A STUDY ON THE EFFECTIVENESS OF ECOLOGICAL CIVILIZATION EDUCATION IN EXPERIMENTAL SCHOOL OF CHINESE EDUCATION FOR SUSTAINABLE DEVELOPMENT

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Abstract: Ecological civilization is the wisdom crystallization of China's long-term explorations and researches based on Marxist ecological theory and scientific outlook on development, and the essence is to achieve sustainable development. Since the beginning of the new century, our government has attached great importance to ecological civilization and sustainable development and school education played an important role in this process. With the active promotion of international and domestic related policies and education administrative departments, ecological civilization education deepen its development. This paper focuses on the summary and analysis of the main implementation models and achievements in promoting ecological civilization education by experimental schools of education for sustainable development in the field of elementary education in recent years, aiming at providing reference for further promoting ecological civilization and sustainable development from the perspective of education.

Key words Ecological Civilization Implementation mode Implementation Effectiveness

Research Background

1.1 Domestic Background

Since entering the new century, ecological civilization and sustainable development have become the main theme of social development. The Chinese government pointed out in many conference reports that we will build an ecologically-civilized society that is harmonious between people and people, people and society, people and

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nature; we will enter an era of ecological civilization with high productivity, prosperous life and good ecological conditions. The Chinese government pointed out in many conference reports that we will build an ecologically-civilized society that is harmonious between people and people, people and society, people and nature; we will enter an era of ecological civilization with high productivity, prosperous life and good ecological conditions. It is emphasized that we must firmly establish the concept of socialist ecological civilization, and regard the harmonious coexistence of man and nature as an important content of the basic strategy for upholding and developing socialism with Chinese characteristics in the new era. Ecological civilization is a thousand-year plan for the sustainable development of the Chinese nation and education is an important path to achieve this goal.

1.2 International Background

In the past ten years, UNESCO has released a series of programmatic documents about education for sustainable development. In 2005, UNESCO issued the "United Nations Decade of Education for Sustainable Development (2005-2014)", which marked education for sustainable development has entered a new period of development; "Shaping the Expected Future" and "Global Action Program (GAP)" released in 2014 have pointed out that in all levels and areas of education and learning, we will strengthen actions aimed at promoting sustainable development. UNESCO calls on the international community to promote education for sustainable development in five key areas: advancing policy, updating learning and training methods, improving the ability of educators and trainers, mobilizing young people to participate extensively, and participating in the formulation of solutions to promote regional sustainable development[1]. By guiding people to adopt a sustainable lifestyle, a sustainable world will be created. In 2015, "The 2030 Education Framework for Action" was adopted in the 38th session of the UNESCO General Conference. In 2017, Global Plan of Action on Education for Sustainable Development Forum published the "Education for Sustainable Development Goals: Learning Objectives", laying a foundation for further deepening education for sustainable development.

1.3 Realistic Background

Students in primary and middle school are the main force for the future development of a green society, so their values and behaviors on ecological civilization have direct impact on the construction of ecological civilization in the future society. In recent years, taking actual conditions of the region and school into account, schools in various regions took specific measures to carry out ecological civilization and education for sustainable development according to local conditions. With a variety

of implementation modes, many schools have achieved certain results, but they still need to improve their ecological civilization awareness and behavior. We have made some achievements in exploring and summarizing effective implementation models of ecological civilization and education for sustainable development, and the top priority is to enhance the pertinence and effectiveness of ecological civilization and education for sustainable development in primary and secondary schools.

2. Main Implementation Models of Ecological Civilization Education

Through the questionnaire survey, I found the implementation models mainly focus on the community-driven model, interdisciplinary model, curriculum integration model, project promotion model, agency-wide model (it was first proposed by UNESCO in the "GAP", which says through this way to promote education for sustainable development, enabling school education, teaching, logistics, society and other departments to participate and fulfill their duties respectively) and problem-driven model. Table 1 below:

From Table 1, it reflected that community-driven, disciplines integration, interdisciplinary and problem-driven models are more widely used in the school's ecological civilization education, while project promotion and agency-wide model are used less. As a whole, the six models have their own characteristics and boundaries. Different regions and schools apply appropriate implementation models to carry out ecological civilization and education for sustainable development according to the actual situation.

