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Master's Thesis

Exploring the Teaching Methods for Environmental Education on Garbage Classification in Elementary Schools: A Case Study in Taizhou City, China

by

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Certification Page

I, MAO YUYING (Student ID 51217004) hereby declare that the contents of this Master's Thesis / Research Report are original and true, and have not been submitted at any other university or educational institution for the award of degree or diploma. All the information derived from other published or unpublished sources has been cited and acknowledged appropriately.

YUYING MAO

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Abstract

In China, solid waste production is currently growing at a rate of at least 10% per year. This not only occupies a large amount of land but also causes serious groundwater pollution, which endangers the health of people. Although reducing waste production acts to alleviate these problems, the amount of garbage generated is unlikely to suddenly decrease in a short period of time in conjunction with improvements in living conditions and population growth. To better solve the waste management crisis, academic researchers have thus examined several different perspectives; many previous studies on solid waste management in China have been focused on policy implementation, analysis of the current situation, and methods of environmental education. This paper also focuses on the environmental education perspective, offering a complete literature review related to the current solid waste management education situation in China. The findings suggest that most of waste management education is carried out at high school and university, and thus few studies have been conducted in elementary schools. Unlike in elementary schools in other countries, environmental education in such schools in China mainly uses transformative learning, which incorporates environmental awareness and skills into different disciplines such as mathematics, language, chemistry, and music. However, according to the literature review, the use of environmentally specialised disciplines for environmental issues is more effective than traditional transformative teaching methods. The lack of detailed environmental teaching material design and reasonable teaching methods has caused Chinese students to develop a gap in the initial stages of their elementary school environmental awareness formation compared with that seen in other countries, which may lead to poor performance in garbage classification behaviours. This study thus examines the effects of an in-depth environmental education on garbage classification in the third grade of elementary school, determining which is the more effective teaching method between teacher-directed and student-centred approaches in the development of children's sorting knowledge. In addition, this paper investigates whether the implementation of teaching methods for children's sorting knowledge in third grade differs for students with different background knowledge and attitudes towards solid waste management at the beginning of such teaching practices.

A pilot was conducted in a school in Taizhou city, China, where lessons on garbage classification where conducted. The third-grade students were separated into two groups: Group 1 consisted of four classes, with a total of 184 students; these students received garbage classification lessons with various teaching methods. A questionnaire was answered before each lesson to evaluate the baseline knowledge of MSW management among elementary school students. After each garbage classification lesson, the same questionnaire was answered again to allow evaluation of the effectiveness of different teaching methods. Group 2 was the control group, and pupils in this group received no education on garbage classification; these students did take two surveys for the purpose of comparison, however. A total of 235 students from 5 classrooms were thus involved, and those who were taught experienced different teaching methods, with both teacher-directed and student-centred teaching methods used.

Questionnaire data were coded in Microsoft Excel 2010 and analysed in IBM SPSS 25.0. After checking the reliability and validity of the data, T-tests were used to compare the knowledge, behaviour, and attitude changes caused by education. Bivariate correlation analysis was used to determine the factors that may contribute to the effectivity of each teaching method. The analysis showed that better sorting knowledge is associated with a good practice in teacher-directed methods. In addition, the number of family members and previews are two factors that can influence the effect of teacher-directed methods. The teacher-directed teaching method is most effective for students with higher pre-education consciousness and background knowledge of solid waste management; where students were still in the stage of gaining environmental sensitivity, it appeared to be better to use student-centred methods. Given these results, the author suggests that due to variance the development of students' cognition, it is important to combine methods to increase students' knowledge of solid waste management in elementary schools.

Keywords:

Environmental education; Solid waste education; Elementary school; Teaching methods; Teacher-directed; Student-centred; China

Chapter 1: Introduction

1.1 Research background

Municipal solid waste (MSW) is the mixture of all solid wastes produced in cities, including food waste, construction waste, and domestic waste; it is characterised by high organic content and a tendency to decay. Improper handling can thus cause serious pollution to the surrounding environment and harm to people's health. Rapid development of urbanisation and industrialisation and improvements of living standards for urban residents, along with increased diversification of consumption patterns has caused the amount of urban rubbish in Asian countries to rise, and this continues to increase. According to the World Bank, urban areas in Asia now generate about 760,000 tonnes of MSW per day, but by 2025, this figure will increase to 1.8 million tonnes of waste per day, or 5.2 million cubic metres of waste[1].

As China is a large developing country with one-fifth of the world's population, the total amount of MSW is growing particularly rapidly there. According to the Urban Blue Book released by the Institute of Social Sciences in 2017, by the end of 2016, China's urbanisation rate had reached 57%, and the urban population was approximated at 770 million. The amount of garbage generated by these people had also increased year-on-year. Urban garbage disposal has thus become a key project of great importance to all levels of government. In 2002, according to the statistics produced by the Asian Productivity Organization (APO), the treatment rates of waste incineration, sanitary landfill, recycling, and composting in China were 56.62%, 27.93%, 15.6%, and 0.03%, respectively. In 2009, the annual domestic waste disposal capacity in China exceeded 140 million tons. The total amount of MSW sent to landfill now exceeds 6 billion tons, occupying arable land of around 500 million km², and causing a direct economic loss of 8.0 billion yuan. Over 200 large and medium-sized cities in China are also surrounded by MSW, indicating that the disposal level of urban refuse in China is low, and that there is a high risk of secondary pollution.

[1] Source: https://siteresources.worldbank.org/INTEAPREGTOPURBDEV/Resources/China-Waste-Management1.pdf

In view of the complicated composition of municipal solid waste in China, the classification and recycling of MSW become the first step that must be taken to address this issue. Since 2000, China has carried out waste classification experiments in eight cities, but the results have not been satisfactory. One of the main reasons for this is a lack of public awareness. Therefore, in light of the current trend for education for all people, the provision on multi-dimensional and multi-level environmental education has become even more important.

Taizhou is a prefecture-level city in central Jiangsu Province in eastern China, located on the north bank of the Yangtze River. Since October 25th, 2017, Taizhou city has started promoting garbage classification among its residents. This study thus takes garbage classification in Taizhou as a starting point for a discussion and investigation of how to evaluate environmental education methods in elementary school.

1.2 Research significance

In the face of its increasingly prominent environmental problems, China has proposed the establishment of a resource-saving and environment-friendly society, thus adopting a path of sustainable development. The "Twelfth Five-Year Plan" as reviewed and approved by the two sessions in 2011 clearly stated this: "In the face of increasingly strengthened resource and environmental constraints, the state must enhance crisis awareness and establish a green and low-carbon development concept. All localities should focus on energy conservation and emission reduction, improve the restraint mechanism, enhance the capacity for sustainable development, and improve the level of ecological civilization".

The problem of garbage classification is a social issue related to the sustainable development of people's livelihoods and society. At-source classification of garbage not only helps reduce waste of recyclable resources but also reduces the need for the exploitation of new resources. After sorting, resources with recycling value can be fully utilized, and the quality and volume of the remaining garbage will be reduced, thus reducing subsequent processing costs.

However, the implementation of waste classification must meet certain conditions in order to be effectively implemented, such as a well-defined legal construction, improvements in support facilities, and popularisation of national education. At present, most research on garbage classification in China is based on theory, and there are few case studies in small and medium-sized cities. In terms of achieving the desired harmonious development between man and nature, environmental education has not exerted sufficient influence, however, and only a certain minimal level of conceptual understanding of garbage classification is held by most people.

Compared with ordinary household garbage, the waste generated by a primary school environment is special, and the garbage groupings are relatively simple, making the potential recoverable value higher. At the same time, primary school students are at a critical stage of their cognitive development. Education at this stage is thus more conducive to the formation of long-term environmentally friendly behaviours in the future.

Based on the literature review, this paper therefore explores the effectivity of teaching methods in implementing garbage classification education in primary schools by evaluating the teaching effect of several methods. If the best techniques can be successfully implemented in pilot schools, schools in other regions can be improved according to their specific conditions, thus helping to promote primary school garbage classification education nationwide.

1.3 Research questions and objectives

A school's garbage classification education aims to guide students to correctly understand the importance of garbage classification, master the appropriate knowledge and methods of garbage classification in daily life, improve students' awareness of environmental protection, and cultivate students' interest in and love for nature. Through effective garbage classification education in schools, respect for the surrounding living environment can be increased, not only fundamentally improving the city's environmental sanitation and maintaining its landscapes but also reducing the

city's operating costs, including those for garbage recycling and urban cleaning management. This research thus aimed to explore the efficacy of teaching methods for environmental education with respect to garbage sorting knowledge in elementary schools.

The research questions are therefore

(1) What is the most effective way to teach students garbage classification?

(2) What are the factors that may influence students' sorting knowledge?

The initial survey on experimental environmental education was performed at an elementary school in Taizhou. The selection process first excluded those schools with the highest or lowest levels of education in the area, in order to select a more representative school as a case study. After selecting such a school, Grade 3 in this school was chosen as the focus age, and different teaching methods for garbage classification suitable for this group were identified. Three main research objectives were put in place:

1) Evaluate the present knowledge status of municipal solid waste (MSW) management among elementary school students;

2) Conduct short-term garbage classification education for a third-grade sample of school students; and

3) Evaluate the effects of different teaching methods on these students' knowledge of MSW management.

Chapter 2: Literature Review

In order to understand the current educational situation and teaching methods for garbage classification in China and other countries, a detailed literature review was undertaken, and the results are presented below. This section is divided into five sections: garbage classification methods in other countries, garbage classification methods in China, two frameworks for environmental education, a review of educational methodologies, and a brief summary.

2.1 Waste classification in other countries

2.1.1 Garbage classification laws

In Japan, garbage classification management began in earnest in the 1980s (Weixia, 2016). An environmental protection law system has been incorporated into the economic system and urban living system, which is the main reason for the success of Japan's waste classification systems (Lin-juan, 2012). According to the current social status and the characteristics of garbage problems in other periods, the Japanese government has formulated laws and regulations over time that are revised continuously to allow for improvement. In 1967 and 1971, the Basic Law for Environmental Pollution Control and the Nature Conservation Law were enacted sequentially. These were established to solve industrial pollution and to preserve the natural environment. However, the country's socioeconomic system and citizens had begun to rely on industrial mass production, mass consumption, and mass disposal, and these laws were insufficient to cope with the increases in problems relating to pollution from cities and households alongside climate change (Ivy, 2012). Hence, in order to reduce the environmental impact of purchasing goods and services, the Green Contract Law was enacted in November 2007 (Minister of the Environment of Japan, 2008). This law also stipulates the relationship between national and local outcomes and defines the responsibilities of local enterprises.

Germany is one of the most successful countries in the world in terms of MSW management. In 1972, Germany promulgated its first Waste Avoidance and Waste Management Law and started to dispose of its waste effectively (Linying, 2017). In 1991, packaging regulations began to be implemented that stipulate that producers and sellers must take the responsibility for and have an obligation to recycle the packaging

of all products. In 1996, the Law on the Control of the Circulation and Waste of Materials was promulgated; this law requires that, in addition to metals, textiles, and paper products being recycled, other recyclable materials must also re-enter the economic cycle after being collected by category. In addition, Germany has formulated a management system for garbage classification and recycling, and punishments for breaking the trash classification rules include warnings, fines, and raised fees for refuse collection (Hu, 2011).

In the United States, the Resource Conservation and Recovery Act of 1976 (RCRA) was used as the basic law underlying MSW management (Taylor, 1966) This law emphasises MSW as a kind of resource, upholding the idea of recycling to realise the closed cycle of materials, reflecting the idea of a circular economy (Shuyue, 2017). In 1980, "Resources Conservation and Recycling Law" promulgated to prevent environmental pollution, protect public health, and maximize the recovery and utilisation of waste resources.

2.1.2 Garbage classification methods

The classification of garbage in developed countries was implemented relatively early, and the implementation schemes are also very reasonable. This effectiveness and experience can thus be used to improve the implementation of garbage classification in China.

