CHAPTER 5

Leading the Way for Students' Growth

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Xingzhi Tao (1891–1946), a famous Chinese educator who studied in the USA in the 1930s and whose work was strongly influenced by John Dewey, said: "Action initiates knowing, and knowledge results from action" (Tao, 1934/2016). After the nature notes program was introduced in the Chinese schools, students began to walk out of the classroom and step into nature. Striving for guided participation in practical outdoor activities under teachers' guidance, the students gradually improved their abilities to observe and feel things in nature around them. While observing nature, not only can the students learn knowledge but they can also develop an understanding of their relationship with nature. In this way,

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students experienced how to respect nature and learned how to get along with nature.

The nature notes program has been held consecutively for seven years from 2014 to 2021. Over the seven years, the development of students' nature notes has transformed from tender to mature. The first participants of the program have entered high schools and colleges with the seeds of their dreams planted at a young age, having grown roots and sprouts. The following section includes detailed stories of the students who took part in the program.

Student Stories with the Nature Notes Reciprocal Learning Program

Student Story 1: Protecting the Mother River—The Youngest River Captain in Chongqing

Chongqing is a city located in the southwest hinterland of China, nicknamed Jiangcheng (river city). The city is located in the upper reaches of the Yangtze river, with its mainstream cutting across the whole territory from the west to the east. It runs up to 665 kilometers, cutting across the three back slopes of Mountain Wu and forming the world famous three gorges: Wutang Gorge, Wu Gorge, and Xiling Gorge. Jialing river coming from the northwest, zigzags threefold through the city center into the Yangtze River. Wu river joins Yangtze river in the Fuling area, forming Libi Gorge, Wentang Gorge, and Guanyin Gorge (three gorges on Wu river).

ZDT was the class monitor and the president of the Water Love club in the Chinese sister school. She had an impressive title, Jialing River-Saddle Creek Stream volunteer captain. She was the youngest volunteer captain officially identified in Chongqing. This title of the caption reflects her participation in the nature notes program. In grade 7, ZDT learned about the program from her teacher and knew that the school was one of the 30 Young River Captain and Young Lake Captain pilot schools across China. She self-introduced herself to the project and wanted to take action to protect the mother river (Yangtze River). She formed a group of student volunteers and carried out a series of voluntary activities. She said: "I grew up by the Yangtze River side and have a deep feeling for it. I consider the protection of the river as a part of my life. The title of Young River Caption

represents responsibility and accountability. I want it to be more than an empty title. I want to do something for it."

ZDT discovered a new frog species living in Chongqing: a white-jawed pan-tree frog. There was a glass observation tank at her home, which she and her father had built together. Inside the tank were potted plants and an artificial mountain with sporadically planted greenery. This little tank carries her stories with the nature notes program. During our interview with ZDT, she spoke with confidence about the tank contents, just like counting house gems: "This clover is planted when I did the experiment of symbiotic nodules as a result of the co-living between root tumor bacteria and legume plants. Don't be tricked by the appearance of the small shallow fish-free pool; in fact, there is a tree frog, which is the one I found as a new record of the species." Proper nouns and special terms bounce out one by one. Compared with an average junior high school student, the 13-year-old ZDT was slightly different.

Out of the school's back door, the Young River Caption, ZDT, countlessly walked on this section of the slate road to the Saddle Creek stream. Patrolling the little river became a routine on weekends. ZDT examined and recorded soil erosion in the fallen zone during each river patrol. She also carried a bag and picked up trash along the way. She wrote down the inspirations to protect the river in her notebook (Fig. 5.1). Carrying the volunteer team flag, with pliers and bags in hands, ZDT and a dozen red-vested team members picked up trash along the beach. ZDT said, "regardless of the sizes, we have almost walked over all the rivers in BeiPei district. If we find that there are some people fishing, picnicking, or growing vegetables in the drop belt, we will communicate with them and stop them from doing what they were doing." Each patrol lasted about two hours and took place once a week. The 13-year-old girl ZDT adhered to this routine for more than a year.

When talking about river conservation, the non-stoppable ZDT had no intention of pressing the pause button. "The purpose of discovering new species or new species records is to protect them," ZDT said. "Once found, the creatures will have one more documented habitat in Chongqing. We should try our best to protect them from getting harmed." "Each patrol trip is a hard journey." ZDT continued, [for example] "during the National Day Holidays, the volunteer team went out for five days. We stayed in the hotel during the daytime to catch up with our school homework. At around 7 pm, we went on the patrol trip with the teacher. We often returned to the hotel at around two or three o'clock in the morning."

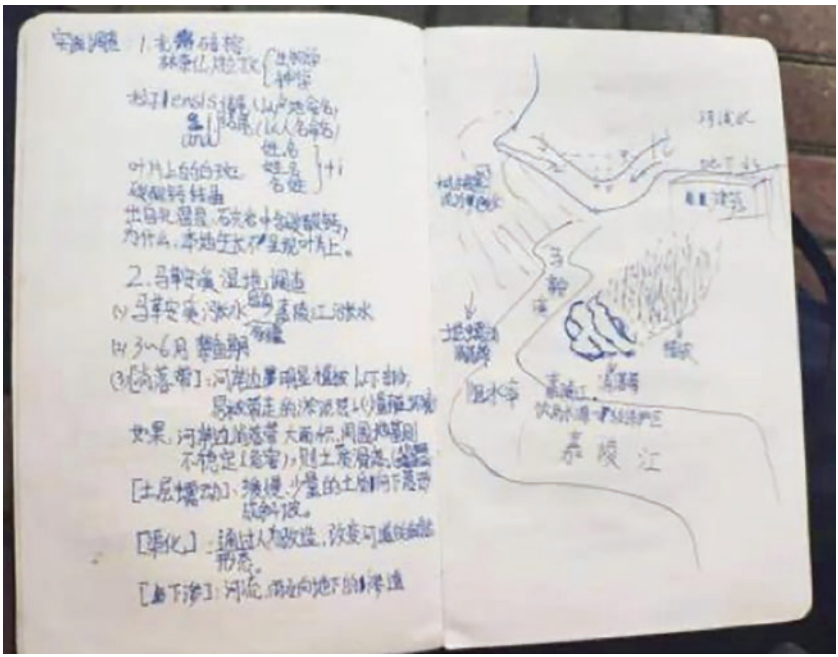

Fig. 5.1 ZDT's Drop Belt Notes

It turned out that since last year, the team and their mentor teacher went on field trips together to carry out natural expeditions. Before each trip, the team determined a target species. They would travel from Mountain Four-Sided, Mountain Fairy, Mountain Zhaomu, Mountain Lushan to Yellow Water, and from the natural forest and the caves to the villages. Each year, they made more than ten of these trips, which would take more than 20 days overall.

ZDT's dad was very proud of his daughter. "Catching the colorfully patterned tree frog is a little thing to her. Catching insects to feed lizards is nothing neither to her." While talking, her dad opened some photos on the computer. "Look, this is a picture of ZDT. She was soothing a dark brown snake with her hand." ZDT glanced at it, raising the corner of her mouth, and said, "this one is not poisonous."

ZDT's achievements after these efforts were eye-opening. Her project on the application of Rhizomes in urban ecological gardens won the first

prize in an international competition held on one Global Nature Day. After three months of adhering to the daily observation of tree frogs chirping, hugging, and spawning, she won the grand prize at the Chongqing 5th nature notes contest for her poster presentation of what she learned about tree frogs. Her poster presentation on leopard cats won the first prize at the nature notes contest hosted by the Ministry of Ecology and Environment.