In terms of frequency, curriculum integration, community, interdisciplinary and problem-driven models are frequently used by teachers. The reason is that for schools and teachers, they have accumulated some knowledge about ecological civilization and education for sustainable development, so those models are more convenient for them to operate, implement and apply. In terms of region, projects are being promoted in Beijing, Shanghai, and Guangdong who applied agency-wide model to advance research on ecological civilization and education for sustainable development. Many social organizations were involved in these projects such as participating in green Olympics, retaining a bucket of water, future scientists of L'Oréal, thirst Silk Road challenges, energy saving and emission reduction projects of the Beijing Municipal Education Commission and so on. Through these activities, students acquired knowledge of energy saving, emission reduction, resources and environmental protection, and cultivating ecological civilization and sustainable development values. Most of schools in Hebei applied community model and discipline integration model, and are weak in agency-wide and problem-driven aspects. This is related to regional policies and administrative support.

Table 1: Survey Form of Implementation Model of Ecological Civilization Education (N=541)

Item	Questions	Option	Percentage
1	Does your school have environmental associations to carry out practical activities about ecological civilization education ?	Yes	67
		No	29
		Unclear	4
2	Did you apply interdisciplinary teaching to develop ecological civilization education during the education and teaching process?	Yes	45
		No	32
		Unclear	23
3	Is there anything that infiltrates ecological civilization and education for sustainable development in the discipline you teach?	Yes	76
		No	22
		Unclear	2
4	Did your school have promoted ecological civilization and education for sustainable development by participating in special projects?	Yes	35
		No	44
		Unclear	21
5	Did your school apply an agency-wide model to implement research activities about ecological civilization and education for sustainable development ?	Yes	19
		No	51
		Unclear	30
6	Did your students conduct researches on practical issues about social environmental protection?	Yes	45
		No	32
		Unclear	23

In terms of participation scope of the six models, the agency-wide model includes more implementation elements, such as schools, families, communities, social groups, companies, state functional departments (environmental protection, water, transportation), so it covers the widest scope. These models have their own characteristics and implementation scope, for instance, the environmental protection community, project-driven, and problem-driven models can be included in the agency-wide model; participants include class teachers, teachers, school management service departments and personnel of social organizations. The interdisciplinary and curriculum integration models are relatively single in the education and teaching process, which means only limited to teachers and students in the school.

3. Effectiveness of Ecological Civilization and Education for Sustainable Development

3.1 Survey on Implementation Effectiveness

The investigation of ecological civilization and education for sustainable development began at the end of the last century. With further researches in education and teaching practice in new century, especially in the past five years, teachers, students, and principals made surveys through questionnaires, interviews, and observations. According to the survey and study, the respondents believe that students have greatly improved their competency, learning ability, and lifestyle. In recent years, the whole organization has implemented ecological civilization and education for sustainable development to promote the curriculum construction and interdisciplinary researches, and thus improving the overall regional education quality. As shown below:

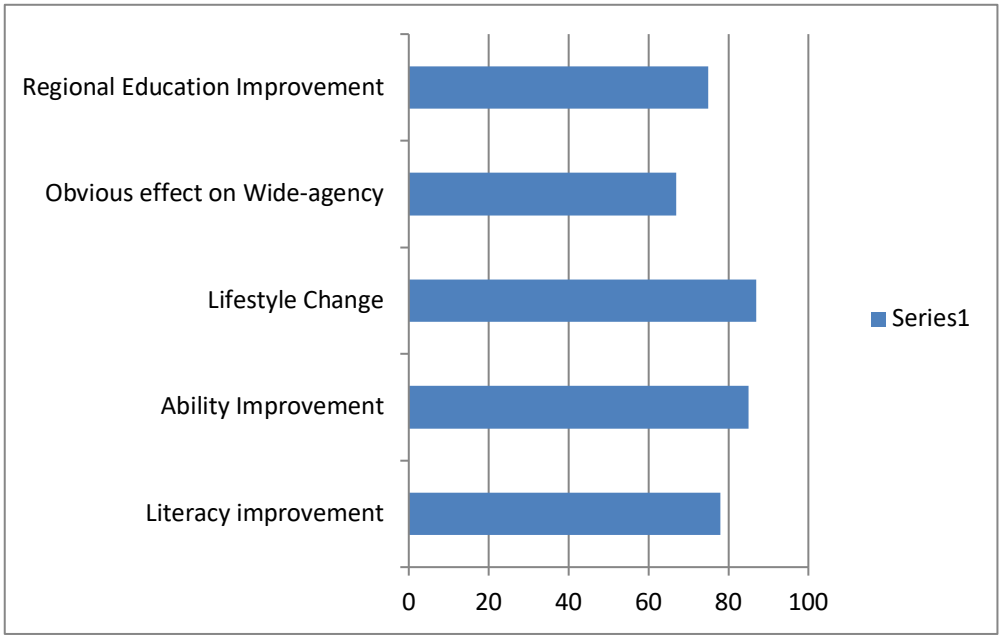


Figure 1 Survey on the effectiveness of ecological civilization and education for sustainable development (percentage) N=541