Japan, due to its small land mass and many people, cannot use landfill waste over large areas as other countries to deal with garbage. In the 1980s, the number of garbage incinerators in Japan was the highest in the world, with its incineration plants accounting for 70% of the world total. This meant that 1/3 of city solid waste was incinerated, leading to dioxin levels in the air seriously exceeding the desired maximums (Zhen-tao, 2013). Subsequently, the Japanese government has attached greater importance to the management of garbage, and with the support of a series of progressive legal systems, the whole population now actively participates in these behaviours. Based on their local situation, different regions have different classification model, but these mainly adopt five distinct categories：

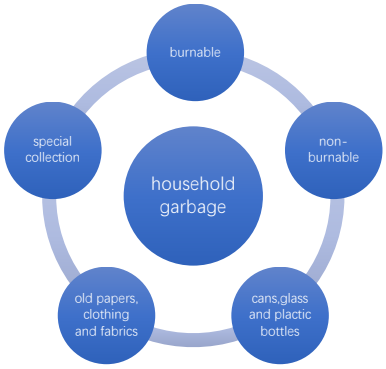

Figure. 1 Five-category garbage classification in Japan

The garbage classification system in Germany has been in place for more than a decade, and this process has become a daily habit for the population. Household garbage is divided into four categories that are collected separately in different coloured bins, yellow, grey, blue, and brown. Most regions use blue bins for paper, yellow bins for recyclables, brown/green bins for bio-waste and grey bins for residual waste (S.Mühle, 2010). Every year, local governments send out the coming year's "garbage clearance schedule" and "garbage classification instructions" to each family (Hu, 2011).

In the United States, modes of garbage classification differ between states. For example, in San Francisco, there are three main garbage bins, green, blue, and black. The green ones offer free recycling by the garbage company, while blue ones are sent to different processing enterprises, and the black ones are transported to landfill (Kemal et al., 2015). According to data published by the United States Environmental Protection Agency (USEPA), 52.6% of the total U.S. waste generated in 2014 was sent to landfill, while 34.6% was recycled or used for composting; incineration accounted for only 12.8% of the total (Shuyue, 2017).

2.1.3 Education in garbage classification

In order to promote the active participation of citizens in the classification of garbage, the government of Japan carries out systematic environmental protection and garbage classification education for all citizens. Family education also plays an important role in education on the classification of garbage and environmental protection in Japan. Kitakyushu City, for example, promotes environmental education based at the North Kyushu Museum. The local government also promotes the learning

of environmental knowledge by supporting a children's environmental club in North Kyushu City, which was established by the children of the city (Lv, 2016).

In Germany, a conference conducted by the Institute for Science Education was hosted in Munich in 1978 that proved to be a key moment in the history of environmental education. The conference noted that the responsibility of schools must be to create "environmental consciousness" and cultivate lasting environmental behaviours (Rachael et al., 1998). At the beginning of the 1990s, multidisciplinary and interdisciplinary content for environmental education was thus written directly or indirectly into the syllabuses of the middle and elementary schools in different federal states (Henry, 2017).

2.2 Waste classification in China

In 2000, in order to promote the garbage classification process in China, Beijing, Shanghai, Guangzhou, Shenzhen, Hangzhou, Nanjing, Xiamen, and Guilin were selected as pilot cities for the sorting of garbage in China. More than ten years have passed, and the effect of this pilot city classification has been very small. In 2008, the classification rates of garbage in Beijing and Shanghai were 54% and 62%, respectively, and the rates in the other six cities were lower than 10%. (Tan J, 2011)

Although the study of garbage classification in China is relatively recent, it has achieved some results. Huang (2011), Liu and Liang (2012), Su (2011), and Huang and Cui (2015) have performed research into waste classification laws, garbage classification technology, and city MSW management in developed countries such as Japan, Germany, Switzerland and the United States. Overall, they recommend that China should learn from the experience of developed countries to strengthen the construction of its garbage classification laws, formulate a scientific waste classification management system, and cultivate people's consciousness of garbage classification and garbage recycling through education. Wang and Ding (2009), Liu et al. (2012), Yang et al. (2013), and many other scholars have also discussed the unique status and problems of waste sorting in China. According to their research, most household waste is still collected using mixed recovery, and systems of enterprise

management and market-oriented operation of garbage classification have not yet been formed.

According to statistics from the Ministry of Education of the People's Republic of China, at the end of 2017, the number of elementary schools in China was 167,009, and the number of elementary school students was 100,937,000. As the output of personal garbage is estimated at 0.65 kg/d per person, the daily amount of garbage produced by elementary school students in China is 65,000,000 t/d, of which much could be reused; if this is not classified and recycled, it will thus lead to a huge waste of resources. However, at present, few elementary schools implement systematic waste sorting on campus, and despite the increasing emphasis on waste sorting in cities in recent years and the further improvement of school classification facilities, there is no follow-up school education process to help pupils develop and improve these behaviours.

Several scholars have put forward different suggestions with regard to the education aspect of the waste management problem. Hao (2009) and Chen et al. (2011) hold the view that it is important to emphasise environmental education, strengthen children's' knowledge of garbage classification, and cultivate good garbage classification behaviours among all citizens. He et al. (2012) and Li Mei et al. (2012) advocate specific Health Education. Musee et al. (2008) also note that garbage classification and recovery can prevent health damage caused by mixed collection of rubbish from humans. Wu et al. (2010) and Song Qing et al. (2015) investigated and analysed the classification knowledge and consciousness of garbage classification in colleges, suggesting improving the garbage classification and recycling management systems on campus and setting out bins more reasonably. This shows that the academic community is becoming increasingly concerned about the issue of garbage classification.

However, there is still a research gap with regard to case studies in elementary schools. At present, most elementary schools set up garbage bins in places such as teaching areas, experimental buildings, and other public activity areas. Students are then required to consciously divide their rubbish into recyclables and non-recyclables according to the markings on the bins. Environmental behaviours have multiple

attributes (Li, 2008): they are interactive and pluralistic (from the perspective of behavioural subjects); subject to differences (from the perspective of behaviour occurrence space); benefit-driven (from the perspective of behavioural motivation); and social (from the perspective of behavioural constraints). Human behaviours are also interrelated in certain circumstances, and each behaviour is affected by the surrounding environment (Gulcan et al., 2010). According to this, as a body of behaviours, students' sorting behaviours are pluralistic; some will abide by the requirements voluntarily and sort rubbish correctly, while some will not. Some students will also imitate the behaviours of others with regard to garbage classification. From the perspective of behaviour occurrence space, students will judge where they will throw away their garbage according to varying requirements on each occasion. For example, at home or in a dormitory, because of the privacy of the place and the individual nature of the behaviour, which is not supervised by others, conscientiousness may be reduced. In contrast, in public places, affected by the surrounding atmosphere, conscientiousness is likely to be improved. With regard to behavioural motivation, whether students consciously perform sorting according to the requirements is largely driven by their interests. This term does not, however, refer solely to personal interests. Taking social responsibility as the starting point, the social benefits brought by a behaviour are transformed into personal interests in other forms; however, any form of interest will promote a change in environmental behaviour. Finally, from the perspective of behavioural constraints, the social nature of environmental behaviours also affects individual behaviours. For example, if most people do not perform a certain behaviour in public, it is difficult to transform an individual’s beliefs into such active behaviour.

2.3 Two forms of teaching methods in environmental education

At present, there are two main forms of educational teaching methods used around the world (Marlyne et al., 2018): transformative learning and interdisciplinary learning.

2.3.1 Transformative Learning

According to the terminology of pedagogy, the Transformative Learning is to infiltrate the knowledge content of a certain subject into the process of other related disciplines, and through the curriculum of each subject, zero-level implementation of education will result in teaching resonance. This kind of curriculum mode is convenient for classifying the content of this subject area, so that learners can acquire corresponding knowledge, skills and emotions in the study of various subjects.

With the continuous progress of society, in the development of education, the interaction between educational disciplines and the comprehensive trend within the discipline is becoming more and more obvious. This is the educational phenomenon caused by social phenomena. The emergence of this educational phenomenon has also brought about the emergence of new thinking about cognitive activities between education and students. The model of Transformative Learning in the discipline formally forms an educational model that emerges due to the continuous development of educational phenomena.

Transformative Learning in western countries emphasizes that the "unconscious" mentality of the educated should be regarded as the beginning of the teaching process (GONG, 2006). With the continuous advancement of the teaching process, it can gradually turn into conscious. The cross-infiltration of teaching, management and social activities is an important teaching tradition in Western countries. In ancient Greece, Plato emphasized the need to form people's rational cognition through the influence of the environment, the infection of music and the cultivation of behavioural habits (DONG, 2008). At the same time, Socrates proposed that teaching should be carried out through discussion and organizational activities, which is called midwifery. In the 18th century, the French enlightenment thinker Rousseau put forward the argument of "being natural" (GONG, 2006). He called for the initiative and self-discipline of students and required teachers to respect the hobbies and interests of students and cultivate natural people who are physically and mentally healthy.

In China, Tao Xingzhi (1919) put forward the "integration of teaching". He emphasized that teaching should be combined with actual life activities, and the

knowledge outside the professional discipline should be infiltrated into the teaching process, thus subtly improving the overall quality of students. In January 2002, Zhu Muju (Deputy Director of the Department of Basic Education of the Ministry of Education) said in an interview with the magazine "Environmental Education": "Since 1992, the Ministry of Education of China has made clear regulations on environmental education in elementary and secondary schools. It is pointed out that environmental education in elementary and secondary schools in China mainly penetrates into the disciplines of ideological education, labor technology, biology, geography, history, etc. At the same time, elective courses and activity courses can also be used to offer special lectures." Afterwards, many scholars conducted in-depth research on Transformative Learning in different disciplines such as mathematics, language, chemistry, and music (HU, 2017; LI, 2011; WEI, 2015). The common characteristics of these studies is---in the classroom which mainly imparts professional knowledge, by adding some relevant unstructured knowledge, students can be guided to feel and experience through practice as well as improving their interest. However, in the implementation process, although most courses have theoretical and practical lessons, they are completely independent. In the teaching process of the theory class, the teacher often ignores the visual display of the physical object and causes the students to be unable to understand and master. This makes the practical class have no theoretical support, resulting in poor teaching effect.

2.3.2 Interdisciplinary Learning

Interdisciplinary learning first appeared in the mid-1920s; it is used to refer to knowledge creation and communication activities involving two or more disciplines without requiring a singular subject boundary (Yanxin, 2016). According to the National Academy of Sciences Interdisciplinary Research Promotion Committee, the interdisciplinary nature refers to promoting basic understanding or solving difficult problems in a single discipline or field by "integrating information, data, technology, basis, perspective, concept and theory of two or more disciplines or professional knowledge systems" (Liu, 1993). The essence of interdisciplinary work is thus to break the boundaries of disciplines and to include and expand the intersections of several respective disciplines in the natural sciences, the humanities, and social sciences, as

well as the intersections of these three types of disciplines. According to Yu et al. (2017), the theoretical core of interdisciplinary teaching lies in constructivism, with the aim being to re-construct knowledge and interdisciplinary relationships based on phenomena, themes, and projects. Disciplinary integration is one of the most important features of this teaching form, and it emphasises that the development of a curriculum should be based on multiple disciplines, establishing meaningful and valuable connections between these disciplines and using this as a link to integrate such disciplines.

In the Australian curriculum (grades 7-10), the disciplines of geography, physics, biology, and chemistry are integrated into a singular course on "natural science" (Weixue, 2017). The course stipulates that every student below high school level must go to a National Park, Nature Reserve, or similar educational centre for a minimum of two weeks of practice each year. As a result, almost all parks and nature reserves in Australia have been developed as environmental education bases, and every year, the Environmental Education Base organises a variety of environmental education practices, such as environmental awareness, waste recycling, and garbage disposal, to allow students to directly participate in environmental protection activities. Similarly, New Zealand has set up organic horticultural planting classes in elementary schools to create environments in which students can learn how to use leftovers as organic fertilizer, how to identify flowers that can be grown for vegetarian dishes, and how to prevent pests and diseases. With the help of local community protection organizations, Bramtech Elementary School in New South Wales has developed a field that allows students to observe animals and plants, collect samples, and do garbage recycling (Wen, 2009). By setting up special environmental disciplines, these countries have integrated professional knowledge of biology, physics, and other disciplines, guaranteed the practice of students throughout their education, and achieved good teaching results.

