獲卓越教學獎的教學實踐

Teaching practices presented with the Award

Science Education Key Learning Area

科學教育學習領域

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Using Science Journals
to engage student learning

Teacher presented with the Award

Ms CHEUNG Tung-ping
(Years of teaching : 33 years)

School

Munsang College

Subject taught

Science (S1-2)

Teaching Philosophy

"In addition to learning science, students can also develop interpersonal and problem-solving skills through science investigation. Through writing science learning journals, students develop an interest in science and become active participants in their own learning."

Interview with the Teacher

Writing journals can help us keep record of what we have done or learnt. In order to keep track of her students' learning progress, Ms CHEUNG Tung-ping from Munsang College has used journal writing to engage students in inquiry-based science learning.


▲Students are very involved in Ms CHEUNG's Science lessons.

"The current S6 students are the best living proof of how writing Science learning journal help them achieve outstanding results in class," says Ms CHEUNG, now happily seeing the fruits where seeds were sown some years ago.

Learning from others

In her 30 odd years' teaching career, Ms CHEUNG has built up her own style of teaching in Science. However, it was not until the late 90s when she participated in an educational activity in which she was strongly stimulated by what another school was doing.

In a sharing session, a teacher from a school using Chinese as the medium of instruction shared his experience of encouraging students to get involved in Science class by asking them to write learning journals.

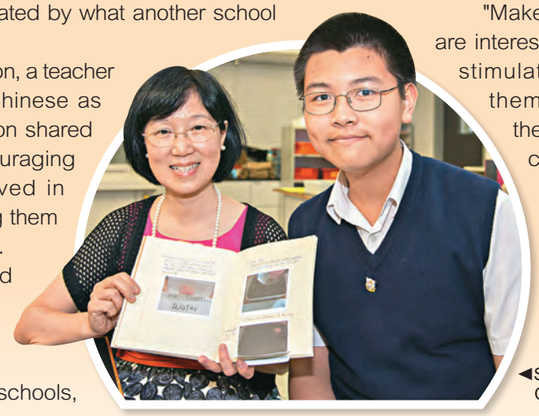
"I was truly amazed by what his students could do," she says. "Although the school wasn't one of the best schools, students did extremely well in Science subjects."

Ms CHEUNG adapted the method and infused her own ideas to make it work in her school, and since then journal writing has become an important part for students in learning Science. She explains, "Science journal writing is basically recording the processes of experimentation, analysing each step and the results. However, asking students to write down every step and observation makes it easy to assess whether they really understand what they have learnt in the process. Putting ideas into words is just as important as performing the experiment correctly — students can only express their ideas well when they fully understand the process."

Jumping out of the box

Ms CHEUNG has worked hard to develop students to be self-motivated learners. She introduces scientific investigations of varying difficulties to students. These investigations are all related to students' everyday life, as she believes that guiding students in investigating everyday phenomena is more important than teaching textbook knowledge. "We started from simple experiments such as observing tea leaves and candles."

"Make sure the issues discussed are interesting to students. This would stimulate their curiosity and lead them to ask questions. When the problem to be investigated came from students, from their need to know or to find a solution, students would feel the autonomy of learning and will be fully involved in the process," she says.


◀Students enjoy writing journals and Ms CHEUNG is amazed by their work.


▲Standard weights are available in the laboratory. What if we do the experiment at home?


▲Students' science learning journals

"I was reading the journals written by the students in response to my question of what will happen to an egg if it is put into some acids," Ms CHEUNG recalls.

While reading the works of students, Ms CHEUNG was slightly upset to see that one of her students did not follow her instructions. But she carried on reading and found that this student in fact did something out of her expectation.

"I asked students to put the whole egg into vinegar, but this student only put half of it into vinegar. She actually wanted to put the egg under two different conditions to compare the results," she says. The result was that the half immersed in vinegar expanded, while the other half remained the same in size.

Ms CHEUNG was very pleased that this student could explore her own ideas further in the experiment, "I've learnt a lesson from this student too — never be too quick to judge."

Another experiment involved testing the elastic limit of an elastic band, measuring how much an elastic band will extend when force is applied. "At school, we use weights or a spring balance to apply the force; so what could students use at home? Here, our goal is to see how creative students are in improvising," says Ms CHEUNG. "Some of them used clothespins, oranges or bottles of water. It's very interesting to see how creative they are."

Students are always very involved in class enjoying their experiences of investigating and sharing their findings with their peers. Through exchanging ideas, students could learn faster and also learn how to appreciate others' success.

Expected learning outcome

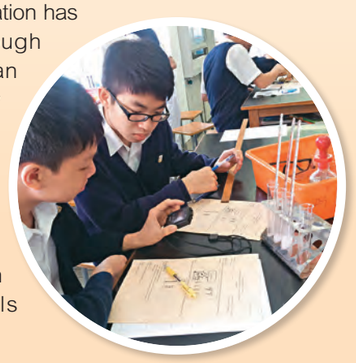
Indeed, creativity, critical thinking and problem solving are all important in scientific investigation. To help students learn better, Ms CHEUNG sets Expected Learning Outcomes for her students and she expects them to make progress through conducting experiments and writing journals.

Ms CHEUNG also uses current affairs to stimulate students' thinking. "For example, discussing the recent Lamma Island boat collision incident, I asked students why the boat sunk so quickly," says Ms CHEUNG.

Practical assessment

Ms CHEUNG recalls that before it took a lot of time and manpower to assess students' performance; now it has become much easier.

"40 students in the class are divided into 20 groups, each pair of students has to design the experiment together and each writes his own report. Since the foundation has been built solidly through journal writing, they can analyse the data they gathered, make the analysis during the lesson and complete the report. They can easily manage each step as they have been practicing these skills since S1," she says.


▲Students show their talents in designing and carrying out experiments in practical assessment.

Rewarding results

Now, the brilliant results achieved by the students have proved the significance of journal writing in Science learning. "We evaluate and refine teaching methods annually to ensure both teachers and students benefit through the process. Our greatest wish is to inspire passion and nurture inquisitive habits and process skills in Science."

Teacher's Sharing

I always remind myself that I am a Science teacher. I keep asking myself, "What is science? How is Science different from other subjects? Why do students need to learn science? How would students learn science best?" If I am not clear about my role and the purpose of learning science, I would not be able to help my students learn better.