Teachers believe that students have changed their lifestyles, improved their learning ability and competency of ecological civilization and sustainable development. But the percentage is relatively low in whether the implementation of multiple models promotes regional education and the effectiveness of the agency-wide model.

3.2.The Implementation Effectiveness of Ecological Civilization and Education for Sustainable Development in Recent Years

3.2.1.Ecological Civilization and Sustained Development Competency Continue to Improve

In 2017, UNESCO issued the "ESD Goals: Learning Objectives" which explicitly put forward eight sustainable development competencies[2]. The survey on those competencies is conducted with the third-year middle school students (finish elementary education in the same school) developed in four years at Shijingshan Experimental School attached to Beijing Academy of Educational Sciences. As Table 2 showed below:

Table 2: Survey Form of Competency on Ecological Civilization and Sustainable Development (2013-2017)

Year	Environmental competency	Resource conservation and green energy	Participate in building a green society	Focus on cultural diversity	Systematic thinking	Anticipatory competency
2013-2014	72.33	71.60	65.45	73.48	70.50	65.40
2014-2015	79.15	75.50	71.93	79.86	73.88	68.11
2015-2016	84.30	81.27	77.29	82.76	76.55	70.46
2016-2017	90.56	88.23	84.96	87.19	82.50	75.99

Note: The data in the table is the total score of each survey scale and has been converted into a percentage score. N=186

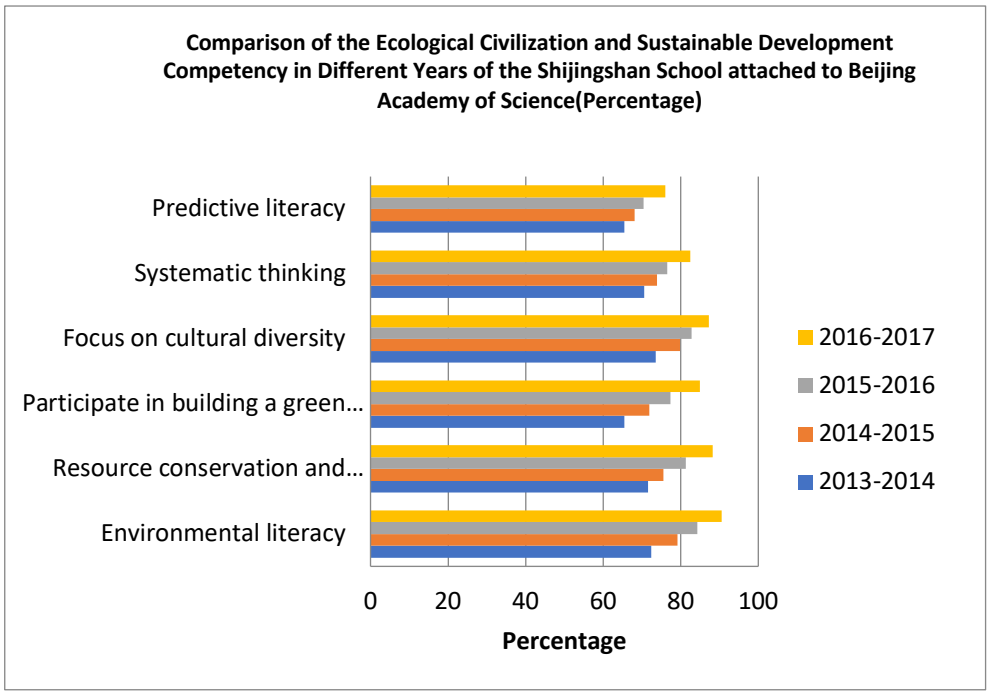


Figure 2 Comparison of Ecological Civilization and Sustainable Development Competency