Interdisciplinary learning has also been highlighted in modern Chinese environmental education. In 2001, the Ministry of Education's "Basic Education Curriculum Reform Program (Trial)" clearly stated its goal for curriculum reform: "Set up a comprehensive curriculum to meet the needs of different regions and students' development, and to reflect the balance, comprehensiveness and selectivity of the

curriculum structure. Change the 'difficulty, complexity, bias, and oldness' of the course content and pay too much attention to the current status of book knowledge, and strengthen the connection between course content and student life as well as modern society and technological development"[2]. The implementation of interdisciplinary teaching should therefore be closely linked to these objectives to teach students the knowledge and skills that they will need in their future lives.

On February 11, 2018, the Ministry of Education and the Ministry of Environmental Protection, along with six other departments, issued the “Circular on Promoting Classified Management of Domestic Garbage in Schools”. This “Notice” pointed out that, by the end of 2020, the prevalence of classification knowledge for domestic waste in schools should reach 100%. Schools should gradually establish long-term mechanism for ecological education, including education on the classification of domestic waste. Based on the cognitive level and development of students of different ages, classification knowledge for domestic waste should be integrated into teaching materials and organically combined with the content of classroom teaching. The introduction of this policy thus highlighted the importance of setting up a special environmental education curriculum. In this paper, interdisciplinary learning is thus selected as the main teaching form for the observed educational activities

2.4 Classification of teaching methods

Teaching method refers to the teaching approaches and tools used by teachers and students to accomplish certain teaching tasks in joint activities (Guihua, 2014). Table 1 shows several different teaching methods that are wildly used in professional teaching materials for students around the world.

[2] Source: http://www.moe.gov.cn/jyb_sjzl/moe_364/moe_302/moe_309/tnull_4672.html

Table 1 Classification of teaching methods

Abroad		China	
Name	***Theory***	***Name***	***Theory***
Babansky	The Inherent Contradictions and Inspirations of teaching methods	**LI Bingde**	1. Language trasfer 2. Direct perception 3. Practical training 4. Appreciation acticities 5. Guide inquiry
Lasca	Stimulus-response ties		
Weston & Grant	The media an means of communication between teachers and students: --Teacher-directed --Interaction --Individualization of teaching content --Practice	**HUANG Fuquan**	Hierarchical teaching methods 1. Principle teaching method 2. Technical teaching method 3. Operational teaching method

Source: (Zhou et al., 2012)

Babansky, a famous Soviet educator in the 1970s, developed "The Inherent Contradictions and Inspirations of Teaching Methods" on the basis of his practical experience, and this was where he first proposed “teaching optimization”. He emphasised the subjective position of students in the teaching process and emphasised the importance of the leading role played by teachers, further demonstrating the relationship between teaching and learning in theory. He suggested that the entire teaching system was built on information factors such as people (teachers, students), conditions, and teaching processes, and that therefore, an optimal combination of teaching and learning within the teaching process could ensure the optimisation of the entire teaching process: "If we do not systematically study the characteristics and activities of students, teachers will not be able to embody teaching and educational tasks and the means of educational influence, which will lead to the formulation of classroom teaching plans and the blindness of teacher actions." In this optimisation the teaching process, both the leading role of teachers and the enthusiasm of students are emphasised, and the optimisation of teaching and learning is thus organically combined. However, this must be coordinated by the efforts of both teachers and students in order to achieve the expected higher results.

The American educator Lasca believed that the teaching method is the process by which the teacher issues, and the student accepts, learning stimulus. His teaching process, “stimulus-response connection theory”, refers to the idea that the teaching

method produces learning stimuli, which in turn stimulate the expected learning effect. In a series of studies, based on their role in achieving expected learning outcomes, learning stimuli were thus divided into four types: A, B, C, and D, which were further classified into four basic or common teaching methods: presentation, practice, discovery, and reinforcement. The discovery method is mainly realised by combining interactive teaching and “flipping” classrooms, thus strengthening the participation and initiative of students as part of the main body of teaching.

In 1986, Weston and Granton suggested that teaching methods can be seen as the medium or means of communication between teachers and students. They divided teaching methods into four categories: teacher-directed methods, interactive methods, individualised methods, and practical methods. The advantage of this classification is that it can greatly improve the effectiveness and effect of classroom teaching, as well as explaining knowledge points in a straightforward and direct way. This is not only conducive to helping students master the teaching materials and required practice comprehensively, profoundly, and accurately but also helps to give full play to the teachers' own talents. This side-by-side training can thus fully mobilise the classroom atmosphere and enhance students' concentration.

In China, the most widely used educational textbook is “Teaching Theory” written by the famous contemporary educator Li Bingde in 1991. The "seven elements” (students, goals, curriculum, methods, environment, feedback, and teachers) form the core part of this book, and the relationships between these elements are seen as mutually influential. The teaching centre is thus based on the status of the student centre, and the quality and effect of teaching are reflected within the student's responses to teaching activities. This viewpoint was also put forward in Huang Fuquan's (2010) hierarchical teaching method.

Based on the literature review, the relationship between teachers and students has always been the main focus of the teaching method field. Therefore, in terms of teaching specific subjects, this paper utilised both Teacher-directed and Student-centred teaching methods for environmental activities. Table 2 shows an overview

of these two methods. Teacher-directed means that students must put all of their focus on the teacher, undergoing Problem Based Learning to learn new knowledge, while Student-centred learning distributes students' focus with an emphasis on group work in class.

Table. 2 Comparison of Teacher-directed and Student-centred methods

	Teacher-directed	Student-centered
Definition	1.students put all of their focus on the teacher 2.work alone 3.PBL:Problem Based Learning	1.students and instructors and share the focus 2.group work
Pros	1.the classroom remains orderly 2.learn independece; make their own decisions 3.easy to grasp the point	1.learn communciative and collaborative skills 2.strengthen the students'subjective initative 3.increase interest in learning
Cons	1.lack of collaboration 2.lack of participation	1.noisy or chaotic 2.attempt to manage all students' activities at once 3.some students may miss important facts

Source: (Lerkkanen et al., 2016)

2.5 Summary of literature review

Compared with that seen in other countries, garbage classification in China began only quite recently. However, with the continuous advancement of socially sustainable development, it has received more attention as time has gone on. Waste is generally divided into four categories throughout the country: recyclables, food waste, harmful waste, and others. Some pilot cities also require recyclables to be classified into smaller subcategories. Although such a classification model helps efficiently recycle domestic garbage, its smooth implementation depends on the people making the waste, however, and due to imperfect education and popularisation work, the implementation effects of the first batch of garbage classification pilot cities in China have not been satisfactory. This makes it particularly important to seek more effective ways of popularising classification knowledge.

Analysis of the factors that promote change in environmental behaviours suggests that although elementary schools are relatively vulnerable to environmental influences and require students to consciously dispose of the garbage according to the requirements, the situational factors affecting pupils' behaviours are not systematically formed, and there are no restrictions on the environment or conditions that stimulate active behaviours. This makes it both necessary and urgent to set up systematic garbage classification education to guide students in order to form active environmental awareness and behaviour in these young people.

In China, many scholars and educators have begun to pay attention to the issue of environmental education and to introduce innovative attempts at teaching methods. However, most of studies remain at the theoretical level, which generally lacks data support and persuasive comparative studies of the effectiveness of teaching methods. Based on this, this study investigates the reality of ordinary primary schools in China. Using a quantitative research method, students in the pilot elementary school are tested with regard to their garbage classification knowledge prior to the introduction of in-depth teaching method design and attempts, and the results of this teaching assessed. This offers a means of identifying the best ways and paths to quickly improve students' sorting knowledge.

Chapter 3: Methodology

In order to determine the knowledge level of students with regard to garbage classification and thus conduct teaching experiments, this paper selected research methods based on the literature review. This chapter, which outlines these methods, is divided into six parts: study area, research design, KABP method review, hypotheses, survey practices, and data analysis methods.

3.1 Study area

On March 18, 2017, the General Office of the State Council issued the "Notice on Forwarding the Implementation Plan of the Solid Waste Classification System of the Ministry of Housing and Urban-Rural Development of the National Development and Reform Commission". This notice clearly stated that, by the end of 2020, China would establish laws, regulations, and standards related to garbage classification, and thus form a solid waste classification model that could be replicated and promoted nationally. In cities where garbage classification is mandatory, the recycling rate should therefore exceed 35%.

Taizhou is a prefecture-level city in the central Jiangsu Province in eastern China, located on the north bank of the Yangtze River. On October 25th, 2017, the Taizhou Urban Management Bureau and the Municipal Supply and Marketing Cooperatives jointly formulated the "Working Plan for the Integration and Recycling of the Recycling Resources of the Taizhou City and the Garbage Separation and Disposal System". Over the ensuing three years, Taizhou aimed to promote the development of "two networks", forming a collection and transportation system based on domestic garbage throughout the whole city. Based on community (village) collection and recycling sites, the street (township) sorting centre and the distribution market are designated to serve as carriers. In order to better implement the "Plan", on November 30th, Taizhou City held a launch ceremony for a pilot project in urban and rural solid waste classification. At the launch ceremony, the urban management department issued a garbage classification score card to residents of the pilot community with a QR code on the card that residents can use with a garbage sorting smart device. They scan the window to identify the QR code and select the "paper, plastic, metal, glass" button. The corresponding trash can lid then automatically opens so they can put the recyclable

materials in the correct bin. The lid closes automatically shortly afterwards. The system then automatically weighs the waste and calculates points. When their points total reaches a certain amount, residents can redeem these for degradable garbage bags, detergents, napkins, and other daily necessities at the community exchange point. At the end of the launch ceremony, the importance of school education was also emphasised. Environmental education is a breakthrough entry point for strengthening citizens' awareness of environmental protection and achieving the harmonious development of both people and nature.

Clearly, urban waste classification and school waste classification education in Taizhou City are in the initial stages. In particular, there are as yet no specific policy measures to promote and supervise the relevant education in schools. To select a case study for a pilot project, the current author thus ruled out the best and worst schools in Taizhou city, selecting Jingjiang New Bridge Experimental School as the chosen school. Figure 2 shows the location of the school. It is in a rural area, and it was also selected as a pilot school for the classified garbage bins scheme in Taizhou City.

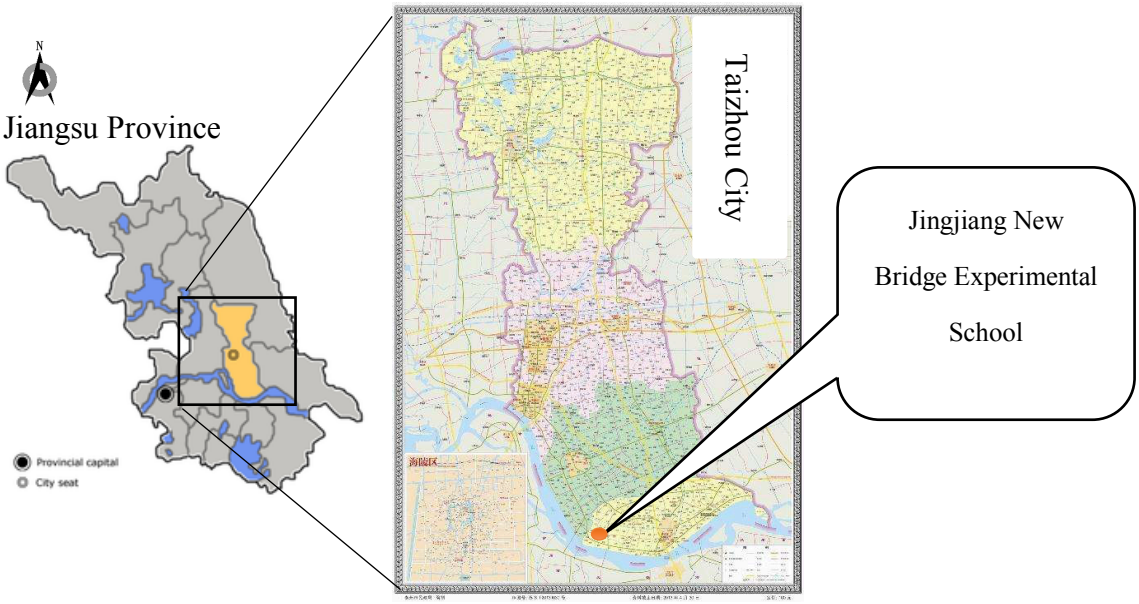

Figure. 2 The location of the pilot school (Source: Google maps)

3.2 Research design

According to Piaget's cognitive development stages (Table 3), infants are at the pre-computing stage. At this stage, they are self-centred, and their judgments are

susceptible to intuitive conditioning. After entering elementary school, students' cognitive development should have entered the stage of concrete operations. In this stage, although children's logic far exceeds that seen at the pre-computing stage, their thinking still has many limitations, and they cannot do many things without specific support. Education intervention is thus likely to be more important for elementary school students, and as students in grades 1 and 2 are still trying to adapt to their new study environment, this paper chose children in the third grade as a study focus.

