) groups, but because 6 groups of them do not have enough samples (less than 30), so there are 69 groups analyzed in the model in the end.

Table 1 Data summary for HLM

Variables	N	Mean	SD	Min	Max
Individual level					
FAMLE	25,558	0.45	0.50	0.00	1.00
ETHNIC	25,558	0.05	0.21	0.00	1.00
PATRY	25,558	0.26	0.44	0.00	1.00
FULLTIME	25,558	0.90	0.30	0.00	1.00
EXP	25,558	19.34	9.75	0.00	52.00
EXPSQUAR	25,558	4.69	3.90	0.00	27.04
EDUY	25,558	11.32	3.00	0.00	24.00
LNWAGE	25,558	6.76	0.78		13.12
Group level					
MEDU	69	11.35	1.36	8.48	14.14
MCWAGE	69	1.54	0.90	0.39	5.14
DCWAGE	69	1.95	3.69	0.21	28.15

measure the effect of educational expansion. MCWAGE refers to the average wages in each group (unit: 1,000 yuan) and DCWAGE refers to the standard deviation of average wages in different groups. These two variables are measures for the outcome of economic development and macro-control variables to observe the impact on individual incomes.

5 Analysis and Results

5.1 The Increase of Returns to Education

The above literature review reveals that the returns to education in urban China have increased at a rapid rate since the 1990s, and this conclusion is proved by our statistical analysis. The result in Table 2 shows that the returns to education in urban China have a prominent increase. The basic model of the Mincer equation shows that the rate of return to education in urban China is 4.8% in 1995, 8.0% in 2002, 9.6% in 2005, 9.5% in 2008 and 13.2% in 2010. When putting control variables into consideration, as shown in the expanded model in Table 2, the rate of return to education in each year seems to go down, but the overall trend remains the same. The rate of returns to education increases from 3.7% in 1995 to 8.9% in 2010. The expanded model of Table 2 also shows that: The female and the minority groups have comparatively lower wages; party membership had a positive impact on wages in the initial period, but have no significant impact since 2005; the state-owned sector had a positive impact on wages before 2002, but had a negative impact in the model of

Table 2 OLS regressions on LNWAGE[a]

	1995		2002		2005		2008		2010		Pooled	
	1	2	3	4	5	6	7	8	9	10	11	12[b]
(Constant)	5.187*** (0.030)	5.241*** (0.041)	5.500*** (0.037)	5.649*** (0.049)	5.993*** (0.076)	5.880*** (0.078)	6.146*** (0.121)	6.073*** (0.144)	5.674*** (0.099)	5.775*** (0.140)	5.314*** (0.025)	5.392*** (0.028)
EDUY	0.048*** (0.002)	0.037*** (0.002)	0.080*** (0.002)	0.065*** (0.003)	0.096*** (0.005)	0.089*** (0.005)	0.095*** (0.007)	0.092*** (0.008)	0.132*** (0.006)	0.127*** (0.007)	0.095*** (0.002)	0.089*** (0.002)
EXP	0.051*** (0.002)	0.051*** (0.002)	0.030*** (0.003)	0.026*** (0.003)	-0.012** (0.005)	-0.008* (0.005)	0.009 (0.007)	0.011 (0.007)	0.017*** (0.006)	0.016*** (0.006)	0.023*** (0.002)	0.023*** (0.002)
$EXP^2/100$	−0.071*** (0.005)	−0.079*** (0.005)	−0.023*** (0.006)	−0.030*** (0.008)	0.045*** (0.012)	0.034*** (0.012)	−0.009 (0.019)	−0.019 (0.019)	−0.025* (0.014)	−0.033** (0.015)	−0.014*** (0.004)	−0.020*** (0.004)
FEMALE	–	−0.109*** (0.012)	–	−0.175*** (0.017)	–	−0.182*** (0.027)	–	−0.188*** (0.041)	–	−0.293*** (0.039)	–	−0.160*** (0.028)
ETHNIC	–	−0.061** (0.027)	– –	0.033 (0.042)	–	−0.190*** (0.063)	–	−0.212** (0.088)	–	−0.155** (0.072)	–	−0.021 (0.021)
PARTY	–	0.101*** (0.014)	–	0.101*** (0.021)	–	−0.029 (0.039)	–	0.077 (0.053)	–	0.044 (0.048)	–	0.065*** (0.011)
FULLTIME	–	−0.001 (0.033)	–	0.127*** (0.020)	–	0.431*** (0.038)	–	0.263*** (0.089)	–	0.185** (0.091)	–	0.086*** (0.002)
STATEOWN	–	0.155*** (0.015)	–	0.044*** (0.017)	–	−0.166*** (0.028)	–	−0.110** (0.043)	–	−0.038 (0.040)	–	–
N	11,045	10,903	9419	6252	2452	2452	1144	1126	1830	1617	25,890	25,612
Adjusted R^2	0.169	0.191	0.168	0.152	0.147	0.212	0.139	0.171	0.207	0.228	0.149	0.162

Note

[a]***$P < 0.001$, **$P < 0.01$, *$P < 0.05$

[b]In order to compare with HLM analysis, "STATEOWN" didn't been put in this model

2005 and 2008, and have no significant impact in the model of 2010; the full-time job has a positive impact on wages since 2002.

The results of OLS regressions can only tell us the changing of returns to education over time, and what we interested is educational expansion and its' impact on the returns to education. In other words, we want to predict the variation of the β coefficient of education in Mincer's equation with factors of macro environment, and take the β coefficient of education as an outcome variable. Before that, a description of the changes of the background in the macro respect from 1995 to 2010 will be conducted.

5.2 Changes in the Macro Context: Educational Expansion and Wage Growth

Since the 1990s, China's education has developed at a rapid speed and tertiary education has significantly expanded after the late 1990s. The gross enrollment rate of tertiary education increased from 7.2% in 1995 to 26.5% in 2010.[4] Particularly, during 1995 and 2010, as the gross enrollment rate of tertiary education increased rapidly, returns to education present a robust momentum of growth. This is likely to indicate the negative impact on returns to education by extension of education that existed in some developed counties did not appear in China. Instead, the conclusion in some developing countries seems to apply in China, which shows that the extension of education has a positive impact on returns to education. But this remains to be testified (see Fig. 1).

In order to observe the variation of the results of educational expansion and its' impact on the returns to education, theoretically, enough time points and large time-series data sets are needed. In fact, this kind of data sets which contain both individual and macro information lacks in China. One of the results of educational expansion is the increase of average education level in society, and it also can be shown as a difference of average education in a society among times. The difference of laborers' average education among different regions, years and labor sectors make it possible that we can use the variation of average education in different region-sector-year groups (which real exist social units) to simulate the variation of average education in a society among times. The difference in laborers' average education among different regions, years and labor sectors have been testified by many studies, and also testified by our data set.[5] For instance, the average years of schooling for laborers raised from 10.76 of 1995 to 12.71 of 2010; the average years of schooling for laborers in Party and government bodies raised from 12.16 of 1995 to 13.88 of 2010; that of the

[4]Source of data: the official website of the Ministry of Education (MOE). (https://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/s8493/201412/181724.html).

[5]Due to the limit requirement of words, this thesis has omitted the detailed results of the differences of years of schooling, labor sectors and regions, as well as the differences in the periods, sectors and regions on the influence of laborers' income.

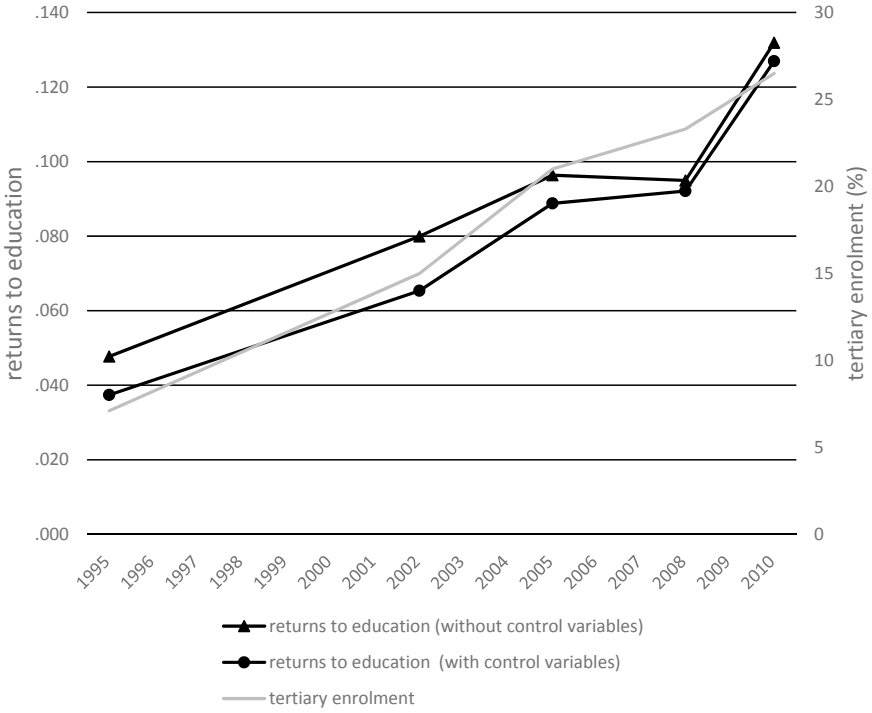

Fig. 1 Enrollment of tertiary education and the returns to education for urban employees. *Note* the data of tertiary enrolment come from the Ministry of Education of the People's Republic of China (https://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/s8493/201412/181724.html); and the rates of returns to education are the results in Table 2

self-employed raised from 10.76 of 1995 to 12.71 of 2010; that of the laborers in developed regions raised from 10.85 of 1995 to 13.19 of 2010; that of the laborers in less developed regions raised from 10.67 of 1995 to 12.42 of 2010.

Another macro factor this study focuses on is the changes (increasing) of average wages of the laborers as a result of economic development. The result of our analysis indicates that the average wage differs at a different time as well as in different regions and sectors. For instance, the result by sample analysis indicates that the average wage increased from 675.39 yuan of 1995 to 3, 011.31 yuan of 2010 (by the currency in 2010; similarly hereinafter); the average wage of laborers in Party and government bodies and institutions increased from 763.64 yuan of 1995 to 2,529.85 of 2010, and the average wage of laborers in private enterprises increased from 876.52 yuan of 1995 to 3,852.36 yuan of 2010; that of laborers in developed regions increased from 844.15 yuan of 1995 to 4,081.49 yuan of 2010 and that of laborers in less developed regions increased from 562.93 yuan of 1995 to 1,887.17 yuan of 2010. Given that the average wage alters with sectors, regions and year, we will, in the hierarchical linear model in the following passage, use the changes of the average wage in each

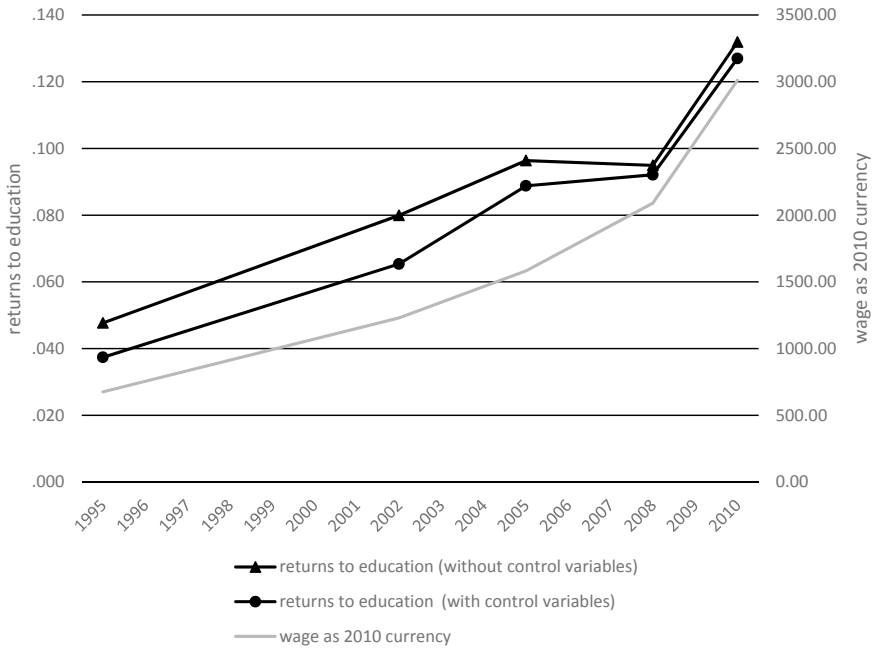

Fig. 2 Average wage and the returns to education for urban employees. *Note* the rates of returns to education is the results in Table 2, and the wage is calculated based on our data set

group classified by "region-sector-year" to simulate the alters of the average wage through time (to overcome the inadequate data of years).

So, what's the relationship between the alter of the average wage and returns to education? Fig. 2 shows that the increase of average wage is synchronized with the increase of the returns to education. Combining with the result shown in Fig. 1, the increase of the returns to education may be resulted from the expansion of education or resulted from the increase of the average wage of laborers with the economy developing. And this is to be testified in this study.

5.3 The Results of Hierarchical Linear Models

The results in our OLS regressions suggest that the returns to education in urban China since the 1990s represent growth in a rapid speed, which is in line with the conclusions of other similar studies. Descriptive studies also indicate that Chia's education has greatly expanded with the rapid growth of returns to education. Then, what's the relationship between the expansion of education and the returns to education? As the expansion of education is a factor in the macro level while the returns to education concern the individual level, this study uses the hierarchical linear model to observe

Table 3 Equations of HLMs

Model	Level-1	Level-2
1	$LNWAGE = \beta_0 + r$	$\beta_0 = \gamma_{00}$
3		$\beta_0 = \gamma_{00} + u_0$
2	$LNWAGE = \beta_0 + \beta_1 FEMALE + \beta_2 ETHNIC + \beta_3 PARTY + \beta_4 FULLTIME + \beta_5 EXP + \beta_6 EXPSQUQRE + \beta_7 EDUY + r$	$\beta_{i0} = \gamma_{i0}$ *(i = 1–7)*
4		$\beta_0 = \gamma_{00} + \mu_0$ $\beta_i = \gamma_{i0} + \mu_i$ *(i = 1–7)*
5		$\beta_0 = \gamma_{00} + \gamma_{01} MCWAGE + \gamma_{02} DCWAGE + \mu_0$ $\beta_i = \gamma_{i0} + \mu_i$ *(i = 1–6)* $\beta_7 = \gamma_{70} + \gamma_{71} MEDU + \mu_7$
6		$\beta_0 = \gamma_{00} + \gamma_{01} MCWAGE + \gamma_{02} DCWAGE + \mu_0$ $\beta_i = \gamma_{i0} + \mu_i$ *(i = 1 ~ 6)* $\beta_7 = \gamma_{70} + \gamma_{71} MEDU + \gamma_{72} MCWAGE + \gamma_{73} DCWAGE + \mu_7$
7		$\beta_0 = \gamma_{00} + \gamma_{01} MCWAGE + \gamma_{02} DCWAGE + \mu_0$ $\beta_i = \gamma_{i0} + \mu_i$ *(i = 1 ~ 6)* $\beta_7 = \gamma_{70} + \gamma_{72} MCWAGE + \mu_7$

the impact of macro factors on individual behaviors. According to the design of this study, educational expansion has led to the improvement of average years of schooling, therefore it uses the alters of years of schooling by groups to simulate the changes of educational level through time (education expansion); in the meantime, it uses the changes of the average wage, one of the results of economic development, as a controlling factor. The equations of level 1 and level 2 of the hierarchical linear model are shown in Table 3, and the analysis result is shown in Table 4.

To compare with the results of OLS regression, a fixed-effect model (regarding that the regression coefficients in level 1 do not vary with groups) will be applied to analyze the alters of labor wages (refer to Model 1 and 2 in Table 4). From Model 1 to Model 2, we can see that 16.2% [(0.61248–0.51328)/0.61248 = 0.16196] of individual wage can be explained by the predictive variables at the individual level, which is consistent with the result of Model 12 of Table 2 by multiple linear regression (adjusted $R^2 = 0.162$ of Model 12 in Table 2).

Model 3 to Model 7 in Table 4 apply varying coefficient models (regarding that the regression coefficients in level 1 vary with groups). Among them, Model 3 is a null model, which has no predictive variables. It can be drawn from the variance components in Model 3 that 35.92% [0.22471/(0.40092 + 0.22471) × 100% = 35.92%] of the changes of individual wages can be explained by the factor of groups (factor in the macro level), 64.08% (1–35.92% = 64.08%) of the changes of individual wages can be explained by the factor of individuals (factor in the micro-level).

Table 4 HLMs for the individual- and Group-level determinants of wage division[a]

	Model1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept β_0							
Intercept γ_{00}	6.763579*** (0.090926)	5.391369*** (0.138123)	6.967415*** (0.057142)	5.755604*** (0.057889)	5.273881*** (0.071200)	5.581281*** (0.073839)	5.544662*** (0.069491)
MCWAGE γ_{01}	–	–	–	–	0.377169*** 0.04311	0.180882*** (0.051153)	0.219094*** (0.037669)
DCWAGE γ_{02}	–	–	–	–	0.040229*** 0.005863	−0.039096*** (0.009405)	−0.050273*** (0.005841)
FEMALE β_1							
Intercept γ_{10}	–	−0.159745*** (0.021464)	–	−0.182424*** (0.014115)	−0.182072*** 0.013905	−0.184253*** (0.014662)	−0.184067*** (0.014792)
ETHNIC β_2							
Intercept γ_{20}	–	−0.019961 (0.028174)	–	−0.088979*** (0.025082)	−0.093855*** 0.024923	−0.094254*** (0.025188)	−0.093535*** (0.025162)
PARTY β_3							
Intercept γ_{30}	–	0.065639 (0.040558)	–	0.084605*** (0.016651)	0.079782*** 0.016838	0.080285*** (0.016812)	0.081417*** (0.017215)
FULLTIME β_4							
Intercept γ_{40}	–	0.084081 (0.082396)	–	0.255119*** (0.033819)	0.247470*** 0.034176	0.248740*** (0.033920)	0.247865*** (0.034107)
EXP β_5							
Intercept γ_{50}	–	0.022892*** (0.007268)	–	0.022663*** (0.003643)	0.022112*** 0.003579	0.021834*** (0.003647)	0.021881*** (0.003659)
$EXP^2/100$ β_6							

(continued)

Table 4 (continued)

	Model1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept γ_{60}	–	−0.020993 (0.013975)	–	−0.037823*** (0.008829)	−0.037860*** 0.008638	−0.036773*** (0.008663)	−0.036906*** (0.008729)
EDUY β_7							
Intercept γ_{70}	–	0.089003*** (0.010916)	–	0.069468*** (0.004614)	−0.000522 0.017385	0.017617 (0.016226)	0.028320*** (0.003524)
MEDU γ_{71}	–	–	–	–	0.006101*** 0.001528	0.000800 (0.001691)	
MCWAGE γ_{72}	–	–	–	–	–	0.027987*** (0.005654)	0.025835*** (0.002423)
DCWAGE γ_{73}	–	–	–	–	–	−0.000908 (0.000961)	–
Variance Component[b]	–						
Intercept μ_0	–	–	0.22471***	0.15643***	0.10341***	0.12026***	0.11196***
FEMALE μ_1	–	–	–	0.00856***	0.00833***	0.00864***	0.00880***
ETHNIC μ_2	–	–	–	0.01441***	0.01483***	0.01601***	0.01601***
PARTY μ_3	–	–	–	0.00803***	0.00876***	0.00928***	0.00932***
FULLTIME μ_4	–	–	–	0.04928***	0.05273***	0.05330***	0.05373***
EXP μ_5	–	–	–	0.00064***	0.00064***	0.00070***	0.00069***
EXPe^2/100 μ_6	–	–	–	0.00361***	0.00355***	0.00387***	0.00383***
EDUY μ_7	–	–	–	0.00118***	0.00100***	0.00045***	0.00044***
Level-1 r	0.61248	0.51328	0.40092	0.32638	0.32644	0.32642	0.32645
Level-1 obs	25,558						
Level-2 obs	69						

Note The numbers in the brackets are robust standard errors, ***$P < 0.001$, **$P < 0.01$, *$P < 0.05$

In Model 4, level 1 has included the predictive variables at the individual level, while level 2 has no predictive variables. To lessen the impact of unknown factors, level 2 has divided the variation of slopes of each predictive variable in level 1 into intercept terms and stochastic terms, among which, intercept terms refer to the average slope of predictive variables in level 1 and stochastic terms refer to the variation of the slopes of these predictive variables. The result of the variance test indicates that all predictive variables at the individual level (including educational year "EDUY") vary in level 2. This result means that, in each group, the predictive variables at the individual level have a different impact on the wages of individual workers (that is the slope is unfixed).

The emphasis of this study is the returns to education, this is the impact of the EDUY on wages. Based on the preliminary analysis in Model 4, it can be drawn that the EDUY's impact on wages varies in different backgrounds (groups). Then, what factors can affect the impact? How are they working? As stated, this study focuses on the two factors which influence the returns to education, namely the effect of educational expansion (the variation of average educational level) and the increase of average wages brought by economic development. Therefore, in level 2 of Model 5, average MEDU is added to explain the variation of the slope of EDUY in level 1. It turns out that MEDU has a significant role in determining the slope of EDUY (in level 1). This means that the average educational level in each group affects the marginal returns to wages by the length of schooling: The higher the average educational level in one group, the greater marginal returns to wages by the length of schooling of these individuals in this group.

However, when adding average wages in each group which is "MCWAGE" and its difference which is "DCWAGE" as control variables in level 2 (see Model 6), the impact of the average educational level "MEDU" on the returns to education for individuals is not significant in terms of statistics, yet the average wage in each group has a significant impact on the returns to education for individuals. This outcome shows that the marginal utility of an individual's length of schooling on wages is affected by the average wage of the group that this individual belongs. In other words, when the average wage of the group is high, the length of schooling of the individual in this group will also produce a high marginal utility on wages.

To simplify the results, the predictive variables without a significant role in level 2 are removed in Model 7. The variance components in Model 7 show that 61.71% [(0.00118–0.00044)/0.00118 = 0.6271] of the alters of the individual's returns to education (the slope of the variable of the length of schooling in level 1) can be explained by the "MCWAGE" in each variable group in level 2. Combining the findings in Model 5 to 7, we can see that what affects the individual's returns to education in level 2 is the general increase in the average wages of laborers, rather than the general improvement of average educational level.

Based on the analysis result of Model 7, a figure about the impact of average wages on the returns to education is made as below (see Fig. 3).

From Fig. 3, the slopes of the EDUY in different situations are apparently different. The higher the average wages of the laborers, the steeper of the slope of the EDUY.

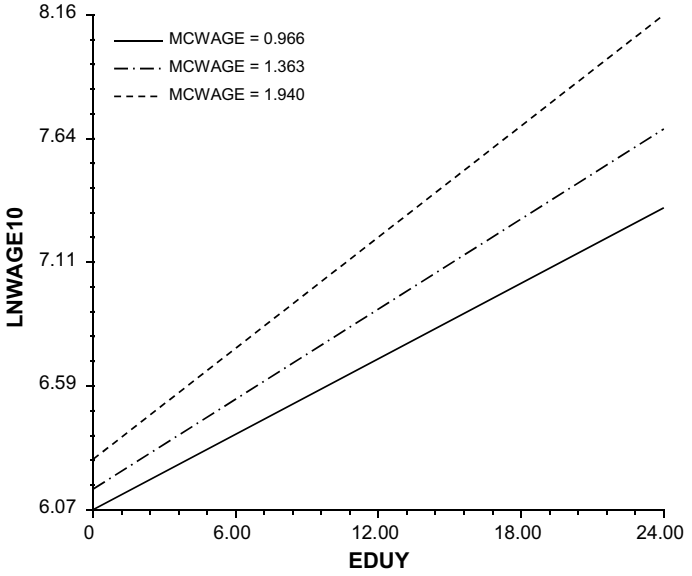

Fig. 3 The impact of average wages on the slope of education

That is to say, when the average wage is comparatively high, the marginal utility of the length of schooling on the wage is great.

6 Conclusions and Discussions

The focus of this study is about the relationship between educational expansion and the returns to education. The outcome of the OLS regression has again proved the conclusions of existing studies, which is the returns to education in urban China have greatly improved since the 1990s. But different from the previous studies which use the expansion of education only as a macro background, this study uses the hierarchical linear model to analyze the relationship between educational expansion and the individual's returns to education. It finds that the expansion of education in China has neither a positive impact nor a negative impact on the returns to education.

As we have reviewed, the expansion of education has a negative impact on the returns to education in developed countries, while in some developing countries (particularly those in market transition), the impact is not negative, but even positive. Regarding these different results, we think that for developing countries, particularly those in the period of market transition, they are in the period of market transition and the initial stage of economic thriving. On one hand, the emerging market system changes the old system of income distribution and makes the performance as the basis for deciding income; on the other hand, the introduction of a market system

has stimulated the development of the economy and boosted the need for a skilled workforce. Due to these two features in the transition period and the initial stage of economic thriving, the expansion of education in developing countries and particularly those in the period of market transition does not have a negative impact on the returns to education, instead, it has helped the increase of the returns to education. While for the developed countries, educational expansion alters the relationship of supply and demand or the signaling or positioning function of education in the labor market in the context of a mature market, so the over-expansion of education can result in the decrease of the returns to education.

As for China, its economy has developed considerably after 40 years' reform and opening up, and the market economy has basically formed. The level of China's economy is between the developed countries and some developing countries (in transition), therefore, the impact of educational expansion in China differs from both. This is testified by this study. The analysis of urban China by the method of the hierarchical linear model shows that, the increase of the average length of education as a result of educational expansion does not have a significant impact on the individual's returns to education from the statistics aspect, while the increase of average wages of laborers as one of the results of economic development, instead, has a great influence on the individual's returns to education. Furthermore, such a conclusion can be drawn: The educational expansion does not have a significant impact on the returns to education and the rising of the individual's returns to education is led by the development of the economy rather than the expansion of education.

If we take the impacts of educational expansion in developed countries and some developing countries as two extremes of a pair of the ideal type, then with the market transition and the maturity of the market, the impact of the educational expansion on individual's returns to education will experience three periods: the rising period, the period of no significant impact, and the falling period. This study indicates that the impact of educational expansion on the individual's returns to education in China lies between those of the developed countries and some developing countries, which is in the middle period. It is still a question to be considered and paid continuous attention to whether this middle period means the continuous and excessive educational expansion will result in the decrease in the returns to education with further maturity of China's market economy and further growth of the economy.

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The Impact of Artificial Intelligence on Skill Demands and Its Implications for Education Supply: An Empirical Study Based on the Routinization Hypothesis

Yuzhi Yuan and Yuhong Du

Abstract Artificial intelligence (AI) will change the demands for skills in the labor market, which imposes new requirements on education. According to a routine-based hypothesis, the skills of the labor force fall into five categories: non-routine cognitive skills, non-routine non-cognitive skills, routine cognitive skills, routine physical skills, non-routine physical skills. This study based on data from the Occupational Information Network (O*NET) of the U.S., as well as the census data (1982–2010) from China, finds that China's labor market has an increasing demand for non-routine cognitive skills, non-routine non-cognitive skills and routine cognitive skills, but a decreasing demands for routine and non-routine physical skills. With economic development, the higher GDP per capita, the greater demands at the labor market for non-routine cognitive skills, non-routine non-cognitive skills and routine cognitive skills, and the less demands for routine and non-routine physical skills. In terms of personal income, based on the CGSS data (2010–2013) and the Mincer income equation, this study finds that routine cognitive skills have an increasing and positive effect on labor income, indicating a strong demand for routine cognitive skills at China's labor market. Considering that the development of AI will lead to increasing demand for non-routine skills, educators are supposed to develop students' non-routine cognitive skills and non-routine non-cognitive skills by giving more integrated courses and using theme-based situational teaching methods.

Keywords Artificial intelligence (AI) · Routine · Non-routine · Cognitive skills · Non-cognitive skills · Physical skills

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1 Introduction

Klaus Schwab, a German economist, the World Economic Forum founder and executive chairman, argues that development of the information technology such as Artificial Intelligence (AI) will disrupt almost all industries in almost all countries, bringing about a new technological revolution called the Fourth Industrial Revolution. According to *the Fourth Industrial Revolution: Strategies for Employment, Skills and the Workforce for the Future*, by 2020, more than a third of the core skills required by most occupations will be different from those for today, based on the results of a survey on more than 13 million workers (World Economic Forum 2016). On the one hand, the development of the information technology represented by AI will require the human labor force to acquire certain new skills to make up for the incapability of AI. On the other hand, just as the previous industrial revolutions have drastically shifted the labor force, which can be demonstrated by the dramatic decline of agricultural employment, the fourth industrial revolution will also move a greater proportion of the labor force to the more specialized fields, requiring better social skills, stronger ability to make innovation and decisions with new ideas under uncertain conditions (World Economic Forum 2016). In a word, the fourth industrial revolution represented by AI will bring in fundamental transformation for most occupations and the skills they require, which will become the source power of educational reform.

1.1 The Routine and Nonroutine Tasks of Professions

According to the characteristics of the job content, the researchers discussed the routine and nonroutine tasks of professions, and generally believed that the higher the occupational routine, the higher the probability of being replaced by information technologies such as artificial intelligence. The exploration of occupational routine provides an analytical basis for studying the impact of information technologies such as artificial intelligence on the skill demand in the labor market.

Autor and others divided work contents into five categories: the non-routine analytical tasks, the non-routine interactive tasks, the routine cognitive tasks, the routine physical tasks and the non-routine physical tasks. Based on the Dictionary of Occupational Title (DOT) of the U.S., these researches identified the professional skill requirements for both the routine and non-routine tasks through measuring the five categories from the following aspects: the employees' math grades in the General Education Development (GED), their capabilities to guide, control and plan the tasks, the accuracy of the employees' capabilities to fulfill the set limits, boundary values or standards, the employees' finger dexterity and coordination among the eyes, hands and feet (Autor et al. 2003).

Based on the researches by Autor and others, Frey and Osborne further studied the routine issues of occupations. They argued that with the development of machine

learning, mobile robot technology and big data, not only the routine tasks can be easily completed by machines instead of human labor, but also the non-routine tasks have also been affected by the development of science and technology including the computing technology. For instance, the routine tasks in medical diagnosis have proven to be replaced by computers. Therefore, based on the O*NET data, the tasks with perception and operation, creative intelligence and social intelligence that are difficult to be replaced by computers have been classified as the bottleneck for computers to replace the human labor. The specialists in the field of machine learning divided 70 vocations into two types: the automatable and the non-automatable. Using the binary classification analysis method of the Gaussian Process, the research estimated the probability of each professional being replaced by computers, which found that about 47% of the occupations in the United States were at risk of being replaced by computers (Frey and Osborne 2013).

Deloitte, a British firm, based on Frey and Osborne's findings, estimated the probability of computers replacing the vocations in the UK, which found that about 35% of the occupations in the UK were at high risk of being automated over the next 10–20 years. From 2001 to 2015, the employees working for the occupations with the low-probability of 10 to 40% in the UK increased and those for the probability of 50% also increased; On the other hand, workers for the high-probability of 60 to 100% decreased (Deloitte 2015).

Marcolin and others studied the routine tasks, based on data from the survey carried out by the Program for the International Assessment of Adult Competencies (PIAAC), setting four indicators in the questionnaire to determine the routine intensity: the easiness to decide the order of priority of tasks; the easiness to decide the types of tasks; the frequency of planning activities autonomously; the frequency of making one's own timetable. According to the intensity indicators, occupations were divided into four categories: the non-routine, the low-intensity routine, the medium-intensity routine and the high-intensity routine. Taking education level and occupation as the proxy variables of the employees' skills, the research found that the higher the skill level of the employees were, the higher the probability of them engaging in the non-routine and low-intensity routine occupations was. On the other hand, the proportion of the employees with the intermediate skill level was the highest in the intermediate-intensity and higher-intensity routine occupations (Marcolin et al. 2016).

1.2 The Trends in Skill Demand

Most previous researches on the changes of various skill requirements applied the job analysis method, through which the details were obtained and classified based on the routinization hypothesis. Considering the changes in the occupational structure, the research concluded with the changing trend of the skill requirements for various vocations. However, the job analysis method is time-consuming and labor-intensive, requiring a lot for the researchers. Therefore, the existing researches based on this

method mostly used the data with detailed occupational tasks open to the public, such as the DOT and the O*NET developed based on the DOT.

Using the DOT data, Autor and others estimated the proportions of various routine and non-routine tasks in different vocations and explored the changes in the occupational skill requirements in the United States from 1960 to 1998 based on the data of the American census and the survey of population status considering the changes in the occupational structure. The research found that the labor input into the non-routine analytical and non-routine interactive jobs rose dramatically over the period of nearly 40 years. The results of the regression analysis of the changes of the labor input in various occupations and the changes in the proportion of workers using computers every year in the industry showed that the rapid computerization led to the decrease in labor input into the routine cognitive jobs and the increase in labor input into the non-routine cognitive jobs (Autor et al. 2003).

On the basis of Autor and others' research, Levy and Murnane divided work contents into five categories: expert thinking, complex communication, routine cognitive, routine physical and non-routine physical. Also using the DOT and the American census data, taking the year 1969 as the baseline, they studied the changes of American professional skill requirements from 1969 to 1998, which found that the requirements for the expert thinking and complex communication tasks continued to grow, that for the routine cognitive and physical remained steady in the 1970s, but fell in the 1980 and 1990s, and that for the routine physical kept declining. To explore the impact of computer use on the changes of the requirements for skills in the labor market, Levy and Murnane found that the demand for both the routine cognitive and manual tasks would increase without using computers based on their prediction on the changes in the demand for skills in the labor force without computers (Levy and Murnane 2003).

Applying the classification of work contents by Autor and others, based on the survey data on professional qualification and professions by the German Federal Institute of Occupational Training, Spitz studied the changes in professional skill requirements from 1979 to 1999, which found that the analytical and interactive tasks increased while the routine cognitive and physical tasks decreased and the non-routine physical tasks fluctuated to a certain degree though it tended to increase on the whole. To explore the influence of computer use on the change of the demand for this skill, based on the regression analysis of the change of proportion of computer use and the change of various work contents, they found that computers and the non-routine cognitive jobs complemented each other, and computers could complete certain routine cognitive and physical jobs (Spitz 2004).

Based on the routine hypothesis, Goos and others divided work contents into 3 types: the abstract, the routine and service, among which the abstract and service belonged to the non-routine which was difficult to be replaced by computers and the abstract tasks demand a higher level of education than that of the service. Using the O*NET data, they quantified the three types and replaced the working hours with the number of working people. Based on the labor survey data by the European Union from 1993 to 2006, they studied the changes of occupational skills in 16 European countries, which found that for every standard deviation of the abstract and service

jobs, 1.33 and 1.28% of labor demand would increase, and for that of the routine jobs, 1.33% of labor demand would decrease (Goos et al. 2004).

Also based on Autor's classification of work contents, Aedo and others regarded it as a representative of the occupational skill requirements. Using the O*NET data, they measured the skill requirements for each occupation, and the results were matched to the occupations (the International Income Distribution Database by the World Bank) in 30 countries including the United States. With horizontal comparison internationally, they found that countries with higher per capita income had higher demand for the non-routine cognitive (analytical and interactive) and routine cognitive skills while lower demand for the routine and non-routine physical skills (physical jobs) (Aedo et al. 2013).

2 The Framework of Theoretical Analysis of the Influence of AI on Skill Requirements

Artificial intelligence completes or assists humans to do intelligent work mainly through simulation, extension and expansion of human intelligence, which means that the development of information technology such as AI will lead to an increase in the probability that the human labor force is replaced by machines. In their book *The Second Machine Age*, Brynjolfsson and McAfee at the Massachusetts Institute of Technology, noted that the first machine age was about the power systems and their ability to transport large quantities of objects, partly replacing manpower while humans became the supplementation of machines to a great degree; The second machine age is more about automation and strengthening of the thinking ability and cognitive activities of machines when machines partially replace the human mind and many daily mental tasks will be computerized (Brynjolfsson and McAfee 2014). This trend can also be seen from the development trajectory of robots. The architecture of robots can be divided into three levels: The first is the implementation function, which simulates the movements and operations of human limbs and it has been applied in the traditional industries, completing certain simple and repetitive tasks by the first generation of robots who can replace human labor at about 5% of the time; The second is cognitive intelligence, which simulates the prefrontal cortex of the human brain for decision-making, planning, reasoning, experience and knowledge learning. The second generation of robots, known as AI robots, has such characteristics as self-instruction and environmental adaptability, such as Da Vinci, a surgical robot by Intuitive Surgical. The second generation of robots could replace human labor up to 60% in the manufacturing sector and even complete intelligent manufacturing tasks entirely unmanned; The third is perceptual intelligence, which means with big data, robots have acquired perceptual intelligence that will eventually allow the machines to replace humans in some industries through certain technologies including radar, infrared, force and touch sensor, GPS, encoder, deep learning and other simulation of

human labor's ability of classification, understanding, senses and visual and auditory pathways (Deng 2016).

According to its development trajectory, machine replacement of human labor was first embodied in the task. Autor, Levy and Murnane argued that if you want to understand the impact of technological progress on the labor market, you must first understand the characteristics of the work contents for different vocations, which include all the activities completed by labor in the production process requiring different skills. If a task can be fully described with rules, it is very likely to be completed by computers, which are good at using rules quickly. At present, the recognition capability of computers is limited to solving those problems that require little situational and no complex perceptual knowledge while those tasks that require complex recognition are still mostly done by humans. Therefore, this research puts forward a routinization hypothesis (ALM hypothesis for short).