The results shown in the above table and figure revealed the sampled students have improved their sustainable development competency presented in the past four years, and the development in all aspects has gradually become more balanced. Relatively speaking, students perform better in environmental competency, resource conservation and green energy, and attention to cultural diversity, but they need to be further improved in participation in the construction of a green society, thinking competency, and anticipatory competency. After many years of concept infiltration and implementation, China's experimental schools on education for sustainable development have significantly improved students' ecological civilization and sustainable development competency through the application of community-driven, problem-driven, project-driven models. Students are cultivating sustainable lifestyles and improving ecological civilization and sustainable development competency significantly. Energy saving and emission reduction have achieved remarkable results. Especially in the recent five years, teachers and students in many schools have gradually developed low-carbon and environmentally-friendly habits in their daily lives, and gradually cultivating ecological civilization and sustainable development values of respecting for the environment and resources. After long-term concept infiltration of ecological civilization and education for sustainable development,

students have gradually realized the significance and role of low-carbon environmental protection and green life in a variety of activities. Teachers guided students to come into the community, rural areas, water plants, construction sites to carry out research activities such as energy saving, environmental protection, garbage sorting, etc. They also conducted researches on various micro-projects, improving students' sense of social responsibility. As shown in figure 2.

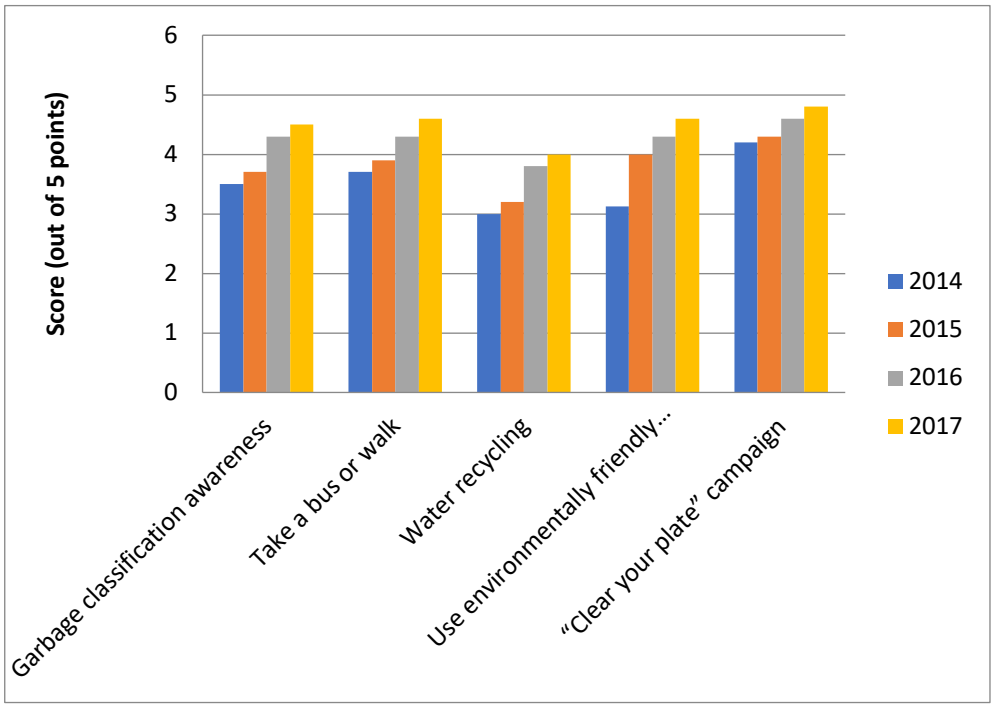


Figure 3 Comparison of low-carbon environmental protection activities in Xingtai No.7 Middle School (2014–2017)

Figure 3 shows that from 2014 to 2017, students have changed their behaviors of low-carbon environmental protection. Sustainable lifestyles such as garbage classification, environmental conservation, green travel, and "clear your plate" campaign are being developed. Students brought these good habits back to the family and the community, so the environmental protection initiative changes from passive behavior to active one.

3.2.2 Sustained Learning Ability Has Gradually Improved

Through curriculum integration and interdisciplinary models, teachers have incorporated relevant knowledge of ecological civilization and education for sustainable development into the education and teaching process, which has broadened students' horizons. In the teaching process, teachers made use of a variety

of research-based learning activities to help students learn in cooperative inquiry methods. Teachers in different subjects worked together to help students to clearly understand the ecological issues of society and gradually acquire the knowledge and values on ecological civilization and education for sustainable development. Students developed a sustainable lifestyle and cultivated their own modern citizenship competency and sustainable learning ability.