Table 1. Piaget's cognitive development stages

Age Range	Description of age	Developmental Phenomena
Birth-2	Sensorimotor-Experiencing the world through senses and actions	Object permanence Stranger anxiety
2-6 years	Preoperational-Representing things with words and images	Pretend play Egocentrism Language development
7-11 years	Concrete Operational-Thinking logically about concrete events and grasping concrete analogies	Conservation Mathemetical transformation
12-adulthood	Formal Operational-Thinking about hypothetical scenarios and processing abstract thoughts	Abstract logic Potential for mature moral reasoning

Fig 3 shows the structure of the survey. The students were separated into two groups, a control group and a treatment group. Group 1 consisted of four classes, who received MSW education using different teaching methods. A questionnaire was answered by each pupil before the education began in order to evaluate the levels of pre-existing knowledge of MSW management among elementary school students. After the short-term garbage classification education was complete, the same questionnaire was answered by each pupil in order to evaluate the effects of the different teaching methods. Group 2 was the control group, who received no additional education; however, the students each took two surveys for the purposes of comparison.

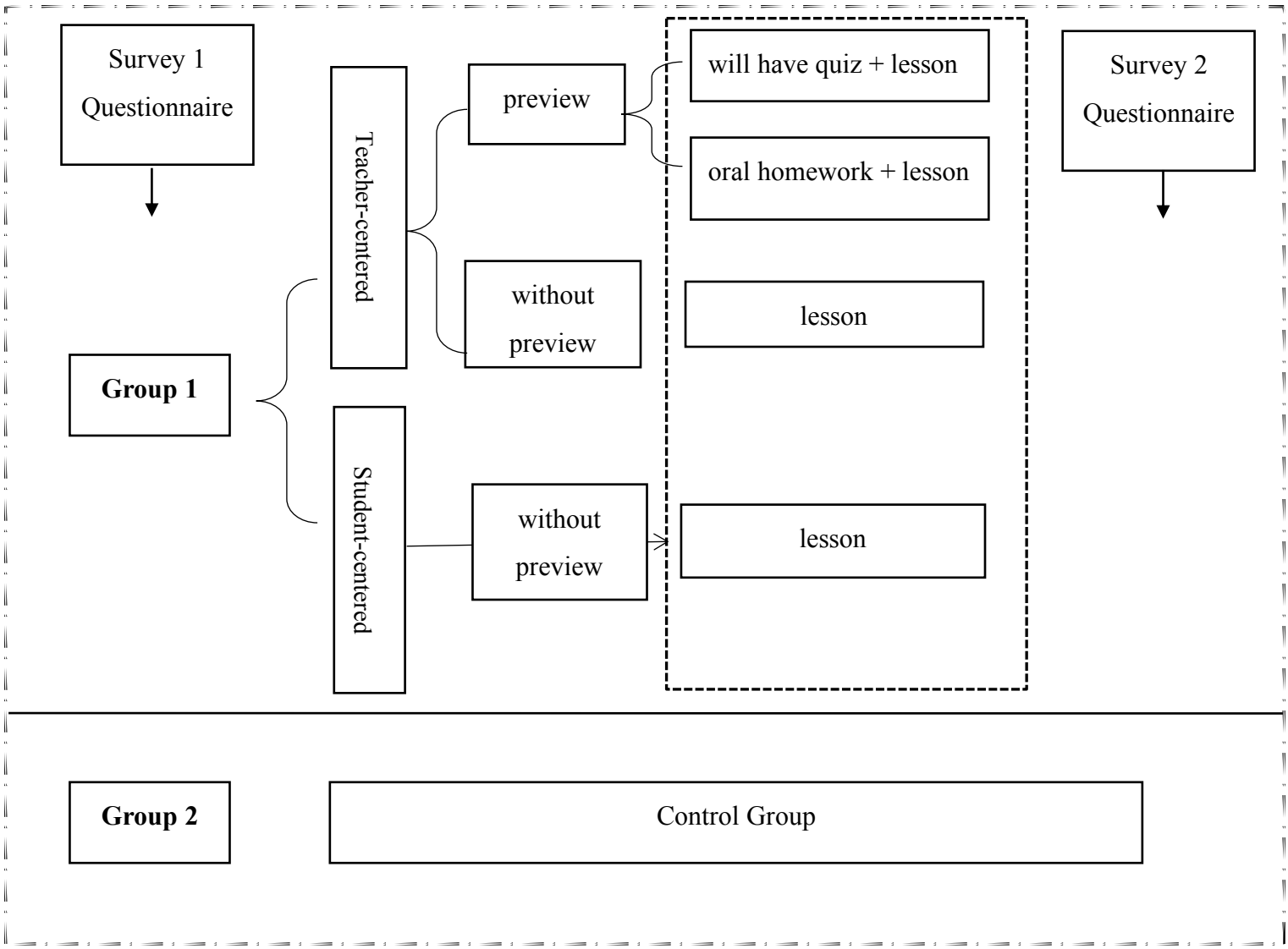

Figure 3 Survey structure

3.3 KABP (knowledge, attitude, belief, practice) mode

3.3.1 The origin of the KABP model

In 1978, Engel published "The Biopsychosocial Model and The Education of Health Professionals", which first defined the Biopsychosocial Medical Model (Gask, 2018). This model transcended the original biomedical model to link biomedical science with sociology, psychology, education, anthropology, and communication, broadening the general understanding of health education. With the continuous development of modern science, the theories and technology underlying these kinds of social humanities have also generated a large number of relevant theories and models related to education and healthy behaviours.

Theories and models primarily applied to self-education and healthy behaviour change include personal construct theory (George, 1950), sensemaking theory (Weick et al., 2005), information search patterns (Carol, 1991), the seeking behaviour model (Ellis, 1997), the theory of cognitive dissonance (Festinger, 1957), the transtheoretical model (Diclemente et al., 1983), the hierarchy of needs (Maslow, 1943), the health belief model (Roger, 1975), and the theory of reasoned action (Fishbein and Ajzen, 1975). Theories and models that are primarily applied to healthy behaviours in school and community education include social cognition theory (Max, 1912), tension and coping theory (Wertheimer, 1986), the rational model (Cleland,1987), the precede-proceed model (Lawrence et al., 1974), the comprehensive school health model (Allensworth, 1987), community mobilization (Concha, 2001), the child and adolescent trial for cardiovascular health (Sarah et al., 1994), the school health promotion model (Stone, 1990), and innovation diffusion theory (Rogers, 1962). Application of theory promoting healthy behaviours mainly through communication education strategies include behaviour change communication theory (Slater, 1999), the inter-departmental cooperation model (Nutbeam, 1997), the organization change model (Elaine, 1981), social market theory (Zaltman, 1971), and policy determinant model (Milio, 1987).

The US Centers for Disease Control has identified the four most influential behavioural intervention theories as being KABP model, Health Belief Model, Social Cognitive Theory, and Behavioural Transformation Model. These theories are thus regarded as the theoretical basis of health education for behavioural intervention (Zhen, 2004). This paper therefore used the KABP model to design the questionnaire used in the surveys.

3.3.2 KABP model framework

The KABP model divides human behavioural change into three integrated segments, knowledge, attitude, and behaviour. Knowledge and learning are the foundations of change, with beliefs and attitudes being the driving forces and generating and promoting changes that encourage healthy behaviour being the goal. This model posits that the transformation of knowledge into beliefs and attitudes can

dominate human actions. Figure 4 shows the three stages of the KABP model.

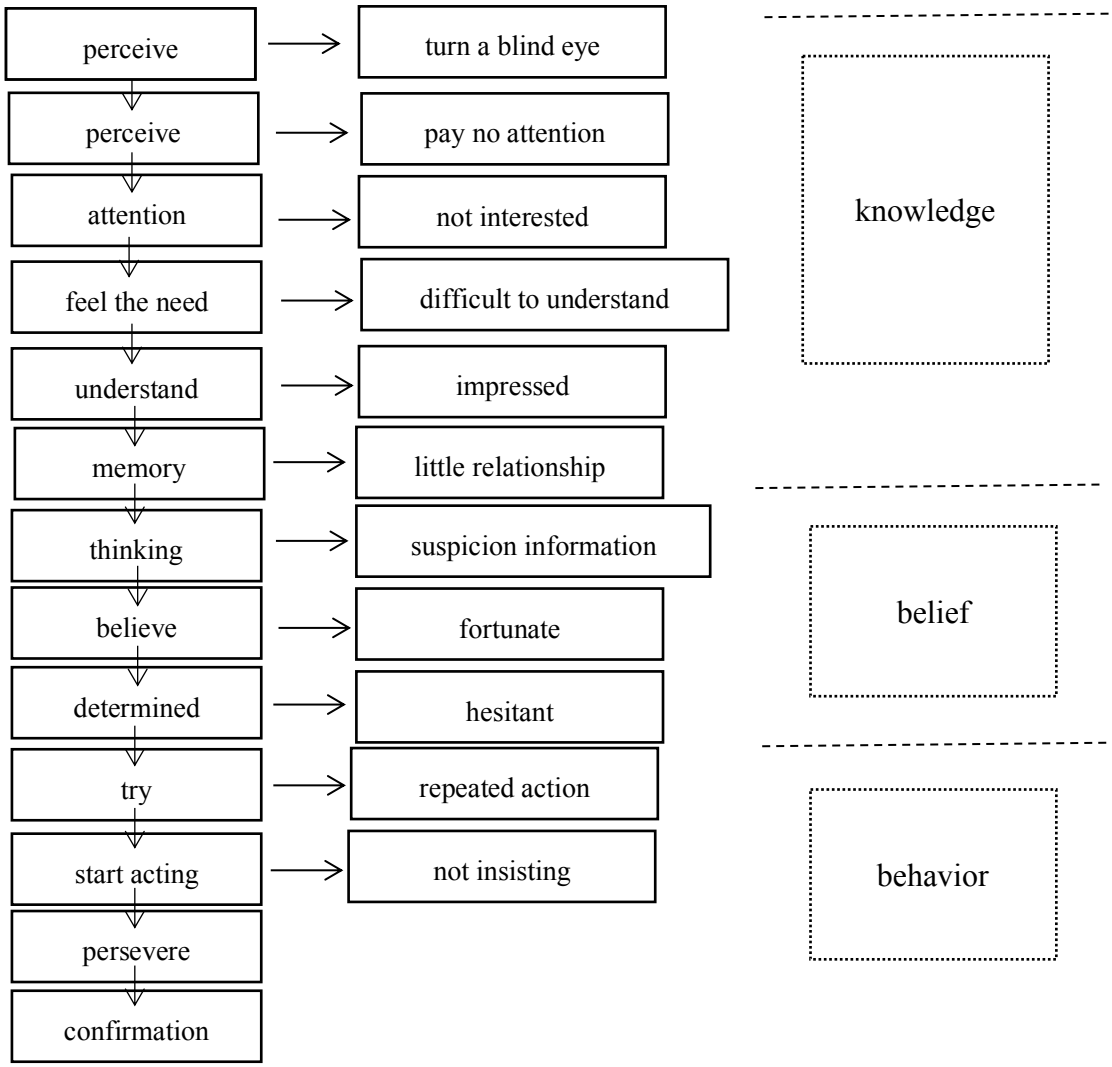

Figure. 4 Psychological Process of Knowledge, Belief, and Behaviour Change in Health Education (Source: MA Xiao, 2004)

This demonstrates that, from information acquisition to behaviour confirmation, each link is affected by external factors. In response to the influence of environmental factors on the individual, the main policies of KABP mode intervention include enhancing the authority of information and the effectiveness of communication; using examples of other recipients of information to enhance the effectiveness of information; strengthening the advertisement of behavioural change benefit expectations and effects; using social learning and practical operations to help establish healthy behaviours; using role models, rewards, and similar enticements to establish adaptive conditioning; and building healthy behaviours through reinforcement, regression, rewards, punishments, and behaviour shaping (Huang, 2006).