Tailor-making the Junior Science curriculum

When I reviewed the Junior Science curriculum in our school in 2004, I came to realise that "science process skills" and "scientific investigation" were the foundations of science learning, and were set as important learning objectives in the Science (S1-3) curriculum guide. I tried to incorporate these learning objectives into our school-based Science curriculum. In the lessons, students learned how to make hypotheses, design experiments and select appropriate apparatus to be used; lessons became more interactive and interesting. In addition, I set Expected Learning Outcomes for each level and shared them with students at the beginning of the school-year, so that they could keep track of their own progress from time to time. This practice, I believed, would help students realise the importance of goal setting in their learning as well as in pursuing their own dreams later in life.

▲Comparing the experimental results of the different groups

Creating an effective and independent learning environment

It is also important for students to make use of resources wisely for independent learning. Each group of students has their own tray of apparatus (test tubes, beakers, funnel, evaporating dish, etc.) in a side bench drawer in the laboratory. They can select from the common apparatus for use in the experiments they designed and clean and return it afterwards. We trust our students and allow them to use the more delicate measuring instruments, such as the electronic balance. They become more serious and cautious in handling the equipment. The autonomy it entails enhances students' ownership of learning and develops their sense of responsibility.

Journal writing

I emphasise learning by doing, so hands-on experiences are important in students' learning, both inside and outside the classroom. Hence, I ask students to keep a personal Science Learning Journal in which they record science-related issues of interest, their observations and their process of investigations.

For example, I asked my students to answer this question at home: "Does adding salt make ice melt more quickly?" Students needed to design a fair test investigation to find the answer, write a laboratory report of their study, evaluate the method and suggest some further experiments that they could do. I was thrilled to find their ideas both creative and unique. The students discovered shortcomings in their investigations and came up with creative ideas for improvement. They voluntarily spent time doing their investigation at home and researching additional information online to solve their problems. A simple task had sparked their curiosity in a quest for some simple truths.

▲Helping students in an investigation

Students' reflection showed that they had gone through an independent research process. They started from not knowing how to conduct an investigation to gradually mastering it. They all faced the challenge of not having the necessary apparatus to perform the experiment at home, so they had to solve the problem creatively. This process was similar to what early scientists experienced in their research: the problem of not having appropriate equipment to perform the experiment and the joy of discovery.

In my feedback to students' journals, I acknowledged their creative ideas and encouraged them to think more critically. I showed appreciation for their creative designs and the efforts they had put into their work. I also shared my thoughts with them. I tried using questions to stimulate them to think and looked forward to seeing improvements in their work. By displaying the good works of some students, I encouraged them to learn from each other. This could cultivate a positive and appreciative culture in class. Students took the good exemplars as reference and were eager to do as good, if not better, in the next task.

Investigative practical assessment

The goal of practical assessment is for students to demonstrate their problem-solving skills in a science investigation. To prepare for the assessment, various investigative and process skills are taught in the different Units from Secondary One.

In a double lesson in S2, students are put into pairs to work on an investigation. They need to discuss the task, design the experiment, carry out the investigation and write down the results in the first lesson. They then write their laboratory reports individually in the second lesson. They work seriously with their partners, and complete the report on their own. Although the data is the same, the presentation, evaluation and reflection displayed in the report varies greatly from student to student. Most students are able to complete the tasks in the double lesson. Such assessment reflects students' learning and provides a good opportunity to evaluate our teaching. It also promotes a positive learning attitude towards investigations in science.

Conclusion

My teaching belief is that students learn through practice. Let students take control of their learning; trust them and they will surprise us.

Assessment Summary

Dedicated to developing the "student scientists" - initiated the science learning journal to motivate students to explore on their own, and provided feedback to promote self-directed learning.

Ms CHEUNG is a dedicated, reflective and charismatic teacher who is keen on exploring strategies to motivate and engage her students in learning. She has worked out a holistic and systematic plan to promote students' scientific thinking at the junior secondary level. By linking up science practical activities with students' everyday life, she has successfully stimulated students' curiosity and interest in science.

To engage students in self-directed learning, Ms CHEUNG guides her students to keep science learning journals for recording and reflecting on their science learning experiences both at school and at home. The various investigation ideas and reflections recorded in the journals not only reflect students' creativity but also their ownership of learning. Under Ms CHEUNG's guidance and encouragement, these students become active learners, designing their own experiments to explore a scientific topic. The science journals of these students show their great achievement of learning.

Ms CHEUNG always provides written feedback on every student's learning journals. These feedbacks include what the students have done well and what else they could investigate further. She also shares with her students the good work of their classmates. With the meaningful feedback she provides, students are able to learn from other's exemplary work and thus motivated to strive hard in order to be in Ms CHEUNG's list of good performers next time. Ms CHEUNG has made very good use of assessment for learning and made positive impact on students' self-directed learning. She makes good attempt in motivating her students to fulfill their potential in science.

A range of good teaching practices has been observed in Ms CHEUNG's classes. Students are allowed to choose the most appropriate apparatus and equipment for doing the experiment; they could make decisions on the procedures and the way they record the results. They could carry out the experiments neatly, efficiently and independently. They work collaboratively and effectively in groups and respond quickly to the instructions of the teacher. There is strong learner autonomy in the classroom where students take up responsibility for their own learning.

Ms CHEUNG has participated actively in education-related researches. She helps in developing exemplary teaching materials, and video clips of her lessons have been uploaded on the web for sharing with teachers. She also supports other teachers through sharing of good practices and teaching ideas in seminars and conferences.

►Students design their own experiments which enhance their interests in learning Science.

Way of Obtaining Information of the Teaching Practice

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▲From left to right: Ms LAW Ming-wai, Mr CHAN Pat-chun and Mr WONG Chi-fai, Thomas

Learning in and learning for the environment

Teachers presented with the Award

Mr CHAN Pat-chun
(Years of teaching : 16 years)
Mr WONG Chi-fai, Thomas
(Years of teaching : 23 years)
Ms LAW Ming-wai
(Years of teaching : 6 years)

School

Queen Elizabeth School Old Students' Association Secondary School

Subject taught

Science (S1-3)
Biology (S4-6)

Teaching Philosophy

"Our school-based Science curriculum is guided by the school motto 'Vos parate ut serviatis' (prepare yourselves that you may serve). We provide different learning opportunities to build up students' knowledge and skills in science. We take students into their community to learn in the environment, and learn for the environment."

Interview with the Teachers

Tin Shui Wai, where the school is located, is rich in natural resources. It is a good platform for science learning and teaching; ample opportunities are available for students to learn in the community.

▲Students working in the Molecular Biology Laboratory

The enthusiasm of teachers is a great asset to inspire students' passion in learning. Coupled with a state-of-the-art laboratory that can provide various experiences in science learning, students, teachers and the community can all benefit. This is the situation at Queen Elizabeth School Old Students' Association Secondary School.

The team of awarded teachers believe that developing students' scientific literacy, so that they can make informed decisions in science-related issues, is as important as passing on knowledge and skills to help them excel in examinations.