Because of such outstanding achievements in the nature notes initiative, ZDT and the other two students became the only high school student team in the country that was interviewed by the Director of the Information Division of the United Nations Environment Program (N.d., 2019). "Mr. Nathan Saba signed for me and encouraged me to continue my inspiration in scientific inquiry and contribute to environmental protection." Speaking of this experience, ZDT said, "it is a very honorable moment. It also ensures me that the efforts of environmental protection are valuable and meaningful."

ZDT was awarded as the national Model Youngster in New Era. She was also named Jialing River-Horse Saddle stream volunteer Caption, by the Beipei District River Office. ZDT said, "I am just a very ordinary high school student, putting aside my love of natural rivers and commitment to environmental protection."

ZDT's story shows that her participation in the nature notes program was inspired by her love of the rivers where she grew up, which is her internal motivation. The encouragement from the Director of the Information Division of the United Nations Environment Program and the awards she received from nature notes contests provided her a positive boost, inspiring her to go further down the road to protecting her mother river. Implementing the nature notes program has enabled many middle school students like ZDT to experience nature, love nature, and protect nature through active engagement with nature. The program's impact on participating students takes place in a way that the spring rain influences all lives, watering them finely and silently!

Student Story 2: Practice Generates Knowledge Through Field Exploration

"The nature notes project started my journey of exploration. I wanted to offer my contribution to nature using what I learned at school." This is how HYF began to introduce her story with the nature notes program.

Shortly after entering the high school, HYF and her classmates were given a task using the format of nature notes to record the natural scenes that interested them. Born and raised on the banks of the Wuxia River, this girl, who grew up with a keen interest in nature, decided to pick a simple topic to work on: ferns.

"How naive I was proved to be! Ferns looked simple in structure, but when I started to draw it, I realized that the leaves of different ferns vary. It required careful observations to draw correctly how the compound leaves split and how the sporangia grow." HYF recalled her first nature notes project. This project won an excellence award in 2015 in the second Chongqing nature notes competition.

In the summer of 2015, HYF was about to enter her second year of high school. She took part in a field science expedition organized by her school. At Jinfo Mountain, she and her classmates, under the guidance of a lead teacher, recorded the chain snakes with a black-banded belly and the red-spotted toads for the first time in Chongqing.

When the research team interviewed HYF, she was a university student studying agricultural water engineering at Sichuan University. She often had fieldwork in remote rural areas and explored how to use the natural resources in environmentally friendly ways. HYF explained how she chose her university major, "My personal interest in nature drove me to choose to participate in the nature notes program. If I hadn't participated in the nature notes program, I wouldn't have become so close with my guide teacher. Without the encouragement from my guide teacher, I wouldn't have participated in a field trip to Jinfo Mountain, and I wouldn't have determined that I liked biology. Although my university major is not biology, but it is related to environment. I am still working on tasks on environmental protection."

In this statement, HYF expressed her growth experience in the nature notes program. In a later interview with her mentor teacher, we learned that HYF came from the countryside. She was interested in nature since she was a child. Her living experience in the countryside built her connection with nature and became her internal drive for her to explore nature. After being exposed to the nature notes program, under the professional guidance of her teachers, she not only gained more specialized knowledge, but more importantly became aware of environmental issues and took actions to protect the environment.

Student Story 3: Embrace the Nature and Build a Harmonious Parent-Child Relationship

Nature is a real and rich encyclopedia that contains great educational wealth. Parents and children can together go into nature without many limitations. As long as parents provide children guidance and accompany and watch for their safety, children can easily become good friends with nature, which not only benefits children physically and mentally but also cultivate their temperament.

GYQ was the winner of the first prize in the 5th nature notes contest in Chongqing. He was fishing with his grandfather and father when he happened to come across the Chinese sand minnow and started his own research. He described the process of his project using a couple of sentences,

> Dad caught something and he believed it was a fish loach, but grandfather said it was a steel loach. They argued. When we got back home, I went on the internet and found that it was neither a fish loach nor a steel loach. I approached a professor for help. He told me that the real name of this creature was Chinese sand loach, a unique fish species in China. I put it back into the river and let it return to nature. I also told my dad to release it in the future fishing.

The judges of the contest commented on GYQ's work this way, "a fishing trip triggered the curiosity of three generations of grandfather, father, and grandson about a fish loach. The experience-based argument between grandfather and father, son's curiosity, the use of modern technology, and the consultation of an expert finally lead to the clarity of the study topic."

What a memorable trip with family members! It was this wonderful family experience that allowed little GYQ to get to know the endemic fish species. Throughout this project, GYQ did not only learn extracurricular knowledge, but also greatly appreciated the togetherness with family members in nature. The parent-child relationship helps improve the environment of family education. Positive and effective parent-child communication can enhance the emotional connection between each other, which enhances the sense of belonging of each family member.

Rain is a very common natural phenomenon and does not usually trigger our curiosity. But LFQ's nature notes project reported a rain-related study he and his father worked on. He illustrated their study,

> I went to the roof with my father and found a lot of shiny water droplets hanging on the clothesline, how strange! I searched the internet and

> couldn't find the reason, so I decided to do an experiment with my dad to explore the formation of water droplets on the steel pipe. We poured water on the pipe first, and there were no drops left on the pipe. Then we reduced the amount of water. Finally, we realized that the shower of last night was the reason for the water droplets on the clothesline. Nature has so much for me to learn. I need to study hard at school.

The rain-related observation and follow-up series of experiments drew a vivid picture of working together between father and son. In the process of parent-child exploration of nature, parents need to pay attention to children's every move, appreciate their struggle and happiness, and respond to their various questions. Parents should have a mindset of playing with children and being a bit childish. The most enjoyable thing to children is their parents' positive mood and adequate patience. Exploring nature together will bring parents and children closer.

Student Story 4: Battling with Wisdom and Courage to Fulfill the Career Dream of Environmental Protection

"The things that make me want to know what they are and what they are all about are the things I should spend most of my time observing," ZW said calmly about her experience in the nature notes program. Her persistence and love for environmental protection affected those listening to her story.

ZW was first introduced to the nature notes program when she took the exploration-oriented curriculum in her first semester of high school. By chance, she and her classmates found a small black and yellow caterpillar on the way to school. With a desire to explore the tenacious life and a love for living things, she took the little bug back to her home to take care of it. After waiting patiently for 25 days, she observed the metamorphosis of life from worm to chrysalis to butterfly and recorded each stage with photos and videos. While observing, she recorded different questions each time, such as, "why do the little bugs change more at night?" A journey of heartfelt feelings and continuous exploration was recorded into a graphic form entitled, *Insect, Chrysalis, Butterfly Transformation Axis* (Fig. 5.2). This work won the first prize in the 4th nature notes contest.

ZW said that making nature notes often requires long hours of observation and recording. Her initial curiosity and interest were fundamental for her persistence. ZW shared her experience of participation in the nature notes program with those who were first introduced to the program. "I once spent 25 days continuously observing and recording the metamorphosis of a caterpillar. In order not to be interrupted, I sometimes even

Fig. 5.2 ZW's Natural Notes Work: Worm, Dragonfly, Butterfly Shift Axis

carried that caterpillar with me, feeling that my whole being had been completely immersed in the caterpillar's world." It is this thirst for knowledge of the unknown world that made her reflect and grow along the way, constantly exploring the larger world!