3.3.3 The application of the KABP model in this paper

In theoretical and practical research aimed at developing comprehensive interventions, researchers generally design a simplified general model framework by integrating multiple theories. This study attempts to affect students' knowledge of, attitudes to, and consciousness of garbage classification by means of educational intervention. The KABP model was thus chosen as the theoretical basis for questionnaire design because of the following aspects:

- Inclusion and practicability

The three-stage "knowing letter mode" has several unsatisfactory factors. For example, its theoretical description is too macroscopic, with each variable's operational definition being vague, and it lacks homogeneity. The structural boundaries between different stages are also very loose. These defects have led to many differences among scholars in terms of theoretical exploration. However, this intervention model, which is not strictly normative, has been at the forefront of behavioural health education for more than a decade of practical testing, indicating that this model is powerfully inclusive and practical.

- Aligned with student's traditional thinking modes

Western thinking modes are dominated by rational thinking, and the concept of judgment and reasoning is used to reflect reality and reveal the essence of things. In contrast, in China, the mainstream thinking mode for primary school students is image thinking. This group's cognition of concepts and things is thus relatively vague, and they are more satisfied with summarisations of experience and more general descriptions of things (Chu, 2011). The KABP model has been widely used and is recognised for achieving specific behavioural interventions in people with a variety of different characteristics; it can thus be used for evaluating the changes in these students before and after education.

3.3.4 Questionnaire design

In order to ascertain the initial knowledge status with regard to MSW management among elementary school students, this paper used the sample survey method and randomly selected four classes in the third grade for the distribution of questionnaires for on-the-spot testing. This paper used the KABP model to design the questionnaires (see appendix).

The main contents of the questionnaire covered

1) Basic demographic information such as gender, age, and grade
2) Thoughts about MSW and level of garbage classification knowledge
3) Evaluation of attitudes towards waste separation
4) Comments and suggestions on garbage classification and participation
5) Representative items for garbage classification

3.4 Hypotheses

The purpose of developing a new curriculum is to change students' ways of learning and to alter the mode used to train students. The key to achieving this goal is making changes to teachers and classroom. In this kind of environment, a common phenomenon in schools is for teachers to ask for extra hours, emphasising that additional teaching content cannot be completed in the same amount of time. One of the most important ways to solve this contradiction is to improve the effects of teaching. Teaching activity is a complex activity composed of many steps. Therefore, many factors, such as the quality of lesson preparation, teaching organisation, placement of and feedback on homework, and the relationship between teachers and students, affect teaching quality. This study focused on two teaching methods, teacher-directed and student-centred, as well as evaluating the impacts of learning purpose, review, and preview in classroom teaching. The working hypotheses were

(1) Students are more likely to absorb knowledge where there is a clear learning goal.

(2) The effect of teacher-centred learning is greater for sociological subjects such as environmental education.

Teacher-directed practices were also expected to contribute more to those students with pre-existing higher awareness of garbage classification.

3.5 Survey practices

Practice for Survey 1

The aim of this survey was to evaluate the knowledge of students with regard to solid waste management before any education activities commenced. To achieve this, survey 1 was taken by all students in the third grade. The questionnaire was distributed to all classes on the same day and the students answered these individually before they were all collected at the end of the day.

Practice for Survey 2

Each short-term environmental education activity provided opportunities for some students in group 1 to learn how to perform household garbage classification. After each education session, survey 2 was distributed immediately to be completed by the students.

Fig 5 shows the teaching progress for each method.

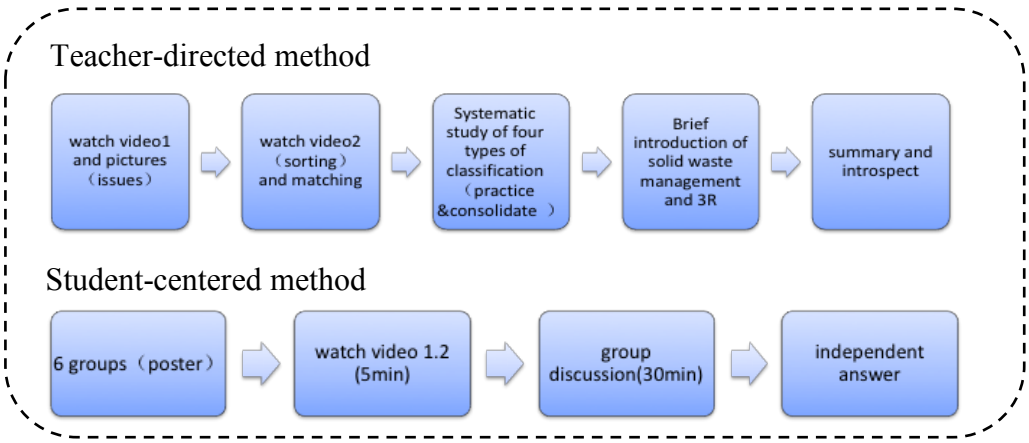

Figure. 5 Teaching progress for two teaching methods

In the teacher-directed method, the main factor that was amended was the preview before the class. The relationship between the preview and the effect on learning was

also be influenced by extraneous variables, which might be thought of as moderator variable. The main moderator here was considered to be whether students had a clear learning purpose. Thus, one class was told before class that there would be a quiz after the session, while another class had only a brief oral homework to let students collect related knowledge. In the same way, in the non-preview group, the review acted as the moderator variable. Video1, which featured environmental pollution problems and was intended to raise their awareness about the importance of garbage classification was shown prior to vidio2, which showed the process of garbage classification and used the PBL method to introduce four different types of classification. A brief introduction to solid waste management and the 3Rs was also given to students at the end of their environmental education.

In the student-centred method, the students were divided into six groups and shown the same videos as used in the teacher-directed method's classes. The main difference was that each group was then asked to solve a set of problems together. During their discussions, the facilitator moved between groups offering suggestions. After 20 minutes' work, two groups were selected to present their results. After that, the whole class was encouraged to generate conclusions together before the correct answers for each question were provided.

3.6 Data analysis methods

3.6.1 Reliability and validity of the questionnaire

Reliability refers to the stability and consistency of survey results. Reliability also reflects the degree of variation caused by measurement errors. This study thus used internal consistency and reliability tests to evaluate the survey scale. Cronbach's α is not only the main method used for internal consistency reliability evaluation but also the most commonly used reliability coefficient test. When the calculated $\alpha>0.70$, the internal consistency is deemed to be good; when the α is between0.35 and 0.70, the internal consistency is medium; when the $\alpha<0.35$, the internal consistency is poor. This study thus conducted an internal consistency assessment of waste classification knowledge, attitudes, and actions.

Validity is used to reflect the accuracy of the variables in a given scale. It is used to measure the ability of the measurement indicators or observations to reflect the authentic information about the measured object. This study used structural validity tests to evaluate the survey scale, a process usually carried out by factor analysis using multivariate statistical methods. The KMO value and Bartlett spherical test were used to check whether the data met the appropriate factor analysis conditions: factor analysis can be performed when KMO > 0.5 and Bartlett < 0.05.

3.6.2 Student's t test

A t-test is any statistical hypothesis test in which the test statistic follows the Student's t-distribution under the null hypothesis. This uses T distribution theory to deduce the probability of a given difference to determine whether the difference between two means is significant. This method was used on survey 2 to evaluate the differences in knowledge, behaviour, and attitude changes generated by different teaching methods.

3.6.3 Bivariate correlation analysis

Bivariate correlation analysis refers to the analysis of two or more variables to measure the closeness of any correlation between those variables (Gao et al., 2012). Unlike studies that reveal and determine the causal relationship between a variable (or set of variables) and another variable, a correlation study discusses the relationship between variables in terms of the consistency of change between the variables. This method is often used as a prelude to further experimental study and can be used to represent related concepts and constructions in the fields of cognition, attitudes, or behaviours (Wang et al., 2016).

There are three main types of data analysis used for bivariate correlation analysis: the Pearson coefficient, the Spearman coefficient, and the Kendall coefficient. This paper aims to examine the impact of changes in attitude and behaviours on knowledge, and as all variables are continuous, the Pearson analysis method is the most applicable. The boundaries for this correlation coefficient are 0.8 to 1.0 for very strong correlations;

0.6 to 0.8 for strong correlations; 0.4 to 0.6 for moderate correlation; 0.2 to 0.4 for weak correlations; and 0.0 to 0.2 for weak or absent correlations.

Chapter 4: Results

In this research, the designed questionnaire was used to conduct two surveys bracketing various teaching activities. The survey process and the results for the environmental education provided are thus outlined below. The results addressing the main research questions are also reported in this chapter. The hypotheses addressed were (1) Students are more likely to absorb knowledge where there is a clear learning goal; (2) Teacher-directed practices will contribute more to those students who have higher pre-existing consciousness of garbage classification; and (3) The effect of teacher-centred practice is better for sociological subjects such as environmental education.

4.1 Basic information

Survey 1 included distributing a total of 235 questionnaires; 224 valid complete questionnaires, were received back, giving an effective rate of 95.32%. Survey 2 also involved distributing a total of 235 questionnaires; 226 valid questionnaires were then received, with an effective rate of 96.17%. A total of 450 valid questionnaires were collected throughout the process, giving an average effective rate of 95.75%.

There were 140 boys in the survey population, accounting for 62.5% of the total, with the 84 girls accounting for 37.5%. In terms of geographic origin, 70 students were from urban built-up areas, accounting for 31.25%, while 154 rural area students accounted for 68.75% of respondents. The number of only children was 74, accounting for 33.04%, with the number of non-only children being 150, accounting for 66.96%. The highest education level of 186 sets of parents was lower than high school level, accounting for 83.09%, while 38 parents had high school education or above, accounting for 16.91%. There were 19 students with low levels of family financial status, accounting for 8.48%; 152 were at the middle level, accounting for 67.86%; and 53 were at the upper-middle level, accounting for 23.66%. Table 4 offers further details on these figures.

Table 2 Basic information on students

Charecteristics of students	Number of students	Rate
Gender		
boys	140	62.50%
girls	84	37.50%
Growth environment		
urban built-up area	70	31.25%
Rural area	154	68.75%
Number of children in the family		
only children	74	33.04%
non-only children	150	66.69%
Highest education level for parents		
primary	61	27.23%
junior high school	49	21.88%
high school	76	33.93%
≥undergraduate	38	16.91%
Economic conditions		
low	19	8.48%
middle	152	67.86%
upper-middle	53	23.66%

4.2 Reliability and validity analysis

Evaluating the internal consistency and reliability of the 450 valid questionnaires received for survey 1 and survey 2, the Cronbach' α coefficients of students' recognition of garbage classification, attitudes, and actions are 0.35, 0.54, and 0.59 respectively. The structural validity of the 450 valid questionnaires was evaluated in several ways, and the scores were KMO = 0.575 and, for Bartlett's test of sphericity, $X^2 = 242.012$, P = 0.000, making them suitable for factor analysis.