The flexibility of subject combinations in the New Senior Secondary curriculum and the new Biology curriculum allow a more diverse learning and teaching experience. "For example, to make lessons on ecology more interesting, I would incorporate historical elements and biotechnology in the traditional oyster culture industry into my science teaching so that students would have a glimpse of how to relate science to history as well as to our daily life," says Mr CHAN.

"In order to develop students' skills in biotechnology, we have been working very hard to equip our Molecular Biology Laboratory for the benefit of the students," Mr CHAN states. "In the past, we had to solicit help from the university to measure the concentration of heavy metals in environmental samples, but now, we are able to estimate it with the use of fluorescent bacteria," explains Ms LAW. "Now, with the equipment and facilities in our laboratory, we can design innovative experiments for students to carry out inquiry learning, and students are able to do their own experiments and collect data here."

Serving the community

Internalising the wisdom and knowledge of the past aside, learning from Nature is the most direct way to understand science and our world. Tin Shui Wai, where the school is situated, is the best location for students to learn from Nature.

"We took students to the Hong Kong Wetland Park, Yan Chau Tong and the oyster fields at Lau Fau Shan, for example," says Mr WONG. "Because science is related to a place's culture, economy and environment, by doing field studies, students are able to understand more about their living environment, the people around them and the history of walled villages. We hope that students will develop a sense of belonging to their community."

For a long time, the school has been designing programmes to engage students to learn and serve in the community. When the Hong Kong Wetland Park was first opened, Mr WONG sought opportunities for his students to serve as eco-tour guides, so that they could gain a better understanding of Nature and develop good communication skills.

▲Students act as eco-tour guides.

Boosting confidence, voicing concern

"Our students have been doing very well in local competitions like the Inter-school Bird Race," Mr WONG says proudly. Apart from local contests, Mr WONG has also been leading teams to participate in overseas conferences. "The experiences are valuable; students not only learnt to use English to discuss with foreign students, but also opportunities to develop their life skills."

Teachers, on the other hand, shared the honour when students won the competitions. "Of course we are pleased to see students winning awards. Even if they did not, gaining the confidence and enthusiasm in learning science is already the greatest reward. Most importantly, teacher-student relationships have been strengthened through the experience," says Ms LAW.

Moreover, students have broadened their horizons and developed their awareness of social issues through various projects, such as the genetically modified (GM) papaya project. In the project, students found that papaya is the most common GM crop grown in local farms. The prevalence of GM papayas growing in the local environment would cause serious problems of genetic pollution. It would adversely affect the organic farming industry in Hong Kong. One of the students working on the project decided to voice his concerns at the Legislative Council about allowing the cultivation of GM papayas in Hong Kong to be legally exempted. "In a three-minute presentation, this student expressed his concerns supported with the data he collected in the project, which I believe is the greatest reward he has gained from the project," Mr CHAN explains.

Language — a big challenge

Although the school enjoys a lot of success in science learning and teaching, language is a big challenge. English is still a concern for many students, but the teachers are determined to help them master both Chinese and English.

"I remember an A-level student came back to school to thank me. She said she passed the university admission interview only because I had insisted teaching in English," Mr WONG says gladly.

▲Students participating in the Hong Kong Science Project Competition

Teachers' Sharing

Scientific Literacy as an overarching goal of our school-based Science curriculum

Our team believes that effective teaching practices in science should embrace the goal of promoting scientific literacy among students so that they can make informed choices and decisions about science-related issues and problems that occur in daily life. Pertaining to scientific literacy we include two related but distinct senses:

* "Being knowledgeable, learned and educated in science" — an understanding about the science contents and themes of science such as the nature of science and scientific inquiry
* "Basic literacy ability" — the ability to read and construct meaning from scientific texts

Being knowledgeable, learned and educated in science

We would illustrate this sense of scientific literacy by our work done in the areas of Education for Sustainable Development, Biotechnology Education, Scientific Inquiry and the promotion of the application of science in real life context.

Education for Sustainable Development

One important characteristic of a scientific literate person is the capability to balance between the predicted positive and negative effects of science on the environment. Our curriculum particularly focuses on strengthening students' understanding of the natural environment and its interaction with science, both in local and global issues.

We organised cross-curricular field studies and visits to provide authentic learning experiences for students. Apart from Science, Geography and Chinese Language are involved in the junior form cross-curricular visits in the coastal areas of Deep Bay (S1) and Tai Tong Nature Trail (S2). Senior form students from different subjects like Biology, Economics, Geography and Tourism and Hospitality Studies would have their Chinese white dolphin watch and Tai O visit. We trained students to serve as eco-tour guides who could also serve to educate a great number of their peers. We also organised international exchange tours and our students have participated in the Youth Conference of the Caretakers of the Environment International since 2000.

Biotechnology Education

We believe biotechnology will likely impact students' life and the community in the future. With this vision, our school decided to establish a Molecular Biology Laboratory in 2005. We tailored our Science curriculum to infuse different biotechnology topics into all levels so that all students in our school are provided with some biotechnology learning experiences. For example, our S1 students would have practical work on DNA extraction. S3 students would learn about genetically modified (GM) food so that they can make informed decisions on whether to support GM food or not. The establishment of the laboratory also facilitated the implementation of biotechnology-related practical work and biotechnology-related inquiry activities, such as the detection of GM papayas by Polymerase Chain Reaction (PCR), the use of bio-indicator species, such as the green fluorescent protein-expressing bacteria *Daphnia*, and water- or air-borne microorganisms in environmental monitoring, at both junior and senior levels.


▲Students working on the solar-cooker project


▲Discussing the experimental findings with students

Scientific inquiry experience

In addition to acquiring scientific knowledge, students need to have an understanding of how science works. Our school-based curriculum is conceptually grounded in the framework of scientific inquiry ladder proposed by Bell et al. (2005): Confirmation; Structured inquiry; Guided inquiry; and Open inquiry. To scaffold students to advance through each level, students at different grade levels are given tasks of different complexities. With extensive experience of conducting scientific inquiry, our students reaped a number of prizes in school science competitions in Hong Kong in recent years.

Application of science in real life context

To achieve the goal of helping students to apply science in real life context, we deliberately provide students with learning opportunities to use scientific ideas, processes and reasoning. For example, our students applied their scientific knowledge of global warming, heat transfer, energy efficiency, etc. to analyse the effect of screen-building in Tin Wing Station near our school, and expressed their concerns to the MTR Corporation Limited and the government in 2012. We also organised our students to serve the community as eco-tours guides in different regions in Hong Kong, like Lau Fau Shan, Nam Sang Wai, Lung Kwu Tan and Lai Chi Wo.