Besides, they also formed a sense of responsibility for paying attention to and solving practical problems in the sustainable development among society, culture, environment, and economy. For example, a middle school made the "Survey of Resources in the Shijingshan Section of the Yongding River" from three disciplines. Through field visits, professional studies, visits, literature search and analysis, scientific experiment design and operation, practical problems are solved with comprehensive application of knowledge innovation. This has changed students' single learning and thinking patterns and improved their ability to apply knowledge in an integrated manner. After the students' investigations and researches, they had a deep thinking and proposed the District Environmental Protection Bureau for protecting the water resources of the Yongding River. Those suggestions were approved and adopted by the experts and the EPA.

Many experimental schools of education for sustainable development have conducted special research through such models as interdisciplinary and curriculum integration. During the learning process, students actively discovered problems, conducted self-initiated investigations and collected information, learned interdisciplinary knowledge and consulted teachers and experts. Besides, they also presented and discussed team solutions, observed implementation effectiveness of the solution, and finally wrote a research report and related suggestions.

All of these have greatly arouse the enthusiasm of teachers and students, increasingly improving their learning ability. Take the Apple Orchard Middle School Affiliated with First Normal University and Shijingshan Experimental School Attached to Beijing Academy of Educational Sciences as an example.

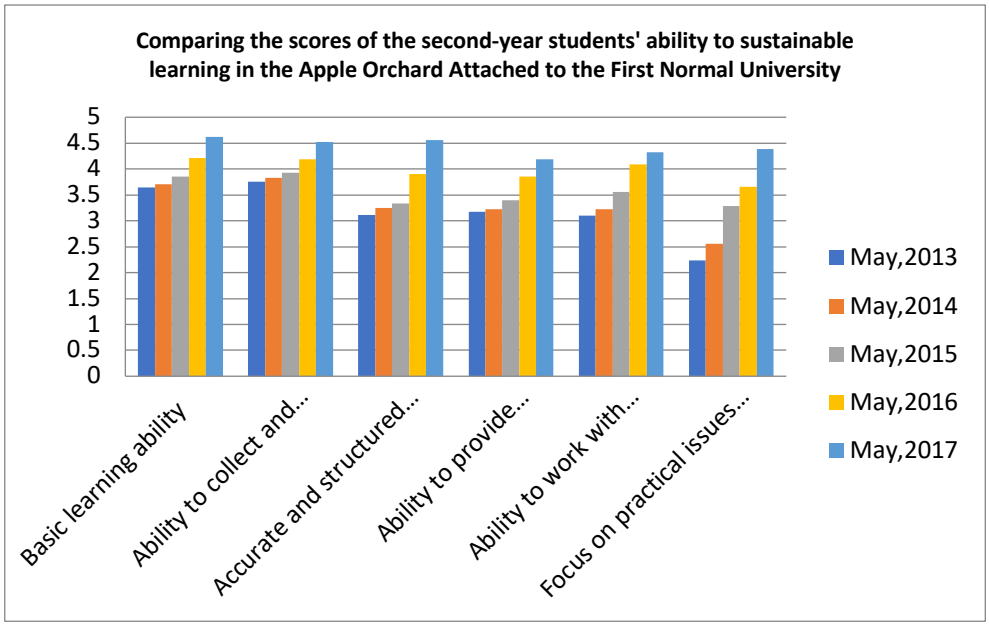


Figure 4 Comparison of Sustainable Learning Capability

Figure 4 reflected that in the past five years, students in Apple Orchard Attached to the First Normal University (from junior and senior high school) has shown an upward trend in sustainable learning. The most obvious is the ability to focus on practical issues of sustainable development and propose innovative solutions. Secondly, it is the ability to communicate accurately and organizationally, to work with others to solve problems. Especially in the past two years, these three kinds of capabilities have improved significantly.

Taking Shijingshan Experimental School Attached to Beijing Academy of Educational Sciences as an example.

The school, under the guidance of the concept of ecological civilization and education for sustainable development, conducted an interdisciplinary study through various projects such as entering Shougang, charity temples and the glacier museum in 2013-2017 and made remarkable achievements. Table 3 is a statistical analysis for the follow-up study of students' ability on based and sustainable learning.