Since then, ZW had been on the road of exploring and recording nature. She and her cousin jointly completed a project entitled, *New Discovery of Black-eyed Toad* (Fig. 5.3), which won the grand prize of the 4th Chongqing nature notes contest. In the closing ceremony of the contest, she said that her constant observation of nature made her have a dream of enrolling in a college majoring in environmental protection.

Fig. 5.3 The 4th Nature Note Contest Grand Award Winner: New Discovery about Black-framed Toad

Since her first nature notes project in her first year of high school, ZW had been fascinated with every "date" with nature. Under the guidance of her guide teacher, ZW had already published a paper on black-eyed toads and had conducted indoor breeding of black-eyed toads under the guidance of her teacher. She discovered that there was a half-hour time difference between the black-eyed toad's calls under different environments indoors and outdoors. It is understood that ZW was chosen to be a member of the Chongqing Youth Innovation Talent Development Program. In addition to her daily studies, she often went to university laboratories to participate in experiments with professors and experts.

The once high school student had now finished her three-year high school study. After graduating from high school, she chose to major in environmental engineering without a second thought. After an in-depth conversation with ZW, we found out that she loved nature from the bottom of her heart. This was why she could always stick to her original intention. She mentioned to us an episode that took place when she decided on a university major. Her parents wanted her to study economics or finance, which was more popular in the Chinese job market. However, she finally convinced her parents to allow her to study what she loves.

The nature notes program has influenced one group of students after another. ZW's initial involvement in this program was no more than a normal trial in her life. However, it was this trial that led her to the field she was interested in and pushed her to keep going deeper and deeper into this field for research. The animals and plants she met during her involvement in the program made her fall more and more in love with nature. She realized how significant the natural environment was for the survival of plants and animals and therefore she chose to major in environmental engineering. Her internal love and curiosity about nature motivated her to further study it. External factors, such as awards, reinforced her motivation to get more involved in nature study.

Student Story 5: Hanging Foot Tower as Culture Memory

Beijing's Courtyard, Shanghai's Shikumen, and Chongqing's Hanging Foot Tower are all original and distinctive urban residential buildings in China. The hanging foot tower is an ancient residential building in southwest China that has a history of 3000 years. It is the iconic cultural symbol of the mountain city, Chongqing. The wise people of the mountain city built their residences by the mountain. These buildings were often situated at the side of a hill and beside a body of water with a shape of a sitting tiger. They were decorated with a green dragon on the left, a white tiger on the right, a red sparrow in the front, and a humous at the rear. These buildings were often oriented to face the south or the north. Hong Yadong in Chongqing is a restored and reconstructed building cluster with the style of hanging foot towers. It is the witness of Chongqing's history and culture and the symbol of Chongqing's city spirit.

LJL, an elementary school student in Chongqing, first learned about the hanging foot tower from her grandmother.

> My grandmother told me that whenever the sun sets, the golden sunlight falls on the group of hanging foot towers at the area of the river gate. These buildings were at different altitudes and with different heights and sizes, but all were designed and located in a beautiful hormonic arrangement. Standing in front of these buildings, one can see in the far distance the shining weaves on the Jianling river. … Unfortunately, these buildings were torn down. There are no handing foot towers that can be seen in urban districts.

LJL was impressed by his grandmother's vivid description of old hanging foot towers. He decided to learn more about them. LJL learned that there were some wooden hanging foot towers in the close-by small town

of Zhongshan. They were protected well. LJL traveled to the town by bus and started his field research about hanging foot towers.

LJL investigated the climate characteristics, geographical location, topographical features, and local plants of Zhongshan Town, and then carefully analyzed the building site, building materials, and architectural style of the hanging foot towers. His research led to a poster presentation entitled, *Nature Notes on the Hanging Foot Towers in Zhongshan Town* (Fig. 5.4). LJL summarized what he learned from his nature notes project by stating,

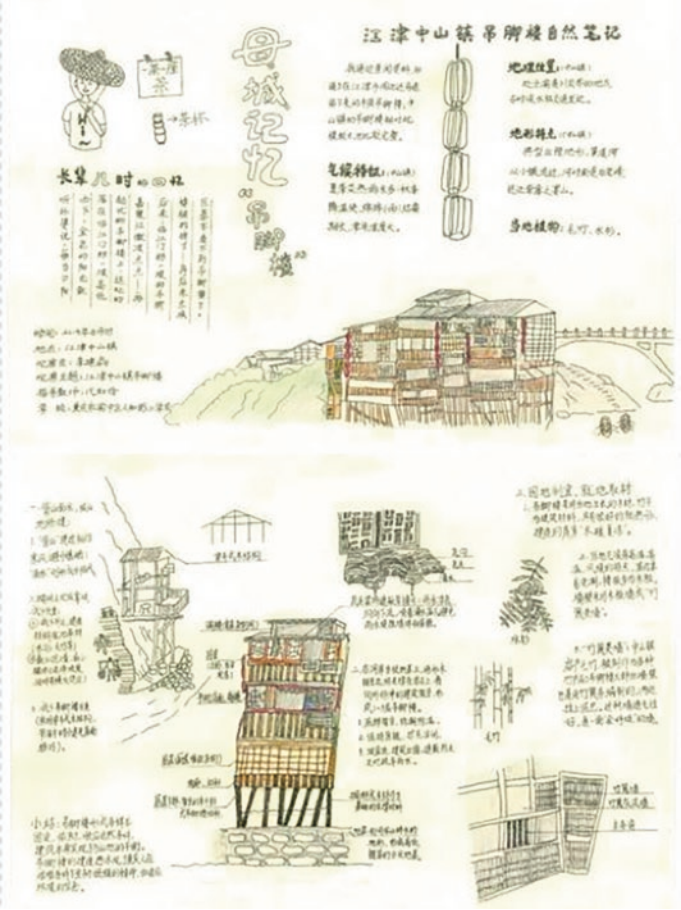

Fig. 5.4 LJL Nature Notes—Hanging Feet Towers

> the process of completing this nature notes project taught me how to observe and think about my study topic carefully and how to record what I saw and heard by handwriting and hand-drawing. I learned how the unique scale of the hanging foot towers are closely related to the local geography, climate, and vegetation. I was deeply impressed by the survival wisdom and tenacity character of Chongqing people and fully appreciate the importance of harmony co-existence between human beings and nature.

In the process of recording the nature notes of handing towers, LJL got to know the traditional cultural knowledge associated with these unique buildings through field research. He learned that the building materials came from nature, and the location of the buildings needed to be carefully chosen to fit into the geographical environment. The structure of the buildings should consider the climate characteristics. Therefore, his learning went beyond the physical feature of the hanging foot towers. Through the project, he was able to appreciate the wisdom of the local people and the charm of traditional Chinese architecture. Through the display of his nature notes, LJL not only deepened his understanding of the traditional architecture of the hanging foot towers but also made more people feel the charm and value of Chinese architectural culture through the exchange of works.

Student Story 6: Survival of the Fittest

Survival of the fittest is a law of nature and applies to human beings. WNY was one of the grand prize winners of the 3rd Chongqing nature notes contest. Her project entitled, *The Scent of Corn,* illustrated that the way that humans treat nature with kindness is not always what nature needs (Fig. 5.5). The contest judges commented on her work in the following way:

> Unlike many other middle school students who commonly used watercolor paint, the author of this product used cartoons and comics to illustrate what she wants to express in the text. The style of drawing was highly compatible with the content of the work. This work nicely recorded an interesting project of discovery. The author noticed a puppy eating corn and found that there were corn kernels in the puppy's poop. She searched for information and learned that too much feeding with inappropriate food could cause the puppy digestive problems. The most remarkable thing is that the author concluded with a reflection: are we human beings necessarily loving and protecting animals by treating them in a way we think is kind?