Basic literacy ability

This literacy component stresses the ability to read and construct meaning from scientific texts. The focus is to boost students' ability to read and write in English and their confidence in using English to learn science.

As academic language used in science differs from language used in everyday life, students face a great deal of linguistic challenges when learning science. We adopt the genre-based approach to teach academic science language. Students are guided to write science texts in English through the provision of sentence patterns in writing procedures, recording observations, writing discussions, drawing conclusions, describing features and causal relationships. We also introduce thinking tools (e.g. visual organisers) to assist students to organise and express their ideas in English.

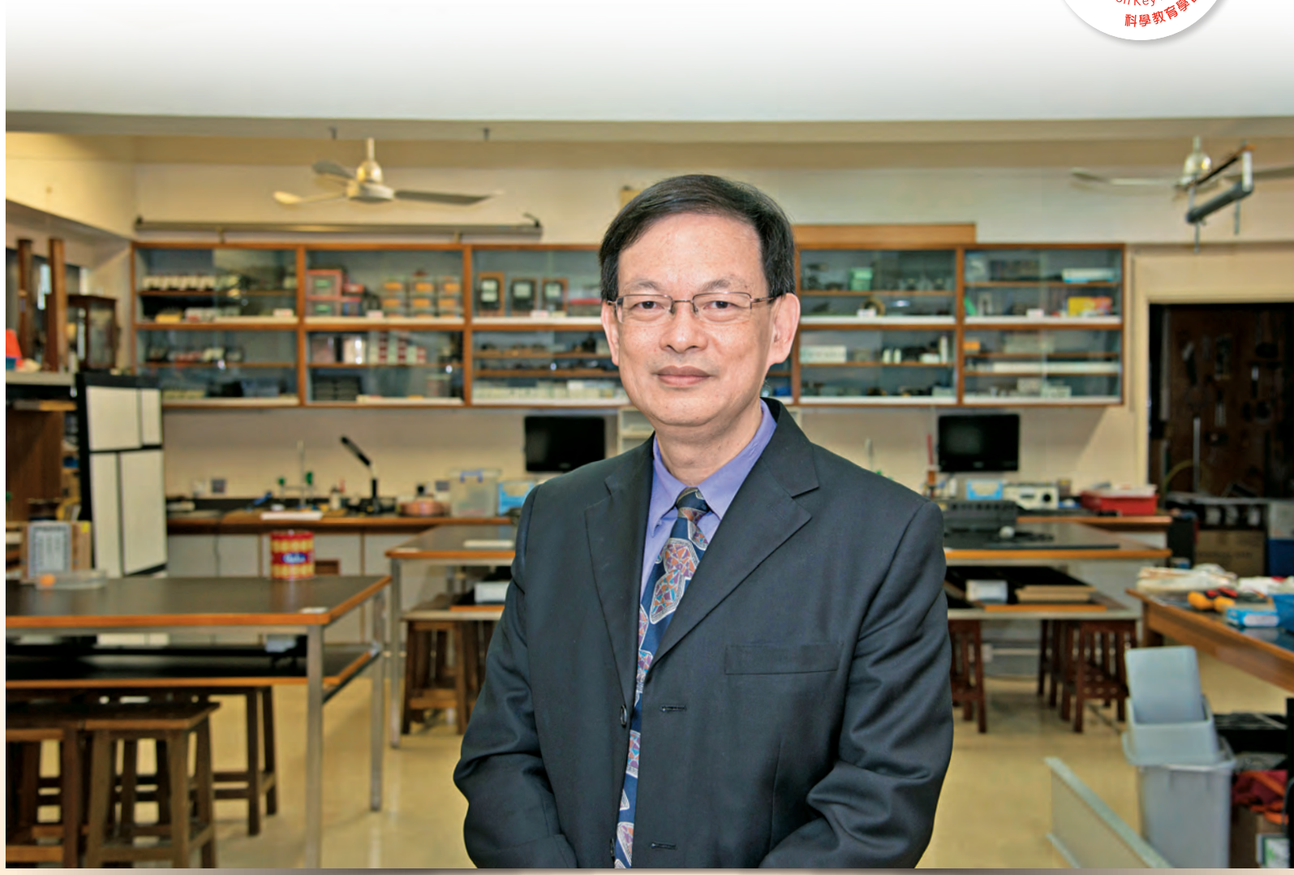
Reflection

Through recent years of work on promoting learning Science in English, we have become more aware of the importance of strengthening the basic literacy ability of students in science lessons. More effort will be made to integrate literacy elements into the planning of our Science curriculum.

We will also continue our tradition and strive for further improvement by capitalising on our own strengths. For example, with the well-equipped Molecular Biology Laboratory, we will strategically incorporate more biotechnology teaching topics or issues related to traditional biotechnology in China (e.g. dyke pond fishing, oyster culture, etc.) into the school Science curriculum.

Conclusion

Reflecting on the work we have done has reinforced our professional vision and mission of the need to promote scientific literacy among students and has allowed us to identify our areas of strengths and weaknesses for future planning to realise our goals.



Enhancing Physics Learning through good demonstrations

Assessment Summary

Enhancing students' scientific literacy and strengthening their environmental awareness

These three awarded teachers have shown great passion and professional innovation in their teaching and curriculum development. The team has worked out a holistic and systematic plan to promote scientific literacy, which includes students' robust understanding of scientific concepts and processes, and the application of science in real life context, with a vision that students would take sustainable actions in everyday life and make informed decisions based on scientific evidence.

It is a carefully planned programme across the six secondary years for the Science Education Key Learning Area. Abundant Nature experiences, such as bird watching and fieldtrips, are provided to develop students' values and attitudes in conserving, protecting and maintaining the quality of the environment. The curriculum materials developed by the team are original, local and authentic with a strong focus on scientific literacy and scientific inquiry. Current issues are chosen to arouse interest and in some of the topics, elements of national education are included as well.

The awarded teachers succeeded in strengthening student sensitivity and confidence in applying science to daily life. Contemporary socio-scientific issues were used to make science relevant to the students and they were led to make informed judgement based on available data. The awarded teachers had also contributed a lot of time and effort in developing students' project skills. Through this, students developed the abilities to integrate science concepts and skills to construct new knowledge and to solve authentic problems. The high quality of their students' work was reflected in the awards gained in various territory-wide science project competitions. Students' spirit of exploration, as well as their independent, logical, critical and higher-order thinking skills had been carefully cultivated. In recent years, efforts were also made to integrate literacy elements into the planning of the Science curriculum to help students to learn Science in English.