The routinization hypothesis divides work contents into two types: routine and non-routine according to the fact that computers have the comparative advantage in processing the tasks with certain rules while humans in completing the tasks requiring stronger recognition capability. On the one hand, depending on step-by-step programs, a machine that lacks flexibility and judgment can easily accomplish the tasks that can be fully defined. Such programmed, repetitive, regular tasks that can be done by computers are called the routine tasks which require an intermediate level of cognitive and physical skills and the employees in these occupations tend to be easily replaced by computers, such as the clerical, sales, production and mechanic staff. On the other hand, those tasks whose rules cannot be clearly identified and cannot be completed with computer programs or machines are called the non-routine tasks, which are further divided into analytic and interactive and manual tasks. The analytical tasks require the labor force to have certain problem-solving and innovation ability with a relatively high level of education. The professional and technical tasks often have such characteristics as those in the fields of law, medicine and science. Such interactive tasks as management work include interpersonal communication. The main reason that analytical and interactive jobs are difficult to be done with computer technology is that they often require a large amount of information input. The manual tasks are characterized by situational adaptation, visual and language recognition, and face-to-face interaction, which are mainly required in the service industry, such as drivers and cooks, which require better physical skills and certain language skills and less education. Such manual tasks are hard to be replaced with computers because the key to accomplishing these tasks is the ability to adapt to the situation and interact with people, which is beyond the capacity of the automated machines. Although AI will make it possible for machines to acquire such capabilities in the long run, it has not been popularized because of the high cost (Acemoglu 2016). The more non-routine analysis and interactive tasks the occupation contains, the higher the education level is required while the more routine and non-routine physical tasks the occupation contains, the lower the education level. There is not a monotonous relationship between the tasks of the routine cognitive tasks and the education level of the labor force: the proportion of the labor force with high school

education and non-undergraduate higher education is the largest among all the staff is engaged in the occupations with more routine cognitive tasks (Autor et al. 2003).

Based on the division of tasks by the routine hypothesis, this study divides the skills needed to complete various tasks into five categories: the non-routine cognitive skills, the non-routine non-cognitive skills, the routine cognitive skills, the routine physical skills, and the non-routine physical skills while *Xi*, a set of skills, is necessary to take up occupation *i*. According to the characteristics of the computer technology and other information technology replacing human labor, or the routine skills easy to be replaced, taking into consideration the employment structure and the changes in the retribution of various skills, this research predicts the changes in the requirements for skills in the future labor market.

$$X_i = \begin{bmatrix} X_i^{non-routinecognitiveskills} \\ X_i^{non-routinenon-cognitiveskills} \\ X_i^{routinecognitiveskills} \\ X_i^{routinephysicalskills} \\ X_i^{non-routinephysicalskills} \end{bmatrix} \quad (1)$$

3 Research Design

3.1 Data Sources

The data used in this research are from the O*NET and China General Social Survey (CGSS).

The O*NET data serve as the indicators to measure the requirements for various occupational skills, an occupational information system developed by the Employment and Training Division of the U.S. Labor Department, which collects the characteristic data of about 974 occupations through a large-scale questionnaire survey of practitioners and occupational experts, based on the Standard Occupational Classification (SOC). The O*NET data describe both employees and their occupations: for the employees, the following characteristics are included: their personal characteristics such as their capabilities, professional interest, professional values and work styles, and the requirements on their skills, knowledge, education and experience; for the occupations, the following characteristics are included: work activities, work environment, career prospects, and other relevant information.

Once a year since 2003, the Renmin University of China and the Hong Kong University of Science and Technology have carried out the China General Social Survey, a continuous cross-sectional survey on multiple households in the provinces, municipalities directly under the central government and autonomous regions in mainland China. By means of the multi-order stratified random sampling method of PPS, the survey collects the data of about 10,000 respondents at all levels including

society, community, family and individual in 28 provinces, autonomous regions and municipalities directly under the central government. The survey collects such information as the respondents' educational background, gender, occupation, income and work experience, which has been coded using the International Standard Occupational Classification (ISCO88) to facilitate making comparative study with the relevant foreign researches.

3.2 Variables and Models

3.2.1 Skills Measurement

Applying the research methods by Acemoglu, Autor, Aedo and others, this study measures 16 indicators of the O*NET, belonging to the non-routine cognitive skills, non-routine non-cognitive skills, routine cognitive skills and routine physical skills and non-routine physical skills, which are needed to complete all kinds of tasks (see Table 1).

Each skill category is equal to the arithmetic mean of its corresponding indicator, which is used to estimate the five categories of skill requirements for each occupation. The occupational classification standards used by the O*NET is O*NET-SOC, a more detailed occupational classification based on the U.S. Occupational Classification Standard (SOC). To facilitate making comparisons across countries, researchers often translate the O*NET-SOC into the encoded data of the International Standard Classification of Occupations (ISCO) based on the assumption that the same skills exist in the same occupations in each country as in the United States (Classifications Crosswalks from O*NET-SOC to ISCO[EB/OL]). Using this method, this study calculates the data of ISCO88 occupation code matching the five types of skills through code conversion (see Table 2).

3.2.2 Model Setup

First, the research studies the overall changes of demand for the non-routine cognitive skills, the non-routine non-cognitive skills, the routine cognitive skills, the routine physical skills and the non-routine physical skills in the labor market. Applying the method of converting China's Occupational Classification into the International Standard Occupational Classification (ISCO) (China Family Panel Studies 2010) by China's General Social Survey and China Family Panel Studies, this study calculates the overall demand for the five types of skills in China's labor market according to the matching data of occupations and skills, obtained on the basis of the census data. The calculation process is as follows: supposing θ_i is the proportion of the employees for occupation i to the total labor force, θ represents the structure of the entire labor market, and D is the total demand for skills in the labor market, which is equal to the sum of the products of the proportion of the employees for each occupation in the

Table 1 Measurement indicators and remarks about the five categories of skills

Skills	Measurement indicators	Remarks
Non-routine cognitive skills	Analytical data or information	Importance degree, a five-point scale, 1 represents not important while 5 very important
	Creative thinking	The same as the above
	Understanding the outside information	The same as the above
Non-routine non-cognitive skills	Establishing and maintaining interpersonal relationship	The same as the above
	Task assignment and motivating subordinates	The same as the above
	Instructing others	The same as the above
Routine cognitive skills	Repetitive but not physical tasks	The same as the above
	Requiring correctness and accuracy	The same as the above
	Structural nature	Freedom, a five-point scale, 1 represents not free while 5 free
Routine physical skills	Adjusting movements to the speed of machines passively	Importance degree, a five-point scale, 1 represents not important while 5 very important
	Operating machines or programs mechanically	The same as the above
	Repetitive manual jobs	Frequency, a five-point scale, 1 represents never while 5 very frequently
Non-routine physical skills	Operating equipment, machines manually	The same as the above
	Handling an object or instrument	Importance degree, a five-point scale, 1 represents not important while 5 very important
	Dexterity of hands	The same as the above
	Positioning accurately	The same as the above

total labor force and the occupational skill requiements.

$$\theta_i = \frac{workers_i}{totallaborforce} \tag{2}$$

$$\theta = \left[\theta_1 \ldots \theta_n\right] \tag{3}$$

Table 2 Variables and their coding pattern

Variable	Definition	Scoring system
Income (Y)	Individual's yearly wage	Continuous variable
Skills	In 5 categories: non-routine cognitive skills, non-routine non-cognitive skills, routine cognitive skills, routine physical skills, and non-routine physical skills	Continuous variable
Education	Highest academic degree obtained by individual (edu)	Dummy variable
Work experience	The time since the individual's first job other than one in agriculture (exp) and the square of the work experience (exp2)	Continuous variable
Other controlled variables (Xi)	Other variables including the individual's gender, region, industry and employer type	Dummy variable

$$D = \theta \mathrm{X} = \begin{bmatrix} \sum \theta_i X_i^{non-routinecognitiveskills} \\ \sum \theta_i X_i^{non-routinenon-cognitiveskills} \\ \sum \theta_i X_i^{routinecognitiveskills} \\ \sum \theta_i X_i^{routinephysicalskills} \\ \sum \theta_i X_i^{routinephysicalskills} \end{bmatrix} \tag{4}$$

Second, based on the CGSS data, this research explores the relationship and the changing trend between various skills and personal wage income. Based on the assumption that the skills required by an individual's occupation are all the skills he or she possesses, or taking the necessary skills as the proxy variable of all the skills possessed by an individual, this research explores the relationship between various skills and the income. Applying the Mincer income equation with the addition of skill variables, as shown in model 5, this research studies the changing trend of the relationship between the skills and the income over time by means of regression analysis of the data from 2010 to 2013.

$$\begin{aligned} In\ Y = {} & \beta_0 + \beta_1 noncog + \beta_2 nonncog + \beta_3 rcog + \beta_4 rman + \beta_5 nonman \\ & + \beta_6 edu + \beta_7 \exp + \beta_8 \exp^2 + \sum \alpha_i X_i + \mu \end{aligned} \tag{5}$$

4 Overall Changes in Skill Requirements

Using the above-mentioned research method, this study calculates the requirements for the non-routine cognitive skills, the non-routine non-cognitive skills, the routine

Table 3 Requirements of the routine and non-routine skills for various occupations

	Non-routine cognitive skills	Non-routine non-cognitive skills	Routine cognitive skills	Routine physical skills	Non-routine physical skills
Leaders of the government agencies, NGOs, enterprises and public institutions	3.679	3.897	2.897	1.974	1.771
Professionals and technicians	3.716	3.215	3.100	2.108	1.923
Clerical and the related personnel	3.145	3.071	3.382	2.391	2.428
Commercial and service workers	2.981	3.185	3.045	2.446	2.336
Employees in the agricultural, forestry, animal husbandry and fishery	2.520	2.675	2.833	3.019	3.238
Production, transportation workers and the related personnel	2.886	2.880	3.174	3.263	3.310

cognitive skills, the routine physical skills, and the non-routine physical skills for various occupations in China (see Table 3).

To be specific, for the leaders of the government agencies, NGOs, enterprises and public institutions, the requirements for the non-routine non-cognitive skills are the highest, followed by the non-routine cognitive skills; For the professionals and technicians: the requirements for the non-routine cognitive skills are the highest, followed by the non-routine non-cognitive skills; For the clerical and the related personnel, the requirements for the routine cognitive skills are the highest; For the commercial and service workers, the requirements for the non-routine and non-cognitive skills are the highest, followed by the routine cognitive skills; For the employees in the agricultural, forestry, animal husbandry and fishery, the requirements for the non-routine physical skills are the highest, followed by the routine physical skills; For the production, transportation workers and the related personnel, the requirements for the non-routine physical skills are the highest, followed by the routine physical skills and routine cognitive skills. Considering the changes in China's occupational structure, the research summarizes the general changes in the demand for various

skills in China's labor market in recent years: before 2000, China's labor market had the greatest demand for non-routine physical skills, followed by the routine physical skills; In China, where the primary industry as its main industry and farmers account for the largest proportion in the labor force, the demand for the non-routine physical skills and routine physical skills is the highest; On the other hand, for the production, transportation workers and the related personnel, who account for the second-largest proportion, the demand for the non-routine physical skills and the routine physical skills is high as well, resulting in a strong demand for the non-routine physical skills and the routine physical skills. However, the demand for the routine cognitive skills surpassed that for the routine physical skills as the second most needed type in 2000, and became the most needed one in 2010, surpassing that for the non-routine physical skills. As can be seen from the above table, for the clerical and the related personnel, the demand for the routine cognitive skills is the highest, while the production, transportation workers and the related personnel, various professional, technical, commercial and service personnel are the second largest group who need the routine cognitive skills. With the development of the secondary and the tertiary industries, these three types of personnel have increased significantly, and the demand for routine cognitive skills has also increased. The demand for the non-routine cognitive skills is the smallest, followed by the non-routine non-cognitive skills while from 1982 to 2010, the demand for these two skills in the labor market rose steadily, and the demand for the non-routine non-cognitive skills tended to exceed that for the routine physical skills (see Fig. 1).

Compared with the findings on the changes of skill requirements calculated by researchers in other countries using the same method, this research finds that China

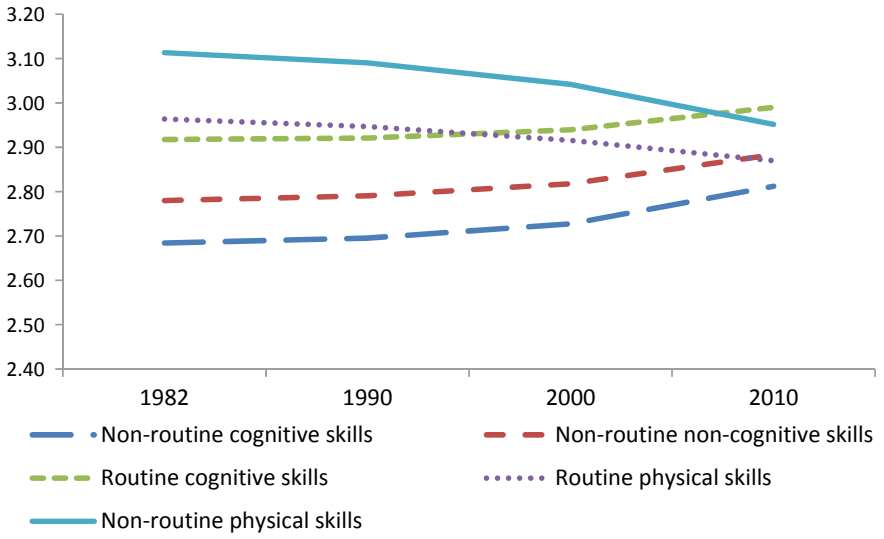

Fig. 1 Change trend of the skill requirements in China's labor market

Table 4 Changes in skill requirements in the labor market across countries

		Non-routine cognitive skills	Non-routine non-cognitive skills	Routine cognitive skills	Routine physical skills	Non-routine physical skills
China	1982	2.684	2.780	2.918	2.964	3.113
	1990	2.695	2.791	2.921	2.947	3.091
	2000	2.727	2.818	2.940	2.916	3.042
	2010	2.812	2.884	2.990	2.870	2.952
America	1980	2.967	2.983	3.181	2.621	2.426
	2008	3.023	3.08	3.130	2.497	2.335
Chile	1992	2.733	2.859	3.035	2.732	2.720
	2009	2.790	2.904	3.031	2.626	2.624
Brazil	1981	2.757	2.909	2.961	2.692	2.61
	2009	2.798	2.921	3.060	2.646	2.554
Poland	2002	2.929	2.969	3.005	2.669	2.639
	2010	2.983	2.999	3.018	2.615	2.568
Turkey	2004	2.809	2.913	2.962	2.826	2.813
	2008	2.827	2.927	2.986	2.771	2.738
India	1994	2.766	2.889	2.866	2.928	3.017
	2010	2.772	2.907	2.889	2.875	2.966

is consistent with other countries in the changing trend of the demand for various skills. (see Table 4).

The demand for both the non-routine cognitive and non-routine cognitive skills is growing in all countries, among which the United States is in the greatest demand, followed by Poland. The demand for routine cognitive skills has risen in all countries except in the United States and Chile, where the demand for these skills is declining but the overall demand remains the highest. The demand for both routine and non-routine physical skills is falling across countries. While the demand for these skills is also declining in China and India, the demand remains the highest among others. By matching the occupational skills with the GDP per capita, this research finds that the countries with higher the GDP per capita have greater demand for non-routine cognitive skills, non-routine non-cognitive skills and routine cognitive skills while the demand for both the routine and non-routine physical skills decreases as the per capita GDP increases (see Fig. 2).

5 Changes in the Economic Return of Skills

Based on the CGSS data in any year, from the perspective of the skills of the labor force with different education levels, the non-routine cognitive skills will improve

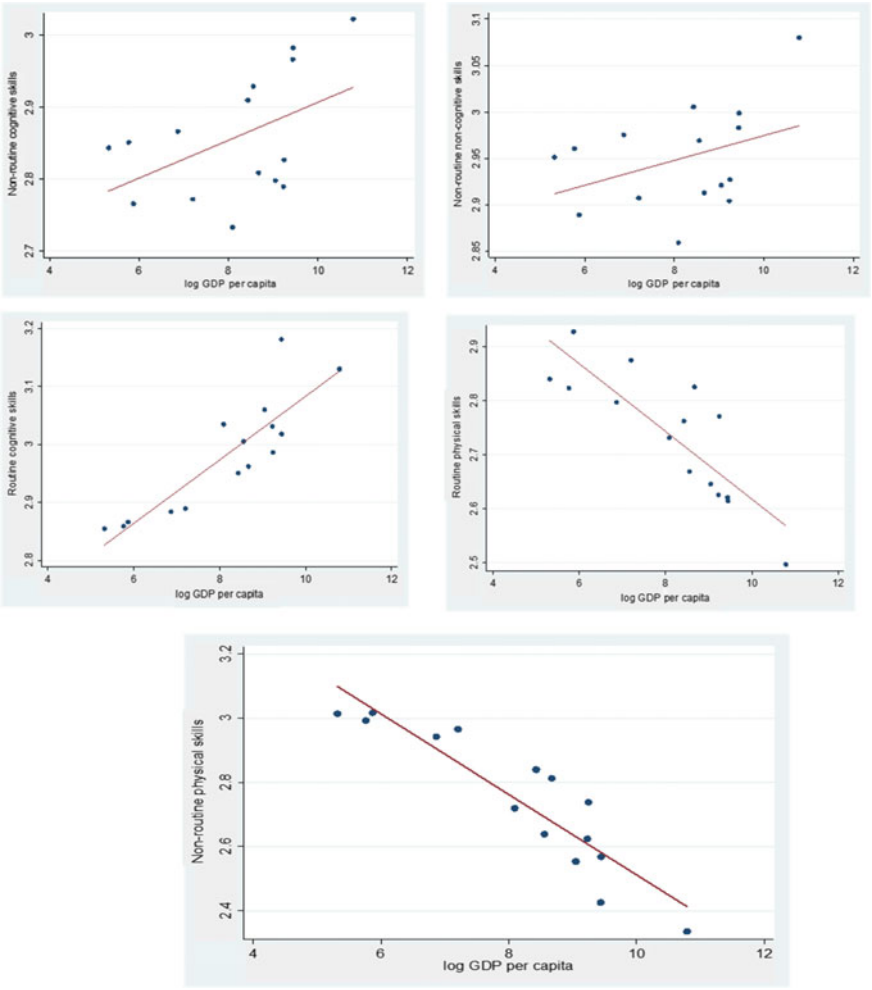

Fig. 2 The relationship between skills and GDP per person

with the improvement of the education level while the routine physical and non-routine physical skills decrease with the improvement of the education level. The non-routine and non-cognitive skills of the labor force also increase with the improvement of the education level, reaching the highest among the labor force with bachelor's degree, while the non-routine and non-cognitive skills of the labor force with a graduate degree and above are slightly lower than those with bachelor's degree. From 2010 to 2013, the highest values of the routine cognitive skills were transferred from the labor force with a graduate degree and above to those with an undergraduate degree, and then to those with a college degree in 2013. Therefore, at present, occupations with higher requirements for routine cognitive skills require a college degree.

From the perspective of time, the demand for vocational skills changed little on the labor force with a high school degree and lower and a graduate degree and above. From 2010 to 2013 and except in 2011, the non-routine cognitive and non-routine non-cognitive skills of the college-educated labor force showed a general trend of decline. On the contrary, also except in 2011, the non-routine cognitive skills, the routine physical skills and the non-routine physical skills showed a general trend of increase. In terms of the non-routine cognitive and the non-routine non-cognitive skills, the changing trend for the undergraduate labor force and those with a college degree remained consistent: they were falling in general while the routine cognitive and routine skills, as well as the routine physical skills, were in a rising trend (see Table 5).

Based on the Mincer income equation, this research explores the influence of the above-mentioned five types of skills on income, which finds that education remains a high market yield rate while the return rate begins to decline with the skill variables added. To list the numbers, the relative rate of return fell 4.9% points for those with junior high school education, 11.8 for senior high school, 23.6 for junior college, 28.6 for undergraduate and 32.4 for graduate and above. From the perspective of skills, the non-routine cognitive skills, non-routine non-cognitive skills and routine cognitive skills have positive effects on the wage income while the routine physical skills and non-routine physical skills have negative effects. Except for the positive effect of routine cognitive skills on income, the effect of other kinds of skills on income fluctuates with time (see Table 6).

6 Conclusions and Their Implications for Education Supply

The new technological revolution led by AI, namely the Fourth Industrial Revolution, will cause fundamental changes in the demand for skills in the labor market, which are mainly reflected in the following aspects: First, the demand for the non-routine cognitive skills, the non-routine non-cognitive skills and the routine cognitive skills in China's labor market has kept increasing, while that for the routine and non-routine physical skills decreasing. The higher the GDP per capita, the greater the demand for the non-routine cognitive skills, the non-routine non-cognitive skills and the routine cognitive skills in the labor market, and the lower the demand for the routine physical skills and the non-routine physical skills. Secondly, the non-routine cognitive skills of the labor force increase with the improvement of the education level, while the routine physical skills and non-routine physical skills decrease with the improvement of the education level. The non-routine non-cognitive skills of the labor force increase first and then decrease with the improvement of the education level while the non-routine non-cognitive skills of the undergraduate labor force are the best. The changing trend of the routine cognitive skills varies with the education level from year to year, but in general, the labor force who score the highest in the routine cognitive skills changes from those with a graduate degree to an undergraduate degree and finally to a college degree, which partly explains the change

Table 5 Changes of the mean value of all kinds of occupational skills for different education levels

		2010	2011	2012	2013
Primary school and below	Non-routine cognitive skills	2.78	2.715	2.795	2.811
	Non-routine non-cognitive skills	3.061	3.046	3.097	3.077
	Routine cognitive skills	2.906	2.876	2.912	2.979
	Routine physical skills	2.751	2.69	2.735	2.762
	Non-routine physical skills	2.723	2.663	2.685	2.753
Junior high school	Non-routine cognitive skills	2.832	2.844	2.868	2.852
	Non-routine non-cognitive skills	3.104	3.096	3.141	3.125
	Routine cognitive skills	2.929	2.921	2.954	2.97
	Routine physical skills	2.618	2.628	2.651	2.631
	Non-routine physical skills	2.569	2.594	2.59	2.593
Senior high school	Non-routine cognitive skills	2.99	3.045	3.006	3.024
	Non-routine non-cognitive skills	3.155	3.219	3.195	3.217
	Routine cognitive skills	3.049	2.988	3.036	3.001
	Routine physical skills	2.488	2.429	2.54	2.426
	Non-routine physical skills	2.387	2.382	2.463	2.365
College degree	Non-routine cognitive skills	3.243	3.37	3.339	3.275
	Non-routine non-cognitive skills	3.25	3.388	3.341	3.311
	Routine cognitive skills	3.155	3.031	3.081	3.109
	Routine physical skills	2.213	2.15	2.254	2.282
	Non-routine physical skills	2.053	1.985	2.104	2.149
Undergraduate	Non-routine cognitive skills	3.415	3.491	3.444	3.415
	Non-routine non-cognitive skills	3.345	3.415	3.364	3.359
	Routine cognitive skills	3.102	3.061	3.086	3.082
	Routine physical skills	2.1	2.101	2.15	2.161
	Non-routine physical skills	1.948	1.952	2.019	2.019
Graduate and above	Non-routine cognitive skills	3.567	3.698	3.573	3.565
	Non-routine non-cognitive skills	3.292	3.395	3.342	3.342
	Routine cognitive skills	3.169	3.011	3.065	3.097
	Routine physical skills	2.066	2.025	2.213	2.126
	Non-routine physical skills	1.873	1.756	1.988	1.946

in the educational background of the workforce in vocations that require a higher level of the routine cognitive skills. Thirdly, the non-routine cognitive skills, the non-routine non-cognitive skills and the routine cognitive skills are positively correlated with the wage income, while the routine physical skills and the non-routine physical skills are negatively correlated with the wage income. From the perspective of time, the positive effect of the routine cognitive skills on income keeps increasing, while the influence of other skills fluctuates.

Table 6 Mincer equation regression results with skill variables from 2010 to 2013

	Mincer equation	2010	2011	2012	2013
Junior high school	0.199***	0.150***	0.036	0.267***	0.114***
Senior high school	0.419***	0.301***	0.219***	0.417***	0.313***
Colledge degree	0.825***	0.589***	0.534***	0.709***	0.482***
Undergraduate	1.159***	0.873***	0.790***	0.924***	0.717***
Graduate and above	1.686***	1.362***	1.173***	1.399***	1.243***
Non-routine cognitive skills		0.140***	0.072	0.158***	0.04
Non-routine non-cognitive skills		0.237***	0.112	0.101*	0.169***
Routine cognitive skills		0.160***	0.175**	0.015	0.183***
Routine physical skills		−0.124**	−0.250***	−0.051	−0.211***
Non-routine physical skills		−0.077	0.042	−0.042	−0.011

Adopting the subject-specific teaching method, both the elementary and higher education in China, at present, aim to guide the students to acquire knowledge ignoring cultivating the students' non-routine cognitive skills such as the ability to solve problems based on real situations.

For elementary education in China, the focus is placed on its role of "transferring talents" to the next stage of education, which is embodied in its emphasis on the graduation rates, the students' grades, and cultivating students' routine cognitive skills rather than their ability to solve problems or other non-routine cognitive skills. Taking the PISA test in 2012 as an example, the participants from Shanghai, China did not perform well in the additional testing part of the problem-solving module based on computers, whose average score was lower than that of those from Singapore, South Korea, Japan and other countries or regions through their results ranked No. 1 in Math, Reading and Science.

China's higher education, strongly influenced by the Soviet model and based on the subject-specific teaching method, is characterized by narrow professional education, which means taking the knowledge points of a single subject as the important teaching objective. Since the knowledge points taught are isolated from one another, the teaching process only involves intellectual enrichment, requiring that the students memorize the knowledge points. Therefore, the educators usually pursue that the students acquire the cognitive skills, especially the routine cognitive skills, which is not conducive to cultivating the students' non-routine cognitive skills such as their problem-solving ability. To facilitate developing students' problem-solving ability and other non-routine cognitive skills, this research proposes that more comprehensive courses should be included in the syllabus, making changes to the traditional

teaching contents and methods which used to rely too much on the subject-specific teaching approach.

For elementary education, this research recommends the teachers apply the situation-based teaching method more frequently, or the theme-based teaching approach while for higher education, the interdisciplinary teaching approach, which facilitates the educators to make integrated curriculums based on an interdisciplinary theme and convey the subject knowledge to their students in a holistic way. Applying the interdisciplinary teaching approach emphasizing the students' development of multiple intelligences based on certain situations and practical problems, the educators usually guide their students to acquire knowledge actively through student-centered activities, in which the students are free to explore any learning material on the subject being taught. The interdisciplinary teaching approach helps to improve students' ability to solve problems and other non-routine cognitive skills, promote the development of the students' thinking ability and enhance the students' cognition transfer effectively.

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The Contributions of Education to the Green GDP

Ran Chen, Xiaohao Ding, and Weifang Min

Abstract Green GDP, which reflects social welfare, social progress and sustainable economic development, can be used to comprehensively measure the role of education within the green GDP accounting system and embody the real value of education in economic growth. The previous literature estimated the contributions of education to economic growth mainly by the means of the traditional national economic accounting system. This study, based on an analysis of the impact of education on green GDP through the green GDP accounting system, aims to explore the significance of education within economic development, especially sustainable economic development. The results show that education benefits national green economic development, and that, compared to traditional GDP, education has a more significant impact on green GDP. Now more so than ever, important strategic opportunities are facing China, where education plays a more significant role in the new model of economic development.

Keywords Green GDP · Sustainable development · Contributions of education

The academic circle has essentially reached a consensus that education has a significant positive effect on economic growth. According to Thodore's human capital theory, education increases productivity by improving human capital. It has become the theoretical basis for a series of studies on the educational economy and evidence

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for empirical analysis after it. Driving the economy through promoting education has also become an effective path for economic development after the 1960s.

Education exerts comprehensive influence on man; it influences the economy through its impact on humans. Man provides the labor force, but he has more roles than simply being a labor provider. Education not only increases knowledge and skills but also brings changes to living habits. Education may even change man's mindset and ideology. Man is the basic unit of economic production. Various effects of education on a man can ultimately lead to influences on economic development. How to comprehensively measure the role of education and reflect its true value in economic growth has been an issue which existing studies have not completely addressed and which requires further exploration.

1 Introduction

1.1 Deficiencies of Traditional GDP Accounting

In the previous literature, when evaluating the contribution of education to economic growth, it mainly adopted the traditional System of National Accounts (SNA), whose emergence and development bore remarkable historical imprints. Keynesianism, which was held by Western countries in earlier years, emphasizes the government's intervention in the national economy; so it needed to measure and diagnose macroeconomics. In the 1940s, Kuznets proposed the concept of Gross National Product (GNP), from which the concept Gross Domestic Product (GDP) was derived. This accounting system was then adopted by the United Nations and became an important indicator of economic development around the world. At the time, the theory of property rights was not yet perfected, and natural resources and the ecological environment, as free public goods, were excluded from the accounting system. As man re-identified his values, the limitations and disadvantages of traditional GDP have become increasingly acute.

In recent years, the increasingly severe global issues, such as global resource shortages and ecological degradation, pose challenges to sustainable human development never seen before. Some economists realize that there are obvious flaws to singularly utilize GDP as a measure of economic development of a nation or region. As a matter of fact, man's economic activities create wealth for society, which is its positive effect; on the other hand, it holds back the development of social productive forces in various forms and means, which are its so-called negative effects.

Such negative effects are shown through two aspects. One is that it endlessly requests resources from the ecological environment, leading to a decline of the absolute amount of ecological resources available, year by year. The other is that man discharges waste or cuts down ecological resources through various production activities, resulting in the quality deterioration of the ecological environment. The existing system of national accounts reflects the positive effect of economic activities but not

the negative effects. Therefore, the system is incomplete, limited and inconsistent with the sustainable development strategy. Therefore, there is a stronger call for improving the national economic accounting system.

1.2 Green GDP Being Put Forward

In fact, there were doubts long before about using GDP to measure economic growth. The traditional GDP method can only measure the output of an economy, but it fails to consider asset consumption caused by said output. That is why GDP cannot accurately reflect the assets and wealth behind the output that truly represents national welfare. John·Richard·Nicolas·Stone, one of the inventors of GDP, pointed out that we should describe the development of a country from economic, social and environmental aspects. To address the deficiencies mentioned above, many scholars have provided improvements to GDP accounting. The concept of green GDP has attracted the attention of the academic circle due to its scientific and systematic nature.

Green GDP refers to the ultimate outcome of economic activities of a country or region after taking into account the influence of natural resources, mainly including land, forest, minerals, water, ocean and environmental factors including the ecological environment, the natural environment, the cultural environment, etc., in a means to deduct the cost of resource depletion and environmental degradation from GDP. By reforming the current SNA, the result of accounting for environmental resources, and deducting the cost of environmental resources, of environmental pollution or degradation from current GDP is called green GDP. Such an indicator actually represents the net positive effect of national economic growth.

Green GDP faithfully reflects social welfare, social progress and sustainable economic development. It is an economic indicator that correctly displays GDP. The implementation of green GDP accounting, which cuts the value of environmental pollution losses and resource depletion caused by economic growth from GDP, is a direct reflection of coordinating development between man and nature; it is a driver for coordinated development between regions and domestic development and opening-up. In the meantime, green GDP accounting is conducive to fully measuring and evaluating the actual effects of economic growth, enhancing public awareness of the need to protect environmental resources, overcoming the tendency to only pursue economic growth, and reversing the GDP-centered evaluation of one's achievements in one's official capacity. It is helpful to reduce the externalities of the economy and thus bring it on a new path of industrialization.

The adoption of Green GDP accounting does not mean that it will replace traditional GDP. Traditional GDP remains the most direct indicator for reflecting national economic development. To comprehensively disclose the current situation of the national economy requires a series of indicators rather than only one. In that case, Green GDP effectively complements the traditional national economic accounting system represented by GDP and is used to eliminate exaggerated economic achievements. Moreover, since there are disagreements on the methods used and the obstacles

faced during the accounting process, green GDP has not been as universally adopted in an authoritative manner as GDP has. The current position of green GDP is closer to a complement to traditional GDP.

As green GDP evolves from traditional GDP, taking the relationship between traditional GDP and education into consideration, this study logically infers that the relationship between green GDP and education may be closer than that of traditional GDP and education. Additionally, countries or regions with higher education levels utilize resources more efficiently and pay more attention to environmental protection.

Due to these reasons, this study focuses on proposing and empirically testing the two hypotheses: first, education is beneficial to the green economy of a nation; second, education contributes more to green GDP than to GDP.

2 Theoretical Background

2.1 Economic Growth Model

The most classic model to show the contribution of economic growth factors is the Solow-Swan model. Since its establishment in 1956, it has become the main theoretical framework used to analyze the relationship between the above three variables. Its basic form is:

$$Y = AK^{\alpha}L^{1-\alpha}$$

In this formula, Y stands for output (GDP), K for capital, L for the labor force, and A for technological development level and other production factors. Subsequent studies on economic growth are largely based on this model. The general approach is separating other influencing factors from A, making it an independent variable. Barro took knowledge and technology (T) into account and added them to the model. The formula is:

$$Y(t) = F[K(t),\ L(t),\ T(t)]$$

Mankiw brought human capital (H) to the model, making the formula:

$$Y(t) = F[K(t),\ L(t),\ H(t)]$$

Technology and human capital in the above models are added as independent factors. The later new economic growth theory with Romer and Lucas as representatives combine the two together and puts forward an endogenous economic growth model which emphasizes the role of knowledge and technology and believes that endogenous technological advancement is the decisive factor for sustained economic growth.

The changes aforementioned are more about amending and extending the model to better explain some phenomena in reality. For example, the basic model of Solow RM fails to explain why capital always flows from poor countries, with more abundant labor, to developed countries. However, N. Gregory Mankiw's model explains it. It points out that poor countries are short of human capital and their marginal productivity of capital is actually much lower. However, the Solow Model and expansion forms built on it remain the most commonly used and feasible models for studying economic growth.

2.2 The Influence of Education on Economic Growth

Most studies on the influence of education on GDP are based on human capital theory. For one, human capital is considered by many as a major contributing factor to economic growth; for another, human capital is closely linked to education. Therefore, when studying economic growth, if human capital is involved, education is often regarded as a proxy variable for human capital. Research on the influence of education on economic growth is by nature on the influence of human capital on economic growth.

There have been many empirical studies on the influence of education on economic growth; almost all of which have concluded that education plays a positive role in economic growth.

Kyriacou, taking the number of years of the working population receiving education as an indicator of human capital, made a regression analysis by using Lucas' endogenous economic growth model. The result shows that the stock of human capital, that is, the education level of a country, is positively related to its economic growth (Kyriacou 1991). Barrow and Lee carried out a comprehensive study on economic growth and reached a positive conclusion on education; they also hold that education is conducive to economic growth (Barro and Lee 1994).

Chinese scholars have conducted similar studies, many of which take China as the object of research. Some scholars, using data from 29 provinces between 1985 and 2000 took the proportion of the population aged 15 and over who had received junior high school education or above as the index of education, employed the Solow Model and analyzed the impact of education on economic growth. The studies found that in China, education has a significantly positive influence on economic growth,; its influence is much higher than the value obtained from similar empirical studies abroad. It is about twice the estimate that Mankiw-Romer-Weil gives. Some scholars explain that this is due to the fact that China's imbalanced capital structure leads to low investment in education, which makes investment in education have high-cost performance (Yang et al. 2006). However, some also point out that the overall contribution of China's education to the economic growth rate generally accounts for a small share and only has a small increase. Scholars who have also used the Solow Model and education index obtained from data, such as the average number of years of the labor force receiving education as an indicator of education level, find that

when comparing the contribution of education to the economy between China, the United States and other six countries, what China's education contributes to economic growth is only equivalent to that of developed countries in the 1960s and early 1970s and that the increase is also much lower than in developed countries (Wang et al. 2009). Despite the disagreement, most studies reach consensus on the major trend, that is to say, education is of great significance to China's economic growth, especially sustainable growth; and that education and the human capital behind it are likely to be the core driving force for China's future economic development.

2.3 Studies on Green GDP

Early in 1971, scholars at the Massachusetts Institute of Technology proposed the "Economic Requirement Indicator (ERI)" which reflects the relationship between economic growth and pressure on environmental resources. In the 1980 and 1990s, the World Bank brought up green accounting and tried to promote it (Xiang and Zheng 2013); it established the system of environmental-economic account (SEEA) in some countries. However, this accounting method has not been widely used thus far, and most countries and regions have not carried out accounting on its natural resources and environment. For example, China released its report on Green GDP accounting from 2004 for the first time in 2006, but it has since been suspended it due to difficulties in accounting, data sensitivity, etc.

Most research on green GDP, at home and abroad, is at a stage of exploration; there has yet to be a mature and perfect theoretical system. The majority of studies discuss how to improve green GDP theory. Boyd explored the possibility of calculating the non-market value of natural resources and what should be included in green GDP in his paper. He proposed that humane resources such as national culture and social stability should be included (Ding 1997). Additionally, some scholars have an actual method of calculation for green GDP. However, due to the difficulty in obtaining data, most of these studies are limited to specific countries or regions. They use ecological and geological methods to measure the output of global natural resources, thus working out the green GDP of each country (Boyd 2007). This is one of the few attempts of calculating the green GDP of countries around the world. Other scholars have tried to obtain the influencing factors of green GDP. Talberth and others, using existing green GDP data from some countries, study the impact of national openness on green GDP. They eventually find that the degree of openness of a country is strikingly negatively related to green GDP; the difference between green GDP and GDP and the degree of national openness are significantly positively correlated (Li and Chuang 2014).

An analysis of the relevant literature shows that a lot of studies have been done on the contribution of educational development to traditional indicators of economic growth, especially GDP, but few have been done on the contribution of education to indicators of sustainable economic growth, such as green GDP. The significance of economic development measured by GDP and green GDP is different. Does the

contribution of education to these two indicators of different developmental significance vary? What are the characteristics? This is not only a novel and interesting research question with academic value, but also an important question for profoundly understanding the role of education in economic development, on sustainable development in particular, and properly managing the relationship between education and economic development. Aimed at exploring the value of education for sustainable development, the following sections of this paper will empirically estimate and compare the difference between the contribution of education to GDP and green GDP.