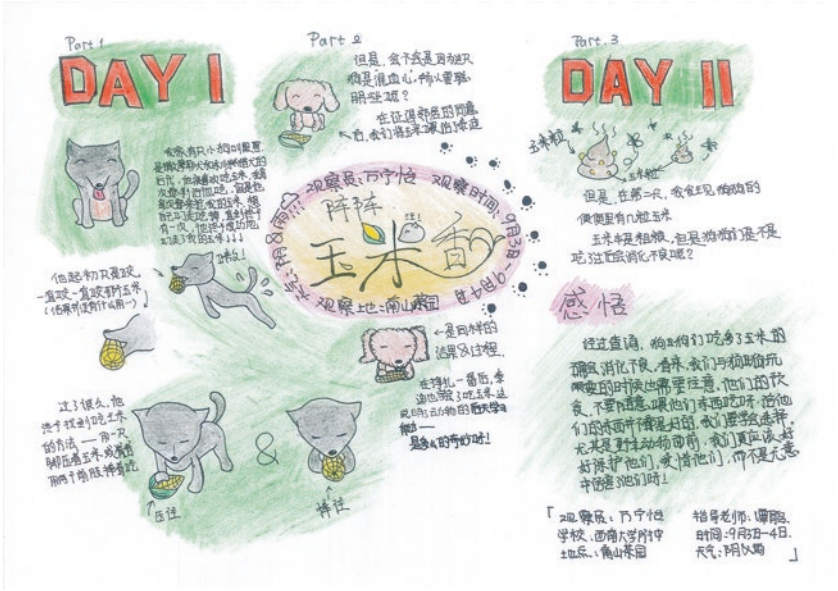

Fig. 5.5 The Smell of Corn

During the conversation with WNY, she told us another scenery she observed in her school:

> There was a newly built bird's nest outside the classroom window. My classmates were attracted by it and often watched the bird at the window. Birds were usually afraid of people, but this one was particularly brave. On a closer inspection, we found that it was a mother bird. She had laid three eggs and had been working hard to protect her children. One day we found that two eggs were hatched, but the third egg showed no sign of hatching. The mother bird led the two young birds to fly away, abandoning the third egg.

In order to provide the two young birds with a better living environment, the mother bird had made the decision to abandon her third egg. This observation provided WNY to experience the meaning of the law of survival of the fittest.

Later in the conversation, we learned that she had chosen to major in medicine at university. The medical profession has always been a popular and well-respected career choice in China, although it is a difficult program to get into and is a strenuous finish. From her initial love of chemistry and

biology to her participation in the nature notes program in high school, she learned about the nature, contacted nature, observed nature, learned the laws of survival in nature, and then bravely faced the challenges and made her own professional choice. This reflects her application of the natural survival law to her own life.

Unlike the student participants mentioned earlier, WNY did not choose an environment-related major. She chose a major in medicine. Someone may think the participation in the nature notes program did not have an impact on her. However, WNY applied what she learned from nature to the human society. She believed that people need to follow the law of survival in society. She chose a more suitable and challenging career for herself. For her, the impact of the program is not only a choice of profession, but a way to help her understand the philosophy of life.

Student Story 7: The Subtle Influence Is Worth a Thousand Words

To further explore the impact of the nature notes program on the students' future careers, we interviewed the guide teacher of both HYF and ZW for their award-winning nature notes projects. The teacher commented on these two students:

> Both HYF and ZW came from rural areas. Their families were not able to provide them with professional guidance. Before they joined the high school, they had zero experience with the nature notes program and other science inquiry activities. After they came to the high school, they started to learn about environment-related majors through participating in the nature notes program. Particularly for ZW, I always encouraged her to participate in science and environment related school activities. In this process, she was particularly concerned about the ecology of the Maanxi Watershed and the Three Rivers watershed, which led her to the major in environmental protection. Based on her study of the watershed, I guided her to write two letters to the Chongqing municipal government, reflecting the current situation of the ecological environment in the Maanxi Watershed and suggestions for its management. These letters received positive feedback and timely responses from the government. Such recognition inspired her confidence in making contributions to the protection of green mountains and water.

Through the teacher's analysis, four factors can be summarized that influenced the two students to choose environmental majors:

1. An interest in nature inspired by their personal upbringing.
2. The platform provided by the school to participate in the nature notes program.
3. The subtle influence of the schoolteachers in leading students in the practical process, the charisma of the teachers' teaching, and their profound knowledge.
4. External incentives and support from the government, media, etc.

After an in-depth analysis, we use the following diagram (Fig. 5.6) to represent the relationship between the environment, internal motivation, external motivation, and students' choice to delve deeper into research.

The nature notes program stimulates and deepens internal momentum. ZW was not initially exposed to the practical activities in the environment. What she was familiar with were plants and animals that she had experienced in her daily life. After entering high school and participating in the nature notes program, she became interested in environmental issues through her exposure to the water project. With the support and encouragement of her teachers and the Chongqing municipal government, she eventually decided on her university major in the environment. From this process, we can see that the nature notes program inspired her cognitive motivation, and the continuous practical exploration and external encouragement deepened her internal motivation.

The determination of a professional career requires both internal and external motivation. ZW, who continuously recorded the process of moths from lava to cocoon to butterfly for 25 days, took nearly 130 photos. While their own internal cognitive drive pushed them to continue their

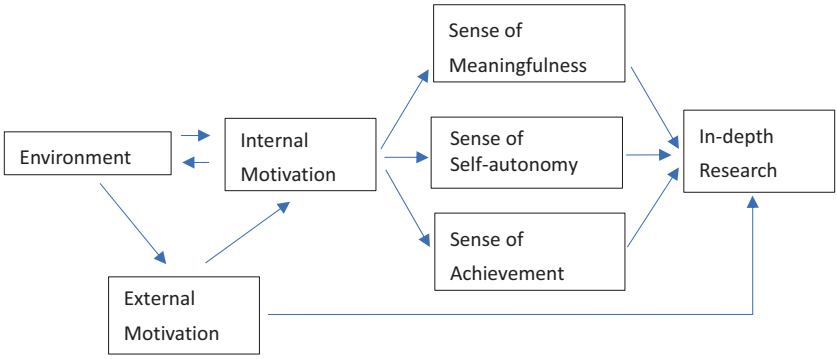

Fig. 5.6 The Internal and External Motivations for Research-based Learning

research, external feedback such as the Chongqing municipal government was an affirmation of their actions, and this external motivation was more like a "cardiac stimulant" that strengthened the direction of their professional decision.

In addition, students need to be trained in career planning through a combination of practical classes and academic classes. In an interview with teacher L, he said, "it's not the teacher who should tell students to choose what kind of career choices. Teachers should respect students' own feelings and experiences." We learned that teacher L was good at influencing students with his own actions in practice. Without dictating, he allowed students to make decisions based on their own experiences. In China, there was no formal career guidance for high school students, so teacher L suggested that a mandatory career planning course should be implemented in the first year of high school. In addition to the career guidance course, teachers should be sensitive to students' interests and provide students with opportunities to reinforce their interests and strengths through comprehensive practical activity courses.