4.3 Correlations between students' internal differences and sorting knowledge

In order to evaluate the underlying status of MSW management among students, survey 1 was conducted before any environmental education was undertaken. This was part of developing an explanation for the factors that can influence students' sorting knowledge. The results identified correlations between students' internal differences and sorting knowledge. More than half of the 225 students surveyed were boys at 62.50%, while 68.75% of students have grown up in rural areas. In addition, 66.69% of

students have one or more siblings, and 83.09% of their parents have not received higher education.

After analysis of variance, the results showed that only children had a higher knowledge levels with regard to garbage classification than non-only children (P=0.032). The remaining basic characteristics, gender, growth environment, parent's highest level of culture, were not related to students' knowledge scores. Table 5 shows a comparison of scores on garbage classification knowledge among students with different characteristics.

Table 3 Comparison of scores on garbage classification knowledge among students with different characteristics

Charecteristics of students	Number of students	Average knowledge score	P value
Gender			0.324
boys	140	38.97	
girls	84	38.22	
Growth environment			0.438
urban built-up area	70	38.2	
Rural area	154	38.38	
Number of children in the family			0.032
only children	74	38.41	
non-only children	150	38.23	
Highest education level for parents			0.067
primary	61	38.37	
junior high school	49	38.16	
high school	76	38.32	
≥undergraduate	38	35	
Economic conditions			0.723
low	19	38.13	
middle	152	38.16	
upper-middle	53	38.27	

4.4 The effect of teaching practices on garbage classification development

4.4.1 Correlations between teaching methods and sorting knowledge development

There were 74 questions about garbage classification in the knowledge section of each questionnaire; each question had a single correct answer, and respondents were awarded 1 point for the correct answer and 0 points for the wrong answer, with the

potential highest total score thus being 74 points. The average score of students in survey 1 was 32.35 points. Table 6 shows the change in sorting knowledge between survey 1 and survey 2. It is obvious that where a clear testing goal was defined before class, the effect of teaching sorting knowledge by teacher-directed methods was much higher than that produced by other methods. The average scores rose to 63.70%, 24.89% higher than before teaching. It can be seen from the table that the scores for garbage classification knowledge for all four classes increased, and that this change has statistical significance (P<0.01), which suggests it was caused by the education. The accuracy of classes who were offered a preview before the education was also higher than for those without such a preview. The accuracy in the control group also increased, by 4.09%; however, this change was not statistically significant (P=0.36).

Table 4. Student knowledge change with regard to garbage classification

Teaching Methods	**Teaching process**		**Class NO.**	**Accuracy rate for sorting**		**P value**
				Survey 1	***Survey 2***	
Teacher-directed	Preview	quiz after class	1	38.81%	63.70%	0.007
		oral homework	2	43.48%	56.68%	3.8*10^-8
	non-preview		3	38.22%	49.00%	0.002
Student-centered	non-preview		4	48.93%	59.59%	1.02*10^-6
Control Group			5	31.73%	35.82%	0.36

4.4.2 Sorting knowledge before and after education

This section gives a detailed explanation of students' changes in sorting knowledge after education.

For survey 1, 224 valid questionnaires were received; thus, if 112 or more students answered a question correctly, the "correct rate" for that question was considered to be higher. In total, only 25 questions had higher rates, and of these 12 were concerned with hazardous waste categories, accounting for 48%. A further 10 questions in this group referred to recyclable waste, and none concerned other waste types.

Table 5. Questions with a higher "correct rate" in survey 1

	Recycable	Harmful	Kitchen	Other	Total
Number of questions	10	12	3	0	25
Rate	40.00%	48.00%	12.00%	0.00%	100%

Based on the "correct rate", the top ten bottom ten questions were identified. This showed that questions regarding expired medicines and organic pesticides were answered correctly by 199 and 176 students, ranking first and second. Among the top ten most correct questions, eight refer to harmful garbage, and the remaining two are about recyclable garbage. The lowest "correct rate" referred to contaminated plastic bags, as only 12 students knew that these belong in "other garbage". In general, the majority of the lower accuracy rates refer to other waste and recyclable waste composed of complex materials.

Table 6. The top and bottom "correct" questions for survey 1

	Waste	Correct Number	Recycable	Harmful	Kitchen	Other
Top ten						
	Expired drugs	199		☑		
	Organic pesticides	176		☑		
	Waste mobile phone charger	172		☑		
	Expired cosmetics	163		☑		
	Wastewater Silver Thermometer	160		☑		
	Waste fluorescent lamps	158		☑		
	Waste carton	157	☑			
	Waste paint	152		☑		
	Correction fluid bottle	152		☑		
	Waste book	148	☑			
Bottom ten						
	Plastic cling film	36	☑			
	Big stick	34				☑
	Weeds in the garden	33			☑	
	Waste televisions	27				☑
	Waste washing machines	27				☑
	Branches and leaves	23			☑	
	Control part of electric blanket	21	☑			
	Broken mirrors	21	☑			
	Cigarette butts	19				☑
	Contaminated plastic bags	12				☑

For survey 2, 226 valid questionnaires were received; thus, where 113 or more students answered a question correctly, the "correct rate" for that question was considered to be higher. Survey 2 displayed total of 46 questions with higher rates, almost twice the number seen in survey 1. As seen in Table 9, knowledge about

recyclable garbage was higher than for other categories, while hazardous waste ranks second.

Table 7. Questions with a higher "correct rate" in survey 2

	Recycable	Harmful	Kitchen	Other	Total
Number of questions	25	15	4	2	46
Rate	54.35%	32.61%	8.70%	4.35%	100%

After analysing the "correct rate" for each question, Table 8 lists the top ten and bottom ten questions for survey 2. Expired medicines still rank first, yet among the top ten questions, seven refer to recyclable garbage, suggesting that students' knowledge of recyclable garbage has been greatly improved. Seven of the bottom ten topics in the ranking belong to other garbage, most of which feature complex materials, such as flower pots, discarded sofas, used ball supplies, and helmets. Students tend to erroneously classify such items as recyclables; Table 10 provides more details.

Table 8. The top and bottom ten questions for survey 2

	Waste	Correct Number	Recycable	Harmful	Kitchen	Other
Top ten						
	Expired drugs	208		☑		
	Melon husk	172			☑	
	Waste carton	165	☑			
	Plastic hangers	162	☑			
	Organic pesticides	161		☑		
	Used books	161	☑			
	Old newspaper sundries	160	☑			
	Old towels, blankets	159	☑			
	Abandoned tablecloth	159	☑			
	Waste mobile phone charger	158	☑			
Bottom ten						
	Flower pot	81				☑
	Abandoned sofa	80				☑
	Nutshell	78				☑
	Cosmetic glass bottles	77	☑			
	Used ball supplies	73				☑
	Cigarette butts	56				☑
	Plastic cling film	48	☑			
	Contaminated plastic bags	44				☑
	Hard hat	44				☑
	Waste glass eye drops bottle	43	☑			

The "correct rate" of 62 questions increased, while the "correct rate" of 12 questions decreased. Nine of the top ten ranking questions are concerned with recyclables. This is likely to be because, in the process of garbage education, the focus was on recyclable garbage and this was repeatedly taught and practiced in the classroom. The largest improvement was in the question about the control device in an electric blanket, which went from 21 people being correct to 128 people, an increase of 107 people. In those questions with reduced accuracy, flower pots, hard hats, and used ball featured significantly, and these belong to the other garbage category. These three questions had a low correct rate both before and after education, however. For several other questions, although the correct rate technically decreased, over half of the students still answered correctly.

Table 9 Garbage classification knowledge before and after education

Waste	Survey 1	Survey 2	Increased numbers	Recycable	Harmful	Kitchen	Other
Top ten of correct rate increase							
Control section in the electric blanket	21	128	107	☑			
Iron Kitchenware	51	134	83	☑			
Branches and leaves	23	103	80			☑	
Metal tableware	64	138	74	☑			
Glass cans of juice	49	123	74	☑			
Broken mirror	21	95	74	☑			
Thermos bottle	50	121	71	☑			
Glass jars for sauces	49	118	69	☑			
Ballpoint pen set	93	150	57	☑			
CD (CD, DVD)	57	113	56	☑			
The questions with decreased correct-rate							
Flower pot	83	81	-2				☑
Hard hat	47	44	-3				☑
Carpet	139	135	-4	☑			
Wastewater Silver Thermometer	160	151	-9		☑		
Waste mobile phone charger	172	158	-14		☑		
Organic pesticides	176	161	-15		☑		☑
Abandoned weeding containers	118	103	-15		☑		
Edible oil	140	123	-17			☑	
Waste fluorescent lamps	158	140	-18	☑			
expired cosmetics	163	143	-20		☑		
Disposable syringe	143	120	-23		☑		
Used ball supplies	96	73	-23				☑

4.4.3 Teacher-directed teaching method and outcomes

This section provides an in-depth analysis of students' attitudes and behaviour changes after experiencing the teacher-directed method. There were 138 students who participated in this teaching method, and in the attitude section of the waste sorting survey, when asked about the classification of waste, 65% of students in survey 1 thought that it was a citizen's duty, 23% of students thought it was the responsibility of

the environmental protection department, and only 7% of students thought that waste classification was too troublesome. After the educational activities, in survey 2, 75% of the students saw waste sorting as the duty of citizens, 17% of students considered it to be the responsibility of the environmental protection department, and the remaining 8% considered classification to be too cumbersome. A T test was used to compare attitude changes towards garbage classification in the two surveys. The results were not statistically significant (P=0.887), however, indicating that the students' views on waste classification were not substantially changed, as shown in Fig 6.

When asked about the purpose of waste sorting, 33.1% of students in survey 1 thought that it reduced environmental pollution, 15.2% thought it turned waste into treasure, 17.4% thought it improved the living environment of residents, and 25.8% thought it improved citizens' environmental awareness. In addition, 3.4% thought it reduced the body's absorption of toxic substances, and 2.8% thought it reduced the area occupied by garbage. After receiving environmental education, 36.5% thought that it reduced environmental pollution, 25.3% identified it as turning waste into treasure, 18.0% thought it improved the living environment of residents, and 15.7% believed it raised citizens' awareness of environmental protection. The T-test indicated no statistical significance for changes in this question (P=0.895), however, indicating that students did not change their attitudes about the purpose of garbage classification after education, as shown in Fig 7.

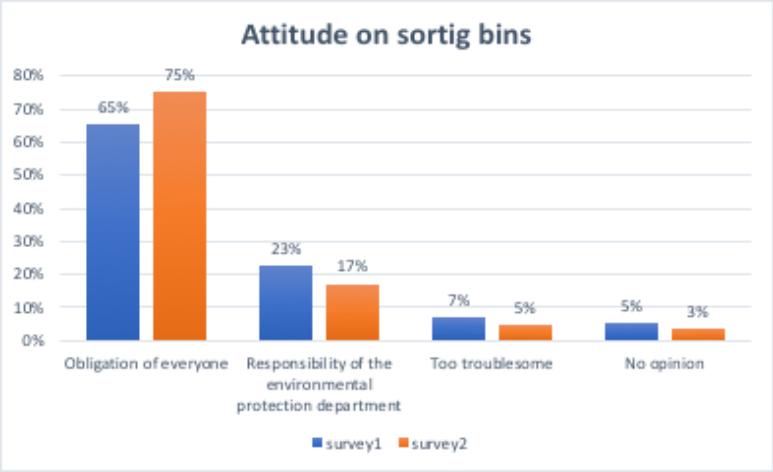

Figure 1. Attitudes to sorting bins

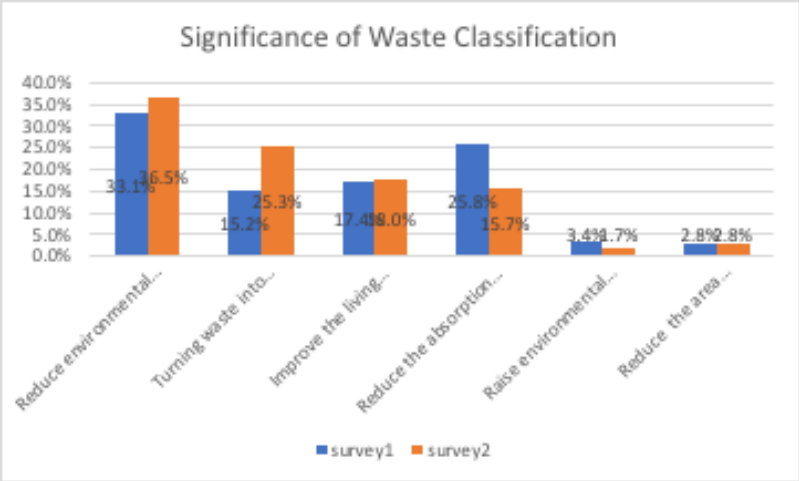

Figure 2. Significance of Waste Classification

Bivariate correlation analysis was then used to examine the effect of students' basic demographics on increases in their sorting knowledge. Table 12 shows the descriptive statistics and correlations for students' attitudes, behaviours, and sorting knowledge in third grade. According to the results, the extent to which students support garbage classification is highly correlated with their sorting knowledge. Garbage classification concern, satisfaction with others' garbage classification, and father's occupation also contribute to the growth of sorting knowledge. After education, the group of students who performed best were those who already had a basic consciousness and background knowledge of solid waste management.