Taking the annual changes as an independent variable and the based and sustainable learning ability as a dependent variable, a one-way analysis of variance was used to compare the differences in the based and sustainable learning ability for each year. See Table 3 below:

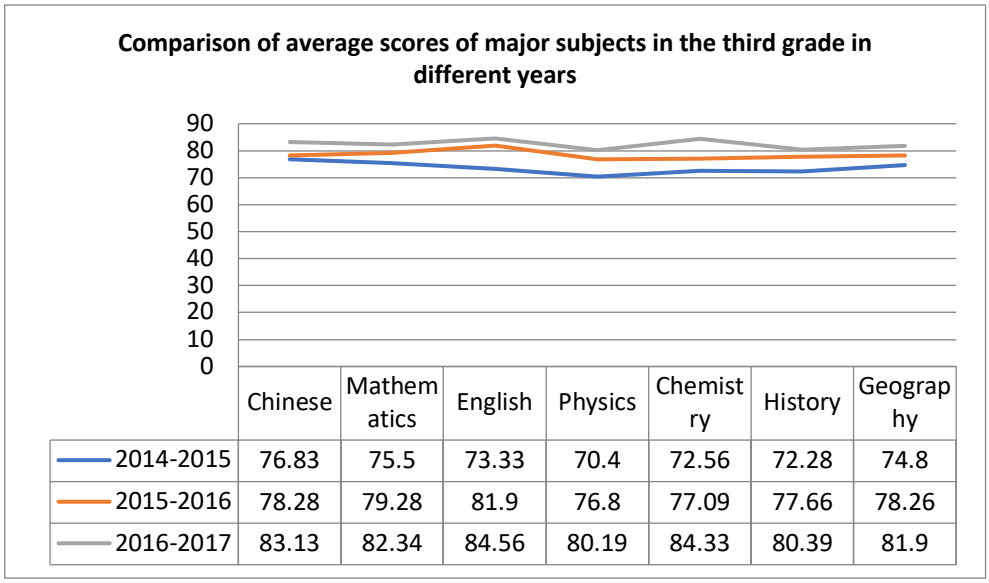
Table 3: Analysis for Students Ability on Based and Sustainable Learning

Dimension	2014	2015	2016	2017	F
Basic learning ability	2.37±0.52	2.63±0.39	2.72±0.43	2.81±0.46	3.01*
Ability to collect, classify and summarize knowledge and related information	2.45±0.71	2.60±0.75	2.67±0.77	2.79±0.70	3.30*
Accurate and structured oral communication skills	2.21±0.71	2.36±0.78	3.11±0.72	3.84±0.66	3.12*
Ability to provide independent analysis and evaluation of book conclusions and others' opinions	2.44±0.70	2.47±0.63	3.52±0.65	3.89±0.71	4.49**
Ability to work with others to solve problems	2.50±0.42	2.56±0.45	3.15±0.52	3.38±0.59	2.36**
Focus on practical issues of sustainable development and propose innovative solutions	1.79±0.70	1.80±0.62	2.78±0.73	3.22±0.67	4.32**

Improvement (M±SD)
Note: The dimension N=150

* indicates P<0.05, ** indicates P<0.01, *** indicates P<0.001

From the results of variance analysis in Table 3, it can be seen that the scores of the students based and sustainable learning ability are increasing year by year, and the difference has reached a statistically significant level. It shows that through four-year teaching and learning in the class, the overall ability of the students' basic and sustainable learning has been significantly improved. At the same time, under the sustainable teaching and learning model, the students' basic learning ability and the five sustainable learning abilities have been significantly improved, and students' academic performance has also increased year by year. As shown in Figure 5:



	Chinese	Mathematics	English	Physics	Chemistry	History	Geography
2014-2015	76.83	75.5	73.33	70.4	72.56	72.28	74.8
2015-2016	78.28	79.28	81.9	76.8	77.09	77.66	78.26
2016-2017	83.13	82.34	84.56	80.19	84.33	80.39	81.9

Figure 5. Comparison of average scores of major subjects in the third grade in different years

As can be seen from Fig. 5, during the last three years, the sample students of 3rd grade in each session have achieved higher scores in major subjects during mid-term examination (school propositions), of which the most obvious ones were physical, chemistry, history, and English. The scores increased more than the previous year in 2015-2016.

In the past year, history and mathematics have seen a significant upward trend. The above upward trend is consistent with the improvement of students' sustainable learning ability and their sustainable development competency.

The sustainable learning classroom and curriculum construction on education for sustainable development in each discipline play a significant role.