In China, after each year's College Entrance Examination (on June 7th and 8th of each year), senior high school graduates across the country must go through the process of applying for colleges and choosing their majors. In this process, many high school graduates and parents often face two challenges. The first challenge is that they need to select a university which their exam scores qualify them for. Careful checking of the ranking of the university, the admission requirements of the university, and the quota of admission are critical factors to consider for success. The second challenge is that students must choose a promising major that maximizes the possibility of being employed after graduation. According to Tang (2013), many high school graduates do not know what they really want to study at university. The biggest disadvantage of an employability-based selection method is that students may not be interested in the major they choose to study. To make it worse, Chinese universities do not offer much freedom for students to switch majors easily.

As an old Chinese saying, "it takes ten years to grow a tree, but a hundred years to make a man." The influence of education on students is not something that happens overnight but takes place in a subtle way over a long period of time. Students spend more time in school than in any other place. School programs should not aim at knowledge transmission but facilitate the discovery of their own interests and development. It is well known that high school education in China is highly competitive and exam orientated. It is the lack of research-based learning activities, like the

nature notes program, that leads students to gradually lose themselves in the heavy academic work. They do not have the opportunity to find their interests and potential, which causes difficulty in choosing a major for their higher education.

The Impact of the Nature Notes Reciprocal Learning Program on Chinese Students

Life is education and society is school (Tao, 1934). Nature is full of all kinds of insects and animals, flowers and trees, forests and wilderness, rivers and streams. The nature notes program provides students a platform to get into nature, explore its mysteries, and experience the joy of studying in nature. In the process of observing the natural environment, students not only learn scientific knowledge and exercise scientific thinking, but more importantly, they learn the methods of scientific inquiry and improve their ability to investigate things. Table 5.1 shows the awards won by the Chinese sister school in the national nature notes competitions in 2018 and 2019. Besides these student awards, the Chinese sister school was recognized as an excellent organizer in the 2018 National Adolescent Nature Note Contest and the 2019 2nd Changlong Cup National Nature Notes Contest.

The nature notes program aims to enrich students' scientific knowledge, improve their scientific research skills, develop their scientific literacy, and deepen their understanding of the impact of science and technology on society and individuals. To examine the impact of the

Table 5.1 Awards Southwest University Affiliated Secondary School students received in the past National Natural Note Contests (2018 and 2019)

Contest	*First prize*	*Second prize*	*Third prize*	*Special award*	*Merit prize*	*Mentor prize*	*Total*
2018 National Adolescent Nature Notes Contest	1	2	14	4			21
2019 National Adolescent Nature Notes Contest	5			3	3	6	17
2019 2nd Changlong Cup National Nature Notes Contest	1	2	1	4	6	17	31
Total	7	4	15	11	9	23	69

Table 5.2 Program impact on participants

	Percentage (%)				
	1	*2*	*3*	*4*	*5*
Knowledge	0	2.15	19.55	56.85	21.35
Skill	0	1.40	19.60	52.90	26.10
Self-development	0.97	4.57	23.67	45.17	25.60

nature notes program on students, the Chinese research team conducted a study on the scientific literacy and self-development of 138 students in their first and second years of the nature notes program at the Southwest University Affiliated Secondary School. In this study, knowledge refers to the students' knowledge reserve after participating in the nature notes program. Skills refer to the skills they acquired through participating in the program, including research skills, communication skills, and collaboration skills. Self-development refers to the students' acquired abilities for personal development through the program, such as career choice. The 5-point Likert scale was used in the survey with 1 to 5 representing strongly disagree, disagree, unsure, agree, and strongly agree (Table 5.2).

The survey results show that over 78% of students agreed or strongly agreed that their knowledge about nature had improved significantly, with about 20% of students not very sure. About 79% of the students agreed or strongly agreed that their inquiry skills had been improved significantly, with about 20% of students not very sure. Over 70% of the students agreed or strongly agreed that they had gained significant self-development, with 24% of students not very sure. It can be concluded that after participating in the nature notes program, students not only expanded their knowledge and improved their interpersonal skills and cooperation skills, but also gradually determined their future career goals and their life direction.

Overall, we believe that the nature notes program enriches students' knowledge, improves students' abilities, and promotes students' self-development. The following section defines each of these ideas in detail.

Enriching Students' Knowledge

Connecting with Reality and Consolidating Classroom Knowledge After participating in the nature notes program, students' knowledge is enriched. Students use the nature classroom to observe and explore plants and

animals, which not only enables them to be inspired by the natural environment, but also consolidates their knowledge learned in classrooms. Students combine their theoretical knowledge with natural phenomena, learning by doing, and doing while learning. ZW measured the latitude and longitude of the observed objects with the help of the Beidou Satellite Navigation System (BDS), thus recording observation notes in more detail. The concepts of longitude and latitude were learned in the geography classroom, but by combining the knowledge learned in the classroom with practical exercises, ZW further understood the practical meaning of the knowledge and improved his ability to apply the theoretical knowledge. The combination of theory and practice helps strengthen students' interest in learning and exploration. During the observation trip to Jinyun Mountain, teacher L introduced the family, genus, and species of a pepper tree, and the common type of pepper trees students often see in their neighborhood. Such field trips provided opportunities for students to connect theoretical knowledge with nature, inspiring them to learn more. Observation and Exploration to Acquire Knowledge About Nature When working on the nature notes project, students can acquire new knowledge through their own observations or by searching for information. HYF shared her field research experience, "while conducting research in Jinfo Mountain, we found a special kind of toad called red-spotted toad in the cave, and then recorded their sound spectrum with the help of university instruments and found that we could identify their genders through the analysis of their sound spectrum." In the process of exploration, HYF not only discovered the red-spotted toad, but also got a chance to use the acoustic spectrum instrument borrowed from a local university to determine the acoustic spectrum of the animal and analyze the test results. She learned how to distinguish male and female animals by analyzing the acoustic spectroscopy, which laid the foundation for subsequent relevant research studies on other animals. Student ZW learned a large amount of knowledge about the conservation of water resources while she worked on her nature notes projects on rivers and lakes. During the interview, ZW concluded,

> I have definitely increased my knowledge of water conservation through my participation in the activities. Firstly, I learned the basics of water resources, such as the classification of water qualities, the indicators of water components, and the advantages and disadvantages of each component. Secondly,

> I learned about how to monitor water quality, such as how to measure water components and how to trace the origins of water pollutants. Thirdly, I learned knowledge about simple and feasible ways to protect water resources and the investigation of technology for water treatment. Finally, I developed a good habit of protecting water resources.

Besides the learn knowledge about nature, ZW also shared her learning of Chinese traditional culture in the interview:

> Initially, my knowledge about the 24 Solar Terms was mostly from the older generation. In my hometown, the 24 Solar Terms were rarely used, so I knew little about them. After participating in the nature notes program, I not only became more aware of the timing of each solar term, but also became more sensitive to the changes in plants and animals and more aware of the customs of the society around each solar term through the observation of the nature and human activities. Secondly, during the project, I also searched some ancient poems about the 24 Solar Terms, which expanded my knowledge about them and deepened my understanding of the traditional Chinese culture. In addition, through the exchange events, I was able to demonstrate the Chinese culture and local ecology to Canadian students and simultaneously learn the Canadian culture and society.

Improve Students' Overall Ability

Improve Observation Skills In the process of participating in the nature notes project, students went into nature, observed nature, and took the initiative to discover the mysteries of nature. In return, their observation skills greatly improved. Students became more sensitive to the changes of nature and more motivated to discover new things. ZDT shared: After participating in the nature notes program, I became more careful and was able to observe and discover a lot of different things compared to other students. For example, I was able to observe the changes of the seasons, the growth of different plants during each season such as the growth of new shoots of saplings when spring arrives. I was able to observe these things carefully so that I could discover many beautiful things and feel the charm of the nature.