Table 10. Descriptive statistics and correlations for students' attitudes, behaviours, and sorting knowledge

Variable	Accuracy rate for sorting knowledge		
	Pearson Correlation	Sig.(2-tailed)	N
agree garbage classifation or not	-.176**	0.005	255
satisfaction with surrounding garbage classification	-.124*	0.049	0.091
garbage classification concern	-.132*	0.036	254
father's occupation	.177*	0.047	126

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

4.4.4 Student-centred teaching method and outcomes

This section analyses the outcomes of students' attitude and behaviour changes on using student-centred methods. Overall, 92 students participated in this teaching method. When asked about their attitudes towards waste sorting in survey 1, 71% of

these students thought that it was a duty of citizens, 23% of students thought it was the responsibility of the environmental protection department, and the rest thought that waste classification was too troublesome. After experiencing student-centred methods, 84% of the students saw waste sorting as the duty of citizens, 10% considered it to be the responsibility of the environmental protection department, and 6% of students still considered classification to be too cumbersome. A T test was used to compare the attitude changes towards garbage classification between the two surveys, and the results were not statistically significant (P=0.787), indicating that, as with the teacher-directed method, the students' views on waste classification were not changed; Fig 8 shows this in detail.

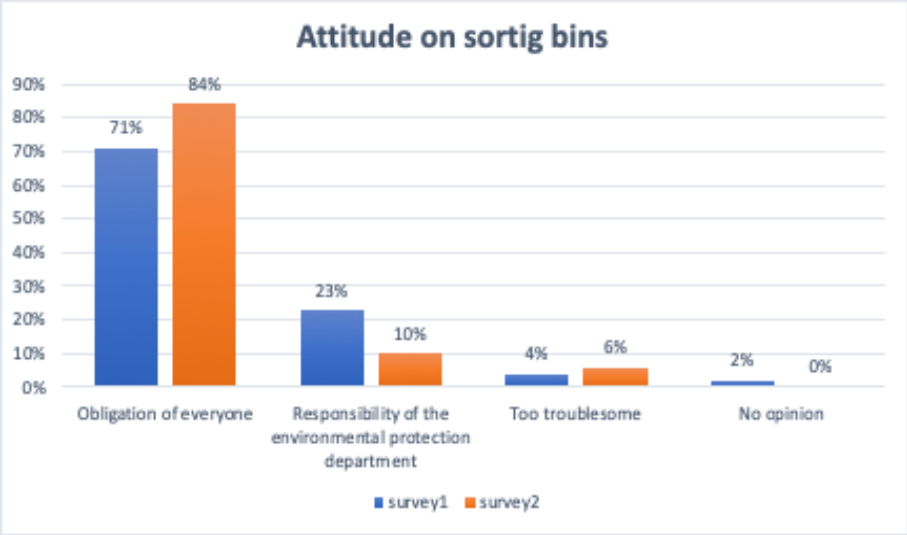

Figure 3.Attitudes to sorting bins

In survey 1, when these students were asked what they would do if there was garbage on the street and there were no trash cans around, 25.7% chose to find the correct trash can and then place it appropriately, while 68.3% chose to it in any garbage bin available, with no consciousness of participating in classification. When further asked if, given the presence of a garbage bin with a clear classification mark in the immediate environment, they would be willing to put a piece of rubbish in the correct garbage bin, 94.6% were willing, with only 5.4% thinking it did not matter, indicating that most students are willing to participate and actively cooperate with garbage classification where this is facilitated by the environment. When asked if they would continue to place a piece of rubbish in its correct bin if there was already mixed garbage in the classified bins, 75.9% of the respondents chose to categorise their addition. In

terms of persuading or stopping the behaviours of people who mis-sort in their daily lives, only 27.9% of students chose to always advise others, while 12.5% chose to never to advise or stop others. These students have requirements for their own behaviours, but they lack the impetus to provide active discouragement to people around them when observing worse behaviours. Table 13 shows the change in students' participation in garbage classification before and after environmental education. The P values show no statistical significance to any changes, suggesting that students did not change their related behaviours with regard to garbage classification after education.

Table 13. Students' participation in garbage classification

Garbage classification related behavior	Survey 1	Survey 2	P Value
Whether to do garbage classification in daily life			0.465
always	66	94	
seldom	82	69	
never	20	9	
happen to have gabage to drop			0.241
find bin	43	49	
find correct bin	114	118	
randomly throw	20	7	
garbage bin with a clear classification mark			0.422
willing	126	152	
unwilling	9	4	
does not matter	33	20	
already mixed garbage			0.148
will	123	126	
will not	39	48	
persuade or stop the behavior of people who mis-sorting			0.349
always	61	81	
seldom	84	78	
never	16	13	

Based on bivariate correlation analysis, Table 14 shows the descriptive statistics and correlations for students' attitudes, behaviours, and sorting knowledge for student-centred teaching methods. According to the results, only the depth of concern for environmental pollution has a high level of correlation with sorting knowledge. Unlike those experiencing the teacher-directed method, students' attitudes towards garbage classification did not contribute to growth of sorting knowledge in this group. It can be seen that, after education, this group has increased sensitivity of solid waste management, but students' understanding of garbage classification knowledge is less

in-depth, and the "correct rate" for the problems is lower than that seen after the teacher-centred method.

Table 14. Descriptive statistics and correlations for students' attitudes, behaviours, and sorting knowledge (Student-centred method)

Variable	Accuracy rate for sorting knowledge		
	Pearson Correlation	Sig.(2-tailed)	N
how deep they concern for environmental pollution	.280**	0.007	91

**. *Correlation is significant at the 0.01 level (2-tailed).*

*. *Correlation is significant at the 0.05 level (2-tailed).*

Chapter 5: Conclusions and discussion

This chapter lays out conclusions drawn from analysis of the questionnaire surveys and summarises the problems reflected in outcomes, reflecting on the challenges ahead.

5.1 Conclusions

5.1.1 Sorting knowledge analysis

Students have the highest levels of recognition for hazardous waste. Among the 24 questions with high accuracy, 48% were in the harmful waste category. For other waste with special materials, such as big sticks, large electrical appliances, and cigarette butts, students have low levels of sorting identification. After the education activities, the students' garbage classification knowledge was greatly improved. Survey 2 resulted in a total of 46 questions with a higher "correct rate", almost twice that in survey 1. Among these, 54.35% referred to recyclable garbage, accounting for the largest proportion. Students' awareness of other garbage was still not greatly improved, however, with flower pots, hard hats, and cigarette butts are remaining subject to lower accuracy. In addition, students have no clear concept of something being "contaminated", with 80.53% of students still classifying contaminated plastic bags as recyclable waste.

5.1.2 Assessment of and attitudes towards garbage classification

According to the research results, most students have a good understanding of the meaning and importance of garbage classification. However, students' satisfaction with the status quo and treatment status of garbage classification was not very high, with the proportion of those expressing dissatisfaction reaching 56.8%, indicating that the implementation status of garbage classification in school is poor. The government should thus vigorously support the construction of waste sorting facilities and guide residents in developing proper waste sorting and distribution.

Most students believe that garbage classification is a duty that citizens should fulfil, indicating that elementary school students have a broad base of garbage classification awareness and the correct attitudes. However, a few people have cognitive misunderstandings and think that garbage classification is a matter for the environmental protection department or that daily garbage classification is too much trouble. In response this, the school should focus on publicity and education,

comprehensively developing the garbage classification management system on campus, and implementing supervision within the system to enhance students' environmental awareness.

Both before and after educational activities, students believe that the most meaningful reason for waste sorting is to reduce environmental pollution, with 34.8% choosing this response. In survey 1, the ranking for other reasons was reduce the absorption of toxic substances > improve the living environment > turn waste into treasure > raise environmental awareness > reduce the area occupied by garbage, while in survey 2, the ranking changed to turning waste into treasure > improve the living environment > reduce the absorption of toxic substances > reduce the area occupied by garbage > raise environmental awareness. This change may be due to the introduction of solid waste management and 3R during education, which included resources on ways of recycling and issues with littering.

5.1.3 Behaviours related to garbage classification

This research showed that students are positive and optimistic about participation in waste sorting, which played an important role in promoting the subsequent education process.

On average, 35% of students want to sort but rarely find suitable trash cans, which indicates a serious shortage of classified bins in the area. Schools should supplement the equipment for sorting in all parts of campus, encouraging more students to adopt waste sorting. During the investigation, 21.3% chose to place items in the garbage bin except where they were recyclable, indicating that this section of the students already had elementary awareness of and behaviours supporting waste recycling; further guidance is expected for them to refine their classifications. Only 1.7% initially chose to turn waste into treasure and re-use it creatively; this proportion rose to 3.8% after the educational activities. In class meetings and school-level activities, students should be strongly encouraged to share stories about using garbage resources to guide other students to learn from them.

5.1.4 The effectiveness of the two teaching methods

This paper discusses the current knowledge situation with regard to environmental behaviours among students as well as examining the effects of in-depth environmental education on garbage classification in an elementary school in Taizhou city. The results show that most students have some environmental sensitivity with regard to solid waste, with 84% of the students knowing what is recyclable and 71% thinking that garbage classification is a citizen's duty and thus being willing to participate. However, their knowledge of garbage classification is limited; before additional environmental education, the average correct percentage for sorting knowledge was 40.23%.

According to the results, environmental education increased this sorting knowledge in elementary school. In general, better sorting knowledge outcomes are associated with good practice and teacher-directed methods. The average correct rate after teacher-directed methods was 59.23%, #3.89% higher than seen for student-centred methods. Teacher-directed teaching methods are most beneficial for students with higher consciousness and background knowledge of solid waste management. The bivariate correlation analysis showed that students' support for waste sorting, attention to waste sorting, and satisfaction with environmental waste sorting are highly correlated with their classification knowledge. However, consciousness of environmental pollution is more highly correlated with increases in sorting knowledge for other teaching methods, which means if the students are still at the stage of gaining environmental sensitivity, it is better to use a student-centred method.

Number of family members and previews are two other factors that can influence the effect of teacher-directed methods. With regard to correlations of gender, growth environment, parent's highest level of education, and number of family members and students' sorting knowledge, the results of variance analysis show that only children had higher knowledge levels for garbage classification than non-only children (P=0.032), but that the remaining characteristics are not related to students' knowledge scores for garbage classification. The class who were required to do a preview scored higher final correct rates for sorting, much higher than those seen in other classes. The "correct rate" for them was 63.70%, 24.89% higher than before education. Thus,

outlining a clear testing goal before class increases the effectiveness of teaching sorting knowledge using teacher-directed methods.

Given these results, it is important to combine the two methods with weightings based on the development of students' cognition to increase students' knowledge about solid waste management in elementary schools.