As a whole, chemistry, Chinese and English have relatively high scores, and mathematics scores are relatively stable. On this basis, under the guidance of the concept of sustainable development, the school achieved excellent results in the high school entrance exam in 2016 and 2017.

The students' ability to learn and innovate on a sustainable basis is gradually improving.

3.2.3 Agency-Wide Implementation Model Leads More Young People to Participate in the Green Society Construction

In recent years, when guiding students to make research projects, many schools in district and county tried to carry out ecological civilization and education for sustainable development activities from multiple angles so as to lead more young

people to participate in research.

This greatly promoted the study and practice on ecological civilization and education for sustainable development. The special studies in many schools have confirmed that the agency-wide participation has become a trend in ecological civilization and education for sustainable development, interdisciplinary research and learning. The following table shows:

Table 4: Research Project Table of the Agency-wide Participating in Ecological Civilization and Education for Sustainable Development

School	Study Content	Participating Agencies (district)	Interdisciplinary
Apple Orchard Middle School Attached to First Normal University	Study on Shijingshan Section of Yongding River	Environmental Protection Bureau, Development and Reform Commission, MaYu Elementary School, Yongding River Management Institute, Wulituo Wastewater Treatment Plant	Geography, Biology, Chemistry
MaYu Elementary School	Coal to electricity research learning	Environmental Protection Bureau, government, coal reduction office, MaYu community, school, village committee, family	Mathematics, Language, Fine Arts, Information Technology
Elementary School Attached to University of Petroleum	Shared Bicycle Study	School, family, District Transportation Bureau	Mathematics, Fine Arts, Information Technology, Science
Shijingshan Experimental School attached to Beijing Academy of Educational Sciences	Study on Traffic Jam at School Entrance	District Transportation Bureau, Public Security Bureau, school, family,community	Science, Information Technology, Mathematics
Experimental Middle School Attached to Renmin University of China in Fengtai District	Agricultural Research	Schools, families, district governments, neighborhood committees, China Agricultural University, Academy of Agricultural Sciences	Chinese, mathematics, science, music

Applying agency-wide and problem-driven models to actively guide students to participate in green society construction has become another new challenge for educators in the new era. In recent years, students have taken the initiative to pay attention to the problems around them, carried out investigations and studies to make suggestions. The values of ecological civilization and sustainable development are gradually being developed. For example, sixth-grade students at Changshengyuan Primary School in Changping District of Beijing conducted a research on shared bicycles. In May 2015, shared bicycles were first used in Changping District of Beijing. Under the guidance of teachers, students were divided into groups to conduct researches. Through field surveys, interviews, statistics, searching information on the Internet, sorting data and drawing survey charts, the students made a survey report in which the survey results were listed. They analyzed the advantages and disadvantages of shared bicycles and made suggestions to Transportation Bureau of Changping

District. The relevant personnel in charge of the Transportation Bureau replied and accepted the students' suggestions.

3.3.4.Constant Improvement in Regional Ecological Civilization and Education for Sustainable Development

The multiple models of ecological civilization and education for sustainable development provide many channels for regional education practice. Education is an integral part of the entire regional ecosystem and must obey and serve the regional sustainable development. The “National Mid-and-Long Term Education Reform and Development Plan Outline (2010-2020)” promulgated in 2010 first mentioned the education for sustainable development. Afterwards, many districts and counties in Beijing, Shanghai, and Guangdong have successively issued policies related to education for sustainable development. Great achievements have been made in capital investment, protection mechanisms, curriculum and teaching materials, student learning methods, learning and innovation. As shown in Table 5.

As can be seen from Table 5, due to the unbalanced regional economic development in each experimental area, the funding supporting for ecological civilization and education for sustainable development varies from place to place so there are also differences in the output outcomes. The scale and structure of regional economic development decided how much education can obtain from national economic income. For instance, the GDP of Foshan District of Guangdong Province has exceeded 170 billion in 2017, of which the special input is much higher than other regions. Meanwhile it also produced more education innovation fruit, which confirms that education is the most effective mode of knowledge reproduction. Giving priority to education development is the inevitable choices for economic growth. Education will promote economic development, and economically developed regions vigorously develop circular economy, leading the construction of ecological civilization. Applying low-carbon technologies to achieve low energy consumption, low emissions, and low pollution is important guarantees for the construction of ecological civilization.