Develop Scientific Inquiry Skills Participating in the nature notes program not only provides students with an in-depth understanding of the traditional Chinese culture, but also expands their knowledge and encourages

them to apply knowledge to their daily lives. Students are encouraged to go out into nature, talk to flowers, birds, fish, insects, and all things in nature, establish a connection with nature, and at the same time develop the ability to inquire about what is new to them.

By going into nature and observing and exploring nature, students not only enrich their scientific and cultural knowledge and deepen their understanding of knowledge, but also learn the methods of scientific inquiry and develop their scientific inquiry abilities. ZW stumbled upon a bug during an expedition to Maanxi Creek. She brought it home, observing the bug's daily growth, taking photos, writing down her thoughts, and recording the weather, date, temperature, and other information about the day. After 25 days of observation, the entire process of the worm turning into a butterfly was recorded with 130 photos. She then selected several photos that best represented the change of the worm and published them with text about her thoughts into a poster that illustrated the complete metamorphosis of the insect. ZW commented on the impacts of the nature notes program on her:

> Participating in this project has enriched my life and expanded the scope of my knowledge, such the production of multimedia, the experience of the defense process, and oral expression and communication skills. After participating in the Nature Notes program, all of these intangibles have been promoted and improved. This program has greatly helped my growth. I have gained a lot from it.

In the process of working on her nature notes projects, ZW carefully and meticulously made observations and records, and constantly found problems and solved them. She gained knowledge and practice in scientific research methods such as observing, recording data, organizing data, representing data using illustrations, and annotating. Such hands-on and mind-on projects improved students' interest and engagement in the inquiry of nature and enhanced their capacity of scientific attitude and inquiry skills.

Change the Way of Thinking and Improve the Ability of Thinking Nature offers great opportunities for students to learn biology, chemistry, geography, and physics. The scientific inquiry methods and scientific thinking

learned in the nature notes projects help students optimize their ways of thinking in classroom learning. ZDT explained: Before participating in the nature notes program, when the biology teacher asked us to investigate something, I would just blindly think about it, not knowing where to start. Now, I am able to work on my biology projects through a rigorous, rational, and goal-oriented inquiry process. I can link my observation of simple subjects to the big ideas. I can reflect on what I observed and get inspiration from what I saw. Most importantly, I became more interested in discovering new things.

Students were able to apply the scientific thinking developed through the nature notes program to their learning in the classroom and gained a clearer and deeper understanding of the subject knowledge. Subject knowledge such as biology, geography, chemistry, and physics come from nature, but also move beyond nature. While working on the nature notes projects, students move from book to nature and nature to book. This is a process of connection between theory and practice, learning and inquiry, which lead to a clearer understanding of knowledge learned in the classroom and an authentic experience of scientific inquiry that classroom instruction cannot often offer. Often, the knowledge learned from participation in the nature notes program goes beyond students' classroom learning scope. This extended learning process can lay the foundation for subsequent school classroom learning and increase students' confidence and interest in school learning.

When students took nature notes, they actively learned from their own inquiry in nature instead of solely learning from a teacher-centered classroom instruction. The biggest gain was their experience with the new way of knowing. ZDT said,

> When I first joined the nature notes program, I lacked training in scientific thinking and had immature views on the things I observed and the problems I faced. For example, I found a frog with a strange sound on a field trip and told my teacher about it. My guide teacher told me that not all frogs are the same frogs as we usually see. What I saw was a tree frog, different from the frog I usually see in my daily life. From this trip, I learned that when looking at things we cannot look at them one-sidedly, we have to look at them with objective and rigorous thinking. When facing problems, we have to think about them in a rigorous way.

In the process of taking nature notes, the teacher guided the students to look at the problem more objectively and critically, to think more carefully and deeply in relation to their existing knowledge. This process enticed their thinking, pushed students to consider all aspects of the problem, and promoted their sense of exploration and innovation in nature.

Improve Students' Collaborative Learning Ability Most nature notes projects were carried out by a group of students, or several groups of students worked on the same project at the same time. ZDT recalled, "When I first joined the Nature Notes project, I was mostly independent, and I thought I would have more freedom and time to complete the project without the time constraints of everyone else." Then ZDT added, "I got more inspiration after sharing my feelings and gains with everyone. And in the process of drawing nature notes, students shared guidance with each other and gave each other some suggestions, and then added their own feelings, which not only improved the efficiency of drawing nature notes, but also improved the quality of the nature notes work." Like ZDT, participants realized that any individual person has limited knowledge and experience, while working together can lead to more knowledge, inspiration, and interest. It will also increase students' reasoning and communication skills. The positive outlook on collaboration developed from the program will benefit students in their future life and career. Develop Students' International Perspectives and Improve Their Interpersonal Communication Skills The nature notes program is a kind of open learning. It is no longer limited to school or classroom, and instead moves into society and nature. It can improve students' confidence, enrich their emotions, and improve their interpersonal skills. Student participant MYL shared, "when we were outdoors investigating wetlands or polluted rivers, we sometimes encountered local people's lack of understanding about what we were doing. We needed to communicate with them and make them understand the meaning of our activities." In such communications, MYL explained the activities to others in detail and the necessity for becoming advocates to protect the ecological environment of the river. In the nature notes program, students were able to engage with the community in a way that is not available on the school campus. Student participant ZW also mentioned in the interview:

> Through the nature notes projects, I learned how to get along with others, to communicate with others, to think differently and to take into account the feelings of others. When I made an arrangement, I first considered whether the appointment time was convenient to other people, followed by whether the location chosen was appropriate, and whether the instrument was being used by others. I learned to integrate all these factors into my arrangement, instead of just thinking myself.

In the process of working together, students learn to communicate with each other and create a harmonious atmosphere of collaboration to accomplish a task together. As a person in society, communication between people is essential, and the development of interpersonal skills is not only helpful for study, but also for life and work.

Based on the platform of the Canada-China Reciprocal Learning Program, the nature notes program exchange activities between Canadian and Chinese students does not only allow students to share different natural and biological knowledge of different countries, but also to exercise their written expression skills, enhance their confidence in communication and learning, and learn the different cultural customs of both sides and the charm of different language expressions.

Promote Students' Self-Development

Environmental Awareness and Behavior The nature notes project not only enriches students' knowledge and broadens their horizons, but also stimulates their awareness of protecting the ecological environment. ZDT, the youngest River Caption in Chongqing, and her volunteer team often carried bags with them when they patrolled the river to pick up trash. They recorded their thoughts about protecting the river in notebooks. The awareness of environmental protection was deeply engraved in their minds. These students put their love for nature and nature protection into action. HYF expressed her joy in the interview, "the excellence award I got in Chongqing nature notes contest gave me a lot of confidence and motivation to love the nature and life more, to observe the world with a more exploratory eye, and to enrich my after-school life." Through the nature notes projects, students connected their observations of nature with the 24 Solar Terms, linking education with nature and real-life experience, and developed students' independence, confidence, self-improvement, and self-management skills. The nature notes program is a

way for students to learn in and about nature. Participating students developed a sense of environmental protection.