The awarded teachers had participated actively in education-related researches. They helped in developing exemplary teaching materials and video clips of their lessons were uploaded on the web for sharing with teachers around the world. They also contributed to the community through training students to conduct eco-tours for teachers and the elderly, which also constituted an important means of developing a sense of care to people and the Nature among students.

▲Sharing with other teachers

▲An ecological cultural study tour to the tropical rainforest in Malaysia

Way of Obtaining Information of the Teaching Practice

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Teacher presented with the Award

Mr LEE Chuet-kwan
(Years of teaching : 35 years)

School
St. Mary's Canossian College

Subject taught
Physics (S3-6)

Teaching Philosophy

"Combining traditional and innovative teaching methods with the use of appropriate physics demonstrations; consolidating the basic foundation but leaving room to develop students' creativity and innovation."

Interview with the Teacher

"I've always wanted to be a scientist when I was a student," says Mr LEE, "When I was in the university, however, I realised I was more inclined to training and inspiring future scientists. That is why I am dedicated to passing on to my students not only knowledge, but also the passion and enthusiasm for science."

"Will the force be larger, smaller, or the same, or it cannot be determined? "

The majority of the class raises their hands to show their answers gingerly, peeking at one another for reassurance. With a seemingly mischievous smile, Mr LEE announces the correct answer. The whole class bursts into discussion, trying to figure out an explanation. When Mr LEE explains the theory behind afterwards, every student suddenly sees the light and is genuinely awed.

Interaction as a crucial element

Similar situations happen several times in every single Physics lesson. "I love to ask students such kinds of questions where every option seems to be possible. This provokes thinking. They will have to integrate what they observe in daily life with the newly learnt knowledge before they make the decision," says Mr LEE. Chances are, the majority of the class will choose the incorrect option, falling into Mr LEE's "trap". This is exactly the perfect timing that he is looking for.

▲Questions focusing on key concepts were asked to promote student thinking

Students pay more attention and their memory lasts longer if the explanation comes after they have all answered wrongly. This also allows the teacher to understand which parts the students are more confused about and how their misconceptions can be clarified.

"I try to add some interactive elements in the lessons to make learning more interesting. At the same time, though, I do not abandon the traditional way of teaching by giving students assignments and quizzes regularly so as to consolidate their foundations."

▲"Beauty and the Weight" experiment

A wonderland laboratory

Assignments, quizzes and challenging Q&A sessions are all useful teaching tools, but Mr LEE's "secret weapon", and the most anticipated part by the students, is certainly the laboratory demonstrations.

The Physics Laboratory at St. Mary's Canossian College is quite different from those in other schools. Of course there is the usual equipment for physics learning, but there are also objects that people would not expect to normally find in a secondary school laboratory — toy cars, exercise bikes, even different kinds of cooking ware! There is physics in almost everything in the world. Mr LEE likes to modify things that can easily be found in daily lives into teaching aids to teach students the physics principles behind.

Every little thing in the laboratory, with Mr LEE's design, can be transformed into interesting devices that aid student learning. An example is a lead ball hanging from the ceiling near the blackboard. In his "Beauty and the Weight" experiment, the lead ball is raised and then released with a student standing

▲Students are observing with interest.

nearby. Other students cannot help but feel worried for their fellow classmate — but of course, as we can all expect, the ball will not even touch the student. It is through this thrilling experiment that Mr LEE implants the idea of "conservation of energy" into his students' minds.

Turn around to the other side of the laboratory and you find a corner named "St. Mary's Kitchen". Indeed, this is a laboratory, not a place for cookery lesson. However, Mr LEE's intention is to arouse girls' interest in physics by illustrating some physics principles through kitchen ware. Vacuum cookers and vacuum flasks are used to explain heat transfer. The microwave oven is turned on to "toast" a fluorescent light bulb so that a gas discharge can be produced. There is still much more to be discovered.

Designing his own teaching aids

"Most of this kitchen ware belongs to my wife," Mr LEE explains, "I like to modify common objects in daily life into useful teaching aids myself. This is not only cost-effective, but can also be tailor-made in a way that I think is the best to aid student understanding." Going around the laboratory, one can see many interesting teaching aids developed from common household appliances. For example, the multi-purpose wireless visualiser which consists of a small camera can project demonstrations on an old TV; a pair of loudspeakers is modified to show effects of electromagnetic induction, etc.

◀The "witch's magical pot" - previously a prop from a school drama, it now has become a teaching aid.

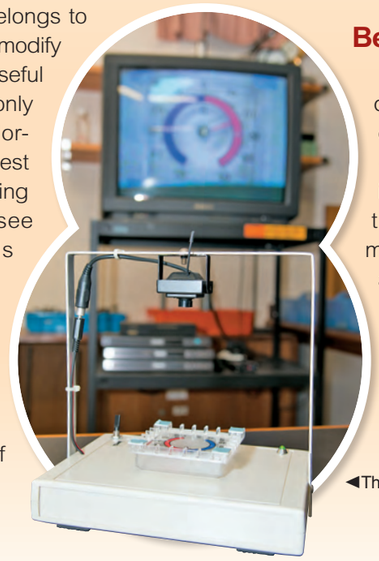
Beyond the Physics classroom

Mr LEE likes to encourage students to participate in competitions so as to gain experience and apply what they have learnt. He always lends his apparatus to the students and gives guidance to them throughout the whole process, hoping that they can achieve the best, not only in terms of the results but also in terms of their knowledge.

Additionally, Mr LEE is actively involved in the school's famous annual dramas, preparing the electrical installations and designing physics-related props. These props often amaze the audience and add much colour to the drama performance. Each year, these props become new members of the apparatus in the Physics Laboratory. For example, there is a pot that continuously produces mist from water. This pot was originally a pot for preparing magical medicine by a witch in a drama! Now this pot, together with the mist produced, is used to demonstrate the reflection of light. These props amuse the audience, while also stimulate students' creativity, showing them that science can be applied in different occasions.

Be the role-model to inspire

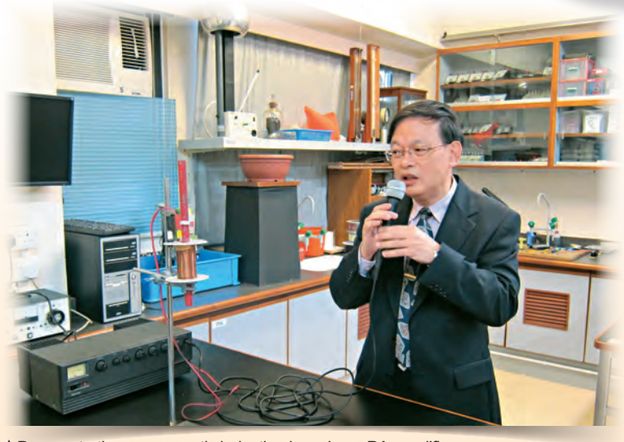
As Mr LEE's retirement draws near, he is very busy writing detailed instruction manuals for demonstration set-ups he has invented during his career. "I hope that my successor knows how to make good use of all these set-ups after my retirement so that students in the future can still benefit from them and be as interested in Physics as I am." says Mr LEE.