3 Research Methodology and Model

3.1 Solow Growth Model with Education

In order to estimate the impact of education on economic development, this paper, referring to the endogenous economic growth model of Lucas, adds variables reflecting the level of educational development to the Solow Model, in reference to human capital. According to human capital theory, economic development depends not only on the quantity of labor but also on the quality of labor. In general, it is related to human capital. In other words, human capital H can be divided into two parts: L which represents quantity, and H which represents quality. Both of which affect economic growth. The educational level can be used to measure labor quality in a more accurate manner and is a suitable proxy variable for H.

After adding the education variable, the model is changed into the following form:

$$Y = AK^{\alpha}L^{\beta}E^{\gamma}$$

E stands for the quality of labor force, and educational level is used as a proxy variable.

3.2 Green GDP Accounting

Research on green GDP has not yet produced satisfactory results, partly due to the difficulty in measuring green GDP. If one accounts for green GDP by deducting resources and environmental costs from traditional GDP, just as green GDP is defined, the problem arises that there are currently no sufficient statistics to support such a study. Under such circumstances, many scholars find new paths and employ an indirect method to measure green GDP, such as the input–output model, which indirectly calculates green GDP based on the output of the economy and the environmental cost per unit of output. However, it requires great efforts to measure the resources

and environmental input needed by the output of industries. There is no obvious advantage over traditional methods in terms of simplicity and accuracy. Therefore, such studies have not provided satisfactory results at the moment.

Assuming that resources and the environment must be used in production, the difference between green GDP and GDP is essentially in the efficiency of using resources and the environment by a country or a region. Therefore, we can start with use efficiency and estimate the green GDP in an indirect way. Measuring use efficiency requires the consideration of two aspects. Firstly, we should consider how much output can be brought by using a unit of resources, then we should think about how much damage the use of resources will do to the environment. Answering the former question, we can get the GDP generated by energy consumption per unit, and the latter the proportion of renewable energy in all energy sources. This paper uses the following formula to measure green GDP:

$$Green\ GDP = GDP \times renew \times Energy$$

In this formula, Energy stands for use efficiency of energy, that is, GDP generated by the energy consumed per unit; renew represents the proportion of renewable energy. The result is an index that reflects both domestic productivity and resources and the environment.

The advantage of using this indirect method to estimate green GDP is that the actual resource consumption and environmental pollution costs are not necessary to calculate. Instead, what needs to be calculated is the efficiency and the proportion of clean energy used, this data is available and relatively complete. However, there are also flaws in using this method to estimate green GDP. Firstly, green GDP loses its realistic significance and cannot be used to measure the actual output or actual green output of a country, but merely as an indicator that is logically related to greenness and operational. Despite the difference of green GDP theoretically, the indicator indeed improves GDP, reflecting the cost of resources and the environment; it is closer in concept to green GDP. Secondly, when studying economic growth, we usually pay more attention to relative change rather than absolute value. Although the absolute value of this indicator does not have realistic significance, the relative change and comparison of indicators still carry practical significance for economic growth. Therefore, this paper uses the aforementioned indirect method to estimate green GDP and apply it to an economic growth model.

3.3 Model of the Impact of Education on Green GDP

First, this paper will verify whether education is conducive to the greenness of a country's economy. We standardized GDP and green GDP as follows:

$$\text{standardized GDP} = \frac{\log(GDP) - \overline{\log(GDP)}}{SD(\log(GDP))}$$

$$\text{standardized } Green \text{ GDP} = \frac{\log(Green\ GDP) - \overline{\log(Green\ GDP)}}{SD(\log(Green\ GDP))}$$

The values of standardized GDP and green GDP can represent the position of the original values in the overall distribution. We take the difference value between standardized green GDP and standardized GDP as an indicator in measuring whether the national economy is greener.

$$GAP = \text{standardized green } GDP - \text{standardized } GDP$$

This formula tells us that, when GAP is positive, it means the position of the country's green GDP in the overall distribution is much higher than GDP. That is to say, the country's economy is greener. Then we take GAP as the dependent variable, education level as the independent variable, and add controlled variables such as capital and labor for general linear regression. By doing so, we can analyze whether education has a positive role in the greenness of a country's economy.

$$GAP = \beta_0 + \beta_1 \times K + \beta_1 \times L + \beta_2 \times E$$

Next, we need to analyze the specific contribution of education to green GDP growth. Combining the previous changes to the traditional economic growth model, we can get: Green GDP = GDP × renew × Energy = $AK^{\alpha 1}L^{\beta 1}E^{\gamma 1}$.

Taking logarithm, we get the general linear model:

$$ln(GreenGDP) = ln(A) + \alpha_1 ln(K) + \beta_1 ln(L) + \gamma_1 ln(E)$$

This study compares the similarities and differences in the contribution of education to traditional GDP and green GDP:

$$ln(GDP) = ln(A) + \alpha_2 ln(K) + \beta_2 ln(L) + \gamma_2 ln(E)$$

After the regression, we compared the parameters of the two models and analyzed the difference in the impact of each factor of production on traditional GDP and green GDP.

We tested the aggregate level and the per capita level separately. For the aggregate level, we used indicators including GDP, capital, labor, and total educational level (average years of education × number of population aged 25 above). For the per capita level, we used per capita GDP, per capita capital, per capital-labor force, and per capita educational level as indicators; their values are equal to the indicators at the aggregate level divided by the population.

4 Empirical Outcome and Analysis

4.1 Data Source and Data Cleaning

Data applied by this study include GDP (constant 2010 USD), GDP per capita (constant 2010 USD), gross capital formation (constant 2010 USD), labor force (total), energy consumption of per unit GDP (kg of oil equivalent per $1,000 GDP constant 2011 PPP), combustible renewable resources and waste (% of total energy) database and population aged 25 and above from the World Bank and data on the average years of schooling (aged 25 and above) from the UN HDI database.

In terms of time selection, since the database of the United Nations Development Programme began to count the average years of schooling in countries around the world after 1990, and, as of 2019, the World Bank database has not updated some of its statistics such as energy consumption of GDP per unit, the proportion of renewable energy, etc. for the years after 2015. As a result, this study extracted data of 26 years from 1990 to 2015. As the countries included by the World Bank public database do not match those included by the United Nations Development Programme database, this study also conducts the necessary screening of the countries, keeping a total of 187 countries and regions (in fact, the World Bank has 189 members and the UN has 193 members). Economies of the excluded countries account for a minuscule proportion in the world and will not have a significant impact on this study. Moreover, the economies of excluded countries are usually malformed due to war and other factors; they cannot reflect the general laws of economic development. Therefore, in terms of quantity and representation, the selected samples in this study are sufficient to reflect the global situation in recent years.

4.2 Influence of Education on Green GDP

With the adoption of a new accounting method, s some changes emerge in the economic development of various countries. In the green GDP accounting system, some countries drop significantly, while others emerge at the top of the rankings of the green economy. We will explore the reasons for this phenomenon, especially the role that education plays in it.

In order to verify the first hypothesis that high-level education is conducive to a greener national economy, we can use the ranking difference between GDP and green GDP and perform a regression analysis according to the previous general linear model:

$$GAP = \beta_0 + \beta_1 \times K + \beta_1 \times L + \beta_2 \times E$$

Through Hauseman test, we perform a regression analysis by adopting the fixed-effects model of the panel data, and the results are as follows (see Table 1).

Table 1 Regression result I

	The aggregate level	The per capita level
Capital	−5.22e-14*	6.30e-06*
	(3.08E-14)	(3.31E-06)
Labor force	−7.34e-09***	−2.26***
	(1.17E-09)	(0.19)
Educational level	3.48e-10***	0.11***
	(6.59E-11)	(0.01)
Constant term	0.13***	0.49***
	(0.02)	(0.07)
Observed reading	2 750	2 750
Number of distinct categories	140	140
$_R2$	0.0016	0.2562

t statistics in parentheses
*p < 0.05, **p < 0.01, ***p < 0.001

It can be seen that, in terms of the aggregate level and per capita level, the effect of educational level on the difference between standardized green GDP and standardized GDP is significantly positive, indicating that a high level of education is conducive to a country's (per capita) green GDP ranking, which is higher than that of its(per capita) GDP. Thus, it supports the first hypothesis: education contributes to a country's green economy.

As for verifying the second hypothesis, that is education contributes more to green GDP than to GDP, based on the previous model, we can perform the following regression to analyze the impact of per capita capital, labor force and education on GDP per capita or green GDP per capita:

$$\text{Ln (GDPpc)} = \ln (A) + \alpha\, 1\ln (k) + \beta\, 1\ln (l) + \gamma 1\ln(e).$$

$$\text{Ln (GreenGDPpc)} = \ln (A) + \alpha 2\ln (k) + \beta 2\ln (l) + \gamma 2\ln(e).$$

The regression results at the aggregate level and at the per capita level are as follows (see Tables 2 and 3).

Combining the seemingly unrelated regression tests to the model coefficients, we can see that the coefficients of capital and education in the green GDP model are significantly larger than those in the GDP model, but this is different in the case of labor force coefficients.

This model adopts a structure similar to the Solow Model, the coefficients of the variables have the same meanings as the Solow Model, that is, the contribution of each factor to economic growth. The coefficients of capital and education in the green GDP model are remarkably larger than those in the GDP model; this means that the growth of capital and education contributes more to the growth of green GDP than to the growth of traditional GDP; the growth of the labor force is more conducive to GDP growth.

Table 2 Regression result II

	GDP	Green GDP	Seemingly unrelated regression test
Capital	0.26***	0.43***	chi2 = 35.97
	(0.01)	(0.02)	Prob > chi2 = 0.0000
Labor force	0.17***	−1.17***	chi2 = 72.87
	(0.04)	(0.14)	Prob > chi2 = 0.0000
Educationa level	0.46***	1.10***	chi2 = 64.88
	(0.02)	(0.08)	Prob > chi2 = 0.0000
Constant term	7.94***	18.27***	
	(0.30)	(1.12)	
Observed reading	2 729	2 729	
Number of distinct categories	139	139	
$_R2$	0.8426	0.2001	

t statistics in parentheses
*p<0.05,**p<0.01,***p<0.001

Table 3 Regression result III

	Per capita GDP	Per capita green GDP	Seemingly Unrelated Regression Test Seemingly Unrelated Regression Test
Per capita capital	0.26***	0.42***	chi2 = 31.04
	(0.01)	(0.02)	Prob > chi2 = 0.0000
Per capita labor force	0.59***	0.09	chi2 = 5.13
	(0.06)	(0.22)	Prob > chi2 = 0.0236
Per capita educational level	0.38***	0.68***	chi2 = 22.25
	(0.02)	(0.07)	Prob > chi2 = 0.0000
Constant term	6.81***	9.57***	
	(0.08)	(0.29)	
Observed reading	2 735	2 735	
Number of distinct categories	139	139	
$_R2$	0.8700	0.1727	

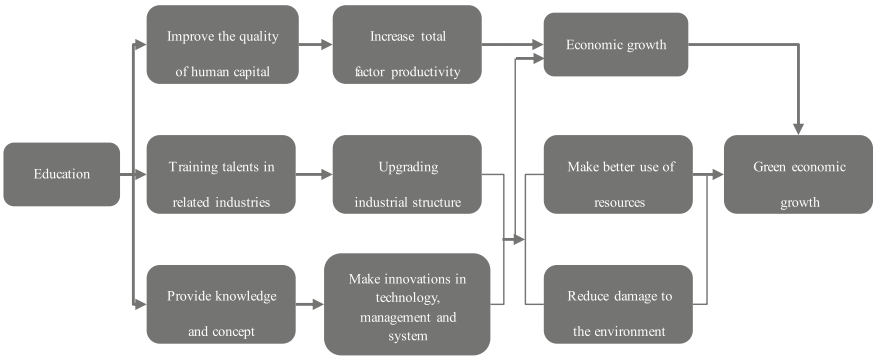
t statistics in parentheses
*p < 0.05, **p < 0.01, ***p < 0.001

Compared to GDP, the growth of green GDP depends more on capital and education, which proves the second hypothesis: education contributes more to green GDP than to GDP.

5 Conclusion

5.1 The Mechanism of Impact of Education on Green GDP

To further explain the impact of education on green GDP, the study displays a mechanism map of the impact of education on green economic growth (see Chart below).



The Mechanism of Impact of Education on Green GDP.

In accordance with the previous conclusion, the role of education in the growth of green GDP is significantly greater than in traditional GDP. That is to say, in addition to improving total factor productivity, education has the effect of making the economy "greener." As some scholars have suggested, whilst improving human capital, education also promotes the optimization and upgrading of industries. In other words, a country's economy shifts from labor-intensive industries to capital-intensive industries, then to knowledge- and technology-intensive industries (Talberth and Alok 2006).

Many factors contribute to industrial upgrading, but fundamentally, the optimization and upgrading of the industrial structure are based on a group of workers with corresponding knowledge and skills. Only high-quality workers can adapt well to high-value-added technology-intensive industries; this means that talent quality determines the future of certain industries. Education creates the necessary prerequisites for industrial upgrades by improving man's knowledge and skills. The optimization and upgrading of the industrial structure are of great significance to the economic growth of a country. It is one of the important sources of economic growth; the timely optimization and upgrading of the industrial structure can ensure stable and sustainable economic development. A country can reduce the cost of resources and the environment with continuous industrial upgrading; thereby achieving a green economy that can sustainably grow. As education plays a basic and leading role in the optimization and upgrading of the industrial structure, it plays an even more critical role in sustainable economic growth.

Additionally, education can also change people's perception; thus, bringing about innovation in technology, management and institutions, which also help develop green GDP. The development of all sectors and industries in society depends on the promotion of innovation. On one hand, innovation can bring new production methods, drive new demand and increase the economic aggregate; on the other hand, it helps make the means of production more sensible and improves the efficiency of economic operations. Innovation is highly dependent on man's existing knowledge and concepts, which, as support, requires a good level of education (Yan 2017).

5.2 Significance of Green GDP to China's Sustainable Development

First of all, China is still in an important period of strategic opportunity for development; comprehensive and sustainable development is of great significance.

For a duration of time, while increasing productivity, China has also paid increasing attention to the sustainability of economic growth. The new development concept has been embraced by people and has become a consensus within society: promoting economic growth through development, replacing social development across the board with simple GDP growth and stressing sustainable development.

The new development direction of China's economy has the following three features.

First, its economic growth has changed from high-speed to medium–high speed; second, the economic structure has been continuously optimized and upgraded; third, its economic driving force has shifted from factor-driven and investment-driven to innovation-driven. China's four-decade reform and opening-up have not only brought about an increase in income but also changes in industrial structures and production models. To this day, China's tertiary industry accounts for more than half of the total GDP and continues to grow. It has become the core driving force for economic growth. This series of internal structural changes enables China to create wealth through science, technology, and culture; thus, its capability for sustainable economic growth has greatly improved.

China has transformed itself from an agricultural nation to a world factory in the past few decades, it is now building itself into a power-filled technology and innovation. In this important period of strategic opportunities, we must not only seize opportunities and overcome difficulties, but also calmly face downward economic pressure, stabilize the quality of economic development and hold the path of sustainable development.

Second, education plays a more important role in the new economic development model.

The United States, Japan, South Korea and other countries have created similar growth miracles and achieved economic growth earlier than China. Behind these miracles lies a unified law: economic development comes with the improvement of

the educational level. Taking Japan as an example, from 1953 to 1992, its GDP grew by 6.5% yearly. This 40-year rapid growth allowed Japan to almost catch up to the United States. In 1950, the GDP per capita of Japan was only equivalent to 19.6% to that of the United States, and by 1992, the figure increased to 90.1%. During this period, Japan's investment in education was maintained at about 5% of GDP, the number of years of schooling per capita went up from only 68.2% of the U.S. in 1913 to 82.4% in 1992. Japan's development is about more than catching up with the economy of world-class countries. It is the advancement of education and human capital. For Japan, a country short of material resources, education is an essential driver for economic growth.

China's investment in education remains low while its economic growth has been kept at a high rate over recent years. Though the educational input is lower than that of developed countries, or even lower than the world average, China still achieves high growth. This may be attributed to many factors such as institutional innovation and demographic dividends. However, high-speed growth is ultimately unsustainable and there are hidden dangers. For example, increasingly serious environmental pollution and wasting resources, as well as social issues like an aging population have severely held back economic development.

How to achieve sustainable economic development has become an urgent issue. Through research on green GDP, we seem to have found a feasible solution. Emphasizing sustainable development, we pay more attention to the factors that affect green GDP growth. Compared to the impact on GDP growth, the number of participants within the labor force has a smaller impact on green GDP growth, while education representing labor quality has an increasing influence on green GDP growth. This shows that the dependence of economic growth on the quantity of labor has plummeted. On the other hand, education, or human capital behind it, can not only provide factors for production but also effectively improve the economic structure and increase production efficiency. Therefore, from the perspective of sustainable economic development, there is no need to worry too much about labor reduction. On the contrary, this is the perfect timing to turn demographic dividends into talent dividends. Phasing out outdated labor-intensive industries and developing high-tech and high-value-added industries has become the inevitable choice in the current reality. Many conditions are required to finish the above-mentioned industrial transformation; education is one of them. Education will play an important and influential role in transforming China's population advantage into a human resources advantage and improving China's sustainable development capabilities.

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Does China's International Education Reduce the Poverty of Source Countries?—An Empirical Study Based on the "Belt and Road" Countries

Yuanyuan Gu and Bin Qiu

Abstract Poverty reduction is an important challenge for the global realization of the UN's Sustainable Development Goals 2030. This study uses 46 "Belt and Road" countries as research samples, and links the "Belt and Road" international students' study in China and the poverty alleviation of their home countries, and analyzes the inherent logic mechanism between China's international education and source countries' poverty reduction. The study finds that the development of China's international education can significantly reduce the poverty of the source countries by promoting human capital accumulation, attracting foreign investment, and increasing technology spillovers. We find that a 1% increase of international students decreases the poverty-headcount ratio by 0.02 and the poverty gap by 0.005. Further research finds this effect is more significant in lower-middle-income countries and small wealth-gap countries. Therefore, the Chinese government is supposed to pay more attention to accurately implement preferential policies for foreign students, such as the "Chinese Government Scholarship," promote the diversified development of China's cooperative programs in international education, optimize the talent-training models of Chinese universities and formulate reasonable evaluation criteria for the quality of international students.

Keywords China's international education · Source countries · Poverty reduction · The "belt and road"

1 Introduction

Poverty reduction remains a great challenge in realizing the UN's 2030 Sustainable Development Goals. While the ratio of people living in extreme poverty was reduced

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between 1990 and 201—from 36 to 10%—there are still 1.9 million people living on less than US$3.2 a day. Accounting for 26.2% of the total population, most of them come from developing countries.

In September and October in 2013, President Xi visited the Republic of Kazakhstan and South Asia, where Xi put forward the proposal of collectively building a "New Silk Road Economic Belt" and a "21st Century Maritime Silk Road". Poverty reduction is an issue around the world and remains a common goal for the "Belt and Road" countries. According to "big data report of trade cooperation under the belt and road initiative (2017)," "the Belt and Road" region plays a significant role; it covers more than 60% of the total population and over one-third of the total GDP, as well as being part of global trade. However, their territorial area, population, and GDP per capita demonstrate that they are still a developing state. For example, India's GDP per capita is US$1,877, and people living in poverty accounts for more than 60% of the total population. China has accumulated significant experience in poverty reduction since the Reform and Opening-up and reduced rural poverty by 790 million and contributed 70% of global poverty reduction, this experience is vital for achieving the 2030 Sustainable Development goal.

Since the launch of "the Belt and Road initiative," the exchange has been continuously enhanced between China and the "belt and road" countries in terms of infrastructure, capacity cooperation, trade, as well as investment. At the same time, cultural exchange with those countries has been enhanced as well. Young people in these countries embrace opportunities for external exchange and more and more students have come to China for education in recent years. Statistics show that in 1999, the total number of Chinese students studying abroad was 44,711. By 2016, it had increased more than 10-fold to 442,773. The number of international students from the "belt and road" countries reached 184,879, accounting for 41.75% of the total number of students. In 1999, the total number of students studying abroad in the "belt and road" countries was 548,800, of which only 7,044 students came to China for studying; by 2011, the number of students studying in the "belt and road" countries increased to 156,600, accounting for 14.76% of the total number of students studying abroad. In 2016, the number of international students from China along the route further increased to 184,900, accounting for 12.7% of the total number of overseas students. The "belt and road" countries not only important trade partners and investors but also great exchange partners in terms of talent and culture.

As an important international developing country, China is growing rapidly in terms of its economy and soft power. However, there is little literature focusing on the potential impact of Chinese international education. This study applies 46 "belt and road" countries as a sample and aims to link students studying in China with poverty alleviation in their source countries, and analyzes the internal logical mechanism of Chinese overseas education reducing poverty in the source country. At the same time, to further explore the poverty reduction effect, we have analyzed and tested three mechanisms related to poverty reduction, including human capital accumulation, Chinese direct investment attraction, and technological progress.

2 Literature Review and Theoretical-Mechanism Analysis

2.1 Literature Review

The research on population poverty can be traced back to the definition of poverty. According to "Poverty: A Study of Town Life" by the British Scholar Rowntree (1901) in the early 20th century, poverty refers to the state when a family's total income is difficult to maintain its basic living needs.[1] Subsequently, Schultz (1965) proposed the concept of poverty economics which then became an important research area in development economics. On this basis, Hu and Li (2001) proposed the concept of "Knowledge Poverty" and classified knowledge poverty as a failure to acquire knowledge, absorb knowledge, and communicate knowledge. Existing literature mainly focuses on poverty reduction from the following aspects: income gap, public policy, trade and investment, human capital, and education influences.

First, economic growth, income disparity, and poverty reduction effects. Klasen (2008) pointed out that long-term economic growth is an important force to fight poverty. Its diffusion effect and trickle-down effect on poverty reduction can bring benefits to everyone and reduce the absolute poverty population by increasing the income level of low-income people (Dollar and Kraay 2002). However, the poorest usually enjoy the fewest benefits resulting from economic development. This means that economic growth benefits the rich more than the poor (Shen 2012). Therefore, income distribution and urbanization have a significant impact on poverty reduction (Kakwani and Pernia 2000). Second, public policy and poverty reduction. Some scholars pointed out that China's rural poverty is largely caused by the lack of rural social security systems (Xu et al. 2007). In terms of urban poverty, it is found that the Minimum Living Allowance Policy can improve the living conditions of low-income persons and alleviate urban poverty to a large extent (Li and Yang 2009). Other scholars have studied the impact of the Financial Assistance Policy for needy students, such as offering a scholarship (Wu and Lu 2014). Third, trade, investment, and poverty reduction. Bhagwati and Srinivasan (2002) suggest that trade can optimize the allocation of resources and promote economic growth; trade liberalization can increase per capita income, thereby reducing poverty (Irwin and Tervio 2002). Chinese scholars mainly investigate poverty reduction from economic growth, price levels, employment, and wages, and affirm the role of trade in reducing poverty (Guo and Luo 2008; Zeng and Jiang 2014). Research on investment and poverty reduction, the main viewpoint of the researchers is that foreign direct investment (FDI) can promote economic growth in the host country, effectively alleviating poverty in the host country (Kevin 2006). Such an effect is even more pronounced in poorer

[1]Data sources: "Concise Statistics of International Students in China (1999–2016)", "UIS Database (1999–2016)". 40 sample countries are included: Albania, Maldives, Mongolia, Malaysia, Indonesia, Thailand, Laos, Cambodia, Vietnam, Philippines, Iran, Turkey, Jordan, Bhutan, India, Pakistan, Palestine, Bangladesh, Sri Lanka, Nepal, Uzbekistan Stan, Tajikistan, Kyrgyzstan, Ukraine, Russia, Belarus, Georgia, Azerbaijan, Estonia, Czech Republic, Hungary, Romania, Bulgaria, Poland, Croatia, Latvia, Lithuania, Slovakia, Slovenia and Armenia.

countries (Gohou and Soumaré 2012). Fourth, human capital and poverty reduction. Poverty occurs due to a low level of education, sanitary conditions, and a lack of knowledge and skills then results in those people who could not share the benefit from economic growth. The common feature of the poor is that the stock of human capital lower than the social average level (Yao and Wang 2010). Since the establishment of human capital theory, the role of education in promoting the economy and eradicating poverty has been increasingly valued by economists (Schultz 1965). Tilak (2002) points out that public resources tend to invest in human capital, which helps alleviate human capital poverty. At the same time, healthy human resources benefit from economic growth by increasing personal productivity and increasing personal utility (Wang 2012). Fifth, education and poverty reduction. Since education plays a vital role in the formation of human capital, scholars such as Awan (2011) have found that education level is negatively related to the incidence of poverty. Children from poor families often fail to receive adequate education due to credit constraints and this can easily lead to the transfer of poverty between generations (Barham 1995). In addition, Chinese scholars on rural poverty found that the education level of the rural labor force largely benefits poverty reduction, and the improvement of education level can significantly reduce the likelihood of rural families falling into poverty (Li 2015; Liu and Liu 2017). Thus, receiving elementary education narrows the income gap of rural residents, thereby benefitting the economy (Cheng et al. 2015). Furthermore, the development of secondary and higher education is also conducive to poverty reduction (Tilak 2007). In 2006, Harvard University's research report on Higher Education and Economic Development in African states that higher education accelerates the pace of technological catch-up and productivity in many industries.

The research on international student education mainly includes the determinants of international student-mobility flows and the impact of talent reflow on the host and source countries. Most scholars explain the motivation of studying abroad under the framework of Push and Pull Theory; when students choose the destination country for studying abroad, they are simultaneously affected by the "push factor" from the home country and the "pull factor" from the destination country (González et al. 2011). Through empirical analysis of international students from 13 countries in the Organization for Economic Cooperation and Development (OECD), Beine et al. (2014) find that geographical distance, cost of living, and official language are of significant concern to international student mobility. Influences of international student flow on destination and source countries can be traced back to the "Brain Drain Theory" proposed by the Royal Society in the 1960s. Bhagwati et al. (1974) believe that the international flow of talents is a zero-sum game: the inflow of foreign students injects a strong impetus into the economy of the destination country, however, a large-scale intellectual outflow is a loss of human resources to the source country (Grubel and Scott 1966). Some scholars also believe that the negative effects of such outflow can be reversed, such as stimulating economic development and technological progress in outflow countries through incentive effects on human capital and network effects (Beine et al. 2001). Studies on China's international education, including the related policy analysis and deficits of Chinese international education investigation (Li et al. 2010; Luan and Ma 2011). Furthermore, several factors determine the number of

international students in China, including economic development, political stability, quality of education services, degree of opening-up, language, cultural atmosphere, living environment, and degree of market liberalization (Qu and Jiang 2011; Gu and Qiu 2017a, b). Since "the Belt and Road Initiative" was put forward, such topics earned more attention than ever before. Huang (2016) points out that "the Belt and Road initiative" is so comprehensive that it includes policy dialogue, trade, financial support, and cultural exchanges. Some scholars analyzed poverty in Southeast Asia in the context of "the Belt and Road initiative," and proposed three perspectives of poverty reduction: primary, industrial, and ecological (Wu et al. 2017). To realize "the Belt and Road initiative" and the 2030 UN sustainable development goal, international high-end talent, and professionals in certain fields should be given solid support. The education of overseas students in the "belt and road" countries benefit cultural exchanges between China and the source countries. At the same time, promoting Chinese international education is also an effective way of realizing "the Belt and Road initiative" (Zhou and Kan 2015; Ma and Zhou 2018; Ni et al. 2019).

2.2 Theoretical-Mechanism Analysis

Based on the above discussion, economic growth is the most significant foundation for improving the overall welfare and facilitating poverty reduction. To catch up with developed countries, developing countries should accumulate education and human capital, realize institutional and market liberalization, and enhance the ability of mastering and applying cutting-edge technologies. Through "the Belt and Road Initiative," China communicates with the "belt and road" countries in terms of policy and system building, as well as talents and culture. Education as a useful tool for encouraging talent mobility and economic benefit from different perspectives. Therefore, Chinese international education can drive the economic growth of the source country from three perspectives: accumulation of human capital, attracting foreign investment, and enhancing technological progress.

2.2.1 The Effect of Human Capital

The direct measure of eliminating poverty is by offering food and income. The indirect method is by offering education, health care, and other services to help the poor gain the ability to escape the "poverty trap". First of all, students from the "belt and road" countries gain access to higher technology by studying in China. When they return to their home countries, they increase the number of talents in many fields (Kapur and McHale 2005). In China, international students face a strict immigration policy. They are not allowed to work in China after graduation. Hence, talents from the "belt and road" countries usually return to their home countries for work after graduation. Returning talents as high-quality human capital can create a high-end supply of human capital equipped with knowledge of advanced technology,

capital, and professional network for its home country (Li and Xu 2011). Secondly, because these returning talents may instead some local talents, so they can create a "Crowding-out Effect," local employees in the same sector will feel this effect and inspire to receive further education or participating in professional training to adapt to the fierce competition in the local labor market, and thus benefit the comprehensive human capital (Mountford 1997). Besides, businesses employing multinational talents compete fiercely with businesses employing local talents and this inspires greater training in businesses with more local talents. On the other hand, businesses pay high salaries to high-caliber talents and increase employee training; these talents in turn will trigger a new round of talent competition, further motivating workers in the country to continuously improve their technology. Therefore, overseas training of students from B&R countries can effectively promote human-capital accumulation, and help them overcome the "ability poverty trap".

2.2.2 The Effect of Attracting Foreign Investment

Students from the B&R countries studying in China can promote direct investment from the host country to their home country through three ways: investment cost reduction effect, investment risk avoidance effect, and talent bottleneck breakthrough effect (Gu and Qiu 2017a, b). Firstly, the lack of information is an important constraint on transnational investment activities. The brain drain can not only enable the outside world to better understand its home country market, reduce the cost of information search for multinational companies, but also effectively weaken reduce cultural barriers between countries and promote cultural integration (Barkema et al. 1996; Portes and Rey 2005). Secondly, institutional guarantees help reduce the risk of cross-border investment, and the outflow of talents can promote the signing of bilateral investment agreements between countries to a certain extent, thereby providing certain institutional support for multinational companies (Jacques and Anna 2010). Furthermore, high-quality local talents are a powerful guarantee for the successful investment of multinational companies. Through the training of multinational talents, high-skilled talent reserves in the countries along the route can effectively facilitate the increased investment of multinational companies. The "learning by doing" effect drives local workers to improve their skills. The study found that human capital flows have significant foreign direct investment-induced effects. A large number of research results indicate that foreign direct investment has a great promotion effect on the host country's economic growth (Casey 2006). It can reduce the host country's income poverty by promoting the host country's economic growth (Kevin 2006). Therefore, students studying in countries along the route can attract foreign direct investment by promoting the countries along the route, which consequently facilitates the eradication of the "income poverty trap".

2.2.3 The Effect of Technological Progress

Technological progress is the most important source of long-term economic growth. The growth of total factor productivity (TFP) comes from domestic R&D capabilities and the ability to absorb knowledge spillovers from overseas R&D capital. At the same time, technology diffusion has a converging effect on economic growth and can effectively alleviate the problem of the large gap between the rich and the poor (Park 2004). Some studies have found that foreign R&D has a positive impact on domestic production, and the more open the foreign trade economy, the stronger the impact (Coe and Helpman 1995). As new technologies are embodied in human capital as well as physical capital and intermediate products, the international movement of human capital will trigger the further diffusion of technology among countries. The training of talents to study in China is a kind of bilateral student exchange across national borders. The inflows of talents from B&R countries acquire Chinese knowledge and technology through professional education and technical training received in China. When these talents return to work in enterprises in their home countries, they pass along the professional and technical advantages to promote the technological progress of the B&R countries. On the other hand, the local technological level can be further improved through the diffusion of technology among domestic enterprises. First of all, companies with more multinational talents use their personnel and technical advantages to implement technology transfer to local enterprises through research and development cooperation agreements or technical cooperation. This promotes the overall technical level improvement in the industry. Secondly, companies with more local talents can imitate and learn from companies with more multinational talents to achieve "learning by doing" technology progress. At the same time, talent flow between the two types of enterprises is also an important channel for international technology spillovers (Zucker et al. 2007). Park (2004) and Le (2010) find that international student mobility is another important channel to promote international R&D spillover effects. Therefore, students from B&R countries study in China, which can effectively facilitate the eradication of the "technical poverty trap". They do this by promoting technological progress in the countries along the route.

Overall, scholars have done a lot of research on poverty reduction and study abroad education, which provides a reference for this study. However, most of the existing discussions on poverty reduction have focused on the factors that affect economic growth or income distribution. Relatively little attention has been paid to other factors that may affect poverty, and most of the research on studying abroad has focused on the impact of study abroad education in developed countries on developing countries. Relatively little attention is paid to the possible impact of study abroad education in developing countries. Therefore, compared with the existing literature, the main marginal contributions of this research include three aspects. Firstly, the perspective of choosing the perspective of cultivating and studying overseas talents has further enriched the content of existing research, and choosing B&R countries as research samples also provide a new theoretical perspective for understanding the achievements of the "Belt and Road" initiative. Secondly, focusing on the impact

of international student mobility among developing countries to further enrich the literature on international student mobility. The study found that developing international education in China can also become a new channel for poverty reduction in developing countries. Thirdly, the research has drawn the mechanism of the poverty reduction effect of China's international education in the source country, the effect of human capital accumulation, the effect of attracting foreign investment, and the effect of technological progress. Fourthly, if this research could further be extended to other countries, it will have some implications for reducing global poverty.

3 Research Design

3.1 Research Samples and Data Sources

According to Zou and Liu (2016), there are 64 the "Belt and Road" countries.[2] Due to the missing data, we finally choose 46 countries as research samples, the research period is from 1999 to 2015. The data mainly comes from the World Development Indicators (WDI) Database (1999–2015), Concise Statistics of International Students in China (1999–2015), China Statistical Bulletin on Foreign Direct Investment (2003–2014), China Statistical Yearbook (1999–2014), and PWT Database (Groningen Growth and Development Centre 2017).

3.2 Empirical Approach and Description of Variables

To test whether the training of overseas talents in China can help alleviate the problem of population poverty in the country of origin, we have established a quantitative model that uses population poverty as an explanatory variable and the size of foreign students studying in countries along the "Belt and Road" as the core explanatory variable. In this study, we use the international standard of the poverty line as a measure of the poor people. Following methods used by Gustafsson and Li (2004), we have applied two common measures of poverty: poverty headcount ratio and poverty gap. The poverty headcount ratio at $1.90 a day is the percentage of the population living on less than $1.90 a day at 2011 international prices. Poverty gap at $1.90 a day (2011 PPP) is the mean shortfall in income or consumption from the poverty line of $1.90 a day (counting the non-poor as having zero shortfalls),

[2]The 46 sample countries in this study include: Mongolia, Malaysia, Maldives, Indonesia, Thailand, Laos, Cambodia, Vietnam, Philippines, Iran, Turkey, Jordan, Bhutan, India, Pakistan, Palestine, Bangladesh, Sri Lanka, Nepal, Montenegro, Kazakhstan Stan, Uzbekistan, Tajikistan, Kyrgyzstan, Russia, Ukraine, Belarus, Georgia, Serbia, Azerbaijan, Estonia, Poland, Czech Republic, Macedonia, Armenia, Croatia, Latvia, Lithuania, Moldova, Slovakia, Slovenia, Hungary, Romania, Bulgaria, Albania, Bosnia and Herzegovina.

expressed as a percentage of the poverty line. Considering the lag effect of talent outflow on the poverty of source countries, equations follow:

$$\text{Model 1}: \quad PHR_{it} = \alpha_1 + \alpha_2 LnTalent_{it-j} + \sigma^T \sum X_{it} + \varphi_i + \gamma_t + \epsilon_{it} \quad (1)$$

$$\text{Model 2}: \quad PG_{it} = \beta_1 + \beta_2 LnTalent_{it-j} + \tau^T \sum X_{it} + \varphi_i + \gamma_t + \mu_{it} \quad (2)$$

In Model 1 and Model 2, the subscript i indicates the sample country, and t indicates the year. The explanatory variables PHR_{it} and PG_{it} are the poverty population ratio and the poverty gap, respectively. The core explanatory variables $Talent_{it-j}$ are the students coming to China from the "Belt and Road" countries. International students in China from B&R countries refer to diploma international students (including junior college students, bachelor's, master's, and PhDs) and non-diploma international students (including visiting students, advanced visiting students, language visiting students, and short-term overseas students). The statistical data of overseas students in China used in this study comprise graduates, freshmen studying in China, and students who continue to study in the same year. The statistics only include international students in mainland China. $\sum X_{it}$ is other control variables, φ_i and γ_t represent individual effects and time effects, respectively, used to eliminate cross-country heterogeneities and control time-period effects, ϵ_{it} and μ_{it} are error terms, α_1, α_2, σ^T, β_1, β_2, and τ^T are the (vector) coefficients to be estimated, j is the lag period.

To avoid the estimation bias caused by missing variables, we select 9 control variables that may affect the population poverty base on the existing empirical literature, including income growth (GNIG), public education expenditure (Education), population growth (Population), Gini coefficient (GINI), foreign direct investment (FDI), urban population (Urban), per capita health expenditure (Medical), and labor force participation rate (Labor) (Gustafsson and Li 2004; Tridico 2010; Janjua and Kamal 2011; Cali and Menon 2013; Lin et al. 2016). The growth rate of per capita income refers to the growth rate of income distributed by the total population. The public education expenditure ratio is the ratio of public education expenditure to government expenditure. The foreign direct investment rate is the ratio of foreign direct investment to GDP. The urban population ratio is the ratio of the urban population to the total population. The labor force participation rate is the ratio of the labor force to the total population over the age of 15.