Career Planning and Professional Selection The impacts of the nature notes program on students extends from middle school and high school to college and even to their future career choices. HYF, a former program participant, is currently a senior at Sichuan University majoring in agricultural water engineering. Her participation in the program had a great impact on her major choice. She participated in the school-organized field trip to Jinfu mountain in 2014. During that trip, she observed different animals, including red-dotted toads and black-belted snakes, which triggered her interest in biology and ecology. She wanted to pursue a career in the use and protection of water resources. ZW, who fought her way through the environmental engineering program, was also deeply influenced by the nature notes program. She says, "The spirit of the nature notes program is that you have your own perceptions and feelings and then share them with others." Growing up in the countryside, her initial curiosity about nature became her internal motivation to participate in the nature notes program. Based on the current employment situation, her parents advised her to choose a popular major such as finance or economics, while she preferred to choose her favoured major in environmental engineering. In order to be admitted to her favoured major, she used a clever way to apply for a volunteer position and was eventually admitted as she wished. Driven by internal motivation, she continued to explore and research nature, discovered a new species of black-framed toad, won the Grand Prize in the nature notes competition, and received positive feedback from government departments; all of which pushed her to study and research further in the environmental field.

Life Philosophy and Survival Wisdom "Survival of the fittest" is not only the law of survival in nature, but also the law of survival in human society. WYN's observation of birds made her realize this. From nature to life, participating students not only applied the wisdom they learned from participating in the nature notes program, but also learned the philosophy of life and experienced the meaning of life. From observing puppies eating corn, to reflecting on how to care for animals in the right way; from observing the growth of tadpoles, to understanding the magic and greatness of life; from observing the process of giant phoebe butterflies

changing from ugly to beautiful, to understanding that things should not just be looked at superficially.

The Impact of the Nature Notes Reciprocal Learning Program on Canadian Students

In order to examine the impacts that students received from participating in this project, eleven students participated in two face-to-face focus group interviews to share their thoughts and feelings. One focus group took place with six Grade 8 students, three females and three males. The other group had five participants, all females. In general, all 11 students felt that the 24 nature notes project was a positive experience for them. They were delighted with this unique learning opportunity. Their reasoning is summarized into three themes:

1. Participants valued the chance of experiencing nature and learning new knowledge;
2. Their personal interest and freedom of learning was fully respected;
3. The project had opened their mindsets.

The Chance of Experiencing Nature and Learning New Knowledge

There were four steps in the nature notes projects, including outdoor observation, data collection, display findings, and communication with sister school partners. Among all responses, seven out of eleven students responded that designing a way to show their learning was their favorite step among the four. They found that putting information together and building a model to present their findings was a fun experience. According to the students' sharing, the nature notes program was a new experience for them. They described some uniqueness that this program had given them. Instead of finding information online as they usually did, students went outside and observed nature. This gave them an actual chance to experience animals or insects on their own, rather than the traditional way of learning from a teacher. Through the whole process of conducting this project, students learned not only knowledge about nature but also a

variety of things, including learning how to write paragraphs, how to find information, how to make a bibliography, and how to work in a team. More importantly, they knew that learning about the specific insects or animals in their surroundings would be beneficial to their studies. Student K1 learned that the common house spider "is not poisonous at all," and therefore he will not fear this insect anymore. Student A1 was satisfied with the project because "you get to learn about different animals, insects, and plants in the world around you." Student J1 also enjoyed a good learning experience in the area near her community. She explained, "we were able to connect to the things that were in our area and experience those things in the outdoors" (Fig. 5.7).

Fig. 5.7 Canadian students outdoors looking for interesting topics of inquiry

Respect Personal Interest and Freedom of Learning

A major feature of this program was that the Canadian students' personal interests were highly respected. Students valued this aspect, as it helped them become self-motivated learners. Besides this, the students were extremely satisfied that they were given complete freedom in selecting topics, as well as designing a way to present their learnings. They indicated that they "had never experienced such full freedom in other assignments." Students particularly liked to have a very broad topic to choose from. They were encouraged to pick whatever topic that interested them. Once they picked a topic, they started their learning observing nature and researching more about the selected topic. After that, students can narrow the topic down and collect data or information. The last step for them was to design a way to present their findings. Student A1 specifically indicated that the teacher allowed them to pick their own inquiry question. "Unlike the other projects, our teacher picks inquiry question for students," she said. Student H1 also shared that she was allowed to pick her own animal or insect, unlike other projects where all students were required to research the most common animal. H1 preferred this way because those teacher-centered projects were "quite boring." Student I1 indicated that the other projects were "structured," and students had to write "long reports." Student J1 also liked that the research topic was not assigned by the teacher but chosen by the student. She enjoyed the diverse options that she could choose from. In this project, the student was the initiator of their own learning. The teacher respected each student's personal interest and set them free to do what they felt was interesting. These two points were essential as they kept students highly motivated. Consequently, students were willing to complete their projects in a timely manner. Take student B1's response as an example, she said that she could do it any way she liked to present her work. All Canadian students highly appreciated the freedom, which helped open their imaginations and create what they felt was appropriate to showcase their learning. To summarize all Canadian students' sharing, with the unique way of doing this program, students had learned how to pick inquiry question(s), how to gather information, and how to answer those questions. Those achievements fulfilled the curriculum criteria, as well as met the program requirements. Moreover, the inquiry topic that they chose reflected their different personal interests. The creativity shown in their final products highlights the benefits of the student-driven process of learning. Four pieces of student work are provided below as examples (Figs. 5.8, 5.9, 5.10, and 5.11).

Fig. 5.8 Showcase 1: Student's inquiry in bees (Inquiry question: How do honeybees survive in winter?)

Fig. 5.9 Showcase 2: Student inquiry in the hibernating bear (Inquiry question: Why do bears hibernate in winter?)

Open Students' Mindsets

Canadian students shared that the nature notes program had opened their mindsets and given them the opportunities to learn from their counterparts in China. The students went to the school garden to look for animals or insects that interested them. This was their initial way of connecting with nature. Unlike their Chinese partners whose parents normally provided transportation to conduct nature observations, these students' parents were not always able to bring them to a more natural environment

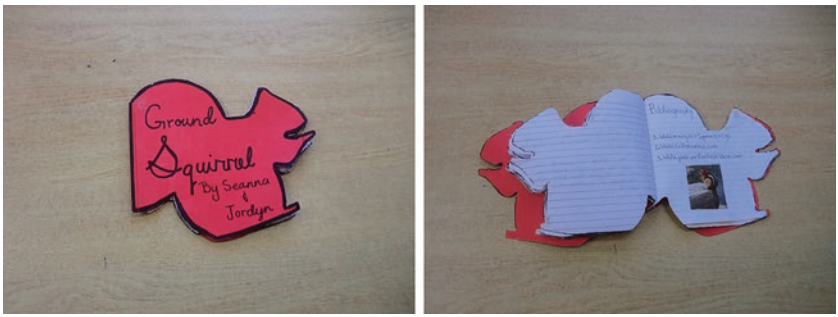

Fig. 5.10 Showcase 3: Student inquiry in squirrels (Inquiry question: When and how ground squirrels decide to go for hibernation?)

Fig. 5.11 Showcase 4: Student inquiry in butterflies (Inquiry question: Why are butterflies an important part of nature?)

due to work or other reasons. Instead, the Canadian students had to find their own way to connect themselves with nature. For instance, student K1 was interested in spiders, but he first thought that the common house spider was poisonous so he avoided touching them. However, K1 decided to do a science project with this insect because he believed that "it's a good project to open up your mindset." He first did some research into the common house spiders and found that they are actually not poisonous. This discovery gave him confidence to catch a spider from his basement and see how long it would live. Student K1 spent a period observing the spider and also feeding it with different foods. He later had some findings about the food that the spider eats. K1 documented the process and

planned to show his pet spider and all his findings to the Chinese partners in the Skype video conference. Unfortunately, this pet spider died for unknown reasons. Student K1 was very upset about that, however, he learned a lot of new knowledge from doing this project and his mindset had shifted.