◀The set-up of the Wireless Visualiser

Teacher's Sharing

In recent years, the learning attitude of students has changed a lot. Experience tells us that it is important to convince students that Physics is interesting before any real learning can take place. In addition, there is also great learner diversity in a class. To look after the average students without neglecting the more able ones, I have adopted the following teaching strategies:



▲Demonstration on magnetic induction by using a PA amplifier

Tailor-made apparatus to improve Physics demonstration

Since the launching of the New Senior Secondary (NSS) curriculum, catering for the diverse abilities of students has become a great challenge to me. I also consider engaging students in interesting learning experiences in Physics an important part of my job. To me, the learning of Physics can be roughly divided into two stages:

- Acquisition of basic knowledge; and
- Application and further development of the basic knowledge.

For stage one, students can acquire basic knowledge quite effectively through lessons, experiments, problem-solving, Q&A and group discussions. For stage two, students can exercise their innovation and creativities almost unlimitedly through projects or science competitions. To leave more time for the students to create or make innovations, it is essential for them to do well effectively in stage one, that is, to understand as much as possible "how things work".

A well-made Physics demonstration is very good in explaining "how things work". Visual examples of abstract concepts aid immeasurably in their mastery. Physics demonstrations also provide an opportunity to illustrate the scientific method and to help students relate experimental observation to scientific theory. It is important that students in the back row, as well as the students in the front row, could see and hear what is going on at the same time so that whole class discussion could be carried out more efficiently. However, most of the existing apparatus and equipment in the laboratory are not suitable for whole class demonstrations. We need teaching aids that can appeal to a big class at once. Since nothing in the market serves the purpose, I challenged myself to making my own teaching aids.

In tailor-making demonstration kits of my own, efficiency is one of my great concerns. I have made necessary alteration in the laboratory so that all of the necessary facilities are close at hand so as to avoid undue confusion. Since the whole class is watching the demonstration at the same time, I can discuss the problem and the Physics principles to be examined in detail and sometimes I can even ask students to suggest the next step or the next piece of apparatus required. Thus the experiment arrangement takes form under student observation and, in part, under student suggestions.

Since the inspirational value of experiments depends so much upon the manner in which they are presented, I have also given much thought on the planning and presentation of the demonstrations as well as the timing at which to perform the demonstration. To show it too soon is to find a class unprepared to appreciate its importance; to delay it by prolonged explanation is to diminish its effectiveness. My students enjoyed the demonstrations and this contributed both to their understanding and their performance in experimental work.

►Mini-project on "Keeping an egg warm"

Participation in science investigations and competitions

To help students develop skills in science investigations, I have introduced a few mini-projects that could be accomplished within lesson time in S3. In S4 and S5, students are encouraged to participate in science investigations and different science competitions so as to put what they have learnt into practice. Since the launching of the NSS curriculum, universities and educational organisations have arranged many competitions. I have always been invited by students to be advisers of these competitions and many of them have won awards of various kinds. I am happy to see that students become more engaged and have learnt how to work in groups after they have participated in the competitions.

Promotion of self-directed learning

- Self-learning through the e-class - students are given a minimal number of written assignments after each lesson and they are expected to do, to check and to correct this minimal number of written work with the help of answers uploaded on the e-class before they hand in their work for inspection. This practice can ensure that every student has acquired the basic knowledge on the topic. For the more able students, they can further choose whatever they wish for further practice from the e-class especially before the examinations.
- Small quiz for each lesson - to ensure that students are doing their work themselves; small quizzes are arranged for nearly every lesson. The results of the quizzes are taken as part of the students' continuous assessment.
- The Question & Answer (Q&A) session - to ensure that students have learnt the topics well, I have prepared a lot of questions to challenge them, some of which requires higher-order thinking and deep understanding of the Physics principles. In every lesson, there is a Q&A session after the quiz. Students are encouraged to answer. Correct answers will be awarded with merits and prizes would be given out at the end of each term to the student who has accumulated the most merits. Students become more engaged and enjoy the Q&A sessions.

Conclusion

"To combine the traditional and new teaching strategies together with appropriate demonstration aids; to consolidate the basic foundation but leave room for creativity and innovation" is what I believe to be the most effective way of teaching Physics. I have a dream - "Making the Physics Laboratory as a whole a big teaching and demonstration machine." I wish my dream can come true one day.

引導科學探究 從小培養好奇心

Assessment Summary

Enhancing Physics learning through developing effective teaching aids for demonstrations

▲St. Mary's Kitchen in the Physics Laboratory

Mr LEE Chuet-kwan is a dedicated and charismatic teacher, who has very good command of the subject matter and teaching skills. He is devoted to developing teaching aids and setting up an environment conducive to student learning. He is resourceful and keen on exploring strategies to motivate and engage students to think.

Mr LEE is a reflective practitioner. He pursues self-improvement continuously. He produces exemplary teaching aids and laboratory equipment to facilitate whole class demonstration and enhance the understanding of Physics. He has collected a number of household appliances and cook ware in the laboratory to help him explain Physics concepts and the working principles of the devices to his students. Every corner of the laboratory is carefully designed to make learning and teaching effective and efficient.

Mr LEE demonstrated very good classroom skills, attended to students' learning needs and performance and maintained a safe, inspiring and harmonious learning environment. He is always well-prepared for his lessons and he could always link the science concepts he is teaching to students' everyday life. He is able to focus his questions on the key subject concepts of the topic and frame them to promote student thinking. Students participate actively in discussions and they work together to share and develop knowledge. They enjoy his lessons because he is kind and humorous, and he always uses eye-opening tools and equipment to teach. He has won students' love and respect.

In adapting teaching and assessment strategies to help students learn, Mr LEE took into consideration the characteristics of his students and their learning diversity. Graded tasks were incorporated on the e-class system with a "platform and stair" strategy to help students consolidate their learning before making a step forward. Mr LEE also provided multifarious scenarios for students to apply their science knowledge. Students were encouraged to participate in different science competitions through which they became more engaged in learning and learnt to work in groups.

Mr LEE also demonstrated curriculum leadership in strengthening links between Physics and Drama education in his school. He had contributed to the production of special sound and visual effects for the school drama, helping to fascinate and appeal to the audience. He also trained up students to operate lighting and sound equipment, helping them to put into practice what they had learnt in Physics. These Audio-Visual Prefects also assisted in the provision of AV services for other school activities.