The total number of international students from these countries is a necessary control, otherwise, we cannot identify whether the poverty reduction effect comes from China or other countries, especially developed countries. Per capita income growth plays a positive role in alleviating poverty when expressed as a growth rate that can eliminate data non-stationary. Formal education is the most important way to form human capital. In many developing countries, promoting the popularization and improvement of compulsory education is of great significance to improving the capacity of the poor. Therefore, the increase in public-education expenditures will

help to alleviate poverty. At the same time, the proportion of a country's public education expenditure to government expenditure can reflect the country's education policy and education quality to a certain extent. After controlling this variable, it can effectively control the differences in the education policies and basic education quality of each origin country. The population growth rate reflects the degree and trend of the population's natural growth. In the economic literature, the general view is that the excessive growth of a population is not conducive to the elimination of poverty. The Gini coefficient is a general indicator of the fairness of income distribution. The fairness of a country's income distribution will directly affect population poverty. The larger the Gini coefficient, the greater the inequality in income distribution. The foreign direct investment reflects a net inflow of foreign capital and may also affect the poverty of the population. Besides, the proportion of the urban population, per capita health expenditure, and labor force participation rate reflect people's livelihood in a country; they are also closely related to the problem of poverty. The reason for using the logarithm of per capita health expenditure in Models 1 and 2 is that logarithms can make the data more stable, eliminate heteroscedasticity, and improve comparability between variables.

According to the Variance Inflation Factor (VIF) method, the VIF mean of all variables is 1.75, and the maximum VIF is 2.57, which is far less than 10, thereby eliminating the possible multicollinearity problem; then through the Lagrange multiplier (LM) test, Hausman test, and the joint significance test of the year dummy variable, meanwhile, considering the huge differences in historical evolution, human geography, economic development, political conditions, social customs of 46 sample countries, finally we employ a two-way fixed effects model to control individual effect and time effect. The Davidson-MacKinnon test shows that the endogenous problem has little effect on the estimation of OLS. To obtain more robust conclusions, we use the heteroskedasticity-clustering robust standard error. Therefore, we have reason to believe that the estimation results of this test method are robust.

3.3 Description of Statistics

From Table 1, it can be seen that from 1999 to 2015, the average rate of poverty headcount ratio in the 46 B&R countries is about 5.9963, with a minimum value of 0, a maximum value of 68.0800, and a standard deviation of 11.5379; the average of poverty gap is about 1.6617, with a minimum value is 0, the maximum value is 27.0700, and the standard deviation is 3.5998. Preliminary statistics show that the dispersion degree of poverty headcount ratio is significantly greater than the dispersion degree of the poverty gap. In terms of the scale of international students in China, the average logarithmic scale of international students is 5.3517, and the standard deviation is 2.1700, indicating that the differences in the scale of international students from B&R countries are relatively small.

Table 1 Summary statistics of the variables

Variable	Mean	Std. dev.	Min	Max	Obs
Poverty headcount ratio (PHR)	5.9963	11.5379	0.0000	68.0800	383
Poverty gap (PG)	1.6617	3.5998	0.0000	27.0700	383
Overseas students in China (LnTalent)	5.3517	2.1700	0.0000	11.0420	760
Total overseas students (LnT-talent)	7.7267	1.8608	2.5649	12.0193	775
Per capita growth rate of national income (GNIG)	4.0868	4.4873	−15.9180	28.6821	676
Public education expenditure ratio (Education)	13.7975	4.1748	6.5261	28.3886	419
population growth rate (Population)	0.6722	1.0763	−2.8510	3.8961	778
Gini coefficient (GINI)	33.4162	5.5555	16.2300	69.4700	382
Foreign direct investment ratio (FDI)	4.6449	5.7898	−16.1545	50.9678	752
share of urban population (Urban)	51.5076	17.4854	12.8860	83.6790	781
Per capita health expenditure (LnMedical)	4.9599	1.3165	1.9334	7.7397	675
rate of labor force participation (Labor)	65.9110	9.7105	38.9000	88.4000	690

Data source "WDI Database" and "Concise Statistics of Overseas Students in China" (1999–2015); except for the logarithm of the scale of overseas students training in China, the logarithm of the total overseas students of countries along the route, the logarithm of per capita medical and health expenditure, and the Gini coefficient, The remaining variables are percentages

4 Empirical Results

In this section, we analyze the poverty-reduction effects of China's international education in source countries by exploring the available panel of B&R countries. First, we used the full-sample analysis to obtain benchmark regression results for Model 1 and Model 2 and then turn to use sub-sample tests to check for robustness. Besides, we also use the two-stage least squares model (2SLS) to verify the conclusions.

4.1 Benchmark Regression

As mentioned before, we use two different measures of poverty: the poverty headcount ratio and the poverty gap. In Tables 2 and 3, we report the estimates of poverty-reduction effects of China's international education.

Considering the long period of poverty reduction effects from international students, we first lag core explanatory variables from one period to four periods in the benchmark regression. The results from Tables 2 and 3 show that China's international education always has a positive impact on poverty reduction. We eventually

Table 2 Benchmark regression of PHR (OLS)

	Lag one-phase		Lag two-phase		Lag three-phase		Lag four-phase	
	PHR	PHR	PHR	PHR	PHR	PHR	PHR	PHR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnTalent	−1.4504** (0.5870)	−2.1568*** (0.7263)	−1.3729*** (0.5242)	−2.0431*** (0.6473)	−1.3981*** (0.5105)	−1.9746*** (0.6429)	−0.8611* (0.4697)	−1.6366** (0.6906)
LnT-talent		−5.2416*** (1.2347)		−5.7512*** (1.1713)		−3.9730*** (1.2765)		−2.8653** (1.3794)
GNIG		−0.1632** (0.0808)		−0.1444* (0.0766)		−0.1644** (0.0766)		−0.1062 (0.0767)
Education		−0.9387*** (0.1841)		−0.8268*** (0.1920)		−0.7712*** (0.2053)		−0.6054*** (0.2133)
Population		1.9459* (0.9900)		2.1141** (0.9448)		1.0726 (0.9727)		1.3967 (1.0235)
GINI		0.3228** (0.1278)		0.3061** (0.1181)		0.3743*** (0.1409)		0.5422*** (0.1431)
FDI		−0.0117 (0.0477)		−0.0017 (0.0440)		−0.0111 (0.0449)		−0.0213 (0.0445)
Urban		0.5001** (0.2347)		0.6926*** (0.2454)		0.4956** (0.2347)		0.2409 (0.2862)
LnMedical		−2.2225 (1.8815)		−1.6656 (1.8318)		−3.5768* (1.9040)		−4.3686** (2.0283)
Labor		0.5251*** (0.1405)		0.4308*** (0.1394)		0.2310 (0.1584)		0.0969 (0.1912)
CONS	16.9139*** (2.3860)	10.4203 (20.7840)	15.9432*** (2.1688)	6.0875 (20.6649)	14.3364*** (1.9918)	19.4304 (23.1907)	11.5094*** (1.8805)	28.4200 (25.5015)

(continued)

Table 2 (continued)

	Lag one-phase		Lag two-phase		Lag three-phase		Lag four-phase	
	PHR	PHR	PHR	PHR	PHR	PHR	PHR	PHR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.3070	0.6217	0.3063	0.5861	0.2932	0.5064	0.2575	0.4774
OBS	361	222	342	212	323	202	294	184

Data source "WDI Database" and "Concise Statistics of International Students in China" (1999–2015); the statistical description of the variables is given in Table 1; the data in parentheses are standard errors; *, **, *** indicates that the coefficient of variation passed the significance test at 10%, 5%, and 1%; OBS indicates the number of sample observations. Same below

Table 3 Benchmark regression of PG (OLS)

	Lag one-phase		Lag two-phase		Lag three-phase		Lag four-phase	
	PG	PG	PG	PG	PG	PG	PG	PG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnTalent	−0.4095** (0.1762)	−0.5247** (0.2163)	−0.3940** (0.1540)	−0.5278*** (0.1918)	−0.4180*** (0.1514)	−0.5445*** (0.1915)	−0.2363* (0.1419)	−0.4371** (0.2108)
LnT-talent		−1.7690*** (0.3677)		−1.9249*** (0.3471)		−1.3568*** (0.3802)		−1.0419** (0.4211)
GNIG		−0.0604** (0.0241)		−0.0510** (0.0227)		−0.0564** (0.0228)		−0.0403* (0.0234)
Education		−0.2741*** (0.0548)		−0.2271*** (0.0569)		−0.2063*** (0.0611)		−0.1578** (0.0651)
Population		0.4870 (0.2948)		0.5919** (0.2800)		0.3033 (0.2897)		0.4145 (0.3125)
GINI		0.1116*** (0.0381)		0.1041*** (0.0350)		0.1376*** (0.0420)		0.1919*** (0.0437)
FDI		0.0015 (0.0142)		0.0036 (0.0130)		−0.0022 (0.0134)		−0.0050 (0.0136)
Urban		0.1252* (0.0699)		0.1612** (0.0727)		0.0959 (0.0737)		0.0307 (0.0874)
LnMedical		−0.5290 (0.5603)		−0.3047 (0.5429)		−0.9898* (0.5671)		−1.2176* (0.6192)
Labor		0.1644*** (0.0418)		0.1329*** (0.0413)		0.0626 (0.0472)		0.0301 (0.0584)
CONS	4.9227*** (0.7163)	3.7132 (6.1895)	4.2494*** (0.6372)	3.4057 (6.1241)	3.7719*** (0.5907)	8.2339 (6.9068)	2.9452*** (0.5681)	9.7964 (7.7848)

(continued)

Table 3 (continued)

	Lag one-phase		Lag two-phase		Lag three-phase		Lag four-phase	
	PG	PG	PG	PG	PG	PG	PG	PG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.3070	0.6217	0.3063	0.5861	0.2932	0.5064	0.2575	0.4774
OBS	361	222	342	212	323	202	294	184

select the results of lagging two periods. Considering that the structure of international students in China includes diploma and non-diploma international students, and the study cycle of these two types of international students is quite different. Therefore, there is a big difference in the time for these two types of international students to return to their home country and exert their poverty reduction effects. The average effect of these two types of international students should be considered in the analysis. According to the relevant data in the "Concise Statistics of Foreign Students in China," we find that a considerable number of international students from B&R countries are non-diploma students (as shown in Fig. 1), while most non-diploma students (including visiting students, advanced visiting students, language visiting students and short-term international students) only study in China from 3 to 6 months, and the maximum period is not more than 1 year. The diploma international students (including undergraduates, masters, and doctoral students) generally study for 3–4 years. Therefore, the average duration of the two types of international students studying in China lasts about 1.5–2.5 years. Thus, overall, we think the result of the lag of the two periods is reasonable.[3]

Tables 2 and 3 report the results of fixed effect estimates using whole samples. The regression results show that the cultivation of talents studying in China has a significant poverty reduction effect on the source country. For example, for every 1% increase in the number of students studying in China, the proportion of the poor will decrease by 0.0204, and the poverty gap will decrease by 0.0053, all of which are significant at the level of 1%. This is mainly due to students studying in countries along the route that can promote economic growth by promoting the accumulation of human capital in their home countries, as well as attracting more Chinese direct investment, and driving home country technological progress through research and development spillover effects. On the other hand, this kind of talent training model provides for the countries along the route, especially with some developing countries lacking public education investment, a kind of transnational talent training model, which helps reduce long-term domestic inequality and promote economic growth because of this training. The model can avoid the impact of inter-generational transfer to a certain extent, weaken the difference between the children of rich and poor families, and finally help to weaken the "Matthew Effect" of the rich getting richer and the poor getting poorer, thereby reducing the intergenerational inequality. Additionally, we also found that the development of education in China has a more significant effect on reducing the proportion of poor people in the country of origin than the poverty gap (Fig. 1).

Regarding other control variables, the coefficient of the number of total overseas students in B&R countries and the rate of public education expenditure is always statistically significant, and have positive effects on poverty reduction, because education has a positive effect on eliminating chronic poverty (Shi et al. 2010). From the perspective of the impact mechanism, education can improve its competitive advantage in the labor market by increasing the human capital stock of the

[3]In order to make the reporting results more concise, in the analysis below (including mechanism inspection), we report results that are two periods behind.

educatees. If education targets the poor, it can increase the income of the poor. This conclusion is also consistent with the existing literature on the anti-poverty effect of public education investment (Tridico 2010; Janjua and Kamal 2011; Lin et al. 2016). The Gini coefficient will significantly worsen the poverty problem, which shows that severe income inequality will further increase poverty. The reason why the urbanization is significantly positive may be that the "negative effects" in the urbanization process of the B&R countries (for example, newly wealthy villagers converted to urban residents cause the urban-rural income gap to further expand) are greater than the "positive effects" (factor return equalization effect of labor mobility can reduce the urban-rural income gap) (Cao et al. 2010).

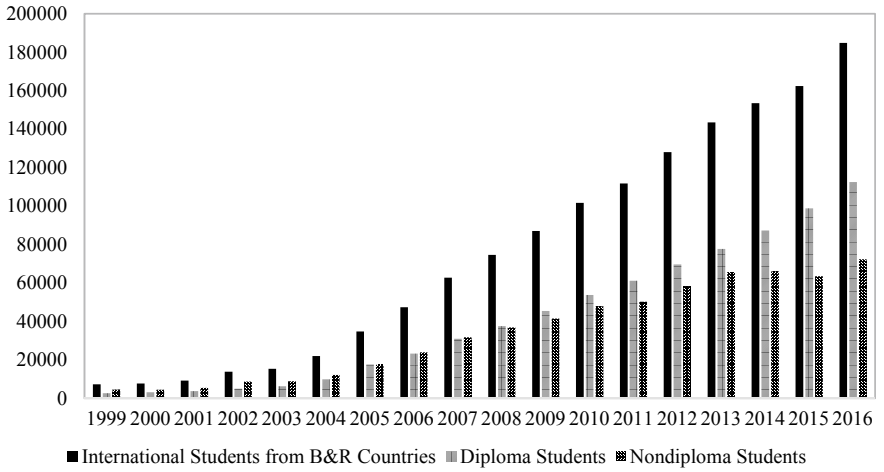

Fig. 1 Diploma and non-diploma international students in China from "Belt and Road" countries during 1999–2016[4]

[4]Data source: "Concise Statistics of International Students in China" (1999–2016). The data includes 46 sample countries: Albania, Bosnia and Herzegovina, Maldives, Mongolia, Malaysia, Indonesia, Thailand, Laos, Cambodia, Vietnam, Philippines, Iran, Turkey, Jordan, Bhutan, India, Pakistan, Palestine, Bangladesh, Sri Lanka, Nepal, Montenegro, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, Russia, Ukraine, Belarus, Georgia, Serbia, Azerbaijan, Estonia, Czech Republic, Hungary, Romania, Bulgaria, Poland, Croatia, Latvia, Lithuania, Macedonia, Moldova, Slovakia, Slovenia, Armenia.

4.2 Robustness Check

4.2.1 Subsample Test of the Different Income Level of Source Countries

According to the 2012 income grouping standard published by the World Bank,[5] we divide the B&R countries into two groups: low-middle-income countries and middle-high-income countries. The former includes 19 countries and the latter 27 countries, respectively. Columns (1)–(4) of Table 4 report the estimation results of countries with different income levels.

Columns (3) and (4) of Table 4 show estimates for low-middle-income countries. From the regression results, it can be found that in low-middle-income countries, the size of international students in China has a significant positive effect on poverty reduction in the source country, and is significant at 1% and 5%, respectively. However, the coefficients become statistically insignificant in middle-high-income countries. The poverty reduction effect of China's international education has shown a marginal diminishing characteristic with the increase of the economic development level of the source country. The reason may be that countries with lower income levels often have an insufficient investment in private education, and China's international education can effectively make up for this deficiency, improve the level of human capital, and alleviate poverty. On the other hand, countries with higher incomes and higher levels of education also have relatively high education levels. Therefore, the talents returning to the home country after studying in China do not have a significant competitive advantage compared with domestic talents. Therefore, it will not significantly promote the accumulation of human capital in the source country. Therefore, the poverty reduction effect is not significant.

As for other control variables, per capita health expenditure has a significant positive effect on poverty reduction, especially in low-middle-income countries. The effect is even greater than the role of China's international education and public education investment, it means the role of healthy human capital in reducing poverty is the most significant in low-income countries. Meanwhile, we also find that income inequality is one of the important factors leading to poverty in middle-high-income countries. This is because although economic growth can generate certain poverty reduction effects, it is more beneficial to richer people. Hence the worsening income gap will hinder the effect of economic growth and reduce poverty (Shen 2012). It can be seen that in formulating anti-poverty policies, appropriate adjustments should be made in countries and regions with different income levels, so as to promote the effect of anti-poverty. In addition, population growth rates help reduce poverty in middle-high-income countries, which may be due to lower or even negative growth rates in these countries.

[5]Low- and middle-income countries with per capita national income below US $ 1,005, lower-middle-income countries with US $ 1,006–3,975, and upper-middle-income countries with US $ 3,976–12,275.

Table 4 Regression results for the subsample test

	Upper-middle income countries		Lower-middle income countries		Large wealth gap countries		Small wealth gap countries	
	PHR	PG	PHR	PG	PHR	PG	PHR	PG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnTalent	0.1754 (0.1687)	0.1091 (0.0784)	−2.9178*** (1.0639)	−0.7750** (0.3131)	0.6521 (0.9901)	0.0852 (0.3061)	−4.3398*** (0.9278)	−1.1069*** (0.2668)
LnT-talent	−0.6711** (0.2774)	−0.2259* (0.1289)	−5.5479** (2.2909)	−2.0855*** (0.6742)	−9.9141*** (1.8493)	−3.8350*** (0.5717)	−2.3455 (1.5117)	−0.6116 (0.4347)
GNIG	0.0039 (0.0196)	0.0058 (0.0091)	−0.1059 (0.1123)	−0.0427 (0.0331)	−0.0100 (0.1103)	−0.0048 (0.0341)	−0.1827* (0.1057)	−0.0590* (0.0304)
Education	0.1284* (0.0661)	0.0185 (0.0307)	−1.7835*** (0.3847)	−0.4788*** (0.1132)	−0.4839* (0.2434)	−0.1245 (0.0752)	−0.8423** (0.3322)	−0.2653*** (0.0955)
Population	−0.8267*** (0.2708)	−0.3080** (0.1259)	3.8821* (2.2130)	1.2116* (0.6513)	0.9336 (1.3197)	0.4157 (0.4080)	3.9583*** (1.3686)	1.0720*** (0.3935)
GINI	0.1241*** (0.0363)	0.0365** (0.0169)	0.3168 (0.2644)	0.1606** (0.0778)	0.7233*** (0.2323)	0.2536*** (0.0718)	0.2057 (0.1528)	0.0765* (0.0439)
FDI	0.0185* (0.0101)	0.0066 (0.0047)	−0.3751* (0.1886)	−0.1210** (0.0555)	−0.0190 (0.0902)	0.0058 (0.0279)	0.0070 (0.0482)	0.0005 (0.0139)
Urban	−0.0040 (0.0712)	−0.0271 (0.0331)	0.6514 (0.7782)	0.0845 (0.2114)	0.7224** (0.2809)	0.2173** (0.0868)	1.0732** (0.4816)	0.2607* (0.1385)
LnMedical	−1.1591*** (0.2753)	−0.1193 (0.1279)	−5.0287** (2.3176)	−1.1870* (0.6821)	5.3133* (2.8326)	1.6474* (0.8758)	0.0291 (2.6835)	0.0404 (0.7716)
Labor	0.2170*** (0.0632)	0.0613** (0.0294)	−0.0881 (0.2769)	−0.0148 (0.0815)	0.4129*** (0.1485)	0.1052** (0.0459)	0.4587 (0.3497)	0.1096 (0.1006)

(continued)

Table 4 (continued)

	Upper-middle income countries		Lower-middle income countries		Large wealth gap countries		Small wealth gap countries	
	PHR	PG	PHR	PG	PHR	PG	PHR	PG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CONS	−9.2985 (6.1081)	−2.0163 (2.8391)	83.3321** (38.1615)	26.9796** (11.2311)	−10.1333 (24.5401)	4.1066 (7.5871)	−42.7139 (44.5157)	−9.9539 (12.8006)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.5370	0.2497	0.7001	0.6766	0.7780	0.7756	0.6499	0.5985
OBS	130	130	82	82	91	91	120	120

4.2.2 Subsample Test of the Wealth Gap of Source Countries

According to the statistics regarding the gap between the rich and the poor in the country of origin, the total wealth of the world's 62 richest people was as high as 1.76 trillion US dollars, which is equivalent to the total wealth of the 3.6 billion poorest people in the world.[6] Global poverty and inequality are widespread. Considering the hindering effect of the wealth gap on the poverty-reduction effect of economic growth (Yao et al. 2004). we further grouped the source countries according to the wealth gap and the mean of the Gini coefficient of the overall sample, as the standard. A Gini coefficient less than or equal to the mean is defined as "the group with a small wealth gap," whereas a Gini coefficient more than the mean is defined as "the group with a large wealth gap." Columns (5)–(8) of Table 4 present the estimation results for different wealth-gap countries.

The results show that the scale of international students in China have a significant poverty reduction effects in the small wealth-gap countries, and it is significant at the level of 1%. At the same time, comparing the regression results of the total sample, we find that in the small wealth-gap countries, the absolute value of the regression coefficient of the scale of international students in China is significantly higher than the total sample. This shows that the narrowing of the wealth gap can promote the effect of poverty reduction in the training of talents studying in China, but this effect will gradually disappear as the wealth gap widens. As the regression results show, in countries with large wealth gaps, the cultivation of talents in China not only fails to alleviate poverty, it may cause the problem of poverty and even worsen it. It can be seen that the worsening of the wealth gap will hinder the exertion of poverty reduction effects in talent training in China. The reason may be that in B&R countries where the gap between the wealth gap is too large, most students study in China may come from wealthy families. The income gaps between those families will further widen after students returning to home countries, resulting in the Matthew effect that makes the rich get richer and the poor get poorer. Deininiger and Squire (1998) also reveal that a high level of inequality tends to hurt overall economic growth and that the poverty reduction effect of foreign direct investment is limited in countries or regions with extreme levels of unequal income, which also makes it difficult to bring out the poverty reduction effect of China's international education (Klein et al. 2001).

4.3 Instrumental Variable Method

To further verify the robustness of the above results, under the two-way fixed-effect model, we also apply the instrumental variable two-stage least squares method (IV-2SLS). We choose the geographic distance between the B&R countries and China as an instrumental variable. The reason is mainly reflected in two aspects, on the one

[6]More details at http://news.cntv.cn/2016/01/20/ARTIhnGKsbto6jYYkuow08v4160120.shtml.

hand, it is considered that geographical distance has strong exogeneity and satisfies the exogenous conditions of instrumental variables. On the other hand, geographical distance is indeed an important factor affecting international students. Given that other conditions remain unchanged, international students from developing countries prefer to study in China if the geographical distance from the source country to China is shorter, and geographical distance also has strong exogenous factors. Furthermore, to meet the relevant conditions of instrumental variables, we conducted a correlation test of instrumental variables by using the F statistic in the first stage of IV-2SLS. The first stage regression results in Table 5 show that the value of the F statistic is 25.5500, hence there is no need to worry about weak instrument variables. Therefore, geographic distance is a good instrumental variable.

However, because geographical distance does not change with time, to further consider the endogenous nature of the explanatory variables, we also use the systematic GMM method and use the lag period of the explanatory variables as instrumental variables to further identify the causal relationship between the explanatory variables and the explanatory variables. Table 5 reports the estimation results of 2SLS and system GMM, respectively. The results show that when using instrumental variables and systematic GMM methods, neither the significance nor the obtained coefficient signs have changed the core conclusions of this paper.

5 Mechanism Inspection[7]

Given that the second part of this paper proposes that the training of talents studying in China affects the poverty of the population in the country of origin through three mechanisms (the effect of human capital, the effect of attracting foreign investment, and the effect of technological progress) we will test it one by one in this section.

5.1 The Effect of Human Capital

To test the promotion mechanism of studying in China on the accumulation of human capital in the country of origin, we first need to select an appropriate method to

[7] As the mechanism testing part involves three regression models different from the main regression model and completely different control variables, and the data of relevant variables in some countries along the line are quite lacking, in order to choose as many as possible when testing each mechanism in the sample countries, we cannot guarantee that the sample selection of the three mechanisms is completely consistent, nor can we keep the sample completely consistent with the main regression model of this study, otherwise there will be too few available samples. This is also a regret in our research, but the selection of several groups of samples All of them are from countries along the "Belt and Road", the sample scope is the same, and except for the serious lack of data on the variables involved in the human capital mechanism regression model, the other three groups of samples can basically correspond, and in order to further confirm the mechanism test results, a robustness test was performed when testing each mechanism.

Table 5 Instrumental variable method

	IV-2SLS			SYS-GMM	
	LnTalent	PHR	PG	PHR	PG
	(1)	(2)	(3)	(4)	(5)
LnDis	−2.2952*** (0.4541)				
LnTalent		−1.9934** (0.9215)	−0.6280** (0.2581)	−0.1521*** (0.0433)	−0.0861*** (0.0223)
LnT-talent	0.3178*** (0.0665)	−0.2736 (0.4664)	−0.1214 (0.1306)	−0.1898*** (0.0383)	−0.0748*** (0.0168)
GNIG	−0.0377 (0.0236)	−0.2332** (0.1159)	−0.0710** (0.0325)	−0.0343*** (0.0058)	−0.0191*** (0.0015)
Education	0.0291 (0.0280)	−0.5360*** (0.1378)	−0.1370*** (0.0386)	−0.1105*** (0.0228)	−0.0257*** (0.0085)
Population	0.3980*** (0.1364)	2.2249** (0.8721)	0.5276** (0.2443)	0.2483*** (0.0515)	0.1058*** (0.0190)
GINI	−0.0376* (0.0198)	0.3811*** (0.0935)	0.1411*** (0.0262)	0.1344*** (0.0068)	0.0528*** (0.0046)
FDI	−0.0440*** (0.0117)	−0.1314** (0.0599)	−0.0221 (0.0168)	−0.0063 (0.0082)	−0.0023 (0.0017)
Urban	0.0353*** (0.0088)	−0.1468*** (0.0559)	−0.0397** (0.0156)	−0.0165** (0.0066)	−0.0044 (0.0028)
LnMedical	−0.1538 (0.1207)	−4.5999*** (0.6409)	−1.1139*** (0.1795)	−0.4308*** (0.0935)	−0.1426*** (0.0292)
Labor	0.0320 (0.0134)	0.2103** (0.0816)	0.0737*** (0.0229)	0.0002 (0.0077)	0.0058 (0.0048)
L.PHR				0.6824*** (0.0074)	
L.PG					0.5992*** (0.0062)
CONS				3.3651*** (1.2550)	0.5995* (0.3354)
Country fixed effect		Yes	Yes	Yes	Yes
Year fixed effect		Yes	Yes	Yes	Yes
First stage statistic F	25.55				
R^2		0.6303	0.5915		
OBS		212	212	165	165
Hansen-Test				1.0000	1.0000
Arellano-Bond test for AR(1)				0.0000	0.0000
Arellano-Bond test for AR(2)				0.152	0.169

measure the human capital stock of a country (H_{it}). According to the existing literature (Yao and Cui 2015; Xu et al. 2016), we adopt the education-year accumulation method to measure the human capital stock of each country. The formula as follows:

$$H_t = \sum_{i=1}^{3} w_i l_{it} = H_t^1 + H_t^2 = \sum_{i=1}^{3} w_i \left(l_{it}^1 + l_{it}^2\right) \tag{3}$$

where H_t refers to the human capital stock, H_t^1 and H_t^2 are two types of human-capital stock: workers and students. w_i is education years, and we assume $w_1 = 6$; $w_2 = 12$; $w_3 = 16$; $i = 1, 2, 3$, refer to the primary-, secondary-, and university-education types. l_{it}^1 and l_{it}^2 refer to the number of employees and students at different educational levels.[8]

To further investigate the impact of education in China on the accumulation of human capital in the countries along the route, and to avoid estimation bias caused by missing variables, we draw on existing literature and select a set of influencing control variables. This includes the total number of students studying abroad (LnT-talent), the gross domestic product (GDP) of the B&R countries, the cultural distance between the B&R countries and China (Culture)[9], public education expenditure (Education), and higher education student-teacher ratio (SSB) of the B&R countries (Xu et al. 2016). Based on the above analysis, we establish the following linear regression model:

$$LnH_{it} = \theta_1 + \theta_2 LnTalent_{it-2} + \mu^T \sum X_{it} + \eta_i + \lambda_t + \xi_{it} \tag{4}$$

The final sample selected for this test is 19 B&R countries.[10] The data from 1999 to 2013 was used for estimations. At the same time, the variance expansion factor (VIF) diagnosis was performed on all explanatory variables and control variables in the model. The results show that the average VIF is 2.52, which can eliminate the serious autocorrelation problem of the model. The Davidson-MacKinnon test shows that the endogenous problem has little effect on the estimated results of OLS. Therefore, we use the DKSE method to take into account the effects of heteroscedasticity, cross-section correlation, and series correlation for estimation. Besides, to further confirm the robustness of the test results, we also use the PWT database to measure the relevant

[8]Education level can only be roughly divided into three levels: primary school, secondary school and university.

[9]As the cultural distance will affect the knowledge learned by international students in the" belt and road" countries, we make "cultural distance" as controlled variable, but because the data are missing, there are only 11 countries left after matching the sample. The results of controlling cultural distance and not controlling cultural distance were also reported.

[10]19 sample countries are included: Mongolia, Turkey, Jordan, Indonesia, Pakistan, Russia, Georgia, Poland, Czech Republic, Estonia, Latvia, Lithuania, Moldova, Slovakia, Slovenia, Hungary, Romania, Croatia, and Bulgaria.

Table 6 The test of human capital effect

	LnH			LnBLH (Barro-Lee)		
	(1)	(2)	(3)	(4)	(5)	(6)
LnTalent	0.4031*** (0.0557)	0.1156** (0.0468)	0.1211* (0.0580)	0.4721*** (0.0159)	0.1775*** (0.0460)	0.1539*** (0.0293)
Culture			−0.1948** (0.0715)			−0.2292*** (0.0549)
Control Variables		Yes	Yes		Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.2894	0.8347	0.8513	0.4704	0.8528	0.9280
OBS	243	148	93	234	138	93

Data source "WDI Database," "Concise Statistics of International Students in China," "China Statistical Yearbook" (1999–2013), Barro-Lee (2013); data in parentheses are standard errors; *, **, *** represents coefficients passing the significance tests at 10%, 5%, and 1%, respectively; OBS indicates the number of sample observations

human capital data of those countries,[11] recalculate the human capital stocks of the B&R countries, and replace the data calculated by the cumulative education method to verify the human capital mechanism again. The results are shown in Table 6.

Regression results display that the scale of international students coming to China from the B&R countries has a positive impact on their human capital accumulation, and these results are significant. It can be seen that the scale of talents studying in China does have a cumulative effect on human capital in the source country.

5.2 *The Effect of Attracting Foreign Investment*

To verify the effect of attracting foreign direct investment we referred to the existing literature (Buckley and Casson 1981; Gu and Qiu 2017a, b) and chose the annual flow of outward FDI of China (Lnofdi) as an explained variable. To solve the problem of zero or negative values of data, we used the formula Ln [OFDI + (OFDI^2 + 1) $^{1/2}$] to change the data (Busse and Hefeker 2007), and to avoid the problem of missing variables, we chose a group of control variables: gross domestic product (gdp), bilateral trade volume (trade), per capita gross domestic product (rgdp), the absolute value of the difference of per capita GDP between countries (relend), and the ratio of total trade volume to the total amount of gross domestic product (open), natural resource endowment (res), and the national economic freedom index (efindex). While

[11] The human capital data in the PWT database mainly comes from Barro-Lee (2013) and Cohen-Soto (2007)/Cohen-Leker (2014). These two databases are updated every five years and ten years respectively; we finally Select Barro-Lee (2013) to calculate human capital stocks in countries along the route.

Table 7 The test of attracting foreign direct investment effect

	LnOFDI (flow)		LnOFDI (stock)	
	(1)	(2)	(3)	(4)
LnTalent	0.5032*** (0.0534)	0.5233*** (0.0912)	0.5632*** (0.0421)	0.4141*** (0.0745)
Control Variables		Yes		Yes
country fixed effect	Yes	Yes	Yes	Yes
year fixed effect	Yes	Yes	Yes	Yes
R^2	0.3353	0.5786	0.5118	0.7100
OBS	386	284	440	318

Data source "WDI Database," "Statistics Bulletin of China's Foreign Direct Investment," "Concise Statistics of International Students in China" and "China Statistical Yearbook" (2003–2014); the data in parentheses are standard errors; *, **, ***Indicates that the coefficient of variation passed the significance test at 10%, 5%, and 1%, respectively; (4) OBS indicates the number of sample observations

considering the lag effect of talent outflow on the level of OFDI in sample countries or regions, the regression equation follows:

$$LnOFDI_{it} = \rho_1 + \rho_2 LnTalent_{it-2} + \tau^T \sum X_{it} + \eta_i + \lambda_t + \xi_{it} \quad (5)$$

The test samples are 44 B&R countries,[12] and the research period dates from 2003 to 2014. At the same time, the variance expansion factor (VIF) diagnosis is performed on all explanatory variables and control variables in the model. The results show that the average VIF values consist of 4.13 and 4.16, which can eliminate the serious autocorrelation problem of the model. Besides, the Davidson-MacKinnon test shows that endogenous problems have little effect on the estimated results of OLS. At the same time, considering that the geographical distance of the control variables in this paper does not change with time in a short time, this paper uses the Least Square Dummy Variables (LSDV) model and introduces time dummy variables based on LSDV. Regarding the heteroscedasticity problem in the model, the clustering robust standard error is used in the estimation. Also, considering the robustness of the results, we use the data of China's direct investment in the B&R countries to replace the flow data to verify again. The regression results are shown in Table 7.

The regression results show that the number of international students studies in China can significantly promote China's direct investment in their home countries.

[12] 44 samples tested include: Mongolia, Singapore, Malaysia, Indonesia, Thailand, Laos, Cambodia, Vietnam, Philippines, Iran, Iraq, Turkey, Syria, Jordan, Israel, Saudi Arabia, Yemen, Oman, United Arab Emirates, Qatar, Kuwait, Egypt, India, Pakistan, Bangladesh, Afghanistan, Sri Lanka, Nepal, Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, Russia, Ukraine, Belarus, Georgia, Azerbaijan, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria.

This result is consistent with theoretical expectations, which is the effect of attracting foreign investment is one of the important mechanisms for the training of foreign students to reduce poverty.

5.3 The Effect of Technological Progress

To test the R&D spillover effect of cultivating overseas students in China, we measured the impact of the number of overseas students in China on the total factor productivity of their home country. Therefore, we first referred to the practice of Zhang and Shi (2003) to calculate the TFP value.[13] To further verify that the results were still robust when we introduced other factors that affect R&D spillovers mentioned in the existing literature (Coe and Helpman 1995; Le 2010; Park 2004), we selected a group of control variables that affect the R&D spillover effect: the ratio of total exports of goods and services to the gross domestic product in these countries $\frac{X_{it}}{Y_{it}}$, the ratio of total imports of goods and services to gross domestic product in these countries $\frac{M_{it}}{Y_{it}}$, and the ratio of total number of overseas students to the country's population in these countries $\frac{F_{it}}{L_{it}}$. We then constructed the following regression equation:

$$LnTFP_{it} = \varphi_1 + \varphi_2 LnTalent_{it-2} + \omega^T \sum X_{it} + \eta_i + \lambda_t + \xi_{it} \tag{6}$$

This equation considers the influence of import and export levels and the factors of talent mobility on the diffusion of knowledge. Although some literature argues that domestic R&D capital has an important impact on productivity, in most developing countries, domestic R&D investment is smaller; hence, to simplify the analysis, we referred to the practice of Coe and Helpman (1995), ignoring the influence of this factor.

[13] Using source countries' GDP, the total fixed-capital formation and total amount of labor to calculate the TFP value; assuming the national economic production function as follows: $Y_t = A * K_t^{\alpha} L_t^{\beta}$, the total factor productivity is defined as $TFP_t = \frac{Y_t}{K_t^{\alpha} L_t^{\beta}}$, and to simplify the problem, the scale of production was assumed to be constant: $\alpha + \beta = 1$. If the logarithm of the production function was $\mathrm{Ln}(Y_t/L_t) = \mathrm{Ln}A + \alpha \mathrm{Ln}(K_t/L_t)$, then, α and β can be calculated by this regression equation: $\mathrm{Ln}(Y_t/L_t) = \mathrm{Ln}A + \alpha \mathrm{Ln}(K_t/L_t) + \varepsilon_t$. Finally, results obtained were $\alpha = 0.6102$, $\beta = 0.3898$. At present, the Levinsohn-Petrin method is the commonly accepted way to calculate TFP and usually requires four aspects of data—industrial value added, labor, and capital agent variables—and intermediate inputs, so it is usually used to calculate the TFP at the enterprise level. In this study, we calculated the TFP at the national level, considering the availability of data at the national level. Ultimately, we used the above method to roughly estimate the TFP of B&R countries.

Table 8 The test of technological progress effect

	LnTFP		
	Fixed Effect		SYS-GMM
	(1)	(2)	(3)
LnTalent	0.0240*** (0.0055)	0.0224*** (0.0022)	0.0038*** (0.0011)
Control Variables		Yes	Yes
L.LnTFP			0.9240*** (0.0095)
Country fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
R^2	0.0602	0.3543	
OBS	523	497	494
Hansen-Test			0.606
Arellano-Bond test for AR(1)			0.007
Arellano-Bond test for AR(2)			0.100

Data source "WDI Database," "Concise Statistics of International Students in China" and "China Statistical Yearbook" (2003–2014); data in parentheses are standard errors; *, **, *** indicate that the coefficients of the variables passed in 10%, 5%, and 1% significance tests; (4) OBS represents the number of sample observations

The final samples selected for this test were 43 B&R countries.[14] The data from 1999 to 2014 were used for estimation. The GDP, total fixed capital formation, total labor force, total imports and exports, and the number of students in Chinese universities along the lines are from the WDI Database (1999–2014) and the website of the National Bureau of Statistics of China (1999–2014). Table 8 reports the regression results for this test. The empirical results show that the training of talents studying in China is one of the important channels to promote the spillover effect of R & D.