5.2 Discussion

5.2.1 Current status of commonalities

Before environmental education, based on the personal information gathered in this survey, only the number of family members had a statistically significant impact on the knowledge waste classification. Students who are only children had a higher level of cognition with regard to garbage classification than non-only children. In general, the learning conditions for single-child families are thus better than those for non-only-child families. This may be due to the heavier burdens on non-only-child families and lower levels of parental education limiting their ability to educate their children.

Developmental environment has a certain degree of influence on students' knowledge of garbage classification. Students who lived in rural areas from a young age had a weaker awareness of garbage classification, while students from urban built-up areas often had knowledge about garbage classification gained to varying degrees throughout their lives and may have had the opportunity to participate in waste sorting activities. Therefore, in order to popularise knowledge of waste classification, the government should strengthen garbage classification knowledge in rural areas, actively improving garbage classification facilities in rural areas on a large scale so as to guide and regulate villagers in implementing waste sorting.

5.2.2 Challenges in the future

With the rapid development of e-commerce, online shopping has become an indispensable lifestyle choice for many modern people. However, with this explosive

growth in express delivery business has come the problem of courier packaging waste, which, though often overlooked, has caused serious environmental pollution and wastes resources. Therefore, the implementation of "green packaging" and recycling in the express delivery industry has become an issue that should be at the forefront of community waste management.

Figure. 6 Online shopping: express packaging garbage problems[3]

In 2015, a research team formed by the National Postal News and Publicity Centre and the Qingdao Research Institute of Beijing Printing Institute completed a three-month visit and “Report on the Status and Trends of Green Packaging Development in China's Express Delivery Industry”. This was China's first research report on express packaging waste by the official commission, which thus offered strong authority and credibility. The data showed that, in 2015, China's express delivery businesses carried 20.67 billion pieces, and the estimated consumption of woven bags was 2.96 billion, with 8.26 billion plastic bags being used and 9.9 billion other packaging types. If only the boxes were counted, this still represented more than 4 billion containers, generating at least 4 million tons of waste.

Express delivery companies consider only the packaging preferences of e-commerce sites and consumers, and thus are not motivated to eliminate over-packaging, as the cost of sending mail is generally based on weight. The heavier the package, the higher the shipping cost, and the faster the company makes a profit. Therefore, many

[3] Source: http://tech.163.com/17/115/13/D39NKMQB00097U7R.html

express delivery companies say that consumers and e-commerce companies that send things must add additional wrapping to prevent damage, even where items are already wrapped. This appears to be in line with the requirements of customers, and it is the business philosophy and corporate culture of express delivery companies. From this perspective, express delivery companies are unlikely to voluntarily reduce excessive packaging or actively recycle packaging materials.

This study found that students' cognition of recyclable waste (especially waste paper and waste plastics) is generally high; in particular, most students know that the garbage generated by online shopping is recyclable. Schools should strengthen this status quo and promote knowledge in this area, guiding students to actively participate in the recycling of online shopping waste.

5.3 Limitations and future research

Compared with that seen in other countries, garbage classification in China began only quite recently. Environmental education can exert great influence, but in China, past literature shows that people only stop at the level of conceptual understanding of garbage classification. While most research focuses on higher stages of education, such as high school or university level, this research fills the gap of environmental education in the field of garbage sorting at the elementary school level.

This study has implemented garbage sorting education in the chosen pilot school, which aims to find the effective ways of garbage classification education for improving the garbage sorting practice in China. The result highlights the importance of school environmental education, revealing that the difficulty in garbage classification education is to distinguish between recyclable waste and other waste, as well as to identify large-volume garbage with special materials. The research also proved that starting to teach students garbage sorting at elementary school level influences the children’s environmental knowledge positively. Moreover, the analysis results of different teaching methods summarized in the Section 5.1 provides guidance for

teachers to better conduct the lessons in order to enhance the students' knowledge acquisition effectively.

However, due to the current researcher's lack of time and experience, there are several limitations to this study:

1) The data samples are not rich enough.

Although several samples were surveyed and environmental education carried out, there is a lack of relevant data on different ages, teaching ability levels, schools and cities; the sample is not very rich and is thus subject to many limitations. Only a few lessons were conducted for each class, for example, and thus the teaching could not take the gradual progress of students' knowledge acceptance ability into account. This means that content of the student's mechanical memory was the only portion analysed, with no opportunities to observe changes in the relevant consciousness and behavioural attitudes.

2) A more scientific teaching outcome evaluation system is needed

This paper used statistical methods to compare the scores on a questionnaire before and after education. However, behavioural changes caused by teaching cannot be reflected only by means of quantitative questionnaires, as teaching effects are multi-dimensional and cannot be judged solely by the evaluation of knowledge scores.

3) Internal relationships of various factors should be investigated in more detail.

A great deal of time was spent on designing the research and collecting the data. However, more data analysis is required in order to discern the internal relevance of students' attitudes toward garbage classification and their behaviours, and knowledge. Students' initial perceptions and attitudes toward garbage classification may also affect teaching outcomes, as cognitive changes can lead to changes in attitudes that in turn change students' environmental behaviours.

The future research thus includes :

- Collecting more samples for children of different ages in different cities in order to better understand the underlying knowledge level with regard to environmental education in China, especially in terms of garbage classification.

- Designing a complete curriculum for waste classification teaching that suits China's national conditions. The best way to implement such a curriculum is to introduce it to the classroom, but if such work in school hours is not allowed, an online course should be considered.

- Developing a more scientific curriculum evaluation model. It might be insufficient to use questionnaire to understand students' knowledge levels. Therefore, future research should take students' everyday environmentally friendly behaviour changes as their ultimate goal. The interview method should be considered for follow-up research to better develop an understanding of the move from knowledge to behaviour.

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Appendix

Elementary School Students' Garbage Classification Situation Questionnaire

Dear students, how are you!

This is a questionnaire about the status of elementary school students' garbage classification, which is divided into five parts: A.B.C.D.E. The situation of the questionnaire will not be reflected in the comprehensive quality evaluation. Please fill in the truthfully. This will be of great help to our environmental awareness. I hope that all the students will cooperate fully, thank you very much!

Student ID: _____

Start time:_____

A. Basic information

1. Your gender:

① Boy ② Girl

2. Your grade:

①Grade three ②Grade four ③Grade five ④Grade six

3. Growth environment:

① urban built-up area 3. rural area

4. Your father’s occupation:

①Workers ②peasants ③soldiers ④businessmen ⑤teachers ⑥medical workers ⑦ Freelance other_____

5. Your mother's occupation:

①Workers ②peasants ③soldiers ④businessmen ⑤teachers ⑥medical workers ⑦ Freelance other _____

6. Number of family members:

①1 ②2 ③3 ④more than 3

7. Your parents' highest level of education is:

①Elementary school ②Junior High school ③High School ④ ≥Undergraduate school

8. What is the financial condition of your family:

①Lower ②middle ③upper

B. Cognition of basic knowledge:

1.  What does this sign mean?

①Recyclable ②reused ③non-recyclable ④ unknown.

2. Do you know what these pictures are?

①Yes ②No ③Impressions but not clear

3. What do you think of the consequences of stacking leftovers, rotting leaves and roots anywhere (multiple choices):

①pollution of the environment ②Breeding bacteria ③No consequences

4. Which of the following is "white garbage":

①milk carton ②toilet paper ③various plastic garbage ④ medical masks

5. Garbage classification mainly refers to (multi-selection):

①Classified collection ②classified input ③classified handling ④classified transportation

C. Assessment of garbage classification and attitude towards waste separation

1. Do you agree with garbage classification?

①Agree ②disagree ③ Never thought about it.

2. Your concern for garbage collection

①Very concerned ② more concerned ③be indifferent to

3. Level of concern about environmental pollution caused by garbage:

①Very concerned ②more concerned ③be indifferent to

4. Your view on garbage separation is:

①It's everyone's duty.

②It’s the responsibility of the environmental protection department.

③Too much trouble

④no opinion

5. Which of the following benefits of garbage classification makes the most sense to you:

①Reduce environmental pollution

②Improve our living environment

③Reduce the absorption of toxic substances from waste

④Raise awareness of environmental protection

⑤Reduce the area of garbage

6. Are you satisfied with the current status of garbage classification around you?

①to feel quite pleased ②satisfied ③same as ④discontent ⑤far from gruntled ⑥do not understand

7. Have you ever noticed a classified trash can when throwing rubbish?

①Yes ② no

8. What do you think of the sorting bin:

①Convenient and better sorting and dumping of refuse

②Will take the time to understand the instructions for sorting trash bins

③I don't know how to sort it. I always drop it.

9. which of the following ways do you think that you can take the initiative to do garbage classification (multiple choices):

①Schools provide special garbage classification education hours

②Implementation of a system of rewards and penalties with appropriate penalties for cases that are not classified

③Facilitated throwing facilities

④Other_____

D. Actions and recommendations for participation in sorting

1. Whether to classify garbage in daily life:

①Always classification ② occasional classification ③never classification.

2. When garbage needs to be thrown, you will

❶Find the trash can and throw it away.

❷Will notice the type of garbage thrown

❸Don't go to the trash can and get rid of the trash.

3. If you live in a neighborhood with a clearly stated sorting bin, would you like to do garbage sorting?

❶Yes ❷No ❸ doesn't matter

4. When the trash is mixed up, will you sort it?

❶Yes ❷no

5. What do you usually do with waste batteries?

❶Put it to recycling hazardous waste.

❷Throw it in a trash can.

❸Thought about sorting, but couldn't find the corresponding location.

❹I don't know waste batteries are harmful garbage, never pay attention to the treatment method

6. Will you advise or stop people around you from littering

❶Always ❷Occasionally ❸never.

7. Have you learned anything about garbage classification?

❶Yes ❷no

8. There are several ways of promoting garbage classification knowledge that you accept (multiple choices)

❶television advertising ❷school classes ❸parents' education ❹never

E. Sorting knowledge

	Recyclable waste	Kitchen Waste	Harmful Waste	Other Waste
1.Plastic containers for toiletries				
2.Melon peel and shell				
3.Expired drug				
4.Control part of electric blanket				

5.Plastic dining box				
6.Branches and leaves				
7.Waste fluorescent lamp				
8.Flowerpot				
9.Waste toilet paper				
10.Egg package				
11.Contaminated plastic bags				
12.Edible oil				
13.Waste water silver thermometer				
14.Carpet				
15.Paint kettle				
16.Ceramic				
17.Waste mobile phone charger				
18.Plastic bottle cap				
19.Cortical aqueduct				
20.Metalic tablewares				
21.Plastic hanger				
22.Tea leaves				
23.Egg shell				
24.Weeds in the garden				
25.Print cartridge				
26.Used tissue paper				
27.Ballpoint pen cover				
28.Worn leather shoes				
29.Optical disk (CD,DVD)				
30.(Magnetic) tape				
31.Organic insecticide				
32.Cigarette end [stub				
33.Expired cosmetics				
34.Safety helmet				
35.Waste paint				
36.Iron kitchen utensils				

37.Oil bottle				
38.Unworn clothing				
39.Abandoned sofa				
40.Abandoned mattress				
41.Waste weeding container				
42.Old newspaper sundries				
43.Old towel				
44.Canned food				
45.Canned snacks				
46.Modified liquid bottle				
47.Single-use syringe				
48.Scent-bottle				
49.Mousse bottle				
50.Canned glass for juice				
51.Empty bottle				
52.A juicy glass bottle				
53.Used ball games				
54.Waste carton				
55.An old television set				
56.Used washing machine				
57.Thermos flask				
58.Big stick bone				
59.Dust				
60.Thermos flask				
61.Dental paste skin				
62.Abandoned tablecloth				
63.Waste toothbrush				
64.Corn kernel				
65.Nutshell				
66.Muck				
67.A broken mirror				
68.A broken bulb				

69.Preservative film				
70.Abandoned eye drops bottle				
71.Plastic packaging for snacks				
72.Waste books				
73.Cosmetic glass bottle				
74.Oil tank				

Question time:_____minutes