Way of Obtaining Information of the Teaching Practice

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獲卓越教學獎教師

李永威老師
（教學年資：15年）

所屬學校
香港培正小學

教學對象
小一至小六（常識科）

教學理念

「以科學創作啟發學生創意，發展研習、協作和解難等共通能力。透過環境教育建立正面態度，培育學生成為地球好管家。」

教師專訪

為了引起學生對科學的好奇心，香港培正小學的李永威老師讓學生從日常生活中發掘問題，運用科學方法深入了解問題，以及進行創作或發明解決問題，從中體驗學習科學的樂趣。

▲學生在課室聚精會神地進行實驗

擁有百多年歷史的香港培正中學及小學，過去曾培育出多位享譽國際的科學家，包括諾貝爾物理學獎得主崔琦教授。校友的輝煌成就，令學校更着重學生在科學學習方面的發展，致力設計特色科學課程，包括按不同班級學生的能力，舉行全校性的科學比賽等活動。

負責統籌這些活動的常識科科主任李永威老師認為：「深奧的科學知識可待中學時逐步汲取，但好奇心必須從小開始培養，所以我們會透過不同活動，提升學生對身邊事物的探究精神。」為了激發學生對身邊事物的興趣，李老師會有技巧地帶領他們觀察周遭環境，以及鼓勵他們多去旅行或到別人家中作客，從中發掘有趣的裝置並思考其背後的原理。例如：電子化的點菜系統、設計獨特的牙籤筒等。

扮演偵探 引導抽絲剝繭

李老師指出學生平日總對身邊事物有很多疑問。因此教師必須有耐性地扮演「偵探」的角色，將學生的疑問組織起來，再延伸討論，引導學生抽絲剝繭，找尋答案。

「現今的孩子生活富足，一切生活問題都有家人為他們解決，結果剝奪了其解難機會。因此，除了培養學生的好奇心和對科學的興趣，我們也着意於科學學習中提升他們的解難能力。」李老師補充。

研究五花八門 打破傳統觀念

在全校性的科學活動中，小五、小六級的學生須分組就自己感興趣的題目進行發明或撰寫研究論文。李老師會一邊跟進學生的進度，一邊為他們提供客觀指導。完成作品或研究後，學生需向全班匯報，接受同學質詢。表現優異的學生不但可與其他班別的同學競賽，更有機會獲推薦參與全港甚至全國的賽事。

◀李老師分享學生獲獎的喜悅

李老師說：「學生的意念五花八門，但題目均與日常生活有關。例如：有學生研究如何可以用盡一支牙膏，有學生研究香蕉成熟到甚麼程度才最甜美好吃。在最後匯報時，學生便可從其他同學身上學習到不同方面的科學知識。有很多研究結果更打破了大家的固有觀念，讓人大開眼界！」

由於題目是學生自訂，因此他們對研究充滿熱誠。李老師說：「研究牙膏的學生最後共收集了五十支別人用剩的牙膏；而研究香蕉的學生即使外出飲宴至深夜，回家後也堅持先完成每日的量度記錄程序才去睡。他們的熱心和毅力令我非常佩服！」

▲「樹木遊蹤」活動大受學生歡迎

▶天台花園提升了學生對植物的興趣

客觀分析 訓練解難能力

為確保研究結果客觀準確，李老師建議研究香蕉的學生先定義怎樣才是「最好吃的香蕉」，然後再以不同量度方法，客觀地收集香蕉在不同成熟程度的各方面數據，包括維他命C含量、糖分、軟硬度等。學生之後自行上網搜尋量度方法，再到藥房購買測試糖分的試紙。後來學生又發現糖分含量太高，難以用試紙比較，於是又想到要加水稀釋搗爛了的香蕉。難怪李老師認為，除了學習到科學知識，整個研究過程也提升了學生的解難能力和合作技巧。最後，學生成功研發出一條「甚麼時候吃香蕉最好」的公式，更憑研究贏得全港性比賽的一等獎。

眾多比賽經驗令李老師感受到學生對自己研究成果的重視。「在其中一次比賽中，學生需獨自向評審委員解釋自己的研究。其中一個學生面紅耳赤地從評審室走出來，原來她剛才正跟評審委員就研究結果辯論，並一直堅持自己的觀點，最後這個學生獲得比賽的季軍。另外，有個學生平日成績平平，但對自己的作品信心十足，每次介紹作品時均雄辯滔滔，可見科學創作為他帶來發揮的平台。」李老師長時間陪伴學生進行探究，不但全面了解每個學生，彼此更一直維持親密的師生關係。即使學生畢業後，他們仍會互相關心。

▲參加比賽的學生在評審委員面前解釋發明品的運作原理

親手耕種 珍惜食物

李老師深明實踐比理論更能加深學生印象的道理，於是在學校天台開墾了天台花園，讓高年級學生體驗親手種植的滋味。「學生每天也吃蔬果，但他們不會去思考究竟這些蔬果從何而來。經歷過親身耕種後，他們便會更珍惜食物。」李老師說：「以前學生總因為掛八號風球可以放假而高興；現在即使只是下雨，學生也會非常緊張，甚至想撐着雨傘上天台去保護植物。」

為了鼓勵學生認識校園裏的樹木，李老師更與校內其他教師合作，製作了一本《校園植物誌》，記錄每棵樹木的品種和位置；然後舉行「樹木遊蹤」活動，讓學生透過提示穿梭校園尋找樹木的名稱，寓學習於遊玩。結果學生反應熱烈，報名人數超出預期。活動當天，一眾學生雖然玩得滿頭大汗，仍然非常興奮。

熱心環保的李老師更希望增長學生知識的同時，可從小改變他們的生活習慣。「現今社會太急功近利，偏偏科學需要花心血，進行長時間的研究。雖然不一定可馬上看到學生學習科學的成果，但他們在研究過程中所培養出來的態度和掌握的共通能力卻是終身受用。」李老師說。

教學分享

科學對小學生而言極具吸引力，問題是我們怎樣引領他們進入這個迷人的世界。我相信為學生安排適切的科學創作活動，不但能充實他們的科學知識，而且能培養他們各種共通能力，對他們有莫大裨益。科學及科技既方便人類，但亦造成環境污染，所以我們在推行科學創作活動時，特別加入了環境教育的元素，以培養學生的科學素養，務求培育地球未來的好管家。