6 Conclusions and Recommendations

This article selects 46 B&R countries as research samples and examines the poverty reduction effect of China's international education in the source country. Research

[14] 43 sample countries tested include: Mongolia, Malaysia, Indonesia, Thailand, Laos, Cambodia, Vietnam, Philippines, Iran, Turkey, Jordan, Bhutan, India, Pakistan, Palestine, Bangladesh, Sri Lanka, Nepal, Montenegro, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, Russia, Ukraine, Belarus, Georgia, Serbia, Azerbaijan, Estonia, Poland, Czech Republic, Macedonia, Armenia, Croatia, Latvia, Lithuania, Moldova, Slovakia, Slovenia, Hungary, Romania, Bulgaria.

results show that the development of international education in China can significantly reduce poverty in the source country by promoting human capital accumulation, attracting foreign direct investment, and promoting technology spillovers, but the effect of poverty-reduction on the poverty gap is weaker than the poverty-headcount ratio. Analytical results also showed that the poverty-reduction contribution is more significant in lower-middle-income countries and small wealth-gap countries. This conclusion has important implications for poverty reduction in B&R countries. It also validates the significance of the "Belt and Road" initiative from a new perspective.

Based on the above research conclusions, this article further puts forward the following policy recommendations.

First, making better use of the accuracy of preferential policies for international students such as the "Chinese Government Scholarship." "Precise policy" is an important idea put forward by General Secretary Xi Jinping in the domestic poverty alleviation work. This strategy is also applicable to the development of education in China for the "Belt and Road" region. B&R countries have huge differences in terms of social systems and economic development levels, we find that China's international education has significantly varying impacts on poverty reduction effects in countries with different income levels and income gaps. Therefore, when formulating relevant preferential policies, the Chinese government should treat them differently depending on the national conditions and economic conditions of the country of origin. In March 2015, the "Belt and Road" scholarship was proposed in the "Vision and Action for Promoting the Joint Development of the Silk Road Economic Belt and the 21st Century Maritime Silk Road"; in August 2016, the Ministry of Education of China proposed that "The Chinese Government Scholarship will help 10,000 freshmen from B&R countries to study in China for the next five years. On this basis, according to the national conditions of the B&R countries and the situation of students, they can further refine their differentiation of Chinese government scholarship policies. In addition, a scholarship policy can be created specifically for overseas Chinese children studying in China. About 60% of overseas Chinese living in the world live in B&R countries. They will help spread Chinese cultural ideas and play an important bridge role in connecting China with B&R countries (Xing 2016).

Second, vigorous promotion of the diversified development of China's international education cooperation programs. The Chinese government and colleges and universities should consider both academic programs for diploma international students and non-diploma international students when setting up various international student programs and pay attention to the balanced development of the structure of international students. Relevant data show that a considerable number of international students from B&R countries are non-diploma students, their study cycle is relatively short, generally, 3–6 months and the longest is no more than one year. Therefore, this kind of international students return home sooner, and their contributions to economic growth have a shorter cycle. At the same time, setting up high-end talent projects for the "Belt and Road" countries, and some high-end training programs specifically targeted at government officials and social elites in B&R countries should be used to further enhance the recognition of the "Belt and

Road" initiative among the elite groups in the B&R countries. For example, the "Full bright Program" in the United States has signed cooperation agreements with more than 160 countries and regions. According to statistics from the US Department of Education and Culture, 395 program members of the US international academic exchange programs, including the Fulbright Program, have become heads of states or governments, 21 members have become leaders of international organizations, and 77 members have become Winners of the Nobel Prize.[15] The construction of the "Belt and Road" requires high-end talents and leaders who are both familiar with Chinese culture and Chinese culture, and this cooperative training method also helps to create a friendly external environment for China.

Third, further optimization of the talent cultivation model in Chinese universities. Colleges and universities should continuously increase the number of majors for international students, and further, optimize the design of the curriculum system for international student education to provide more internship opportunities for international students. At the same time, taking into account the huge differences in religious and cultural traditions of B&R countries, colleges and universities should also be committed to the training of "multilingual" talents, and attach importance to the important role of language and culture in promoting the development of international education in China. According to relevant data released by the Institute of International Education (IIE) in 2016, China has become the world's third-largest study destination after the United States and the United Kingdom.[16] The "Belt and Road" countries have become an important growth point for studying in China. From 2004 to 2016, the total number of students studying in China increased by almost three times. During the same period, the number of students from B&R countries increased by more than seven times. Seven out of the ten countries with the largest number of students studying in China come from the "Belt and Road" countries. Therefore, while attracting students from the "Belt and Road" countries to study in China, we should try our best to attract high-quality students to come to China. We should continue to focus on the entry threshold for international students, the establishment of an international student admissions assessment system, and the establishment of reasonable evaluation standards for the quality of international student education, and the strict control of the quality of graduates. Only by effectively guaranteeing the quality of international education in China, then we can continue to improve the international reputation of China's higher education, and finally, achieve the purpose of attracting more international students through education quality in China.

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The Double Constraints of Educational Evaluation—A Case Analysis of the College Entrance Examination Reform of China

Weihe Xie

Abstract Educational evaluation is an important and complex activity in the field of education. Rooted in the complicated, significant and multi-factor study of educational evaluation, the variables affecting educational evaluation can be summarized as two constraints: scientificness and publicity. The former, required to briefly grasp the key points of evaluation, is limited by value, space and time; the latter, required when focusing on educational equity, takes educational evaluation as public policy; it describes and analyzes the ways to realize publicity from the perspectives of participation and decentralization. The college entrance examination system in China, a sort of educational evaluation covering a vast range of aspects and involving a large number of stakeholders and the most complicated variables, is also constrained by both scientificness and publicity.

Keywords Educational evaluation · Scientificness · Publicity

Educational evaluation refers to:

> The systematic investigation into the process or outcomes of the implementation of a particular educational program, also synonymous with 'program evaluation': such investigations answer calls for accountability, assist in decision making, aid program development and planning, and serve the needs of research. Current approaches to evaluation (in this programmatic sense) stress a comprehensive, naturalistic methodology that goes beyond sole reliance on quantitative analysis (William 2003: 130).

Evaluation is an important and complex procedure in educational activities. It is important because it plays a guiding role in educational activities; it is complex because it involves various boundary conditions and variables, which are obscurely correlated. More importantly, as a value-assessing activity, evaluation is highly subjective. Evaluation research can be defined as the systematic assessment or investigation of the worth, merit or value of an innovation, an initiative, a policy or a program. As well as gauging the worth or value of innovation, evaluations have been used to measure the 'efficacy', 'effectiveness', 'efficiency' or 'impact' of interventions or initiatives (McCulloch and Crook 2008). Based on its significance, multiple

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variables and subjectivity, in reference to the classification of evaluation in *The Routledge International Encyclopedia of Education*,[1] variables and boundary conditions, which affect educational evaluation, are summarized as double constraints, namely, the constraints of scientificness and publicity. These constraints are requirements of evaluation, for efficiency and equity. They are complementary and consistent. Lastly, the evaluation reform of the college entrance examination (CEE) in China is taken as a case to display the working mechanism of the double constraints and their mutually restrictive relations.

1 The Scientificness of Educational Evaluation

The scientificness of educational evaluation implies a process that can assess how much an educational activity meets the needs of its subject or whether it has realized or potential values, as required by science. It has two basic implications. Firstly, considering the characteristics and requirements of science itself, this sort of educational evaluation has to be classified according to disciplines, that is, evaluating according to the types of educational activities. This is both a basic requirement of scientificness and a fundamental characteristic of science. Classification is a critical basic standard to ensure fairness in educational evaluation. Clearly, it would be inappropriate to apply the laws and standards of natural science education when assessing developments in humanities and social science education. Therefore, a reasonable classification of the evaluated objects is a prerequisite for a scientific-educational evaluation. Secondly, scientificness in educational evaluation also requires highly correlated variables or important variables of priority to be identified using approaches such as clustering from the various variables that affect educational evaluation, and thus display the values and functions of the evaluated objects. It must be pointed out that highly correlated variables should meet two conditions. First, they should be in a minor amount and not endogenous. For instance, when evaluating the educational positioning of a high school, a highly correlated variable would be the percentage of high school graduates admitted to college. If most high school graduates are admitted, it is a preparatory high school; if only a minority are admitted, it is a terminal high school (Trow 1961). Whether it is longed for by international youth is also a fundamental metric for measuring the level and quality of internationalization in a university. Too many variables or factors usually reveal an insufficient understanding of the core values of the evaluated objects. Second, there needs to be conciseness and immunity from ambiguity. For example, when assessing the teaching quality of a university professor from an academic perspective, a scientific variable would be an audit by peer teachers of the same discipline. Or, when assessing the developmental stage of higher education, the most recognized and convenient indicator is Gross

[1] The Routledge International Encyclopedia of Education classifies evaluation as two types. One is democratic, or participative, as opposed to non-democratic; the other is scientific, or experimental, as opposed to naturalistic.

Enrollment Ratio; 15% of GER meaning massification stage, 50% meaning universalization stage. Finding highly correlated variables like these is critical for ensuring the fairness in educational evaluation.

Generally speaking, the scientificness constraint of educational evaluation involves three significant restrictive factors.

Firstly, one must understand the values of the evaluated objects, that is, the most essential educational values of the object itself.[2] This is the most fundamentally restrictive factor in regard to ensuring the sensibility and scientificness of educational evaluation. As various educational variables are obscurely correlated, some scholars even believe that, "school is an unopened black box with unknown features…The variables and boundary conditions are complex. Their relationship is not a simply linear one" (Hallinan 2004: 50). Therefore, what matters more in the educational quality of schools and the academic development of students has always been an important question to answer in educational evaluation. Meanwhile, as required by science, different educational activities carry different values. Thoroughly and accurately revealing their core values through educational evaluation is the most important condition for the scientificness of educational evaluation. For example, to evaluate the research outcome, the number of published papers should not be the sole factor. Instead, the standard of representative publications recognized by academia should be employed, because representative publications are highly correlated with scholars' professional depth and abilities, while simple quantitative metrics are easily biased. Another example, evaluation in physical education is typical in identifying the core values of educational activities. Physical performance is not synonymous with physical fitness or athletic performance. It would be unfair for students in different physical conditions and it is not consistent with the core values of physical education itself. Mr. Liang Shuming[3] (2012) has a classic statement for this,

> Physical education is not training for military or other purposes. Neither is it merely for improving physical stamina and dexterity. It is for the improvement of the whole person. It combines education with exercises to develop what distinguishes between humans and animals, which entails not only physical growth because the stamina and dexterity human acquired from long periods of training will never compete with the stamina of a cow or the dexterity of an ape. However, humans transcend animals for the ability to harness their body using their will.

The training of will and the cultivation of self-discipline therefor are the exact essential purpose of physical education and are naturally regarded as the main criteria for the evaluation in physical education.

Secondly, the space factor in educational evaluation is important, that is, the restrictive effects that space characteristics of evaluated objects have on educational

[2]Two nouns are used in educational reference books when it comes to educational evaluation, namely, evaluation and assessment. This paper distinguishes educational measurement from educational evaluation or assessment and sees it more like a basic step of evaluation. While educational evaluation or assessment is a kind of valuation based on the results of measurement. This paper mainly deals with educational evaluation or assessment.

[3]Liang is a famous philosopher, educator, and leader in the Rural Reconstruction Movement in the late Qing dynasty and early Republicaneras of Chinese history.

evaluation. Evidently, the significance and values of evaluated objects are closely related to space they are in. It can even be held that different space characteristics have different education activity requirements. For example, in the realities of Chinese higher education, higher education institutions directly affiliated to the Ministry of Education (MOE) have different characteristics than those in local areas; this means that they have different objects of service and, thus, evaluation criteria. Therefore, evaluation criteria for the former cannot be replicated for the latter. During the educational evaluation of higher education institutions in the late 1990s, it was heatedly debated that how to assess the state universities in contrast to the provincial HEIs. Namely, whether the standards for "excellence" should be differentiated for the two different types of HEIs. After discussion, the *First MOE Expert Evaluation Committee on University and College Education* agreed that they should be the same. Despite they are differences in space characteristics and objects of service, being able to provide quality teaching services for their subjects should suffice for excellence. Educational level implies differences in service objects, while educational quality indicates the differences in service quality. Therefore, a top-tiered HEI can be of low quality because of its poor service; a low-tiered HEI can be of high quality because of the quality services it provides (Xie 2014). These differences are determined by the space characteristics of educational activities. An irrational evaluation would overlook the space characteristics of educational activities or the evaluated objects. More importantly, the educational evaluation that takes into account the space characteristics of educational activities could facilitate higher education institutions playing their role in guiding local economic and cultural development and impose higher standards on those under direct MOE affiliation.

Thirdly, there is a time factor in educational evaluation, that is, evaluating based on the time or time efficiency characteristics of educational activities. As it is known, time or time efficiency is a remarkable characteristic of educational activities. Entrusted with expectations from society, it usually takes a long time for education to fully register its impact. However, the time or time efficiency characteristics of educational activities register differently with different majors or disciplines and therefore it becomes a confining factor for evaluation. For example, the research findings of science and engineering disciplines and those of humanities and social sciences disciplines are strikingly different in terms of time or time efficiency. Similarly, compared to the evaluation of applied research, the evaluation of fundamental research takes longer, often more than a decade or even decades. One research finding, in particular, explains very well the difference caused by disciplines. Robert King Merton, a prestigious American sociologist, introduces a comparative study on the citing of papers of different disciplines. The citations from natural science papers are found to be mostly from papers published within five years from their time of publication. For example, in physical science, as represented by *Physical Review and The Astrophysical Journal*, 60 ~ 70% of citations are from publications of the recent five years, while only a few are from publications from five years ago or even earlier. As for social sciences, citations are seldom from publications within the last five years. For example, as shown in *The American Sociological Review*, *American Journal of*

Sociology and *British Journal of Psychology*, 30–50% citations are from publications from the last 5 years. However, in humanities and liberal arts, citations from publications from less than 5 years ago account for the least percentage. For instance, in *The American Historical Review*, *Art Forum* and *The Journal of Aesthetics and Art Criticism*, 10–20% of the citations are from publications within the last 5 years, whilst most of the citations are from publications produced 5 years ago or even earlier (Merton 2006). This research finding is strong proof that there is a great difference in the time cycle between the social sciences and the humanities and liberal arts. The former tends to be shorter, the latter longer. They cannot be treated equally. Thus, the time or time efficiency characteristics of different objects should be considered, and those of different disciplines should be respected. Since the amount of citations now weighs more in educational evaluation, this finding serves as a great reference for improving our mechanism of evaluation.

Apparently, scientificness is a basic constraint of educational evaluation and the basis for ensuring its reasonableness. To achieve scientificness, the significance and values of evaluated objects should be accurately understood, scientifically categorized and well summarized.

2 The Publicity of Educational Evaluation

The publicity of educational evaluation refers to the attributes and characteristics common to public policies that educational evaluation has. In other words, in the category of public policies, the educational evaluation must be subject to their constraints and regulations. Determined by the spillover effects (or externalities) of educational activities, the publicity of educational evaluation is closely related to the fundamental attributes of educational activities. Well-known economists like Milton Freidman and Robert Lucas have explained and discussed the spillover effects of educational activities from the perspective of their producers and recipients (Xu 2015). Domestic scholars have also distinctively pointed out that with its considerable external benefits, education can benefit both individuals and society greatly, either economically or otherwise (Xu 2015). There are two types of spillover effects of education. It can be remarkably positive, or negative because of its intrinsic problems. For this reason, the evaluation of educational activities cannot afford to be overlooked as a critical subject matter in public policies. Especially, in modern society where education is universal and critical to people's development, it has become a matter of interest that draws direct and realistic attention (Xi 2013). In many countries, education usually receives special attention from country leaders and is very attended to in national public policies. It has even become a significant discourse given by state leaders and their administrations.

The scientificness of educational evaluation requires educational activities to be efficient, while its publicity requires them to be fair. Moreover, they are unified. In modern society, educational equity is an essential part of educational quality

and a basic requirement for achieving reason in educational activities. An important goal of educational modernization is ensuring educational equity and continuously improving its quality. Therefore, educational quality is an essential part of the publicity of educational evaluation. One of the main goals of educational activities, and their publicity, is to maintain and promote educational equity and thus improve the scientificness of educational evaluation more effectively. The progress of time and education in and of itself have furthered the features and the implications of educational equity. In the twenty-first century, the value of the publicity of educational evaluation has at least three new layers of meaning for educational development.

Firstly, educational equity has become an independent variable that affects individual development and social progress. The conventional theory and idea of "basic equity," the basis of educational equity, is undergoing remarkable changes. According to H. Beck, the so-called "basic equality" is the principle which is fundamental to all egalitarian theory. "It is the idea that all human beings are equal in dignity and worth, and are therefore equally worthy of concern and respect" (Hallinan 2004: 119). Equity here is mentioned as the effect in the cause-and-effect relationship. Therefore, "it defines equity in fundamentally negative terms therefore, in terms of freedom from, rather than freedom to" (Hallinan 2004: 119). Educational equity is now defined in more positive terms, namely, it is no longer the effect in a cause-and-effect relationship or a "dependent variable," but an "independent variable" in the development of mankind. This demonstrates the ever-greater emphasis and attention that educational equity now receives. Among the five areas concerned with people's wellbeing, education, health care, employment, income distribution and social security in our society, education has become a primary issue (China Daily 2013).

Secondly, the intrinsic differences of education itself have posed great challenges to the publicity of educational evaluation. Undoubtedly, the 9-year compulsory education and the massification and upcoming universalization of higher education mean a remarkable step forward for educational equity. Education is now far more accessible. However, improvement in the quality and extent of educational participation presents more serious challenges to the public nature of educational evaluation. Because the improvement has enlarged education's intrinsic differences, including the differentiation of education itself, the different demands of different stakeholders, the fundamental differences in educatees' academic and literate level, etc., how to better meet the demands of different stakeholders and educatees with different personalities and in different conditions and how to promote the common development of people and social equity will become the new task for educational equity. Especially during a social transition, people would pay more attention to educational equity and have greater demands for it since they would observe the group as a whole and through comparison, have an intensified sense of deprivation.

Thirdly, equality of outcome is becoming the main goal in the pursuit of publicity in educational evaluation. Amid the social development and educational reforms in the twenty-first century, the goals of educational equity are changing. According to some researchers, equality of opportunity is determined by the different levels of education received by the less advantaged groups of people in a stratified society and educational system. Equality of participation, a stage more advanced than equality of

opportunity, is measured by participation rate rather than access, and/or the quality and nature of experience and participation in different educational departments and areas by different groups of people, whilst equality of outcome or success is measured by the educational success or the educational success rate of marginalized groups. As participation in certain fields of education, notably university education, is often defined as the pinnacle of educational success—implicitly if not explicitly (Hallinan 2004: 121). Clearly, China now faces challenges with its CEE reforms, it is proof that this sort of equality of outcome is becoming the goal of educational equity. Therefore, the publicity constraint of educational evaluation must coordinate with the demands of different stakeholders in education, continuously strive for equality of outcome whilst ensuring equality of opportunity and participation, so it can achieve as much educational equity as possible in the society. The publicity constraint of educational evaluation plays a guiding role in educational reforms, facilitates the equitable distribution of education resources, governs the behavior of various stakeholders and resolves conflicts, thus promoting the development of education. Not a necessarily appropriate analogy: the publicity of educational equity is like the dishes of a feast, recognized by guests with different tastes. The key is not necessary to ensure the quality; instead, it is more important to discover the common ground shared by the guests, which entails a certain degree of cooperation and compromise. This happens to be one of the functions and values of public policies.

Generally speaking, the publicity of educational evaluation and the formulation of relevant public policies can be realized in two ways. First, through an open, fair and standard procedure where representative stakeholders participate; the subject matter of one educational public policy is thoroughly discussed in order to achieve as much consensus as possible. This kind of public engagement is an important channel of publicity of educational evaluation, a necessary procedure in ensuring and improving its reason and a fundamental social foundation for formulating its criteria. For instance, to formulate the evaluation standards for the titles of professor and associate professor, considering that various disciplines and academic fields are involved, the university first submits the drafted articles to some faculty in different schools and departments for discussion and guidance, revises them based on the general requirements of the university and guidance from various sides, and finally puts them to a vote by the entire faculty of related schools and departments. Then the evaluation guidelines and documents can be finalized after a majority consents, as required. In another instance, to accommodate geographical and disciplinary differences and reach a consensus on the standards, departments in charge of execution invite experts and representatives for discussion, consult and revision. Finally, the evaluation scheme is formed based on suggestions and guidance from various sides.

Second, to implement and showcase the publicity of educational evaluation through the delegation or division of powers. When the differences conflict and the divergence of externalities from certain educational activities are so significant that the consensus or a unified evaluation scheme is hard to achieve through proper procedures, delegation or division of powers are needed for the implementation of educational evaluation. Delegation or division of powers in educational evaluation

means that in order to maintain the reasonableness of educational evaluation, a delegation or authorization mechanism is employed by evaluating agencies at various levels and of different types to evaluate educational activities and educational institutions. This kind of delegation or division of power is necessary and justifiable in educational evaluation. Especially so when evaluating areas or departments of a strong professional nature; it is difficult to reach a consensus regarding the evaluation criteria and schemes for various professional educational activities, making it necessary to trust or authorize professional institutions to form an evaluation. For instance, to develop the disciplines of liberal arts which involve various disciplines and fields including management, economics, law, literature, history, philosophy, and art, a university specifies that on the general basis of "quality first," academic evaluation should be carried out by the basic academic unit so that the distinctive characteristics of each discipline should be respected. Instead of forming uniform evaluation criteria and requirements for all schools or departments of liberal arts, the university allows each department/school/institute to have its own criteria and requirements, achieving general diversity in evaluation (Xie 2011). It must be pointed out that despite certain differences, this sort of delegation or division of powers is more equitable and reasonable. The reason being, adapting to various disciplines or majors which have their own features and rules, builds more practical criteria, which can be more easily recognized and thus better promote educational reforms. There are no unified requirements for this kind of delegation or division of powers. Neither is it pure laissez-faire. Usually, it is a combination of centralization and decentralization. In the above case, the university proposes the requirements "regarding it at the national level, striving for impact worldwide, standing the test of history and contributing to practices," the guiding role of "three impacts," namely, academic impact, social impact and international impact, and emphasize the "intersection" between the development of liberal arts and the country, as well as between a nation strong in higher education and a world-class university (Xie 2011). Practices have shown that educational evaluation with this kind of oriented delegation or division of powers usually promises a better chance at reason and equality, and thus promotes educational reforms more effectively.

It can be concluded that the publicity and scientificness of educational evaluation are not contradictory. Instead, they are unified. Because publicity helps to maximize and balance shared values in educational evaluation and earn recognition as widely as possible. This happens to be what the scientificness of educational evaluation intrinsically requires.

3 The Double Constraints of CEE Reform

The CEE system of China is an educational evaluation activity covering the largest majority population and involving most stakeholders; it is influenced by the most complicated variables in the Chinese educational system. The double constraints of

educational evaluation are essential to the scientificness, equity and reasonableness of the CEE system.

3.1 The Scientificness Constraint of CEE Reform

The scientificness constraint of CEE reform mainly lies in the formulation of various policies including the creation of tests, scoring, admission and so forth. It is governed by the regular patterns of the system. Among them, the foundation of the system, are the core values of the examination itself.

Undoubtedly, as higher education evolves from the phase of massification to the phase of universalization, as the connection between basic education and higher education, the CEE system also plays a role in selecting talents and guiding education whilst fundamentally fulfilling its basic role in moral cultivation. These two are both fundamentally important functions of the system. However, how to bridge and coordinate them organically is one of the main contradictions within the system and the greatest challenge and difficulty it faces during test question design, test organization and systemization. The reasonableness of the examination basically relies upon whether these two basic functions can be scientifically coordinated. It has a direct bearing on the fulfillment of the fundamental functions and core values of the CEE system; it is also the most essential implication and object of its scientificness constraint.

Despite that basic education and higher education both fall in the category of education and follow common educational rules, they are different. They are at different levels and of different types and follow different principles, orientations and approaches. The reform of the content of CEE is an essential part of the system. It connects the curriculum systems, curricular materials and forms of organization of basic and higher education. The scientificness constraint of the CEE requires a scientific cohesion and coordination of the two.

From the perspective of the CEE content reform, scientificness has a role to play in the following three aspects.

Firstly, to connect and coordinate the curricular materials of basic and higher education and to seek "intersection" between the two in content. These two types of education are remarkably different in terms of the level of curricular materials. Basic education pays more attention to general knowledge, whilst higher education emphasizes professional knowledge. The former pays more attention to the cultivation of people, whilst the latter emphasizes the cultivation of talents. The former pays more attention to the acquisition and training of basic knowledge and abilities, whilst the latter emphasizes the investigation of advanced knowledge and the training of research abilities. The list goes on. Coordinating the two kinds of curricular materials and finding their intersection is an apparent and significant aspect of the reasonableness of the CEE content.

Secondly, one ought to connect and coordinate the curricular logic of basic and higher education, and to seek "intersection" in curricular orchestration. Clearly, the

curriculums of basic and higher education are orchestrated in different ways and follow different logics, which leads to differences in the teaching and acquisition methods and curricular evaluation. In regard to this, the renowned American educationalist John Dewey has an important statement. He points out that every study or subject has two aspects: one for the scientist as a scientist and the other for the teacher as a teacher. These two aspects are in no sense opposed or conflicting. But neither are they completely identical. For the scientist, the subject-matter represents a simple given body of truth to be employed in locating new problems, instituting new researches, and carrying them through to a verified outcome. To him the subject-matter of the science is self-contained. He refers various portions of it to one another; he connects new facts with it. He is not, as a scientist, called upon to travel outside its particular bounds; if he does, it is only to get more facts of the same general sort. The problem of the teacher is a different one. As a teacher, he is not concerned with adding new facts to the science he teaches, either in propounding new hypotheses or in verifying them. He is concerned with the subject-matter of the science as representing a given stage and phase of development of the experience. His problem lies in inducing a vital and personal experience. Hence, what concerns him as a teacher, is the ways in which that subject may become a part of the experience; what aspects there are in the child's present that may be useful to refer to; how such elements are to be used; how his own knowledge of the subject-matter may assist in interpreting the child's needs and doings, and determine the medium in which the child should be placed in order so that their growth may be properly directed. He is concerned, not with the subject-matter, but with the subject-matter as a relational factor in the overall growing experience. Thus, to see it is to psychologize it [16]. It can be seen that the coordination and "intersection" of the two curricular logics are intrinsically required for the reasonableness of the exam. To reform the CEE and improve its reasonableness, the intersection between the psychological logic of the curriculum of basic education and the scientific logic of the curriculum of higher education should be understood and identified, so that they may be coordinated in an organic manner.

Thirdly, one must connect and coordinate the curricular forms and structures of basic and higher education, and seek an "intersection" with the form and structure of the CEE content. It can be seen that basic and higher education is organized in different ways. Although their curriculums are both related to "disciplines" or "subjects" (in Chinese they are both written as xue ke), they mean different things. Subject in basic education equals to curriculum, and the evaluation of subject equals to curricular evaluation. While in higher education, the curriculum is closely related to many disciplinary factors, is an important aspect of the discipline. Curricular evaluation is part of the disciplinary evaluation. Subject and discipline, the different words of choice, exemplify their differences in form. Subject, often used in "subject matter," has a closer relation to knowledge. While with the connotation of controlling one's behavior, discipline stresses the boundary conditions and limits of knowledge. This difference is significant and embodies the important features of these two different kinds of education. It reflects different learning modes and different educational patterns at different stages of physical and psychological development. Certainly,

the CEE reform and its reasonableness also require it to coordinate the two forms of knowledge, find and locate their "intersection." To put it more straightforwardly, this kind of coordination and "intersection" should be demonstrated by the structure of test papers and the type of questions it presents. It is only by coordinating and merging the knowledge which has two different logics and forms, relevant learning methods and the ways of thinking that the CEE mechanism displays in its role in talent recruitment and teaching guidance, can it realize its core values.

3.2 The Publicity Constraint of CEE

The publicity constraint of CEE mainly refers to the procedural constraint on the CEE equity, including the choice of tested subjects, the proportions of compulsory and elective subjects, the policies of CEE and the independent recruitment exam of many universities, the weighting of weighted scores, the time scheduling and other procedural requirements for the fairness of the relevant rules and regulations. The CEE system concerns the interests of thousands of families. It is a highly sensitive evaluation activity in terms of educational equity. To some extent, it even matters to national and social stability. Therefore, the publicity constraint is a key process and requirement for the reasonableness of the CEE system.

In fact, due to the imbalance of social and educational development and the division of interests, despite being restricted by the publicity of educational evaluation, the CEE reforms and improvements cannot be unanimously recognized by different social classes, geographical regions and stakeholders across society. CEE reforms in some provinces are possibly more criticized for public reasons than for scientific reasons, which makes the constraint of publicity even more prominent. The CEE system is one of the most important public policies in a country and a society. The ability to earn as much common ground as possible across different social classes, regions and stakeholders across society has a direct bearing on its success and reasonableness. Taking into consideration this orientation, requirement and the current realities, the publicity constraint of the CEE system should be implemented in the following aspects.

The first aspect should be public engagement. Public engagement is one of the main forms and approaches through which the system administers its constraint of publicity. One of the basic practices is to invite representatives from different groups or stakeholders to a joint exchange and consult on CEE reform and to solicit opinions from various groups, including those with different stances. In this process, different viewpoints can be exchanged and discussed. The goal is to coordinate the appeals of different stakeholders and reach a broad consensus. The forms and channels of public engagement can certainly be diverse. A typical example would be a social evaluation of two educational loan programs of the World Bank. To push the educational loan programs to not only improve educational efficiency but also achieve equality to the greatest extent possible and expand the beneficiary coverage, the World Bank authorized an independent third-party panel to execute a social

evaluation on the feasibility of studies of involved schools and institutions. To put it simply, in this basic form of social evaluation, the stakeholders of related projects are scientifically sampled, then the opinions of various parties, mainly their views and understanding on the pros and cons that the project has on each of them, are solicited through questionnaires, interviews and other forms of fieldwork. Then, the views are summarized and concluded to devise a feasibility report for relevant schools and departments. Constructive revisionary advice is also proposed. Moreover, this kind of social evaluation is an important reference for the World Bank Executive Committee in its decision-making process.

Secondly, there should be a delegation in the CEE system, including delegation across areas, types, levels and so on. The goal of the publicity constraint is to reach consensus across different areas, types and levels; the CEE system has to not only satisfy nationally uniform requirements but also accommodate the different characteristics of different areas. This is another contradiction within the system and the most vital aspect of its publicity constraint during procedure and regulation formulation. However, as society further divides, educational differences grow, people begin to have the diversified pursuit of interests. Moreover, different areas are imbalanced in their level of basic education development. Therefore, it is hard to achieve general or major consensus within the CEE system and the exam content through simple public engagement. In this circumstance, the publicity constraint has to be exercised in the form of delegation, making it the second basic approach.

There are four basic types of delegation in the CEE system. First, delegation across regions. Namely, for some reason, certain provinces can hold independent entrance exams in a manner of limited delegation or authorization, just as those holding a few years earlier in certain provinces, municipalities and autonomous regions. Second, creating test papers independently. For particular reasons, some places cannot be included in the national exam and need guidance and assistance from the government. They can design their test papers independently from the national exam with the help of relevant government departments and thus accommodate the demands of local educational development and realize the fundamental functions and core values of the CEE system. For instance, several sets of tests have been created over recent years in this way to meet differentiated demands. Second, the delegation is across different levels. The CEE system is delegated across the different levels within the higher education system, that is, institutions of higher education directly supervised by the MOE, local universities, local vocational and technical colleges. For instance, institutions of higher education directly supervised by the MOE recruit nationally and serve the nation as a whole, and therefore have to take the national-level exam. Certain key disciplines or majors of local universities, having met required conditions, can voluntarily apply to join the national level through certain procedures. While local institutions of higher education mainly recruit and serve at the local level, which requires them to accommodate local characteristics. Therefore, they are not required to join the exam system at the national level and can recruit autonomously through appropriate delegation or authorization practices. While some vocational or technical colleges can even employ the registration enrollment scheme provided that fairness and quality are ensured. Lastly, the CEE for higher vocational education can,

according to the characteristics and demands of vocational education, employ delegation, authorization or independent test development and other appropriate forms to better accommodate its requirements for development. This sort of delegation is by no means entirely fixed. It can be a form of delegation or authorization that is fused with the NCEE system or the CEE content.

It has to be pointed out that delegating the CEE system or its content is not forsaking educational equity. It is done precisely for the realization of more reasonable educational equity. One, it is difficult to achieve educational equity by applying uniform content to different regions, levels and types during evaluation. Moreover, from the theoretical perspective of educational equity, delegating the CEE is more in line with how different stakeholders in modern society subjectively perceive educational equity. This is because according to the basic theories of educational socialism, when society divides and regional development is biased, in concern of the pursuit of educational equity, people prioritize equity between groups over equity within groups. Theories of educational equity also uphold this order of priority, as people tend to refer to their surroundings when judging and evaluating educational equity.

Of course, this kind of delegation is not laissez-faire. It is governed by uniform guidance and principles; it is decentralization combined with centralization and delegation. The governmental departments in charge have the right of direct guidance and supervision over the decentralization of the CEE system, which is also their responsibility.

Thirdly, there should be stability within the CEE system; this is an important aspect of the publicity constraint of educational evaluation or the CEE. This requirement of stability aligns with the basic characteristics and rules of educational evaluation and meets people's demands on the reform and betterment of the CEE system.

The CEE stability can be interpreted in at least two aspects: firstly, reform on the CEE system and content cannot be frequent, let alone changeable. There should be a bottom line for its cycle or a time limit. As stated by Laozi in *Tao-Te Ching*, "Running a large country is like cooking a small fish." In a country as populous and imbalanced developed as China, stability deserves even more attention. As validated by theories and practices, unduly frequent CEE reforms could only bring negative influence on educational development. Secondly, consistency is necessary for the reforms on the CEE system or its content, which are required to keep up with social development, scientific and cultural progress and educational reforms. After all, the CEE in the early twenty-first century has a drastically different historical background and social pursuit than it did in the late 1970s. But consistency must remain within the CEE system and its content reforms. The changes which are made should mainly be minor, major ones are to be avoided. There is no doubt that China's CEE reforms should learn from the progressive mode that economic and social reforms undertook. In the meantime, it should avoid points occurring periodically over the accumulation of contradictions and problems as well as the "stresses" that explode at these points, which occurred in the progressive mode of economic and social reforms. This is what distinguishes educational reforms from the economic and social ones. Therefore, CEE reforms including those on its content should be progressive and gradually, in

a well-planned manner, eliminate various conflicts which have accumulated along the process.

Essential to the publicity constraint, stable CEE reforms aim to provide relatively stable social expectations for the public and the stakeholders, as well as a relatively stable institutional environment for the reform and development of China's basic and higher education. This is a foundation for a well-designed CEE system.

Clearly, the publicity and scientificness of the CEE evaluation system are consistent. This is especially so, as both the public engagement in CEE reforms and the delegation and stability benefit the CEE evaluation system in terms of efficiency and scientificness. Imagine a CEE evaluation system that fully reflects the different appeals of basic and higher education, coordinates the tension between different variables, and embodies the characteristics of schools and regions at different levels and of different types as well as the inherent requirements for stable educational activities. Certainly, it can better coordinate the purposes of talent recruitment and teaching guidance, adapt to the demands of institutions of higher education and regions of different levels and types, enhance the degree of recognition and satisfaction from the public and the various stakeholders with the CEE evaluation system and the maximization of its values.

Educational evaluation is an extremely complex educational activity that involves a manifold of variables. The CEE reform is a public policy that receives the widest attention and can produce domino effects. Its constraints of scientificness and publicity raised in this paper, are fundamentally vital.

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How to Retain Rural Teachers? An Empirical Study Based on a Survey of Special-Post Teachers in G Province in China

Yipeng Tang and Heng Wang

1 Introduction

During the fast urbanization process, remote schools in suburban areas face challenges in the form of survival and development. The retention and expansion of rural teacher teams are even more difficult. The *Rural Teacher Support Program (2015–2020)* promulgated in 2015 once again drew the policy focus on rural teachers and aroused the scholars' consideration on how to retain rural teachers. In fact, when one asks how to retain rural teachers, they are actually exploring the factors affecting the retention of rural teachers. With the field survey data, we conducted an empirical study and attempted to find answers for ways to retaining rural teachers by combining modeling analysis and local experience.

2 Literature Review

The recruitment and retention of high-quality teachers is an issue of global significance. Scholars have done a lot of research concerning teacher retention and teacher attrition. In the 1980s, American scholar D. Chapman put forward the conceptual model of teacher retention from social learning theory (Chapman 1983). Relevant empirical research started from Neil Theobald's study of teacher retention in American public primary schools and public middle schools. Theobald (1990) analyzed

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from personal factors, professional factors, district factors, and found that length of teaching, salary and age is positively correlated with teacher retention. Similarly, some scholar, based on the survey data of American middle school and primary school teachers, categorized the public school teachers into "stayer", "mover", and "leaver", and used discriminant analysis to compare the attribute of these three types of teachers (Shen 1997). The study of Huges (2012) classified the factors affecting teacher retention into personal factors, school factors, organization factors and teacher efficacy, and used binary logistic regression to conduct empirical confirmation. This revealed that the length of teaching, social-economic status, salary, work load, parent participation can significantly influence the rate of teacher retention. Most inspiring is Djonko-Moore (2016), who used the data from National Center for Education Statistics to conduct multinomial logistic regression on teacher attrition in poor and racially segregated areas. He found that the school environment significantly influenced teacher attrition.