4. Reflection and Suggestion

4.1 Agency-wide participating in advancing ecological civilization education and striving to build a benign regional ecological system and study field.

Strengthen the communication between schools, governments, communities and enterprises, and improve the policy operation mechanism. Ecological civilization education should also deepen the agency-wide model, attracting more schools, teachers and students to carry out practice and researches. Drawing on the PPP

(Public-Private-Partnership) model[3], the government established and improved a comprehensive, wide-ranging, multi-level coordination mechanism between schools, governments and enterprises, enabling the three to perform in a normal and orderly manner in the collaborative process. Cooperation between governments, research institutes, international organizations, companies and NGOs is especially prominent. At the same time, a learning exchanges platform connecting domestic and foreign market will be made to build a virtuous-cycle regional sustainable development ecosystem and high-quality learning field with various measures. In this way, the coordinated development will be achieved between education for sustainable development and ecological elements related to education within the region, ensuring the promotion of ecological civilization and education for sustainable development.

Table 5: Table of Ecological Civilization and Education for Sustainable Development in Part of Experimental Zone in 2017

ESD experimental area	Regional GDP (100 million yuan) / GDP per capita (yuan)	Experimental school (number)	Regional policy support	Special funds (ten thousand yuan)	ESD Technology Innovation Awards in City (5 years)	Local ESD textbooks (sets)	Teaching-Learning Method Innovation	Project advancement
Putuo,Shanghai	973.9 /75607	60	Yes	10	25	3	Yes	Energy Saving and Emission Reduction; L'Oreal Project
Foshan,Guangdong	1750.56 /154330	40	Yes	100	30	4	Yes	Thirst; Energy Saving and Emission Reduction
Shi Jingshan, Beijing	465.6 /75611	50	Yes	40	18	3	Yes	New Energy Classroom; Retain a Bucket of Water
Haidian District,Beijing	5036.8 /144370	20	Yes	20	10	3	Yes	Energy Saving and Emission Reduction; L'Oreal Future Scientist
Tongzhou,Beijing	643 /49406	30	Yes	10	17	2	Yes	World Bank New Energy Classroom; Energy Saving and Emission Reduction
Fangshan,Beijing	593 /60026	30	Yes	50	8	1	Yes	Retain a Bucket of Water; Energy Saving and Emission Reduction
Changping,Beijing	708.6 /38221	20	Yes	10	8	1	Yes	World Bank New Energy Classroom; Energy Saving and Emission Reduction

Source: Project leader's speech material of Education for Sustainable Development Conference in District and County in 2017

4.2 Further Integrate Ecological Civilization Concepts into Green Campus Construction and Curriculum

Under the drive of the community model, project-driven model, and curriculum integration model, the concept of ecological civilization and education for sustainable development is penetrated through green campus construction. Schools must think deeply about how to formulate and implement plans for green ecological campuses, and make reasonable plans for ecological and green issues. Besides, schools need to conduct comprehensive practical activities with the theme of ecological civilization and education for sustainable development to pay attention to the issue of sustainable development around them. By conducting collaborative inquiry such as investigations and research studies, they put forward feasible suggestions, thus cultivating problem-solving ability and competency. At the same time, those schools attach great importance to the development of integrated practical curriculum and school-based textbooks about ecological civilization. With all sources of education resources and local practical problems, they guide students to carry out practical research on ecological civilization education so as to support the sustainable development of society.

4.3 Emphasis on New Media to Special Training for Teachers' Ecological Civilization

The building of teacher teams concerns the overall situation of ecological civilization and education for sustainable development. Social development puts forward higher requirements on the overall quality of teachers. Therefore, it is imperative to strengthen special training on knowledge about ecological civilization and education for sustainable development. Through training, teachers should guide students to change their learning methods so as to better implement the philosophy of ecological civilization and education for sustainable development. With new media, teacher will get a broader, faster, and more convenient learning path through online learning platforms such as official websites, WeChat, Weibo and clients. This will reduce field training costs and increase the depth and breadth of participation. As a result, teachers can lead students to better integrate inner and outer class, online and offline. Multiple implementation paths create more and effective implementation models, better promoting the practice of ecological civilization education, which will further promotes the sustainable development of society.

(This paper presents stage achievements of “studies on the implementation path of ecological civilization and education for sustainable development in primary and secondary schools" (CEJA1707) focused by the "13th Five-Year Plan" of the Beijing Municipal Educational Science Program.

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