透過科學創作活動培養共通能力

科創活動按照學生的不同學習需要分四階段進行：

年級	科創活動	內容
小一 小二	親子廢物創作活動	讓學生在家長的鼓勵和幫助下初嘗科創的樂趣。
小三	科學幻想畫活動	讓對科學有初步掌握的學生，透過獨立完成一幅幻想畫，表達科學思想。
小四	科學創作活動	學生開始分組合作，從無到有，動手製作小發明品。
小五 小六	科學創作活動	學生的科創自由度進一步提高，可自由選擇課題作科學發明或撰寫科學研究論文。 以下是普遍學生的科研之路： 學生分組自訂科研主題 → 徵詢教師的意見 → 微調至可行及有意義的研究主題 → 進行科研 → 教師跟進學生進度並給予意見 → 學生在課堂匯報科研成果，並接受老師和同學質詢

▲學生在進行科學實驗

有意義的科學探究活動有助培養學生的創意、協作和解決問題等共通能力。當他們將來在生活中遇到與科學有關的議題或困難時，亦能以科學方法分析和解決。

啟發創意思維

我校常識科自2009年起採用創意教學大師陳龍安教授提出的十項創造思考策略，包括：假如、替代、組合、可能、列舉、除了、想像、6W(為甚麼)、類推、比較，有系統地根據學習需要從一年級至六年級，循序漸進地訓練學生的創意思維，並與科學創作活動相輔相成，讓他們於畢業時掌握一套完整的思考策略。以小三的「現代家居」課題為例，我們以學生經常接觸的「膠袋」作教材，着學生運用「組合」思考策略，把膠袋和其他物件組合成一個超級膠袋，引發他們的創意；並帶領他們建基於已有知識作擴散性思考，在過程中逐步建構新知識，從而透徹掌握膠袋的特性和優缺點。

◀李老師鼓勵學生參加科學比賽，擴闊視野。

推薦學生參賽 擴闊視野

我們積極推薦科創作品水平高的學生參加不同比賽，擴闊他們的眼界。在過往六年，學生的成績理想，除了在全港性科學比賽得獎，亦代表香港在全國和世界賽中屢獲佳績，這些特別的學習經歷除了能鼓勵學生，亦肯定了他們的學習成效。

鼓勵教師 凝聚團隊精神

教師是學校的重要資產，建立緊密的隊工合作關係，在校內營造和諧積極的氣氛，是有效推展活動和促進學生學習的潤滑劑。我努力為同工安排有關「科學創作」的講座、觀課、共同備課等活動，提升他們對科學教育的了解。於每年的常識科檢討會議中公開表揚同工的強項，並記錄在會議紀錄中，既可肯定他們的教學專長，鼓勵同工力臻完善；也可以此作為其他教師借鏡的亮點。

培育地球好管家

我常思考：科學教育的宗旨是甚麼？如果學生空有滿腦子的科學知識，卻不懂得處世之道；急功近利、目空一切，自以為大地在我腳下、科學勝於一切，或以為可以更先進的科學技術彌補現今科學造成的環境污染，世界會變成甚麼樣子？

正因如此，我們更需要培育一批具豐富科學知識、純熟技能和正確態度的地球好管家。橫跨六年的校本課程的其中一環——「環保孩子自我挑戰獎勵計劃」的教學活動涵蓋認知、實踐、向他人推廣等層面。另外，我們亦有一套完善的獎勵制度。學生完成某項要求便會得到不同款式的貼紙貼在獎勵記錄冊上；獎勵貼紙金光閃閃，造型獨特，是每個學生夢寐以求的獎品，集齊一套的滿足感更是不能言喻。

▶「環保孩子自我挑戰獎勵計劃」小冊子

結語

惟有在課程中着重科學知識、技能與態度三者的培養，才能孕育出地球好管家——愛護環境、關心世界、處事成熟且目光遠大。他們具備知識，就能明白事理，解疑釋結。他們態度積極，就具備做好每一件事的決心和堅毅精神，並能構思各種方法，懂思考分析，能與人合作無間。在培正小學推行科學創作及環境教育活動，就是要讓學生從小植根，動手去做，養成習慣及建立穩固的基礎。盼望能將這願景與教育界及其他人分享！

評審撮要

以「科學創作」活動啟發創意，用環境教育培養科學素養，發展學生的共通能力。

李老師重視科學知識在日常生活中的應用，發展以科學為骨幹的環境教育，讓學生透過環保教育把學到的科學知識，配合各種科技工具應用出來，培養他們的科學素養和尊重環境與生態的態度。

李老師相信學生要在科學探究中作多方面思考，才能學會解決日常生活的問題或進行科學性的探討；因此積極籌劃多元化的學習活動，讓學生透過探究和解難培養堅毅的精神。他以生活化的課題作為引入點，提供既切合學生能力，又具挑戰性的學習活動，激發學生的好奇心，引起他們對科學的興趣，訓練其邏輯思維；透過做實驗和搜集資料，培養學生主動學習、尋根究柢的精神。

李老師有組織、有計劃地促進學生發展有系統的思考策略，並在畢業前完成一項「科學創作」或一篇「科學論文」。他自2009年起在各級常識科引入創意思維訓練。例如：李老師在示範課中，仔細分析學生提出的論點，然後加以分類和歸納，與學生一起繪製概念圖，清晰地為學生演示了邏輯思考的過程。李老師的傳意技巧良好，解說流暢，鋪陳有序；亦能適時提點學生的不足，補述和修正學生推論有所缺漏、舉證有欠完整之處。課堂學習常規建立；分組活動甚具效率，學生投入學習任務，討論言之有物，匯報條理井然。課堂氣氛融洽，能讓學生有條理地發展科學認知和技能，以及培養良好的學習態度。

家長讚賞李老師的熱誠、努力和專業表現，並肯定其對培養學生環保意識所作的努力。李老師讓學生透過參與學校的「環保孩子自我挑戰獎勵計劃」，在日常生活中身體力行地實踐環保；亦能成功引發學生的學習興趣，在科學探究活動中能擔當學習促進者、輔導者、顧問等多種角色，培育學生成為獨立的終身學習者，使他們善於發現生活中與科學有關的問題，並展示鍥而不捨的解難和探索精神。

李老師積極與業界交流，除了跟本港小學作科創交流，亦跟外地學校就科學、科技和環保等方面分享教學經驗。另外，他亦於校內發表有關「科學創作」的論文，協助編寫記錄校園植物資料的《校園植物誌》，並負責編寫學校「蝴蝶園」內有關香港常見蝴蝶的資料等；又積極為常識科組的30多位教師安排有關「科學創作」的講座、觀課、備課等活動，對推動校內的科學教育貢獻良多。

▲與教育同工分享教學經驗

索取有關教學實踐資料的途徑

學校網址：
http://www.pcps.edu.hk

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