There are many Chinese scholars focusing on the recruitment and retention of teachers. The former group of researchers concentrated on job-seeking motivation and profession selection. The latter group is concerned about teacher attrition, especially the rural teachers (Lou and Liu 2016). A recent study (Zhou 2015) reviewed the literature on teacher mobility and attrition and found the factors behind rural teacher mobility and attrition included low salary, heavy work pressure, limited room for promotion, and low material guarantee, etc. In spite of this, based on the domestic literature we have reviewed, due to the limitation of data (mainly because the resigned teachers' information is largely inaccessible), there are few empirical studies using microdata regarding teacher mobility. Most studies used questionnaires to study teachers' moving intentions and possible influencing factors. However, the latent psychological structure cannot be directly gauged using the teacher mobility data. Thus the reliability of relevant studies is affected.

The review of the literature above revealed that China is at a different developmental stage from Western countries. Relevant research cases have different value orientations. In America and European countries, the public schools are inefficient and their teacher quality is poor, due to the high market learning operation and strong teachers' trade union. Accordingly, their research is generally concentrated on the retention and attrition of teachers in public schools (Cochran-Smith 2004). In China, a developing country, urbanization and the urban-suburban gap caused by urbanization draw the scholars' attention. As a result, the attrition of rural teachers attracts more concern (Gallo and Beckman 2016).

Following the value orientation of domestic studies, we focused on rural teachers. Different from the existing studies, this study used the data of Western special-post teachers to find out the attributes of teachers who are more willing to stay in rural areas. We adopted the methods used by scholars such as Hughes and Demi-monde and used binary logistic regression to explore factors influencing rural teachers' retention.

3 Sample and Data

This study sampled the teachers of compulsory education at D town of W County in G province. All data come from the education management center of D town. With a population of 1.4 million, W County is a populous county in G province, and also an ethnic area, with ethnic minorities consisting of 23% of the population. In 2012, the county was designated by the State Council Leading Group Office of Poverty Alleviation and Development as a "contiguous poor area". The poor economy of the county severely affected the development of its education. Problems such as delayed enrollment, dropouts, and lack of school facilities remain unsolved for long periods of time. Compulsory education popularization and illiteracy elimination among young and middle-aged people lags far behind the national level. The lack of teachers is the main reason. In 2006, the Ministry of Education and the Ministry of Finance jointly implemented the Special-post Plan Supported by the Central Government, and provided solid support for the teacher team development in W County. The special-post plan supported by the Central Government became the most important means to supplement teachers for compulsory education in W County. Take D town for example. There were 432 teachers in service, among whom 285 were special-post teachers, including those who were serving their special-post term. Special-post teachers accounted for 65.9% of the total teachers in service; 86.4% of the new teachers were recruited after 2006. Therefore for D town, special-post teachers constitute a majority group. This not only represents the teacher team in D town but also reflects the rural teacher team in poverty-stricken areas in the west part of China.

We conducted field investigations in W County and collected considerable amounts of first-hand data regarding special-post teachers. During the data mining work in the latter part of the research, we matched the recruitment data of the special-post teachers with the data of teachers currently in service and established the special-post teacher recruitment and retention data for D town. The recruitment data of special-post teachers recruited from 2006 to 2015 came from the Education Bureau of W County. The 2006 data provided personal details such as nationality, college, major, ranks, etc. The 2007 data were not available as W County did not recruit special-post teachers in 2007. From 2008, the information about the special-post teachers was more detailed and comprehensive. This includes residence, the discipline they teach, the educational stage, as well as the previously available data like nationality, college, major, rank, etc. The data of teachers in service came from the 2015 in-service teacher data provided by the education management center of D Town. This includes the basic data of all in-service teachers of D Town. We sorted through all the special-post teachers by "means of recruitment". By matching the data of special-post teachers in service with the recruitment data of special-post teachers, we obtained the complete data set of special-post retention and resignation in D Town. Although the data obtained did not reveal whether the teachers who did not continue to work in D Town transferred to other places or resigned, we believe that the data of transfer (mobility data) is negligible, because there were only 56 cases of normal transfer (mobility) from the year the special-post teacher plan was

implemented, according to the statistics of Education Bureau of W County. We will refer to those teachers who did not continue to stay as "resigned", as opposed to "in-service".

4 The Recruitment and Retention Rate of Special-Post Teachers

As the earliest province to implement the special-post plan, G Province has accumulated rich experience in recruiting special-post teachers and has devised a set of policies with distinct characteristics, such as setting local special posts. Among all the provinces across China, G Province pioneered in terms of overall planning and implementation of special-post teacher plan. The recruitment plan followed a bottom-up route, namely the grass-roots units reported their needs for approval by supervisory units. Before 2015, the needs submitted were essentially approved by the Ministry of Education. However, the actual recruitment number varies sharply from year to year, as shown in Table 1, due to the uneven attrition in different places and the fixation of posts and staff required by the Ministry of Education.

Table 1 showcases the recruitment of special-post teachers at D Town over the years. Till the end of 2015, D Town recruited 463 special-post teachers altogether. Male teachers occupied 57.7% of the total number of recruits, which coincided with the fact that the overall proportion of male teachers in G Province is larger than that of female teachers. Among the recruited special-post teachers, teachers of Han nationality were the majority, accounting for 73.4, and 26.6% of the total were ethnic minorities (higher than the proportion of ethnic minorities in W County in the Sixth Nationwide Census data). Special-post teachers of Yi nationality, Hui nationality and Miao nationality took up more than half of the ethnic minority special-post teachers. This reflected the fact that the recruitment in D Town was effective in recruiting ethnic minority teachers, which is very important for D Town as it is located in an ethnic minority area. Regarding diploma holder status, most of the special-post teachers recruited had diplomas at the junior college or undergraduate level (55.3% and 37.1% respectively). The proportion of teachers with a bachelor's degree is increasing year by year. There were some special-post teachers with secondary normal school certificates, however, their number is very low. This is mainly due to the requirement of having a diploma to be considered for special-post teacher recruitment. In order to implement the documents of the Ministry of Education and recruit high-quality teachers, W County adopted favorable policies that exempted those with bachelors' degree from the written tests. The different levels of special-post teachers constituted a phenomenon unique to G Province, where a reinforced local version was implemented. Besides the special-post teacher plan at the state level, G Province required its cities and counties to set up "local special-post teachers." [1] From

[1] The forms and criteria of local special-post teacher recruitment varied from year to year. In 2008, special posts were set at provincial and city levels. In 2012, special posts were only set at only

Table 1 Recruitment data of special-post teachers of D Town (2006, 2008–2015) (head count)

	Sex		Nationality			Diploma			Level		Subtotal
Year	Female	Male	Han	Yi, Miao, Hui	Others	Junior college	Undergraduate	Secondary normal school	State	Local	
2006	11	34	26	9	10	43	2	0	45	0	45
2008	41	69	78	13	19	87	7	16	9	101	110
2009	12	19	19	7	5	5	26	0	29	2	31
2010	29	34	45	10	8	28	26	9	35	28	63
2011	13	17	24	3	3	6	24	0	30	0	30
2012	22	11	25	5	3	28	5	0	33	0	33
2013	33	32	56	6	3	33	29	3	41	24	65
2014	29	40	52	15	2	26	36	7	46	23	69
2015	6	11	15	2	0	0	17	0	16	1	17
Subtotal	196	267	340	70	53	256	172	35	284	179	463

2008, D Town recruited 179 local special-post teachers, constituting an important supplement of the local teacher team.

Based on Table 1, we calculated the retention rate of different categories of special-post teachers, as shown in Table 2. Overall, the retention rate of female teachers was higher than that of male teachers. The retention rate of teachers of Han nationality was slightly higher than those of Yi, Miao and Hui nationalities. The retention rate of other ethnic minority teachers was only half of the former two. The retention rate of teachers with a bachelors' degree was higher than that of teachers with associate degrees and teachers with a secondary normal school diploma, although the differences among the three were not significant. The retention rate of special-post teachers recruited at the state level was lower than those recruited at the local level.

Viewed from the variation of data over the years, the retention rates of teachers recruited before 2012 were generally low while the retention rates of teachers recruited after 2012 were generally high. Behind this phenomenon lie factors related to system planning and teacher professional development. First, the government requires a three-year service period for special-post teachers. These teachers were required to pay significant compensation if they decided to resign during their service period. This was a relatively rigid institutional constraint for raising teacher retention. Second, the implementation and popularization of the special-post teacher plan needed some buffer time. The special-post teacher recruited earlier were very likely to choose to resign due to misreading of policy caused by information asymmetry. Third, the economic decline after 2008 exacerbated college students' difficulty in finding and changing jobs and raised the retention rate. Fourth, from the perspective of teacher professional development, professional fatigue generally occurs after one has worked for three to five years. Therefore, the teachers recruited before 2012 would be likely to resign due to professional fatigue.

Due to the incompleteness of data for the special-post teacher recruited in 2006, the analysis of data in Table 1 was not complete, especially the interpretation of the residence and disciplines to teach. Below is the analysis of the special-post teachers in D Town using the data from 2008 to 2015, as shown in Table 3. The "hometown" of teachers refers to the residential information extracted from the first 6 digits of teachers' ID number. As regards the teachers' hometown, most of the recruited teachers came from G Province, accounting for 85.9% of the total. For those coming from G Province, those from B City took up more than half (55.7%) of the total and one-third (30.1%) from W County.

The proportion of disciplines is another big problem in rural teacher team construction, and especially the teachers of music, physical education and art are the least common among rural teachers. From the data of D Town, every year witnessed a certain number of teachers for these disciplines being recruited, accounting for 19.4% of the total. In certain years, such as 2011, recruitment of teachers for these disciplines even reached 50% of the total. This reflected two points. For one, in a tight job

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county level. According to state regulations, the local special-post teachers of G Province had to serve special-post for 3 years, before being formally accepted as publicly funded teachers. What is noteworthy is that the local special-posts were funded by county finance.

Table 2 Retention rate of special-post teachers at D Town (2006, 2008–2015) (%)

	Sex		Nationality			Diploma			Level		Subtotal
Year	Female	Male	Han	Yi, Miao, Hui	Other	Junior college	Undergraduate	Secondary normal school	State	Local	
2006	45.5	35.3	38.5	33.3	40.0	34.9	100.0	–	37.8	–	37.8
2008	39.0	36.2	42.3	30.8	21.1	37.9	14.3	43.8	11.1	39.6	37.3
2009	33.3	26.3	42.1	14.3	0.0	40.0	26.9	–	24.1	100.0	29.0
2010	41.4	44.1	40.0	80.0	12.5	42.9	38.5	55.6	34.3	53.6	42.9
2011	38.5	47.1	41.7	100.0	0.0	50.0	41.7	–	43.3	–	43.3
2012	72.7	90.9	84.0	60.0	66.7	82.1	60.0	–	78.8	–	78.8
2013	100.0	90.6	96.4	83.3	100.0	100.0	89.7	100.0	92.7	100.0	95.4
2014	96.6	95.0	98.1	86.7	100.0	92.3	100.0	85.7	97.8	91.3	95.7
2015	100.0	100.0	100.0	100.0	–	–	100.0	–	100.0	100.0	100.0
Subtotal	63.8	57.3	64.7	60.0	30.2	56.6	65.1	60.0	57.5	61.6	60.0

Table 3 Recruitment of special-post teachers at D Town (2008–2015) (head count)

	Hometown				Disciplines to teach		Stage of education		Subtotal
Year	W County	B City	G Province	Other provinces	Core disciplines	Music, Physical Education, Arts	Primary education	Junior middle school	
2008	15	54	110	0	106	4	103	7	110
2009	3	5	29	2	25	6	0	31	31
2010	24	35	59	4	53	10	39	24	63
2011	4	19	26	4	21	9	8	22	30
2012	9	23	29	4	28	5	27	6	33
2013	10	17	30	35	54	11	26	39	65
2014	30	34	62	7	51	18	21	48	69
2015	13	13	14	3	12	5	0	17	17
Subtotal	108	200	359	59	350	68	224	194	418

market, students from these majors were willing to teach in rural areas. For another, the salary and welfare of D Town helped to attract teachers of these disciplines.

Similar to Table 2, we calculated the retention rate of different categories of teachers based on Table 3, as shown in Table 4. The distance from their hometown does not seem to be significantly related to the teacher retention rate, as the retention rate of teachers from other provinces was as high as 84.7%, while that of the teachers from G Province was only 58.8%. This is related to the higher salary of G Province for special-post teachers, and the teachers who chose to stay were from Sichuan, Chongqing, Hunan, Guangxi and Yunnan, five neighboring provinces of G Province. However, the fact that some teachers from other provinces such as Liaoning and Henan chose to leave pointed to another important factor; namely, their identification with the neighboring cultures. Of course, the retention rate of teachers from other provinces recruited before 2012 was not high (recruitment numbers were also small). From 2013, the retention rate of teachers from other provinces remained as high as 100%, which is largely attributed to the constraints of contracts. In G Province, the geographical factor plays a significant role. The retention rates of teachers from W County and B City were 77.8% and 63%, respectively, higher than the retention rate of teachers from G Province. The data by year echoed this trend. It should be noted that in 2013 and 2014, the attrition rates of teachers from G Province were higher than those of teachers from other provinces. Regarding disciplines, the overall retention rate of music, physical education and art teachers stood at 69.1%, which is slightly higher than that of the core discipline teachers (61.1%). The fluctuation of retention rates of music, physical education and art teachers were even more striking, as compared with the rising retention rate of the core discipline teachers. In fact, our field investigation revealed that, it was extremely difficult to teach music, physical education and art courses with the poor facilities in poor rural schools. Particularly at some schools, due to the shortage of teachers, teaches of these disciplines had to teach core discipline courses at the same time. These are the factors leading to the attrition of music, physical education and art teachers.

Regarding the stages of education, the retention rate of junior middle school teachers was 68%, about 10.4% higher than that of primary school teachers. The high retention rate of junior middle school teachers can be explained by two factors. First, compared with primary school teachers, junior middle school teachers have higher social status and self-identification. Second, in the special environment of D Town, working in junior middle schools means better work conditions and more convenient transportation. Currently, there are 15 schools in D Town, 2 junior middle schools and 13 primary schools. Among the 13 primary schools, only one (D Primary School) was located in D Town. In addition, during the period from 2008 to 2012 when there were no contract constraints, the retention rate of junior middle school teachers was much lower than that of primary school teachers. The retention rate of primary school teachers not only started from a high value, but also increased very fast.

Regarding the time slot between graduation and recruitment, fresh graduates generally have a higher retention rate than those who graduated in previous years. However, when comparing the retention rates year by year, we found that in most

Table 4 Retention rate of special-post teachers in D Town (2008–2015)(%)

	Hometown				Discipline		Stage of education		Subtotal
Year	W county	B city	G province	Other provinces	Core disciplines	Music, physical education and art	Primary school	Junior middle school	
2008	60.0	37.0	37.3	NA	36.8	50.0	39.8	0.0	37.3
2009	100.0	60.0	31.0	0.0	32.0	16.7	–	29.0	29.0
2010	50.0	45.7	44.1	25.0	39.6	60.0	46.2	37.5	42.9
2011	50.0	36.8	38.5	75.0	47.6	33.3	62.5	36.4	43.3
2012	88.9	87.0	86.2	25.0	82.1	60.0	74.1	100.0	78.8
2013	90.0	94.1	90.0	100.0	94.4	100.0	100.0	92.3	95.4
2014	93.3	91.2	95.2	100.0	98.0	88.9	90.5	97.9	95.7
2015	100.0	100.0	100.0	100.0	100.0	100.0	NA	100.0	100.0
Subtotal	77.8	63.0	58.8	84.7	61.1	69.1	57.6	68.0	62.4

years, those who graduated in previous years have higher retention rates than the fresh graduates, especially in 2008 and 2010. This reveals that the fresh graduates, due to their lack of social experience, are more arbitrary in job hunting and resignation.

5 Factors Influencing the Retention of Special-Post Teachers

Whether a teacher chooses to stay is largely a matter of personal preference, but it is also influenced by a variety of external factors. As mentioned in the literature review, the factors affecting their retention can be divided into personal factors, school factors, and community factors. For those special-post teachers working in poor rural areas, the external environment may play a bigger role in their decision making. Therefore, based on the D Town data, we constructed the following logit model to examine the factors affecting special-post teachers' retention. The model goes as follows:

$$S_i = a_0 + b_1 \cdot Dem_i + b_2 \cdot Hum_i + b_3 \cdot Sch_i + b_4 \cdot Geo_i + b_5 \cdot X + \varepsilon_i$$

In the formula,*si* stands for whether a special-post teacher stays (stay = 1, leave = 0). *Demi* stands for the demographic variables to describe special-post teachers, including sex (male = 1, female = 0) and age (continuous variable). *Humi* stands for human capital variable, which mainly includes diploma (junior college as a reference), disciplines (music, physical education or art = 1, core disciplines = 0), level (state level = 1, local level = 0). *Schi* means school attribute variable, mainly including education stage (junior middle school = 1, primary school = 0), the proportion of special-post teachers in all in-service teachers (%), the proportion of teachers with high professional titles in all in-service teachers. *Geoi* means geographical variable, including nationality (nationalities other than Han, Yi, Hui, and Miao as a reference), hometown (other provinces as a reference) and geographical index.[2] X is a dummy variable denoting whether the teacher is in his/her special-post service period. What is worth pointing out is that, in both domestic research and research abroad, the salary level was an important factor affecting teachers' professional choice and retention, but it was not included in the model above for two reasons. First, the current databases do not contain teachers' salary data. Second, the sample was restricted to a town, where the salary level was largely homogenous and the estimated bias due to its absence was very small.

Table 5 showcases the estimated results of the binary logistic regression. Differing from common multivariate linear regressions, the regression coefficients of binary

[2]Geographical index was formulated by coding hometown information as follows: Other province = 0, G Province = 1, B City = 2, W County = 3. The bigger the value is, the more geographical relevance it has.

Table 5 Binary logistic regression results of special-post teacher retention

	Model A		Model B		Model C	
	B (SE)	Odds ratio	B (SE)	Odds ratio	B (SE)	Odds ratio
Demographic variables						
Sex (male = 1)	−0.279 (0.203)	0.756	−0.053 (0.262)	0.948	−0.006 (0.270)	0.994
Age			−1.200*** (0.402)	0.301	−1.212*** (0.447)	0.298
Age squared			0.017*** (0.006)	1.017	0.017*** (0.007)	1.017
Human capital variables						
Secondary normal school diploma (Yes = 1)	0.076 (0.402)	1.078	−0.935* (0.559)	0.393	−0.890 (0.589)	0.41
Bachelor's degree diploma (Yes = 1)	0.214 (0.253)	1.239	− 0.033 (0.512)	0.967	0.062 (0.548)	1.064
Discipline (Music, physical education, or art = 1)	0.356 (0.291)	1.427	−0.054 (0.398)	0.948	−0.168 (0.412)	0.845
Level (state level = 1)	0.039 (0.253)	1.040	0.051 (0.432)	1.053	0.151 (0.443)	1.163
School variables						
Education stage (Junior middle school = 1)			−0.300 (0.608)	0.741	−0.326 (0.639)	0.722
Ratio of special-post teachers (%)			3.861** (1.848)	47.490	4.056** (1.913)	57.745
Ratio of teachers with high professional titles (%)			3.769* (2.284)	43.332	3.978* (2.340)	53.421
Geographical variable						
Han Nationality (Yes = 1)	1.372*** (0.324)	3.944	1.144*** (0.430)	3.139		
Yi, Hui, Miao (Yes = 1)	1.191*** (0.391)	3.289	0.865 (0.526)	2.374		
From W County (Yes = 1)			0.401 (0.606)	1.493		
From B City (Yes = 1)			−0.219 (0.575)	0.803		

(continued)

Table 5 (continued)

	Model A		Model B		Model C	
	B (SE)	Odds ratio	B (SE)	Odds ratio	B (SE)	Odds ratio
From G Province (Yes = 1)			0.051 (0.548)	1.052		
Geographical index					0.298* (0.173)	1.347
Special-post service period			2.807*** (0.502)	16.568		
Constant	−0.829** (0.361)		16.228** (6.763)		16.573** (7.515)	
N	446		398		266	
Pseudo R^2	0.0407		0.2936		0.0709	

Note: *, **, *** means significance at 0.1, 0.05 and 0.01 levels

logistic regression do not express the marginal influence of independent variables on dependent variables. We need to use the logistic function to calculate the odds ratio. Model A, a basic model including only sex, diploma, discipline, level, and nationality, did not find a significant statistical effect, except for the nationality variable. Regarding the nationality variable, the teachers of Han nationality had the highest retention rate, followed by teachers of Yi, Hui, and Miao nationalities. Teachers of other nationalities have the lowest retention rates. The retention rate of teachers of Han nationality and that of Yi, Hui and Miao teachers were 3.944 times and 3.289 times the retention rate of teachers with other nationality backgrounds. Model B added age, special-post teacher ratio, the ratio of teachers with high professional titles and the hometown factor to the basic model. In order to control the time effect, we added the dummy variable "special-post service period". The results revealed that geographical variables, including nationality and hometown, did not have a significant influence. Only age and school variables had significant influence. Age had a significant reverse U-shaped influence on teacher retention, that is, after 35 years old, the retention of special-post teachers would drop significantly. The special-post teacher ratio and the proportion of teachers with high professional titles could significantly raise the retention of special-post teachers. Model C replaced the geographical variable with the geographical index. The results revealed that the geographical index significantly raises the retention rate of special-post teachers. For every unit of geographical index increase, the retention rate of teachers will increase by 34.7%.

Based on the model results, we believed that age, the ratio of special-post teachers, and the proportion of teachers with high professional titles have strong policy implications. First, age is an inflexible factor. For special-post teachers, 35 is the threshold age. Marriage and family are key factors influencing whether the teacher will stay after the age of 35. For example, if the male special-post teachers cannot successfully establish a double-income family, their likelihood of staying will drop dramatically. The ration of special-post teachers is a school-level variable. The higher the ratio is,

the more homogeneous the teacher team will be in the school, the easier special-post teachers will find it to blend in. On the contrary, if the ratio is very low, it means the school has a low approval level of special-posts, and the likelihood of retention will be very low. Regarding teachers with high professional titles, if a school has a higher proportion of teachers with high professional titles, it means they have a stronger teacher team, the special-post teacher will have more professional support and opportunities for growth, and the school will have greater attractiveness, cohesion and centripetal force.

6 Supplementary Analysis Based on Field Survey

The previous sections mainly used the data of the education department of D Town to analyze the factors influencing the retention of special-post teachers. Although the retention model tried to consider the possible factors, there were still many latent factors, such as system, finance, and culture, which cannot be incorporated into the model. For this reason, we will conduct a supplementary analysis of other factors that may influence the retention of special-post teachers.

6.1 The Special-Post Plan Supported by the Central Government Effectively Guided the Local Corollary Funds, but at the Same Time, it Exacerbated the Local Financial Burden and Lowered the Local Governments' Initiative to Retain Special-Post Teachers

From the perspective of the Central Government finance, the aim of the Special-post Plan supported by the Central Government was to use intergovernmental transfer to gradually increase the local government's support for education, so that the local finance will ultimately be able to fund teacher supplement independently. From the start of the policy, it was explicitly stated that the Central Government budget would support each special-post teacher for three years, after which his or her salary would be paid by the local governments. In our field investigation, we found that the Education Department of G Province was very supportive of the Special-post plan of the Central Government, but they also stated that the length of the Central Government's support was so short that the local governments cannot ensure the adequate payment of teachers' salary after their special-post service period. In addition, in order to respond to the Central Government's policy, the Education Department of G Province also introduced their local version of the special-post plan, which requires the cities and counties benefitting from the special-post plan supported by the Central Government to recruit local special-post teachers using the funds of the local government, which further exacerbated the finance of the poor areas, and affects the local

education authorities' willingness to retain the special-post teachers, because, after their service-period, their salary and welfare would be paid by local government.

In the case of W county, its fiscal condition had been in severe imbalance. Statistics revealed that the expenditure-revenue ratio was 3.7 in 2006 and 6.7 in 2014, and the gap expanded year by year. There were 12,000 teachers of rural compulsory education in W county. Assuming each teacher had an annual salary of 77,000 yuan, the county government had to pay 940 million yuan for their rural compulsory education teachers. Considering the fact the intergovernmental transfer by the Central Government for the special-post teachers in their service-period was 31,000 yuan per person every year (2280 persons), the reduced fiscal burden on local government was only 70 million yuan. There was still a gap of 870 million yuan. It can be seen from the above that the local government has a heavy fiscal burden.

6.2 Rural Teachers Have to Take up Much Other Work Besides the Heavy Teaching Workload, and Their Own Work and Professional Development Are Severely Affected

Due to the shortage of teachers in rural schools, the student–teacher ratio runs very high and the rural teachers are overloaded all year round. In one of the schools we investigated, there are 250 students in 6 classes, but only 6 teachers. Teachers have to teach all the time, barely having time to consider whether they qualify for the discipline they teach. In addition, in the rural and remote villages, the surrounding environment makes it very hard for teachers to teach. Due to the general low education level of parents in rural areas, they do not pay due attention to their children's education. The difficulty in connecting with parents becomes a problem for teachers in their management of students. If a student has an accident or illness, serious or not, the teacher becomes the first to be responsible. The students' medical fees have to be paid by the teacher in the first place if they fall ill. This increases the teachers' economic and spirit burden.

In order to ensure the safety of the stay-at-home children, the rural teachers have to take up supervisory tasks. For example, W county implemented a monthly report system of stay-at-home children's care. Every township government sets up a support system of stay-at-home children, the schools being the center, and teachers being the responsible person. Each teacher is responsible for several children and has to perform regular home visits. In addition, the supervision of the local government includes rigid formalism. For example, the teachers have to take pictures of them helping students; they also have to manually copy the materials for inspection. A principal of a school complained that he could only spend one-third of this time on teaching, the rest of his time had to be spent on writing reports and getting ready for inspections.

6.3 Scarcity of Material and Inadequate Facilities Were Still Important Factors Affecting Rural Teacher Retention

The scarcity of material conditions, especially of the scarcity of water in some areas of G Province went far beyond the imagination of common people. There was no tap water in the living quarters of the teachers in the schools of W county. They had to fetch water from neighboring water cellars, which were filled with rainfalls, without due treatment such as filtration or disinfection. The teaching spots of W county fared even worse. The school did not even have water cellars to collect rainfalls. The drinking water problem had not been solved for students and teachers.

In terms of infrastructure, although most schools (teaching spots included) had built or rented dormitory buildings for special-post teachers, with the support of local governments, due to the limited resources, they could only meet young teachers' contemporary needs for living. For those who were ready to get married, such living quarters could not satisfy their needs after getting married. Considering the unbalanced sex ratio in G Province, marriage problems, which were exacerbated by the living conditions, severely affected male teachers' retention. For those married teachers, due to the lack of kindergartens or nursery centers, they had difficulty in caring for their own children. Just as some female teachers complained, their own children also became "stay-at-home" children.

7 Policy Recommendations for Raising the Retention Rate of Rural Teachers

At the start of 2018, the CPC Central Committee and the State Council promulgated the *Opinions on Comprehensively Deepening the Reform of the Construction of Teaching Staff in the New Era* (hereafter referred to as *Opinions*), signifying that the China's teaching staff construction had entered a new era. The *Opinions* explicitly mentioned "substantial improvement of rural teachers' treatment", and interpreted it from the subsidy, housing, life, promotion, honor awarding, training, etc., reflecting the high concern of the CPC Central Committee for the construction of rural teaching staff. In fact, the issue of rural teachers includes not only the problems of staff construction but also their development problem. Therefore, multiple measures should be taken to increase the attractiveness of the rural teacher profession, treat the teachers well so as to retain rural teachers.

7.1 Continue to Increase the Intergovernmental Transfer and Extend the Special-Post Plan by the Central Government

During the 10 years of special-post plan implementation, an excellent achievement was made. The plan not only increased the local government's willingness to invest in teaching staff construction but also inspired the college graduates' enthusiasm to work in rural areas, providing strong support for the balanced development of compulsory education. However, the investigation results of G Province revealed that, in order to meet the requirement of a special-post plan of the Central Government (fixation of posts and staff), there was a huge gap between the intergovernmental transfer by the Central Government and the actual expenditure of the local government. In the 10 years of the special-post plan implementation, the local government budget was drained. They called for increasing intergovernmental transfer. We believed that, with the acceleration of taxation system reform, the Central Government should adjust the amount of grants per capita for the special-post teachers based on the fluctuation of the overall price level, and consider extending the service period to four or five years.

7.2 Build an All-Round Support System for Rural Teachers' Professional Development

The Rural Teachers' Support Program (2015–2020) explicitly discussed the major issue of how to construct a complete rural teacher support system, but it did not discuss the professional development of rural teachers in detail. The results of this paper revealed that both new and experienced rural teachers faced severe problems in their professional development, mainly due to heavy teaching work load, the multitude of non-teaching tasks, and outdated knowledge system, etc. With the backward infrastructure and weak fiscal support, the majority of the rural teachers found it hard to find opportunities for training. We believed that the Central Government should try establishing funds for rural teacher professional development under the current rural teacher support initiative, and require the local government to arrange corollary funds, to provide help for the professional development of rural teachers. Accordingly, local government should, with the rural teacher support funds, construct a reasonable and complete support system for professional development, provide the rural teachers with stable in-service training opportunities, and ensure the professional development of rural teachers.

7.3 Avoid Recruiting Too Many Local Teachers and Increase Rural Teachers' Cultural Identity

In order to solve the employment problem of graduates who live locally, many places demonstrated a preference for local candidates in their recruitment of rural school teachers. This research revealed that, although geographical factors were very important for the retention of rural teachers, there was no statistical significance between the retention rates of the candidates of local origin and those from other places. Hence the preference for candidates of local origin was not statistically supported. Besides, the recruitment of local candidates would not only entail nepotism but also affect the quality of teachers recruited. In addition, the huge cultural differences constituted another factor affecting the retention of rural teachers, as a big share of rural teachers teach in ethnic minority areas. Therefore, the orientation training and in-service training should include the content of local culture, which would not only increase the cultural identification of rural teachers, but also increase their fondness for an ethnic education career.

Teachers are the primary resources for education development. Retaining and making good use of rural teachers is key to the construction of the rural teacher team. In 2018, the National Education Conference once again stipulated that "more educational investment should be put into the construction of rural teacher team", instilling new vigor into the rural teacher team construction in the new era. We believe that, under the influence of a multitude of major policies, rural schools will be a glorious profession with more happiness, achievement and honor, and there will be more good teachers with conviction, moral, knowledge, and benevolence.

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Policy for Rural Primary School Teacher Supplements Over the Past 70 Years: Retrospect and Prospect

Wei'an Yang

Abstract The policy concerning rural primary school teacher supplements in China has passed three stages in the past 70 years: supplementation via recruiting both public school teachers and private school teachers, supplementation by assigning graduates from secondary teacher-training schools and employing substitute teachers (as a supplementary means), and supplementation through open recruitment and special projects. At present, a series of contradictions and problems are exposed in rural primary school teacher supplements. There is a contradiction between the strict control of the total staff size of the rural primary school teachers and the insufficient quantity of rural primary school teachers, the weak career attraction, and the low professional quality of rural primary school teachers. There is also a contradiction between the oversupplied primary school teachers nationwide in general and an insufficient supply of rural primary school teachers, the limited financial resources of governments at the county level, and insufficient funds for rural primary school teacher supplements. In addition, there exist unique hurdles in primary school teacher supplements deep in poverty-stricken areas, such as the Tibetan areas, Qinghai, Sichuan, Yunnan and Gansu, and four prefectures from southern Xinjiang, and three prefectures Liangshan Prefecture from Sichuan, Nujiang Prefecture from Yunnan, and Linxia Prefecture from Gansu. In the new era, we are supposed to increase the attraction of a career as rural primary school teachers by optimizing the external environment and strengthening internal support, solve the problem of rural primary school teacher supplements in the framework of teacher staff size, focus on the rural primary school teacher supplements through the supply-side reform of teacher preparation, open diversified channels for rural primary school teacher supplements, and make special policies for rural primary school teacher supplements in the extreme poverty-stricken areas.

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Teachers are the core element influencing education development. The teacher supplement policy determines the number, quality and structure of the teacher team. It is of great importance to rural school development because it is the primary part of the teacher personnel management, which consists of recruitment, management and resignation. Over the past 70 years, since the founding of the People's Republic of China, the policy for rural primary school[1] teacher supplement has evolved in response to the main contradictions and problems in different stages. The means of the supplement have been actively explored and reformed. However, no policy reform can solve all problems for good and all. Constrained by historical and real-world factors, the rural primary school teacher supplement still faces difficulties such as the inadequate number and low quality of teachers, the lack of a teacher training organization, and a lack of funds. In the new era, these problems should be solved through further reforms.

1 Rural Primary School Teacher Supplement Policy in the Last 70 years

1.1 Supplementation by Recruiting Both Public School Teachers and Private School Teachers (1949–1977)

After the founding of the People's Republic of China, due to insufficient resources, organizing teachers and raising funds to develop education became the most important thing in the education work of the Communist Party of China and the government. After the government put forward the initiative to popularize primary school education, many primary schools were set up, however, schools and colleges did not train enough teachers with formal qualifications to meet the growing demand for teaching staff. As a result, the shortage of teachers grew day by day (Che and Xu 2014). At the same time, rural areas were the key areas to popularize primary school education because the urbanization rate was very low and people were largely distributed in rural areas. The severe shortage of rural schoolteachers forced the government to recruit among private school teachers to alleviate the shortage of teachers. Due to

[1]From 2011, the *Educational Statistics Yearbook of China* adopted new criteria for the urban-suburban division, changing the original terms such as "city", "county" and "villages" into "city district", "town district", and "township village" respectively. "City district" includes main city and urban fringe. "Town district" includes central district, town fringe and special areas. "Township village" includes main township and villages. The "township village" in this text is the opposite of "city town"(city district + town district). "Agricultural village" (town district + township village) is the opposite of "Town city"(city district). "Township village primary school" refers to primary schools in township central area and villages across China, including teaching spots.

the fact that cities were given priority regarding development, teachers with formal qualifications were assigned to schools in cities to meet the requirement of education development in cities.

Statistics revealed that[2] from 1949 to 1977, when the employment of private school teachers reached its peak level, the number of primary school students increased from 24.391 million to 146.176 million, increasing six-fold from the number of students in 1949. At the same time, the number of primary school teachers increased from 836,000 to 5.226 million, increasing six-fold from the number of teachers in 1949. Secondary normal school graduates numbered only 1,745,600. Even if all of them were assigned to primary schools, there was still a deficit of 3.4804 million. Under this condition, many teachers (private school teachers) without formal education qualifications were recruited. This stage can be further divided into three sub-stages. The period from 1949 to 1951 featured fast growth. The proportion of private school teachers increased from 10% to over 30%. The stage from 1952 to 1957 was a stage of initial readjustment and the proportion of private school teachers decreased to 10%. The period from 1958 to 1977 was a stage of fluctuation and fast increase, and the proportion of private school teachers stayed above 15%. In 1965, the proportion of private school teachers in rural primary schools exceeded 50%, and the proportion continued rising steadily afterward. In 1977, there were 3.439 million private primary school teachers. The rural private primary school teachers reached 3.3435 million, accounting for 97.22% of the total. At that time, the private primary school teachers were largely distributed in rural areas. In 1977, the total number of primary school teachers reached 4.5662 million, and the majority were private school teachers, accounting for 73.22% of the total. During this period, the teacher team received supplements by recruiting public school teachers and private school teachers. After the mid-1960s, especially in the 1970s, private school teachers became the main body of teacher supplement in rural primary schools.

1.2 Supplementation via Assigning Secondary Normal School Graduates and Employing Substitute Teachers as Supplementary Means (1978–2000)

Private school teachers made great contributions in expanding teaching teams and promoting primary education development in China. However, private teachers have not received formal teacher education. In addition, private school teachers were of mixed quality, due to the fact that their recruitment was not as strict as it should have been. After 1978, the government began to readjust policies governing rural private school supplements. In January 1978, the State Council approved the *Opinions on Strengthening the Management of Primary and Secondary School Teachers,*

[2]Source: *National Educational Statistics of the Last 30 Years (1949–1978)*, Ministry of Education of People's Republic of China.

which raised the management authority of private school teachers to the educational departments of county level. In October 1981, the Ministry of Education forwarded the *Notice on Experience of Readjusting Private School Teachers in Hebei Province*, which stipulated that qualified private school teachers must be issued certificates and for disqualified private school teachers to be dismissed. With the normal schools resuming their order of education and expansion of their enrollment scale, in December 1986, the National Education Commission and other ministries jointly issued the *Notice on the Special Quota for Public Teachers Selected from Private Teachers in Primary and Secondary* schools in 1986, which stipulated that no new private school teachers would be recruited.