According to the two Canadian teachers, their students loved the idea of "life lessons" which was shown in the Chinese students' project work. In a Grade 8 class, teacher H had a discussion with the students after having the video conference, one of her students told her that the Chinese students "included a moral, like the legend building" in the project. The students hoped teacher H could incorporate that idea in the next round of their projects. Teacher F's students also had such hopes. In response, teacher F added two new questions which helped her students looking at the animals, plants, or nature from a new perspective. Her students welcomed this addition. In the group interview, all Grade 8 students reported that they liked the idea of making stories to reflect on what they learned from nature. Student D1 shared her view by giving an example. She commented that the Chinese students "always have really interesting stories. Like that one girl who talked about the tree [the tree in her backyard was struck by lightening. She was very sorry for the tree. But the tree surprisingly came alive in the spring. The student commented that a person should not give up]. That was like a real story, and it was cool." Student A1 elaborated her feelings, "it is easier for you to relate to the animals when you learn the similarity between you and the animals." Take another story as an example, a Chinese student used to have a pair of pet parrots. One day, one parrot escaped from the cage, but it did not fly away. The Chinese student interpreted this as the parrots staying loyal to each other because the one that escaped was waiting for the other one to be set free. Canadian students appreciated this story, but they had a little bit different interpretation. Student B1's reflection was, "you should stay loyal to someone accompanying you. You have someone in such a lower situation, you have to still stay with them and help them." This example showed that forming a life lesson like their Chinese counterparts was a brand-new experience to the Canadian students. Canadian students appreciated the Chinse students' inspiration in creating stories related to human life. They were also willing to try the Chinese way of perceiving life from a different angle. For instance, Canadian student J1 studied caterpillars (Fig. 5.12), and she shared a life lesson that she learned, "people should not judge other people based on their appearance." This example demonstrated that

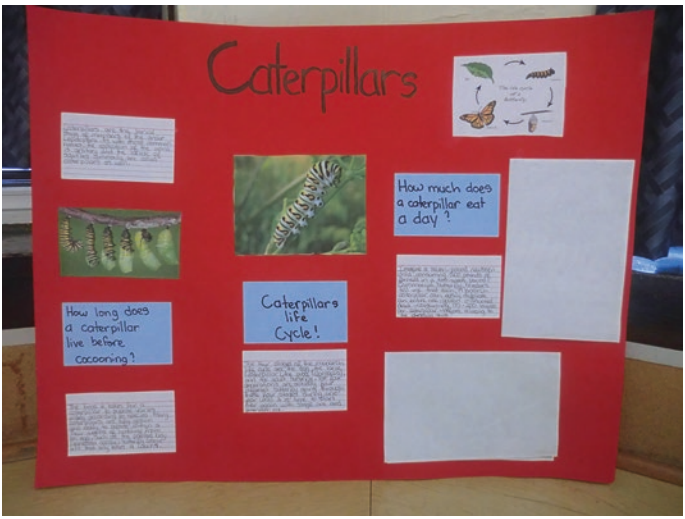

Fig. 5.12 Caterpillars

the student's understanding gained from this activity stepped forward from just simply doing a regular project, to forming a deeper understanding of life. This change suggested that Chinese students' work had a great impact on how Canadian students viewed the human-nature relationship.

Cultural Differences and Mutual Impacts

In this program, Canadian and Chinese students realized the differences between them. Chinese students often expressed their reflection on their nature observation by connecting nature with their own lives or human society in general. Canadian teachers and students were inspired by this new aspect of outdoor learning. For example, Canadian student J1 took a life lesson from her observation of how "ugly" caterpillars turned into beautiful butterflies.

Chinese students realized the strength of Canadian students as well. Canadian students demonstrated great creativity in presenting their works. For instance, their innovative ways of presenting can be illustrated by a 3-dimensional butterfly (Fig. 5.13), a ladybug-shaped cake (Fig. 5.14), and a clay model hedgehog in a shoebox (Fig. 5.15).

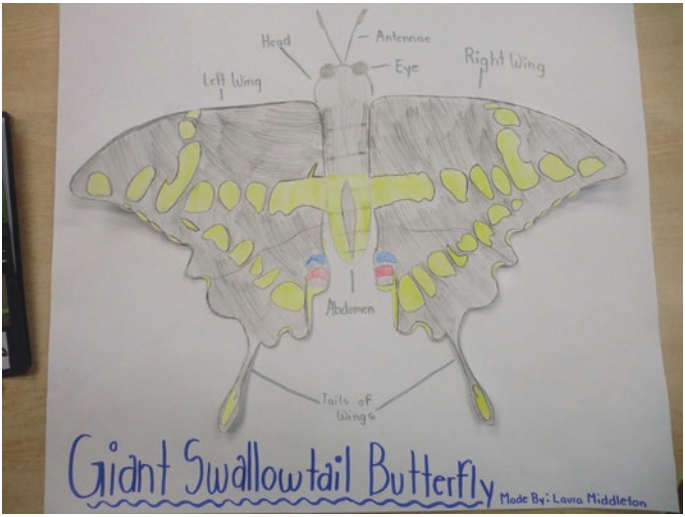

Fig. 5.13 Giant Butterfly Three-dimensional Painting

Fig. 5.14 Ladybug Cake

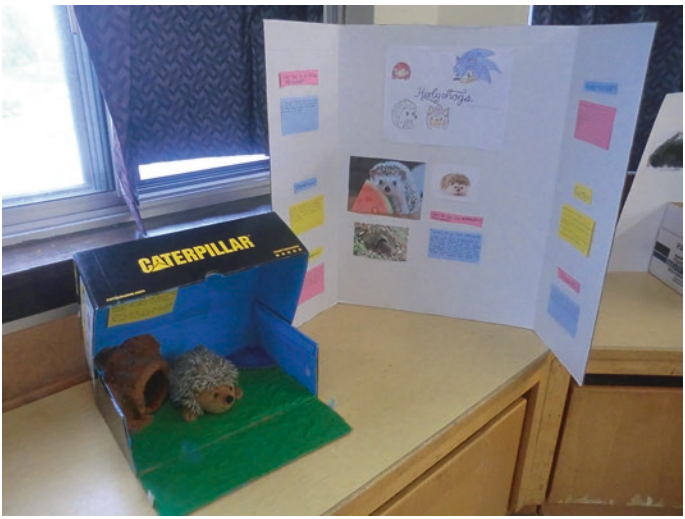

Fig. 5.15 Hedgehog in a Shoebox

During the Skype meetings, Canadian students noticed the differences between themselves and the Chinese students in terms of presenting what they learned. They appreciated the Chinese students' talent in art, as they always drew beautiful pictures. However, student D1 proposed a critical point, "they all presented their work in the same way. They all drew pictures." Unlike Chinese partners, Canadian students presented their work in many different ways. Canadian students were proud of their own creativity because it "makes the project more fun." Since they noticed these differences, Canadian students gave some constructive suggestions to their Chinese partners. They suggested Chinese students "change the way of presentation, not just doing it like a picture and writing." The Canadian students hope to see the Chinese students' uniqueness in their ways of presentation because they wanted to help them become creative members of the learning community.

Reflecting upon each other's strengths and weaknesses made the program a valuable reciprocal learning opportunity for students from both sides. Since its inception, the nature notes program has not only improved students' knowledge and abilities but has also demonstrated its unique characteristics in terms of self-development. The nature notes program has

been a platform for students from both sister schools to exchange and learn about their respective cultures, especially in science and technology.

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