From 1978 to 2000, the number of rural primary school students remained high and so did the demand for teachers. After the policy on supplement private school teachers was revoked, no new private school teachers were recruited across the country. Existing private school teachers were completely eradicated through means such as qualifying them after enrollment at normal schools, transferring to public schools, and employment termination. In 2000, the problem of 3.3293 million (as of 1978) private primary school teachers was essentially solved. About 2 million private primary school teachers were transformed into public teachers via different methods. About 1 million were dismissed from the rural private primary school teacher team.[3] In order to bridge the gap of more than 1 million teachers, which was caused by the dismissal of rural private primary school teachers and the retirement of other public teachers, rural teachers were mainly supplemented by assigning secondary normal school graduates and no longer relying on recruiting the private school teachers. From the mid-1980s, the scale of secondary normal school graduates expanded gradually. Every year, there were more than 200,000 students graduating from secondary normal schools. In the late 1990s, this number exceeded 300,000. They became the main source of rural private primary school teacher team supplements. However, the demand for rural private primary school teachers was still not met. After 1986, when the private schoolteacher supplements were stopped, the demand had to be met by using alternative means. Substituting teachers constituted an important means of teacher supplement. In China, substitute teachers had existed for a long time. In the 1980s the number of substitute teachers continued increasing and underwent rapid growth in the 1990s. In the 1980s, substitute teachers accounted for 5 to 7% of the total number of rural primary school teachers. In the 1990s, the proportion exceeded 10%. In 1997, the proportion reached the peak of 19.39%, which meant there were 730,200 substituting teachers in rural primary schools. They became one of the important sources of supplement to rural primary school teachers.

[3]Based on statistics of relevant departments of Ministry of Education.

1.3 Supplements Through Open Recruitment and Special Projects (2001 Till Now)

In the early 2000s, secondary normal education was greatly reduced. This is because a teacher education system gradually took hold, with normal colleges playing the major role and other colleges participating. The original three levels of teacher education (secondary school, three-year college and four-year college), became the new set of three levels, namely three-year college, four-year college, graduate school. The teacher recruitment testing system, after many years of research, was implemented. This was combined with the expansion of higher education institute enrollment and reform of the teacher education system, the steady increase of college graduates with teacher's certificates, and the advancement of public institution reforms. In September 2003, the Ministry of Education and the Ministry of Human Resources and Social Security of the People's Republic of China jointly promulgated the *Opinions on the Implementation of Deepening the Reform of Personnel System in Primary and Secondary Schools*. At the end of 2003, the Ministry of Education held the middle school and primary school personnel work conference, deploying the specific requirements and plans of the reform. In December 2005, the Ministry of Human Resources and Social Security issued *the Interim Provisions on Public Recruitment of Personnel by Public Institutions* and the Ministry of Education drafted documents for recruitment of primary and middle school teachers, establishing a system in which candidates have to pass tests in order to become primary school and middle school teachers. Thus the supplement of rural primary teachers switched from assigning secondary normal school graduates to the supplement policy system of public recruitment via testing.

With the gradual loss of attraction in a rural teachers' career, in regards to the supplement to primary school teachers, public recruitment cannot meet the needs of rural school education. In the new century, the government began to reduce substituting teachers on purpose, because a high proportion of substituting teachers hinders the standardization and high-quality construction of rural primary school teacher teams. In 2006, the Ministry of Education required that substituting teachers should be dismissed as soon as possible. Afterward, the number of substituting teachers at rural primary school teachers shrank quickly from its peak of 730,200 to 73,200 in 2017. The proportion of substituting teachers dropped from 19.39% to 4.13%. In the face of such a situation, in order to attract more quality talents to work in rural schools, specific policies or projects were introduced to open up new channels for the supplement to rural primary school teachers. In February 2006, nine ministries including Organization Department of the CPC Central Committee and Ministry of Human Resources and Social Security promulgated the*Notice on Organizing the College Graduates to Work in Rural Areas to Support Teaching, Agriculture, Medicare and Poverty Alleviation Work* (Hereafter referred to as "Three Supports and One Alleviation Plan"). In May 2006*, the Ministry of Education and Ministry of Finance promulgated the Special Post Plan for School Teachers in Rural Compulsory Education Stage (hereafter referred to as "Special-post Plan").* In May 2007, the Ministry

of Education, Ministry of Finance, Ministry of Human Resources and Social Security, and State Commission Office of Public Sectors Reform jointly published the *Measures for the Implementation of Public-funded Education for Normal University Students Directly under the Ministry of Education* (hereafter referred to as "Public-funded Normal University Education Student Plan"), after which normal universities of provincial-level started to recruit public-funded students. In 2010, the Ministry of Education expanded the recruitment of the Rural School Master of Education Teacher Development Plan (hereafter referred to as "Master of Education Teacher"), including the rural primary school teachers. According to statistics from 2006 to 2018, 740,000 special-post teachers were recruited, and more than 100,000 public-funded normal university students were recruited. The number of special-post teachers, public-funded normal university students, students of "three support and one alleviation" plan and master of education teachers reached about 1 million.,[4] They became one of the most important sources of supplementation to rural primary school teachers.

2 Practical Difficulties Facing Rural Primary School Teacher Supplement Policy

2.1 Contradiction Between Strict Control of Staff Size and Inadequate Supplement Rural Primary School Teachers

Nowadays, the compulsory education of China has completed the transition from large-scale popularization to quality improvement strategy, but this does not mean the demand for rural primary school teachers will shrink. In the future, the number of Chinese rural primary school teachers required will be relatively big, due to three factors. First is the influence of the universal two-child policy, which causes the increase of school-age population and reduction of teachers due to maternal leave. This factor causes a deficit of around 100,000 teachers. Second is the new demand for rural primary school teachers caused by urbanization. With the outflow and natural decline of the rural school-age population, many small-scale schools emerged. Although the number of students decreased, the curricular plans by the state have to be implemented and the number of teachers cannot be reduced in proportion to the decline of student numbers. Investigations have revealed that, on the one hand, in many rural primary schools there is more teacher than needed, however, on the other hand, there is a structural shortage of teachers. The third is the requirement of new curriculum reform. The ongoing curriculum reform continued incorporating new

[4]Calculated based on the data released by the Ministry of Education and the planned recruitment numbers over the years.

courses into the compulsory education curriculum system. If there is no supplement of teachers, it will be difficult to complete teaching tasks (Wu & Chen, 2018).

The supplement of rural primary school teachers is very difficult due to the state's policy of strictly controlling the number of financial support personnel and the total number of personnel (which will not increase but decrease). In 2017, the student–teacher ratio at rural primary schools was 15.66:1. It seems that teachers are adequate in rural primary schools, far higher than in city district (21.67:1) and in town district (20.16:1). However, if one examines the class-teacher ratio, the rural primary school has a ratio of 1:1.75, indicating the inadequacy of teachers, far lower than that of city district (1:2.09) and town district (1:2.11). Although the state introduced a favorable personnel quota policy for small-scale schools in rural areas and set the quota for class-teacher ratio and student–teacher ratio, the effect of its implementation was not obvious, due to the constraints of personnel quotas. Survey results indicated that 82.51% of the small-scale rural primary schools have more teachers than personnel quotas. Some schools have not supplemented new teachers for nearly ten years. The personnel departments follow the principle of "financial support personnel will not increase but decrease," constraining the autonomy of educational authority in the supplementation of teachers. Even if the county finance can cover the extra personnel cost for supplementing teachers in some areas, they cannot supplement teachers based on the need of the small-scaled primary schools (Liu, Wang & Wu, 2017). When new teachers cannot be supplemented, a series of problems emerge. The workload for teachers becomes too heavy. Courses like music, physical education, and art cannot be taught. The aging of the teacher team becomes more serious as a result. In a word, the quality of education and teaching is affected in many aspects and the long-term stable construction of rural teacher team is influenced.

2.2 The Contradiction Between Low Career Attraction and the Low Quality of Rural Primary School Teacher Supplements

The low career attraction of rural schoolteachers prevents teachers, especially excellent teachers from choosing rural teacher posts. Our investigation found that the low attraction of a career as a rural schoolteacher comes from the poor living condition, low pay, heavy workload, and barriers to professional development (Qin, 2018). A rural teacher's lack of career attractiveness directly affects the supplement of excellent graduates and urban teachers to the rural teacher team. First of all, 80.2% of the normal university students "would like work as teachers," but only 38.0% of them "would like to work as teachers in rural areas." The proportions of students willing to work as teachers in rural areas in the "211 project" normal universities, key normal universities of provincial level, and normal universities of provincial-level are 31.7%, 33.2%, and 43.7% respectively. Secondly, urban teachers would not like to work in rural areas in exchange for their current position. The in-service teachers' upward

mobility rate is 67.3%, downward mobility rate is 4.5% and parallel mobility rate is 28.2%. About 77% of the urban teachers "would not like to" work in poor rural schools in exchange. And 52.4% of the urban teaches would not like to work in rural areas in exchange for their current position, even if there is a pay raise. Thirdly, as many excellent rural teachers move to cities, it brings challenges to the supplement of rural teachers. Statistics revealed that 21.5% of rural teachers "would like to stay," 36.7% "would like to leave," and 65.2% have relocated before. The proportion of county town schoolteachers who have been working in their current position since their initial employment stands at 35.4%. Township schoolteachers stand at 56.1% and that of village schoolteachers are at 51.2%. Most of the teachers who have experienced redeployment have been supplemented into county town schools and township schools. 89% of teachers working in county town schools who have the experience of relocating came from township or village schools (Wu & Qin, 2015, p. 277–288). In other words, the rural primary schools' overall quality cannot be raised and the supplement of rural primary school teachers meets the quality problem, because of their inability to attract excellent talents and their loss of in-service rural primary school teachers.

2.3 Contradiction Between the Overall Structural Surplus of Primary School Teachers Across China and the Inadequate Effective Supply of Rural Primary School Teachers

Due to the uniqueness of rural society and education, it has been universally acknowledged that teachers who are to work at rural primary schools should be specially prepared or educated for that purpose. The acknowledgment of this uniqueness for recruitment candidates, education content and means of instruction will help attract more students to work at rural primary schools (Li & Wu, 2018). The overall supply of teachers far exceeds the demand. Statistics reveal that in the 10 years after 2006, the average number of graduates from normal universities was 701,600, while the number of graduates recruited by schools was only 195,700, taking up only 27.89% of the total. This means that more than 70% of students did not work in the educational field after graduation from normal universities (Xie, 2016).

Although the overall supply of middle school teachers and primary school teachers exceed the needs, the actual supply of rural primary school teachers is far from enough. First, there is a shortage of primary school teachers educated specifically for rural areas. Although a multitude of students is being educated to become teachers, their education is city-oriented; few are being educated to love the rural area, learn about rural areas and are willing to work as rural primary school teachers. The current status of rural primary schools has changed dramatically, with the coexistence of small-scale schools and board schools, as well as many stay-at-home children, requiring a special teacher education that is oriented towards rural areas.

However, there are few such schools specially designed to educate rural primary school teachers. Second, there is a shortage of high-quality rural primary school teachers. High-quality schools in the cities mostly recruit teachers educated at high-quality normal universities, with few working in rural areas. Third, there is a structural imbalance in the supply of teachers in rural primary schools, where there is a surplus of Chinese teachers and mathematic teachers, while there is a severe shortage of teachers for disciplines such as music, physical education, art, science, information technology, comprehensive practice, etc. There is a surplus of young female teachers, while there is a shortage of young male teachers. The surplus does not meet the demands. The lack of institutes especially educating rural primary school teachers has led to the inadequacy of teachers specially trained for or oriented towards rural primary schools.

2.4 The Contradiction Between the Limited County Government Budget and the Low Funding for the Supplement to Rural Primary School Teachers

At the county level, the personnel quota, which is the number of staff, which is accessible to public institutions such as schools, is mainly decided by the county government. It verifies and allots the financial support personnel quotas for the entire whole county. With the primary school teachers' salary paid by the county government expenditure, the willingness of the county government to supplement teachers is mainly decided by the fiscal condition of the county government and the importance attached to local education career by the county government, because the number of teacher posts is set according to the availability of personnel quota and the personnel quota is related to the government fiscal investment. After the taxation reform, the overall county fiscal strength across China is generally weak. In most counties, the financial power does not match their administrative power. If county governments would like to develop education using their weak fiscal strength, they will have to reduce education expenditure to keep their budget balanced, because the high proportion of education expenditure in the public budget is a common phenomenon. In the 12 counties investigated, the lowest proportion of education expenditure in the public budget is 17.21% and the highest is 29.52%. In order to alleviate the fiscal pressure, the county governments tend to not increase the personnel expenditure of the educational sector (Liu, 2016). The strict control of personnel quota policy, which stipulates that financial support personnel cannot increase but only decrease, matches the policy choice of the county governments. In addition, facing so many expenditure demands, the county governments tend not to prioritize education, which is regarded as an uncertain investment, which has an unclear ratio of return on investment and a long return period. Instead, they tend to determine the personnel quotas in the education sector based on their fiscal strength, rather than the actual needs of education

and instruction. As a result, even if there is a personnel quota, they are not willing to supplement teachers and they are not willing to implement extra personnel quotas.

2.5 Difficulties in the Supplementation of Rural Primary Teachers in "Three Areas and Three Prefectures"

The deeply impoverished regions, such as the"Three Areas and Three Prefecture",[5] deserve special attention, because they are the most challenging areas of "poverty alleviation through education" campaigns and the weakest areas of teacher team construction, due to their poor natural environment, backward infrastructure, complicated ethnic conditions, and difficult work environment. According to the investigations by the Central Committee of the China Association for Promoting Democracy, the rural teacher supplement in the"Three Areas and Three Prefectures"faces immense challenges. First, the teacher team construction in these areas depends heavily on the special support policy of the state. The fiscal strength of the government of various levels in these areas is barely self-sufficient. Developing education with loans is common in these areas. Over 90% of their education expenditure money comes from the intergovernmental transfer by the Central Government. The teacher team construction, including teacher supplement, depends heavily on the special support of the Central Government's transfer. Second, there is a severe shortage of teacher personnel quotas. In the "Three Areas and Three Prefectures," due to the geographical characteristics, many villages have an uneven distribution of population and schools, requiring more teachers to offer all required courses. This further aggravates the shortage of personal quota. For example, the personnel quota gaps in Liangshan Prefecture, Aba Prefecture and Ganzi Prefecture of Sichuan Province reached 10,000, 4,042 and 4,298. Third, the shortage of teachers coincides with the low overall quality. Due to the poor natural environment and extremely difficult work condition, it is very hard for the "Three Areas and Three Prefectures" to recruit and retain quality rural teachers, causing the rural teacher supplement problem and rural teacher quality problems. For example, teachers whose first diploma consists of an undergraduate diploma only account for 7.8% of the total in Ganzi Prefecture of Sichuan Province (Lv, 2019). The special difficulties in supplement to teachers in these poverty-stricken areas have to be solved with the help of special policies of the state.

[5]The "three areas" of "Three Areas and Three Prefectures" refers to Tibet, the Tibetan areas from Qinghai, Sichuan, Yunnan and Gansu, and four prefectures from southern Xinjiang and three prefectures Liangshan Prefecture from Sichuan Province, Nujiang Prefecture from Yunnan Province, and Linxia Prefecture from Gansu Province.

3 Policy Outlook for Rural Primary School Supplement in the New Era

In light of the main contradiction of the Chinese society and the need for balanced development of urban and rural education, in the new era, breakthroughs must be realized in the promotion of teachers' career attraction, innovation of personnel quota system, supply-side structure reform in the education of teachers, and diversification of supplement.

3.1 Optimize External Environment and Strengthen Internal Support

Only by raising the rural primary school teachers' career attractiveness can excellent teachers be recruited into the rural primary school team. The rural primary school teachers' career attractiveness can be improved using external and internal aspects.

The external aspect of education involves the rural revitalization strategy and improvement of overall rural living condition. The teaching profession does not cause the low career attractiveness of being a rural teacher, but the social position is determined by where the schools are located. It is the combination of space and profession that causes the situation where the same profession has different levels of career attraction in different spaces (Wu & Qin, 2015, p. 311). According to relevant investigation results, teachers living and working in rural areas, teachers working in urban areas and normal university students yet to graduate all harbor a negative image regarding the living condition in remote rural areas, and some even have a very negative image. This impression significantly affects the teachers' and normal university students' willingness to work in rural areas (Wu, 2014). In order to improve the living condition of rural areas, we must adhere to the rural revitalization strategy, coordinate the rural economic construction, political construction, cultural construction, social construction, ecologic civilization construction and Party building, cultivate strong agriculture, beautiful villages and rich farmers. The promulgation of rural revitalization strategy and the realization of its goals of different stages will significantly improve the habitant environment in rural areas, and as a result, attract more and more high-quality teachers to work at rural primary schools.

The internal aspects of education involve the implementation of *The Rural Teacher Support Program (2015–2020)* (hereafter referred to as "Support Program") and raise the rural teachers' professional status. The Support Program mainly improves rural teachers' treatment via ideological and political quality and higher moral levels, supplement channel, benefits, personnel quota standard, professional title awards, exchange of posts, capacity, and honor conferring system, in order to solve the problems in the weak rural education. After the Support Program was implemented, the rural teachers' career attraction was greatly improved; rural teachers were supplemented from a variety of sources. New vigor was instilled into rural schools (Fu &

Fan, 2018). An encouraging situation has been basically established, where qualified teachers are recruited for rural schools. These schools are able to retain these teachers, and these teachers can teach well (Chen, 2017). However, the implementation of the Support Program still faces several problems, such as uneven implementation progress, inadequate supplement, poor quality of teachers, and the lack of smooth mechanisms for teachers to move from city schools to rural schools (Fu & Fan, 2018). Future education work should be carried out in three aspects. First, the policy should be promoted well, so that more rural teachers will know and understand this favorable policy introduced by the Central Government. Second, local governments should strictly follow their implementation plan for the Support Program, determine the roadmap, schedule their implementation, designate responsible persons, coordinate education resources, and ensure a source of funding. Third, inspections should be strengthened. Governments should, together with third-party organizations, conduct inspection and evaluation of the implementation of the Support Program on a regular basis, provide timely feedback and publish inspection results. For those who failed to implement the policy adequately or those who implement the policy without achieving anything, the designated responsible persons will be held accountable.

3.2 Perfect Management Mechanism and Implement Personnel Quota Approval System

Under the strict control of the staff size of teachers by state policy, the number of rural teacher supplements to rural primary schools is constrained. Forced by the rigid demands on teachers, the local governments introduced a series of reform featuring supplementary off-staff teachers, including the direct government purchase of teacher service, labor dispatch, teacher employment system, as well as a recent new mechanism in which the schools recruit the teachers they need, perform autonomous management and bear full responsibility for their expenditure. These reforms alleviated the shortage of rural primary school teachers caused by the teacher staff size control policy to a certain degree. However, these measures also brought a series of problems. Teachers' contracts may involve risks. Their benefits cannot be guaranteed. The teacher team is not stable. The off-staff reforms may not last (Wu & Chen, 2018). Whether the rural primary school teacher supplement problem should be solved within the framework for the staff size of teachers or not needs serious consideration. According to the *Guiding Opinions of the CPC Central Committee and the State Council on Promoting the Reform of Public Institutions by Classification* promulgated in 2011, compulsory education belongs to Type I public institutions, which requires the strengthening of public-welfare nature and the guarantee of funding from the government budget. This type of public institution cannot have a market to allocate resources and it is not suitable for the market to play the role of allocating resources. In 2011, the General Office of the State Council of the People's Republic of China issued the *Opinions on the Establishment and Management of*

Innovative Institutions, stipulating that the Type I public institutions continue to implement the institution staff quota approval system, and complete the management system. Based on the public institution reform tendency, we can predict that the management of compulsory education personnel will continue to be conducted within the framework of staff size of teachers.

3.2.1 Establish Education Personnel Fund Sharing Mechanism Among Central Government, Provincial Governments and County Governments

Staff size is closely related to fiscal expenditure. Consequently, fiscal strength is the basis of increasing staff size. Currently, education personnel funding mainly comes from the county government budget. Some county governments have weak fiscal strength and can barely support an adequate supply of teachers. Limited by their weak fiscal strength, some counties do not employ enough teachers to fill up their staff size quota and do not supplement teachers even when there are vacancies. In response, the level of overall planning for education personnel funding should be elevated. The ability of the county budget to bear education expenditure must be objectively assessed. An education personnel fund sharing mechanism must be established among Central Government, provincial governments and county governments, based on the county government budget's ability to bear education expenditure (Liu, 2016). For the areas where fiscal revenues are weak, the Central Government and provincial governments should provide more financial assistance and take up bigger proportions of educational personnel funding.

3.2.2 Determine Teacher Staff Size Scientifically

The basis of adequate teacher supply should be based on scientific methods used to determine teacher staff size. The teacher staff size in the county should be determined by considering the following factors. First, the allotment of staff quotas should give priority to the teacher team. The *Opinions on Comprehensively Deepening the Reform in the Construction of Teacher Team in the New Era* (hereafter referred to as "*Opinions on Reform*") promulgated by the Central Committee of Communist Party of China and the State Council in 2018, stipulated that concrete measures should be taken to optimize the staff structure, allowance should be given to teacher team, and the total number of teachers should be increased via a variety of means. By recovering personnel quotas from government downsizing and the "public-institution-to-enterprise" transfer, governments can set up a contemporary personnel quota pool for middle school and primary school teachers, in order to increase the total staff size of teachers in the county. Second, different means should be adopted to determine staff sizes of schools in cities and rural areas. Besides implementing a unified standard for teacher staff quota in both urban and rural schools, the government should give allowance to rural schools, especially small-scale rural schools and boarding

schools. The staff size of small-scale rural schools should be decided by combining the student–teacher ratio and class-teacher ratio. The staff size of rural boarding schools should be expanded, according to the actual needs of instruction and management, via overall planning of current personnel quotas and increase the strength of adjustment. Third, a double-track mode including basic staff size and additional staff quotas should be implemented to fill up vacancies caused by temporary absences of teachers. For example, teachers need certain periods of time for training in order to develop their professional knowledge and skills. Furthermore, in the wake of the implementation of the "universal two-child policy," numerous female teachers at primary schools may ask for maternal leave, require unexpected sick leaves and other types absences.

3.2.3 Perfecting Staff Size Management and the Inspection System

If a policy does not have a rigorous management or inspection system, it becomes ineffective or cannot be implemented well. Today, there is no complete system for staff size management and inspection. Some local governments determine their staff sizes according to their fiscal strength rather than the actual need of the schools. As a result, no supplement is made, even if there are vacancies and personnel quotas; a lot of substituting teachers are being employed; some teachers not working at their posts take up the personnel quotas; additional staff size is not implemented and loses its regulating function; the determination of staff size lasts too long or the staff size plan is outdated and arbitrary. These problems keep the personnel quota resources from being utilized effectively and affect the timely supplement of teachers. Therefore, a system of reporting, inspection and accountability should be set up for the management of staff size at governments of different levels. Management and inspection groups for staff size should be set up at the provincial level, city level and county level, examine the use of teacher personnel quotas in different counties by combining regular inspection and irregular checks, diagnose cases of nonconformity timely, and investigate the responsibilities of relevant units and persons.

3.3 Promote Supply Side Reform, Educate Teachers Oriented for Rural Schools

Currently, the oversupply of teachers coexists with inadequate effective supply. The teacher education organizations are unable to produce high-quality teachers specially educated for rural schools, are willing to work in rural areas and content with teaching in rural schools. The *Opinions on Reform* explicitly advocated structural reform of the supply side in teacher education, encouraged the local government and relevant institutes to improvise by recruiting students with pre-assigned posts, conducting oriented education and providing regular service, and to cultivate "teachers with one

specialty and other abilities" for rural schools and teaching spots, give priority to the teacher supplement needs in the former revolutionary base areas, the ethnic minority areas, the border areas and the poor areas. According to this document, the education and supplement of rural primary school teachers should include efforts to identify rural primary school teacher candidates, increase the localization awareness in pre-service training of teachers, train teachers with one foremost specialty and many other abilities as additions, and educate teachers in several disciplines.

3.3.1 Pre-assigned Enrollment and Teacher Recruitment

The research literature reveals that only those coming from rural areas or those who are interested in rural education may actively choose to work in rural areas (Roberts, 2004). Traditionally, members of the Chinese nation are attached to their native land and unwilling to leave it. The rural areas generally have the poor treatment and poor conditions. The separation from one's hometown and relatives may devastate a rural teacher's confidence to continue working in rural areas. If the education of rural teachers adopts the pre-assigned enrollment and teacher recruitment policy, according to which the candidates go back to where they are from after graduation, rural primary school teacher candidates will find it easier to settle in villages and teach in those in villages. Regarding the procedures, the county (district) bureau may work with financial departments, human resources and social security departments as well as the department governing staff size to draft next year's plan based on the needs of local rural primary schools, as well as the current teacher staff size, and then submit the report to supervisory departments. Relevant departments at the provincial level will approve the report before allocating the pre-assigned enrollment quotas for different counties or districts that propose to set up such posts. The counties or districts that set posts will organize the selection procedure, such as the enlistment procedure, qualification examination and preliminary interview for the candidates from college entrance examinations in the same year as the year in which the plan is to be implemented. The candidates who have passed the initial selection will sign an oriented education agreement and pre-assigned employment agreement with the county government and colleges that will hire them. They will promise to work at rural primary schools in the county for several years (Pang et al. 2017). The candidates' tuition will be paid by the government and be given a certain amount of allowance. After they graduate, candidates will have a personnel quota from public institutions.

3.3.2 Oriented Education

Education always occurs in a certain field; it needs specific experience as a basis, and it cannot happen without the previous experience of students. Therefore, oriented education is not "employment education," but "local education" in a pedagogical sense, which is based on local cultural, natural and industrial advantages. The teacher education is based on the local field, in response to local education problems, and it

trains teachers who can adapt to the local environment, because the local environment not only entails the existing experience of local children, but it also constitutes the source and social basis of children's new experience (Wu, 2015). Many excellent city teachers' inability to adapt to rural teaching demonstrates the importance of local education. Therefore, in order to prepare candidates for rural society and rural primary schools and help them to conduct high-quality teaching at these schools, the designated colleges for teacher education should designate a certain proportion of courses featuring local knowledge and local culture, as well as organize all-round experience activities.

3.3.3 One Specialty and Many Abilities, Education of Several Disciplines

It cannot be argued with certainty whether it is better to teach by a single discipline or teach by multiple disciplines. A young child's world is more holistic and undivided; it has limitless potential for further development. Therefore, it may be better for students' development to teach children using multiple disciplines at primary schools, especially in the lower grades in primary schools. In addition, given the existence of numerous small-scale rural primary schools, teaching using multiple disciplines can save on the number of teachers and lower the financial burden on county governments. Under the financial system in which the teachers' salary is mainly paid by the county government, it is basically impossible to employ too many teachers. In order to ensure that all the disciplines required by the state can be offered and taught well, teaching using multiple disciplines becomes the best option. In order to meet the actual needs of rural schools and the interest of students, a multiple discipline teacher education which features one specialty and many skills requires the colleges to explore the multiple combinations of discipline modules, such as "Chinese + Society + Art," "Math + Science + Physical Education," "Chinese + Math + X." At the same time, it should strengthen the compulsory courses such as "Head teacher work + child psychology + Curriculum and theory" (Wu, 2015). The students educated in this manner can have more flexibility between "specialty" and "many skills," meet the requirement of teaching by single discipline at the higher grades of primary schools, and prepare for junior middle school study.

3.4 Optimize the Staff Structure, Diversify Supplement Sources

3.4.1 Combine Staff and Off-Staff Teachers

In order to ensure the public welfare nature of compulsory education and the public nature of public primary school teachers, future supplements of rural primary school

teachers will mainly be implemented within the framework of staff size. This does not mean that all teachers must be supplemented using staff quotas. If the supplement of teachers cannot be met using staff quota adjustment, market and social forces should be allowed to play their role in allocating teacher resources, acting as auxiliary means of rural primary school teacher supplement. This includes purchasing services for schools so that the quotas of service personnel can be used to supplement teachers, recruiting off-staff teachers, inviting public welfare personnel to offer characteristic courses, and support private schools to fill the gap of public school teachers.

3.4.2 Combine Incremental Supplement and Stock Supplement

The *Opinions on Reform* stipulated that "we should make overall consideration and reasonable verification of staff size based on the needs of education development within the framework of staff size, activate the stock of the staff quotas in institutions, optimize the structure of staff, incline to the teaching staff, increase the total number of teachers in various forms, and give priority to the needs of the development of education." This reflects the inclination of public institution staff quota policy towards teaching teams, and marks a major progress of primary and middle school teacher staff management development (Wu and Chen 2018). However, under the strict control of staff size, the room for rural primary school teacher supplement is limited. Therefore, we should activate the stock of teacher staff quotas, implement reforms in the overall planning of teacher staff quotas in cities and rural areas among districts, as well as the dynamic management of staff quotas. The combination of "recruitment by county and employment by school" policy with the staff size management system will create a staff quota pool in counties. A variety of measures, ranging from integrated management, regular exchange, competitive employment among schools, mobile teaching, voluntary teaching, recruitment of excellent retired teacher for rural schools, should be taken to alleviate the lack of excellent teachers and shortage of some disciplines, such as Music and Physical Education in rural schools.

3.4.3 Combine Oriented Education (Assignment) and Open Recruitment and Special Projects

Since the beginning of twenty-first century, China has established the rural teacher supplement system, combining open recruitment and special projects. However, problems remain unsolved. Inadequate supplements to rural primary school teachers, lack of abilities, instability in personnel rooster, and structural imbalance among others, are all issues. Considering the lack of career attractiveness and the general small-scale of rural primary schools, the future supplementation of teachers to rural primary school should optimize and perfect the oriented education (assignment) policy for localized and multiple discipline teachers, making it a major channel of rural primary school teacher supplement (Panget et al. 2017). At the same time,

the current open recruitment system and special projects should be perfected, and multiple channels should be adopted to attract excellent talents to teach in rural primary schools.

3.5 Special Support Policies for the "Three Areas and Three Prefectures"

For the deep poverty-stricken regions such as the "Three Areas and Three Prefectures," full consideration must be made for the special conditions of ethnic minority regions, and the impacts brought about by "poverty alleviation through education" campaigns and population policy. We must construct overall plans, scientifically verify the teacher staff size, and adopt multiple measures of supplement to meet the demands for rural primary school teachers (Li & Zhi, 2018). Beyond the reform thought and measures, we should focus on the following three aspects. First, the Central Government should continue strengthening the overall planning. Considering the low economic and social development level and limited financial strength in the poverty-stricken regions in the "Three Areas and Three Prefectures," the Central Government should ensure the improvement of rural teacher supplement number and quality with the substantial intergovernmental transfer of funding. Second, education and recruitment of localized teachers should be the main means of rural primary school teacher supplement, which is particularly important for the stability of rural primary school teacher team in the "Three Areas and Three Prefectures" and the improvement of their quality. The size of education candidates should be increased for the rural primary school teachers in the "Three Areas and Three Prefectures," especially the education of bilingual teachers in the ethnic minority areas. At the same time, more special-post teacher quotas should be assigned to the "Three Areas and Three Prefectures," provincial governments should be encouraged to implement local versions of rural teacher "special post plan," in order to provide the rural primary schools in the "Three Areas and Three Prefectures" with more teachers. Third, special care and protection should be given to the life and health of rural primary school teachers. Considering the severe environment, poor living condition, and the fact that teachers working in plateau areas are prone to high altitude sicknesses, necessary medical support should be arranged for rural schoolteachers by cooperating with local medical institutions and inviting excellent doctors to schools for healthcare. Oxygen supply projects should be implemented for rural schools in high altitude areas. The schools should be equipped with adequate oxygen supply equipment, so as to reduce the occurrence of high altitude sicknesses among teachers. Meanwhile, in counties (cities) with relatively low altitudes and relatively good conditions, centralized teachers' residences should be built for teachers' transition from high altitude areas to low altitude areas, to ensure that these teachers can enjoy good health after retirement (Lv, 2019).

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Report 2018 on Frontier and Hot Issues on China's Education

Editorial Department of Educational Research

The first national education conference in the new era was held in 2018 when reform and opening up saw its 40th anniversary. The education community has thoroughly studied and implemented the spirit of the conference, systematically reviewed the achievements and experience of 40 years of reform and development in the education field, continued to explore the frontier and highly debated issues in the field of education, and produced a number of new educational theoretical results.

1 General Secretary Xi Jinping's Important Statement on Education Has Developed and Enriched the Theoretical System of Socialist Education with Chinese Characteristics

On September 10, 2018, the CPC Central Committee held the first national education conference in the new era. General Secretary Xi Jinping attended the conference and delivered an important speech, which summed up the achievements and experience of the education reform and development since the 18th CPC National Congress, systematically expounded the development law of socialist education with Chinese characteristics, and further developed the theoretical system of socialist education with Chinese characteristics.

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i. The important speech of General Secretary Xi Jinping on education is a major innovation in the theoretical system of socialist education with Chinese characteristics.

Since the reform and opening up, socialist education with Chinese characteristics has taken shape and continuously evolved. The most important theoretical achievement of the first national education conference in the new era was using the "Nine Upholds" to summarize the new philosophies, new ideas and new strategies of the Party Central Committee's reform, as well as the development of education since the 18th CPC National Congress. "Nine Insistence" refers to upholding the party's comprehensive leadership over education cause, taking strengthening moral education and cultivating people as a fundamental task, giving priority to the development of education, adhering to the direction of running socialist schools, adhering to develop education based on China's reality, upholding people-centered education, deepening education reform and innovation, taking serving the rejuvenation of Chinese nation as an important mission of education, and taking teaching staff as basic work. These constitute the pillars of General Secretary Xi Jinping vision for education, which indicates that our party's understanding of the laws of education has reached a new height (Sun 2018a, b). In addition, it marks a new milestone in the history of education in our country (Chen 2018) and started a new journey in the development of socialist education with Chinese characteristics. It is the latest achievement of scientific socialist education theory (Cui 2018). It not only inherits the basic principles of Marxist educational thoughts, but also enriches and develops scientific socialist educational theories, and blazes a trail of socialist educational theories with Chinese characteristics (Cui 2018).

ii. The Important Statement of General Secretary Xi Jinping on Education is an Ideological System with Rich Connotation

The important statement of General Secretary Xi Jinping on education is a theoretical system of socialist education with Chinese characteristics in the new era containing rich, extensive and profound connotations. It systematically explains the essential characteristics, functional positioning, strategic goals, fundamental tasks, development laws, education model, source of power, supporting power, governance system and other major issues (Cui 2018). Strengthening the party's overall leadership over education is the fundamental guarantee for developing education in a positive direction (Wang 2018a, b). The concept of strengthening moral education and cultivating people, building an education system that comprehensively fosters the students' all-round moral code, pairing intellectual and physical and aesthetic grounding with a hard-working spirit, and finally cultivating talents in the new era—these all grasp the essence of education modernization. It reflects the accurate grasp of the rules of a socialist school program, the law of teaching and educating people, and the law of student growth (Zeng 2018). Prioritizing the development of education is a primary move to promote the development of various undertakings of the party and the state. Adhering to the direction of running a socialist school systematically answers the fundamental questions of who this education is meant to train

and training methodology. Developing education in accordance with China's reality shows the firm confidence of developing education according to our vision. The development of education centered on the people not only profoundly clarifies the socialist nature of education in China, but also shows China's education is people-oriented (Sun 2018a, b). Deepening education reform and innovation not only shows that education reform is a powerful driving force for the development of education undertakings but also conveys the great determination to deepen the reform of the education system. Serving the great rejuvenation of the Chinese nation is an important mission of education, as it emphasizes the realization of the two centenary goals, as well as promoting the fact that the Chinese dream of the great rejuvenation of the Chinese nation depends on talents and education (Sun 2018a, b). Looking at teaching teams as the basic work shows that teachers are the primary resources of education (Zhang 2018a, b, c, d, e).

iii. The Important Statement of General Secretary Xi Jinping on Education is the Fundamental Observance of Education Reform and Development in the New Era

The important statement of President Xi Jinping on education is a component of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, and the fundamental observance of education reform and development in the new era (Tian 2018). In implementing the fundamental tasks of strengthening moral education and cultivating people and fostering socialist builders and successors, it is necessary to proceed onwards from the physical and mental characteristics of students and the ideological reality. One needs to improve delivery mechanisms, and bring Xi Jinping Thought on Socialism with Chinese Characteristics into the class and be known to students (Sun 2018a, b). From the perspective of improving the quality of the entire nation, the plan places physical education in the school in a more important position, strengthens students' physical exercise, strives to cultivate students' sports interests and sports habits, resulting in a strong and determined individual (Zhu 2018).. To develop labor education in the new era, we must be determined to adjust and reform the curriculum structure and use top-level policies to ensure practical results (Xu 2018). In further developing comprehensive education reform, we must accelerate reforms in key areas and links to lay the foundation for advancing education modernization. We must highlight quality education evaluation, and resolutely overcome the fundamental problem of only putting importance on exam results, degrees, thesis and titles. Leading educational institutions should put the focus of school management on fostering people. We will improve the Double First-class initiative and dynamic adjustment mechanism, and improve the level of talent cultivation, innovation, and service contribution. In accordance with the country's future development and industrial transformation, we will timely reform and adjust disciplines in universities. We will integrate positive forces to carry out collaborative innovation and long-term research, which will ultimately provide support for technological innovation (Sun 2018a, b). In implementing the prioritized development strategy of education and optimizing the allocation of resources, we will promote the implementation of the

responsibility of prioritizing the development of education, improve the funding mechanism for education, and prioritize education and financial investment in the economic and social development plan. Furthermore, we will give priority to guaranteeing education investment and the allocation of public resources to meet the needs of education and human resource development. We will further adjust and optimize the structure of education expenditures, continue to increase investment in education and teaching reform, and comprehensively improve the efficiency of the use of educational funds (Zeng 2018). To develop education in correspondence with China's reality, we should not only learn from the useful practices and experiences of other countries, but also take into consideration Chinese history, study China's national conditions, and serve China's national needs (Ge 2018).

2 Exploring the Logic of Educational Reform and Development in the 40 years of Reform and Opening-up

The year 2018 marked the 40th anniversary of reform and opening up. Reviewing 40 years of education reform and development and clarifying the logic of education reform and development over the past 40 years, education researchers have provided ideas by conducting research, reflecting strong collective awareness and academic consciousness.

i. Resolving the Issue of Access to Education by Focusing on the Word "Greatness" and Improving Popularization

China's education has seen great changes. This change is represented by the substantial increase in the gross enrollment rate of all types of education at all levels, the significant increase in the level of popularization and the number of years of schooling per ca pita. This addresses the issue of access to education. In general, education has seen "four major shifts". These are the strategic position shifting from strategic focus to priority development, the development focus shifting from scale to quality improvement, the function shifting from society-centered to people-oriented, and the development mode shifting from copy-and-imitation to independent exploration (Zhong 2018). This means that China's education has progressed to a new level of quality education. In terms of all levels and types of education, an inclusive public service system that highlights public welfare has been initially established at the preschool education level (Yu and Zhang 2018). Compulsory education has been universally popularized, entering a new stage of balanced development and integration of urban and rural areas. The enrollment rate of basic education at all levels has reached the average level of middle- and upper-income countries in the same period (Zhang 2018a, b, c, d, e). The efficient and fair development of basic education can be attributed to the top priority given to compulsory education (Yuan and Liu 2018).

Higher education policy development contained four stages: preliminary construction centered on comprehensive reconstruction, standardized development with a focus on structural optimization, prosperous development driven by scale expansion and focusing on connotation construction (Qi and Li 2018). Vocational education has been vigorously developed, with secondary and higher vocational education occupying half of secondary education and higher education respectively. In the past, the teacher education system was closed and training and fostering were separate. Now it becomes the open and integrated system. The teacher education model has gradually diversified, and the management system has changed from plan-oriented to standard-oriented (Qu and Yu 2018).

ii. Pushing Education Reform to "Deep Water Zone"

The history of 40-year educational development is also a history of educational reform. Major progress has been made in reforming the personnel training system, examination methods and enrollment system, modern school system, school administration system, education management system, the rule of education law, and the opening up of education. The reform of the education investment system has also formed an education funding input system that focuses on government investment and multi-channel investment in line with the nature of education services and national conditions (Wang and Zhao 2018) From a wide logical perspective, these reforms can be described as the rational allocation and competition of interests between different levels of government and their departments, between governments and schools, social organizations, markets, and school leaders, teachers, and parents. It is a process that begins from rebuilding the education order and then breaking the regulation, empowerment through the rule of law, and promoting co-governance through negotiation. This process seeks moderate tension among different educational interests, stimulates their vitality, and that transitions from regulation to empowerment (Fan and Sun 2018) Since then, education reform has entered the deep water zone. The difficulty is that it is reform after the establishment of the basic framework of its own body, and the reform after the pursuit of high-quality development in education (Deng 2018). The reform of the "deep water zone" should be applied in areas such as improving the implementation of the system of moral education, promoting reform on the school-running system and education management, improving education's ability to serve economic and social development, and expanding education openness.

iii. Developing World-class Modern Education with Chinese Characteristics

In the new era, the main theme of education is developing world-class modern education with Chinese characteristics, building a strong education power, accelerating educational modernization, and providing satisfying education. With the new methodology, the institutionalized, systematic, and standardized school education system and its functions have undergone revolutionary changes. They call for a new education system and education governance mechanism (Fan and Sun 2018). For example, talent training should fully and correctly utilize information technology to cultivate talents with ideals and belief, innovative thinking, courage and dedication.

It should furthermore contain development across the board and personality development (Gu 2018). The focus of compulsory education reform and development should be gradually shifted to the development of special features; national projects that have developed special characteristics of compulsory education should be strengthened (Fan and Song 2018). At the same time, we must persist in opening up to promote reform and development, and push China's basic education toward the world stage through reform and going global too (Yuan and Liu 2018). The development of higher education policies requires a coordinated and unified mechanism, as well as a sufficiently rich and diverse value orientation. The process guarantees continuous to make new policy tools, and policy discourse strengthens public participation (Qi and Li 2018). The reform of education funding input should use the system to regulate government education investment and non-compulsory education tuition income and strengthen private education and social donation incentives (Wang and Zhao 2018). The development of the rule of law in education should further strengthen the value of the rule of law in education, and it should be implemented through legislation, law enforcement, justice, and law compliance to ensure the comprehensive promotion of the modernization of the rule of education (Shen et al. 2018).

3 Fostering Students' Values Guided by Core Socialist Values

The cultivation of values is the first priority in education. Fostering character and civic virtue is the fundamental task of education. Cultivating students' core values of socialism is one of the most important components of this fundamental task. The academic field continues to pay attention to the issue of value education, and profoundly focuses on the era characteristics and requirements, fundamental directions and foundations and school education paths.

i. Value Education Faces the Dual Challenges of Diversity and Complexity

The values of the times are the background and starting point of value education at school. Diversity and complexity are words commonly used to summarize the characteristics of the values of the times. "Our social environment is showing a diverse and complicated situation." (Zhang 2018a, b, c, d, e) The development of new media has exacerbated the epochal characteristics of such plural values. New media technology, such as the mobile internet, is a fundamental feature that not only changes the way individuals communicate with each other but also accelerates the formation of coexistence in the overall diversity of the social environment. In light of university students, the "decentralization" and "fragmentation" of the new media not only dispels the recognition of their socialist core values but also blurs their value judgment (He 2018). It can be said that the values of this generation of students is diversified and interwoven with each other.

ii. Values education needs to be dominated by pluralism and neutrality

The coexistence of values comes as a result of social development and individual thought development. However, excessively diversified values will restrict the individual value identity and hinder the integration of social values. Therefore, in values education, a commonly used and effective method is to identify a leading one among the various values. The leading content is the core values of socialism, the orientation, guidance and leadership of strengthening core values in value education (Lin 2018). The dominant character and abilities mainly include valuable judgments, social responsibility, and social emotion. Value judgment determines value choice and action. The real task of value education is to improve the value judgment ability of students. The core of value education is grasped when the improvement of value judgment ability is handled (Gao 2018a, b, c). Social responsibility is a core attribute in the development of young people's values. It is necessary to attach great importance to the influence of family, as well as emphasizing a student's own experience, and developing and practice of core socialist values (Su 2018). The improvement of social-emotional ability can realize the social construction of students, which can ultimately promote the healthy operation of society (Du and Mao 2018) The emotion of shame also has significant educational values. It can provide motivation for education, and education itself is a way to deal with shame (Gao 2018a, b, c). On the leading mechanism, the first is to realize the sublimation from individual moral consciousness to the common ideal through cultural identity (Song and Niu 2018). The second is to emphasize the mutual relationship between moral emotion and value (Wang 2018a, b). The third is to establish the overall ethics pattern (Sun 2018a, b). In addition, the complex living world also requires education for "baseline values" (Yu and Gao 2018).

iii. Strengthening School Exploration by Following the Rules

Education ultimately takes place in the school, so does value education. Based on reviewing the past exploration by schools, research has increasingly emphasized that values education must be compliant with the laws of education and the principles of values education. The core socialist values are a structured ideological system, and the core values of socialism should lead to the integration of moral education. In light of the education path, more emphasis is placed on the construction of school culture, the modernization of school systems, the transformation of teaching methods, and the deepening of teacher–student interaction (Yang 2018). From the perspective of the implementation strategy, more emphasis is given to the "connection point" of content, the "access point" in time, and the "growth point" of morality (Feng and Wei 2018). In particular, "dimensional consciousness" should be strengthened, and the relevant values should be aligned with the three dimensions. These are the state, society and citizens. It should be pointed out that at the 2018 session of The Chinese Society of Education's Young and Middle-aged Theoretical Workers, many scholars paid attention to the value improvement of schools themselves, believing that today schools should realize the shift from management to governance in value education (Chen and Zeng 2018).

4 Building School Life for Children

Children are both participants and constructors in school education. School education is not only a means for achieving a better future for children but also an important part of a better life for children in the present. An in-depth understanding of children and their lives is of great significance for the construction of current school life.

i. Recognizing Children as Children

In modern society, children occupy a prominent position and become the starting point of modern education. This is largely due to the discovery of childhood and the recognition of children as children. Childhood may influence an adult life. For example, childhood is the predecessor of adulthood, and hence the future of tomorrow's adults depends on today's children (Ye 2018) Children also have the significance of an independent stage, like the children's impact on the world. Children are the source of all human and cultural resources (Liu 2018a, b, c). It may be manifested as children's subjective status. For example, only by truly recognizing children's subjective status in theory, can education be shifted from "shaping" to "cultivating" and "serving", from "burning yourself" to "igniting others"; from designing the future for children to helping children create their future (Xiang 2018). It may also mean that children have the need to grow up. We should avoiding overemphasizing, boosting or overstating children. The idea that discussing children abstractly, romantically, sadly, or even exaggeratedly is harmful. Modern education needs to respect children's autonomy, independence, and creativity. At the same time, it should be strict with children, guide children in a correct and effective way. They cannot treat every child with an abstract, universal, and general perspective (Wu 2018). Education is of the children's interest, and receiving an education is often regarded as children's inalienable right. Because education is inherently related to the overall interests of each child, thus constituting children's basic interest and well-being. Moreover, this right is, to a large extent, unique to children; it profoundly affects their opportunities and achievements in the future (Cheng 2018a, b).

ii. Children as Constructors of World's Significance

Children are not just adults in development, or existing social adaptors, they are also newcomers to the world. Their arrival brings new life to the world, adding vitality to the world, and brings new forms of life, new works, and new action. At the same time, they are thrown into this world and enjoy the significance of this world by participating, experiencing, feeling, thinking, exploring, listening (Jin 2018a, b). These newcomers grow and construct themselves by interacting with this world while in the company of others. For example, building blocks display children's natural abilities. Nursery rhyme performances mark the beginning of an individual seeking the sense of rhythm and aesthetic harmony. Learning classical poetry means that children will form a cultural world containing the aesthetic rhythm of the Chinese language. They all start from the body, centered on the activation of perceptual

abilities and the arousal of aesthetic rhythm, gradually develop the possibility of children's better life (Liu 2018a, b, c).

iii. Improving Educational Life at School

Education is not only an important way for children to integrate into society, realize their own interests, and pursue a better life but also part of their better life. The first is to protect the basic interests of children. Education constitutes an important aspect of children's interests. Specifically in terms of individual adults and public life. In selecting and determining children's educational matters, children's basic interests or rights need to be taken seriously (Cheng 2018a, b). The second is guiding children to open their life. A good school education life should be inspired by love. In the context of loving interaction, we should activate the individual's current perception, thinking, memory, imagination and past experience, integrating past life with the present, thereby opening up the current life as a whole and forming a situation in which the individual's life is actively developing (Liu 2018a, b, c). The third point is guiding children to enjoy life. Children learn to create a better life by enjoying a lovely life. Enjoyment highlights children's subjective participation in the world, shows children's spiritual acquisition and transformation, and builds the essential relationship between children and school life. Only when schools become children's spiritual homes and call for them to "stay freely" can children's hearts be soothed and grow (Jin 2018a, b). The fourth is promoting practical education. Educators, Through purposeful, planned and organized practical activities, enable learners to personally experience the acquisition and construction of knowledge in real-life situations, or to verify existing knowledge in practical application, to gain a sense of reality and practice, thereby forming practical innovative ideas, and develop the necessary problem-solving mentality and key abilities (Zhou and Hu 2018).

5 Information Technology Promotes Profound Changes in the Relationship Between Teaching and Learning

The relationship between teaching and learning is the basic relationship of education. Establishing a new teaching–learning relationship based on students' development is an academic trend and policy requirement for teaching reform. Information technologies such as the Internet, big data, and artificial intelligence have become important driving forces for profound teaching and learning.

i. Information Technology Is Changing Teaching and Learning

The development of information technology poses challenges to traditional teaching content, teaching methods, learning methods, teaching organization frameworks, and evaluation methods. The curriculum is no longer the sole source of knowledge, and the classroom is no longer the only place to learn. New technologies such as mobile Internet, big data, and artificial intelligence have greatly expanded the time

and physical boundaries of learning, changed the way of learning and the way of interaction between man and knowledge, and changed all aspects of knowledge teaching as a whole (Liu and Tan 2018). With the support of technology, there is no longer a fixed time, space and content limit for learning. Learners can learn whatever they want to learn at any time and any place according to their own needs, and seek the guidance they need. The central position of pupils in learning will become increasingly prominent (Yang and Hu 2018). Teachers make full use of modern information technology to implement evidence-based teaching (Zheng and Cui 2018). Information technology not only changes the environment and methods of teaching and learning at the technical level but also changes the thinking and theory of teaching and learning at a conceptual level.

ii. Deep Integration of Information Technology and Curriculum Teaching

Changes caused by information technology, such as flipping classrooms, MOOC, deep learning, and blended learning, reflect deep integration of information technology and curriculum teaching. Taking flipped classrooms as an example, the focus is on solving the problems of the intrinsic relationship between teaching autonomy and other disciplines, the fragmentation and systemization of knowledge, shallow learning and deep learning, and the similarity of teachers and students in the exchange of time and space (Du and Du 2018a, b). The main value of this teaching process reform is to promote students' deep learning (An 2018). Deep learning sets the goal of teaching improvement as the development of students' core literacy and the enhancement of students' deep understanding, practical application and creative problem-solving ability; all of which helps to improve the formalization, superficiality, fragmentation and mechanical training in the current classroom teaching in elementary and secondary schools (Zheng and Liu 2018). In the process of deep integration, future learning, future education, and future classrooms are flourishing.

iii. The Relationship Between Teaching and Learning Is Quite Complex

Although the relationship between teaching and learning is changing under the advancement of information technology, the relationship between teaching and learning is not completely dominated by information technology, and it is considerably more complex. No matter how advanced the technological media elements may be, it is not possible for them to generate educational significance alone in the teaching system. After all, they are to serve teaching and promote learning (Yu 2018). This complexity is reflected in the sense that, on one hand, teaching must refocus on "learning". It must be student-oriented and built on happy, healthy, and personalized growth of students. "Teaching" should be student-centered, and it should be built on the diversity of the students, and the demands of the students' diversity (Fang and Gong 2018). It can even be said that the classroom is neither teacher-centered nor student-centered, but centered on learning. It serves the learning and development of students (Ran 2018). On the other hand, the relationship between teaching and learning must be demonstrated through classroom teaching. "Learning" and "teaching" are not isolated, and they complement each other. Students in

"learning" and teachers in "teaching" exchange knowledge and "create" and "enjoy" teaching (Li 2018). This complexity means that the adjustment of the relationship between teaching and learning requires the practical wisdom of teachers. It should flexibly be adjusted according to the teaching theme, teaching conditions and teaching context. In addition, under the condition of information technology, teachers cannot surrender their roles and responsibilities in the teacher-student relationship to artificial intelligence (Xin 2018).

6 Promoting the Healthy Development of Inclusive Preschool Education in Post-Popularization Age

The gross enrollment rate of the three-year preschool education in 2018 reached.

81.7%, entering the post-popularization era. In November 2018, the CPC Central Committee and the State Council issued the Opinions on the Standardization and Development of Deepening the Reform of Preschool Education, which further clarifies the direction and measures for reform of preschool education, and promotes the universalization of preschool education, as well as the development of high-quality health.

i. Inclusiveness Has Become the Value Pursuit of the Reform and Development of Preschool Education

Expanding the supply of preschool education resources remains the major task of preschool education. To increase the penetration rate and meet the demand for admission, we have explored a variety of methods, such as mobilizing the government, communities, enterprises, institutions, and private sectors to establish kindergartens. Inclusiveness has been elevated to the value pursuit of preschool education. Inclusive kindergartens, public or private, are supported by the state. In order to encourage inclusiveness, we will continue to run public kindergartens. Additionally, we will increase efforts to support inclusive private kindergartens. In particular, supporting private kindergartens to provide inclusive services is an important way to expand inclusive resources and promote the non-profit shift of inclusive private kindergartens which better suits China's national conditions (Wei et al. 2018).

ii. Shoring Up the Weakness in the Development of Preschool Education

Although issues like the difficulty to go to kindergarten and the high cost associated with a kindergarten have been alleviated to some extent, the imbalanced and inadequate development of preschool education remains acute. Insufficient teaching staff, obstacles to welfare access, and the development of teachers outside staffing plans are still difficulties of squad building (Hong and Jiang 2018). The government's responsibility for developing inclusive preschool education and national standards for inclusive education are unclear (Yuan 2018). The government's financial subsidies for inclusive private kindergartens are small and the methods are simple.

There is a certain gap between the external support provided by the government and the actual needs and interests of inclusive private kindergartens. The environmental and regulative support for professional development is obviously insufficient (Wang et al. 2018). There is a huge gap of inclusiveness in rural preschool education between different provinces (Chen and An 2018). There are many reasons for the imbalance and inadequacy, but the fundamental one is the lack of legal protection. Therefore, we should accelerate legislation for preschool education, and identify the fundamental nature of preschool education in the legal form as public and inclusive and uphold it. We should incorporate preschool education into the basic public education service system and important social public undertakings, clarify governmental responsibilities, stipulate management system, investment systems, operation systems and teacher policy system for the development of preschool education. We should make it clear that we welcome non-governmental kindergartens and stress inclusive benefits and quality. We will effectively activate all kinds of resources, and truly establish a public service system for preschool education with public kindergartens, government-supported kindergartens, and inclusive private kindergartens as the main body. We will adhere to the principle of "equity and balance", and give more support to central and western regions, old revolutionary base areas, areas inhabited by minority nationalities, remote and border areas and poverty-stricken areas and rural areas (Pang 2018). Only by shoring up these weaknesses can preschool education achieve healthy, orderly, and sustainable development.

iii. Achieving Healthy and High-quality Development on the Basis of Inclusion

In the post-popularization era, the focus of preschool education development will shift to safety and quality, and to highlight healthy development. The Opinions on Deepening the Reform of the Educational System and Mechanism has clearly defined State Council leadership, coordinated by provinces and cities, and with counties as the main body. This is a major adjustment of the preschool education management system and will have a fundamental impact on conditions and teams for preschool education, infrastructure and funding. We should accelerate the implementation. When it comes to the development of inclusive private kindergartens, we should step up the research and development of the guiding standards and regulations of pre-school education for inclusive benefit, clarify the beneficiaries of pre-school education of inclusive benefit, set application requirements for inclusive pre-school education institutions, make it clear shall be basic support given to inclusive private kindergartens, and strengthen regulation on their kindergartens (Huo, et al., 2018). We should improve the external support system to promote the development of inclusive private kindergartens, establish an internal and external evaluation system, build a unified standard for evaluating the quality of inclusive private kindergartens, increase the proportion and weight of process quality indicators in the evaluation system, and build a two-way interactive evaluation and feedback mechanism between the government and inclusive private kindergartens (Hu and Hu 2018). With the significant increase in the pre-school education penetration rate, the key factor affecting the healthy and high-quality development of pre-school education is the establishment of a pre-school

teachers' squad. We should establish independent colleges to produce pre-school teachers in a planned manner, enhance the educational level of pre-school teachers, and establish strict supervision guidance systems. Furthermore, it is advised that we standardize the education process of pre-school teachers, and strengthen the construction of local pre-school teacher training institutions. Internship in kindergartens is an important stage in the pre-school teacher training process, and it is an important link for pre-service teachers to obtain practical knowledge. We should provide multi-dimensional guarantees for education practice from aspects such as university student management and internship (Dan et al. 2018). There is another beneficial aspect of healthy and high-quality development, which is to support science and education, and to avoid building kindergartens into primary schools. We should make great efforts to continuously improve the professionalism and service quality of child care and education, utilize games as basic activities, cherish the unique value of games and life, and promote the happy and healthy growth of young children. We should explore the construction of gamification of kindergarten's curriculum and transform kindergarten's curriculum reform from "textbook theory" to "action-oriented practice" (Cai 2018). Avoiding building kindergartens into primary schools is a matter concerning both kindergartens and elementary schools. Therefore, while kindergartens insist on game activities, primary schools should implement zero-point teaching.

7 Promoting Integrated Governance of Compulsory Education in Urban and Rural Areas

Promoting the integration of urban and rural education and promoting the balanced and high-quality development of urban and rural education are the basic projects to be implemented as part of the strategy for rural rejuvenation and poverty alleviation advancement. Promoting integrated governance of compulsory education in urban and rural areas continues to be a hot topic of academic attention.

i. Urban and Rural Compulsory Education Shifts to Integrated Governance

Compulsory education is the top priority of education reform and development. It is the basic public service provided by the government and provided to all. Compulsory education for all people is the essential requirement of compulsory education. However, in terms of specific strategies, China has adopted a step-by-step strategy. After undergoing basic popularization, comprehensive popularization, and balanced development, compulsory education has now entered a new stage of integrated urban and rural governance. The reform and development of compulsory education in urban and rural areas has gone through stages of uneven development, balanced development and integrated development (Yang and Li 2018). In 2018, the CPC Central Committee and the State Council issued a series of policies including Opinions on Implementing the Strategy for Rural Rejuvenation and Guidance on Three

Years of Action in Fighting against Poverty, which put forward new requirements for accelerating the integration of urban and rural compulsory education.

ii. Basic Concepts of Integrated Governance of Compulsory Education in Urban and Rural Areas

Integrated governance of urban and rural compulsory education is an inclusive concept which involves a multitude of factors: integration of school layout adjustments, school construction standards, allocation of school conditions, school funding, and manning quotas. The real integration of urban and rural compulsory education is reflected in the aspects of coordinated management, rational layout, equal resource allocation, equal attractiveness, equal development opportunities for students, and coordination with urbanization (Zhang 2018a, b, c, d, e). The integration of urban and rural compulsory education is a result and a process. In terms of integrated governance, rural area leans towards the weaker side. The basic concept of integrated governance of urban and rural compulsory education is based on the following understandings. The first is to focus on both the inside and outside. Institutional arrangements should be adopted to solve the problem of insufficient investment of overall rural public resources caused by the traditional dual urban–rural structure (Jin 2018a, b). The second is to grasp the urban and rural areas together. Large class size should be eliminated in urban schools, and rural schools should enhance foundation by shoring up weaknesses, shortcomings, especially for controlling dropouts. The third is to implement hardware and software together. Schools in urban and rural areas should adopt the same standard for equipment and manning quota. The fourth is to focus on process and outcome together. We should be upgrading supervision of balanced development of compulsory education, and promote development through supervision.

iii. Promoting Integrated Governance of Compulsory Education in Urban and Rural Areas through Multiple Paths

The integrated governance of urban and rural education faces a series of difficulties. To resolve the problem of "urban schools being crowded, countryside schools being weak and village schools lacking students" and the problem of integrated governance of urban–rural school layout, we should find an effective path from the rural revitalization strategy, as well as reference the urban–rural integration development layout. The integration of urban and rural compulsory education funding is a prerequisite for the construction and operation of urban and rural schools. The public funding standard is unified between urban and rural areas. Additionally, the government has already introduced policies, allowing the transferring of public funds with children of migrant workers. Local governments should set up specifications to ensure the implementation of the rules and alleviate the financial pressure of governments with in-flowing students. The core of people's demand for quality education is the demand for quality teachers. The integrated governance of urban and rural areas requires the coordination of urban and rural teachers. We can consider establishing a dynamic mechanism for the establishment of teachers based on the school-aged population

holding a residence permit, implement a dynamic manning quota assessment system with unified central leadership, provincial co-ordination, hierarchical management, and special establishment for special use. We should reserve certain manning quotas and improve teaching staffing efficiency (Wu and Chen 2018). The construction of rural teacher squads should clarify the special legal status of teachers, promote the professional development of rural teachers, and improve the quality of rural teacher squads (Cheng 2018a, b). Teachers' sense of achievement, happiness, and security stem from their status and treatment. Practical measures should be taken to improve teachers' social status and salary (Wang 2018a, b). The integration of school conditions is a hardware guarantee for the integration of urban and rural education. For the shrinking of scale benefits in small schools, we must develop the hardware construction standards for rural small schools based on the principles of meeting the bottom line, ensuring quality, and avoiding waste, and promote standardized construction of school (Qin 2018). In addition, we should explore the integration of urban and rural compulsory education functions, and the integration of urban and rural school culture as well as building a learning community for teachers and students in urban and rural areas (Ji 2018).

8 Reform on Innovation and Entrepreneurship Education-driven Mode to Train Talents in Colleges and Universities

In May 2018, General Secretary Xi Jinping pointed out at a symposium attended by teachers and students at Peking University that colleges and universities should take developing a high-level talent training system as fundamental work. The reform of talent training mode in universities has entered the fast lane. Innovation and entrepreneurship education have become one of the driving forces for the reform of talent training models in universities.

i. Multi-level and Multi-type Talent Training Is A New Theme for Talent Training in Colleges and Universities

Talent training is the primary function of higher institutions, and teaching duties are their central work. People must profoundly and proactively understand the importance of talent training in universities and thought about the reform of talent training models. We should strengthen the fundamental function of talent training and allow the essential mission of the talent training back to its original form. Achieving a multi-layered, multi-typed talent training pattern is the subject of higher education talent training in the new era (Qu 2018). From multiple perspectives, returning to undergraduate education, initiating reform on undergraduate teaching, and creating student-centered education is inevitable for the current development of higher education. The undergraduate education of first-class universities has a greater impact on the value enhancement of students' critical thinking ability. In order to promote and

implement first-class undergraduate education in first-class universities, we should focus on cultivating and improving the critical thinking ability of college students.

(Zhang and Shen 2018) The conditions for the cultivation of top-tier innovative talents are becoming increasingly mature, and we should strengthen the cultivation of top-notch innovative talents. At present, a two-dimensional classification system with three types of selection and training has been formed: "strong selection-closed special zone cultivation", "strong selection-semi-open dual cultivation", "weak selection-open pass cultivation" (Lu et al. 2018). From the perspective of multiple types, it is impossible for homogeneous universities to cultivate multiple types of talents, so classification reform is a solution. Classification reform can provide a diversified higher education supply. The essence of higher education classification is the classification reform of talent cultivation. We should establish a classification system of higher education based on the positioning of talent cultivation (Li and Xue 2018). Simultaneously, the performance grading of talent cultivation in universities is of great import. We should change the quality concept of talent cultivation through performance evaluation, scientifically review the quality process of talent cultivation, serve the function of higher education, and establish long-term management incentive strategies (Zhang 2018a, b, c, d, e).

ii. Innovation and Entrepreneurship Education Is A New Lever for Reforming the Talent Training Model

There are multiple ways and options for reforming the talent-training model. In essence, the starting point of innovation and entrepreneurship education is to improve the employment competitiveness and overall quality of college students. During the reform, people increasingly find that innovation and entrepreneurship education is of significance, and it may be the focus of the reform on talent training models in colleges and universities. To deepen the reform of the talent training model, colleges and universities should promote overall and systematic changes, upgrade training goals, build curriculum system, initiate innovation in training mechanisms, and reform teaching methods, so as to integrate innovation and entrepreneurship education into the talent training system of universities. This will also establish a market for and social demand-oriented, learner-centered, competency-focused, and diverse talent training model (Zhao 2018). With the rapid development of China's economy, industrial structure adjustment and development model transformation and upgrading, increasing social demand for innovative, composite, and application-oriented talents make reform of talent training models driven by innovation and entrepreneurship education inevitable (Ren and Liu 2018). There is no doubt that innovation and entrepreneurship education is first of all to improve the comprehensive quality of entrepreneurship and employment competitiveness of university graduates (Huang et al. 2018). But we should not be content with this. We must highlight the shaping of "complete and independent individuals. This means integrated training in multiple dimensions such as thinking mode, mental model, creativity, character, will, and problem-solving ability (Chen and Yuan 2018). We should focus on cultivating students' positive psychological qualities such as active response, enthusiasm and

innovation, keen excellence, self-efficacy, social wisdom and optimism, as well as promoting students' overall positive growth (Ye and Xu 2018) Such innovation and entrepreneurship education will spur the reform of the talent training model.

iii. Integration with Professional Education Is the New Trend of Innovation and Entrepreneurship Education

Innovation and entrepreneurship education that drives the reform on the talent cultivation model must be integrated with professional education. Innovation and entrepreneurship education is the best combination of professional education and innovative spirit, practical ability, cognitive ability and non-cognitive ability. To this end, we should embed innovation and entrepreneurship in classroom teaching, and reform teaching methods to form reflective teaching, ability teaching, and self-efficacy teaching, improve internalization of disciplines, and promote the cultivation of innovation and entrepreneurship (Shi and Wang 2018). We should establish and improve a new teaching system based on the concept of using innovation and entrepreneurship education to transform knowledge impartment, attach importance to the development and integrity of curriculum operation practices, and emphasize the generation of knowledge and abilities of students' innovation and entrepreneurship (Du and Du 2018a, 2018b). Moreover, the new curriculum system needs a two-way discipline integration system orientation and social demand orientation to reconstruct the interdisciplinary curriculum system (Liu 2018a, b, c). By doing so, we can achieve integration with professional education. However, the current innovation and entrepreneurship education lacks a multidimensional quality evaluation system in concerted majors (Huang and Lv 2018). As such, there is a long journey before innovation and entrepreneurship education can be integrated with professional education.

9 Strengthening the Construction of Teacher Squad with the Ability to Educate People as the Core

The national education conference proposed that the construction of a teacher squad should be the basic task. Building a teacher squad with both adequate intelligence and virtue is a blessing to students, the nation and the state. In January 2018, the CPC Central Committee and the State Council issued Opinions on Comprehensively Deepening the Reform and Construction of Teacher Squad in the New Era (hereinafter referred to as the Opinions). In February 2018, five ministries including the Ministry of Education issued and implemented the Action Plan on Revitalizing Teacher's Education (2018–2022) (hereinafter referred to as the Plan), which identifies the reform direction of the construction of the teaching squad in the new era.

i. Putting the Construction of Teacher Squad in An Unprecedentedly Important Position

Entering the new era, the CPC Central Committee attaches unprecedented importance to teachers' work. General Secretary Xi Jinping places great importance on the construction of the teaching team, and puts forward a series of requirements, which include that teachers should have conviction, virtue, knowledge and love; teachers should be the pathfinders, helping students foster strong mind, acquire knowledge, make innovation and contribute to the world; teachers should adhere to the unity of teaching and education, of verbal instruction and personal example, of asking and focusing on the unity of society, and of academic freedom and academic norms. These point out the direction for the construction of the teaching team. The National Education Conference summarized a teacher's mission of the times. This includes spreading knowledge, ideas, truth, shaping the soul, the message of life to new people. This is a new summary of the role and status of teachers and highlights the extreme importance of teachers to students, society, the state, the nation, and the future. We should comprehensively strengthen the construction of teaching teams as a major political task and a fundamental livelihood project, and build a high-quality teaching team with strong political qualities, excellent business abilities, and a high level of education (Chen 2018). The atmosphere of respecting teachers and valuing education throughout the society is becoming thicker, and the tradition of teacher's dignity is being revived.

ii. Integrating "teaching" and "educating people"

Teaching and educating people is a teacher's duty, but there is an obvious phenomenon where schools overestimate teaching and underestimate educating people. In some places, primary and secondary schools, under the guidance of score-oriented and enrollment-oriented evaluation, underestimate or even neglect education. It is common in universities that research is overemphasized and teaching is neglected (Wang 2018a, b). Fostering character and civic virtue is the fundamental task of education. Schools are where fostering character and civic virtue takes place, and teachers are the ones who foster character and civic virtue. Therefore, in the new era, the construction of a teacher squad must return to fostering character and civic virtue, and to pondering the fundamental question of who should be trained, how to train people and for whom people are trained. The construction of the education squad should integrate "teaching" and "educating people" in value orientation and pay more attention to educating people. We should first train teachers to embody these values. The comprehensive development of teacher ethics is the key to improving teachers' ability to educate others. On the one hand, we should vigorously improve the ideological and political quality of teachers. On the other hand, we should comprehensively improve the professional ethics of teachers (Wang 2018a, b). This requires teachers to take responsibility and regard the mission as their pursuit and goal. They should not only respect and love their job but also should also fulfill their social responsibility. They should be faithful when assuming the responsibility and mission of educating people (Gao 2018a, b, c).

iii. Improving the Education Capability of Teachers

Generally speaking, there are two dimensions: one is a virtue and the other is talent. In terms of virtue, the emphasis is on fostering educational feelings and professional emotion. Educational feelings are the spiritual character of teachers who are obsessed with teaching and educating people. It can produce the spiritual experience of "cultivating students' mind with the teachers' mind", and exert the educational effect of "cultivating people and mind". Enhancing teachers' educational feelings, integrating teachers' perseverance with inherent strength and spiritual support, and enhance their sense of gain, honor, and happiness play a vital role in (Han and Liu 2018) awakening moral consciousness. Nurturing professional emotions can make positive emotions such as care and love play an important role in education (Gao and Yu 2018). As for developing talent, the first is knowledge sharing which plays an important role in promoting the professional development of teachers and improvement of education. We should encourage and help teachers build a sound professional knowledge, skill system, and sustainable self-development capabilities, as well as create an organizational atmosphere conducive to knowledge sharing within the school, and effectively promote and enhance teachers' performance in collaborative learning, interactive communication, and knowledge and skill sharing (Zheng and Fu 2018). The second is education practical capability. The pre-service teachers' educational practical capability is a comprehensive ability consisting of reflective practical ability, academic integration ability, and action research ability (Hu 2018). Then comes the personal education philosophy. As educators with virtue and conscience, teachers themselves should improve their philosophical care. The formation and systematization of teachers' personal educational philosophy are the most profound changes in professional development (Cai et al. 2018).

10 Enhancing the Subject Consciousness of "Chinese Pedagogy" in the Construction of the "Three Major Systems"

Constructing the "three major systems" such as the discipline system, academic system, and discourse system with their own characteristics is a major task for the development of philosophy and social science with Chinese characteristics. The "three major systems" of pedagogy have to be reflected by different expressions in the long course of introduction, rooting and expansion of Chinese pedagogy over a hundred years. There is a long journey ahead. This awakening of subject self-awareness is the inherent strength of a discipline trying to construct its own "three major systems", and it is also the tenacious pursuit of Chinese pedagogy in the framework of "Sino-foreign relations".

i. Dedicated to the "Three Systems" of Pedagogy with Chinese Characteristics

The subject consciousness of Chinese pedagogy starts from the "meta-research" on a subject's nature, subject position, subject independence, and uniqueness. With the strengthening of the self-awareness of pedagogy, building "three systems" of pedagogy with Chinese characteristics has become a hot topic in pedagogy research.

On the one hand, it is a top-down, external-internal theory call for a reasonable extension to the discipline of education. On the other hand, it is also the theoretical consciousness of convergence that emerges after the development of the discipline itself reaches a certain height. The reason why "three major systems" are relevant, realistic and urgent in the field of Chinese pedagogy is that the universal issue captures the public issue of contemporary Chinese philosophy and social science research. More importantly, many fundamental and endogenous problems faced by contemporary Chinese pedagogy can also be made clear in this issue. It can also be expected that new theoretical solutions will be obtained in further deliberation and investigation. In response to the extremely unbalanced derivation of the pedagogy concept system, strengthening the research and construction of the basic concepts and terminology system of pedagogy is a basic and fundamental task for the scientific development of pedagogy. Education needs to restructure the core concepts, redefine what education is, what learning is, what school is, and what a teacher is. Based on this, an original theoretical explanation of Chinese education practice is created. All these need to study the subject with a clear discourse consciousness, return to the cultural origin of Chinese pedagogical discourse creation, and accumulate the power of discourse innovation in the "education of discourse".

ii. From Education Sinicization to Chinese Pedagogy

"Sino-Foreign Relations" in the development of educational disciplines was considered as the "issue of the century" that will influence the development of education in the future. The development and transformation of pedagogy in modern China is almost all "introduced" from abroad and built on the model imported from foreign countries. For more than a hundred years, Chinese pedagogy has not yet overcome this primary problem in theoretical production. In the sense of subject consciousness, "localization" and "sinicization" are almost the "cross-generational consensus" of Chinese education scholars for almost a century. However "sinicization (localization)" of education is a theoretical solution with inherent deficiencies. Therefore, from the "sinicization" of education to the creation of "Chinese pedagogy" based on Chinese educational practice has become a two-way transformation between "Chinese creation and world creation" in which Chinese pedagogy seeks Chinese discourse and world discourse in pedagogy. This is an important value orientation.

Research outcomes that can be qualified as "Chinese Pedagogy" should be manifested as summarizing Chinese features, providing products created by China, forming Chinese systems and enhancing China's influence. The future of Chinese pedagogy should go beyond the thinking of simply seeking "Chinese pedagogy", and strive to form a "pedagogy" community with world pedagogy, create a new "pedagogic" world, and thus become a "community with shared future for mankind" in

a unique and indispensable way of expression and realization in the field of pedagogy. By doing so, Chinese pedagogy is not just pedagogy "in China", or "pedagogy sinicization", but become "global Chinese pedagogy".

iii. Making Research on Pedagogy More Normative and Scientific

Being normative and scientific is the key to the quality of pedagogic research and the level of educational discipline construction. Promoting the transformation of the research paradigm of educational disciplines and improving the standardization and scientific level of research are urgent tasks for the development of educational disciplines in China. According to the reality of pedagogical research, we will improve the standardization of pedagogical research and focus on three aspects: strengthening the literature awareness, constructing a self-consistent theoretical analysis framework, and focusing on the appropriateness of research methods. Literature is a knowledge map and the starting point of research. Without a comprehensive literature review, we do not know what others have done, nor where to start our research, and we cannot assess the value of the research. The self-consistent theoretical analysis framework is the pillar of the research, which reflects the research ideas and structure. The precision, reason and innovation can be reflected in the framework of theoretical analysis. In terms of research methods, there is more discussion needed, plus a quantity of empirical research. Pedagogical research in China lacks empirical research, which has shown a trend in the background of standardization and science and is in line with the trend. The widespread use of empirical research is an important turning point in the development of educational disciplines i.n recent years. But at the same time, empirical evidence is just one method among many, and it will not and cannot replace other methods. The key is to find the appropriateness and suitability between the method and the subject. The goal of making pedagogy research more normative and scientific is not to "scientize pedagogy", but to form "education science" based on the scientific logic of pedagogy. It is meant to break through the boundary of connotation and extension, to form our own scientific boundary, and build our own scientific paradigm of "education science".

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