全球環境變遷的教學

Teaching and Learning of Global Environmental Changes

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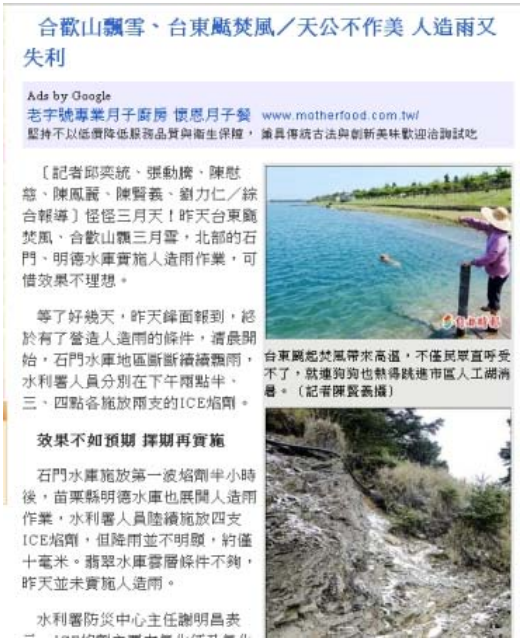
新北市某小學六年級學生，進行畢業環島校外教學，上午 10 點左右行程到了中部的合歡山，遇到了下雪，雖然寒冷，但對於亞熱帶的小孩來說，是難得的體驗，師生雀躍不已。中午下到平地並南下台東，在大武遇見了高溫達攝氏 33 度的焚風，為怕了中暑躲在車內與屋內不敢外出。

Sixth graders of some school in New Taipei City participated their graduation field trip around the island. They arrived Hehuan Mountain at 10 in the morning. It was snowing, cold as well. Still, it was a novel experience for these subtropical kids. They were really jubilant over the snow. Descended from the mountain, they headed south to Taitung and were surrounded by foehn wind. They would rather stay in cars and houses preventing from sunstroke.

在一天之內，從冰點以下到高溫中暑，就發生在 2013 年 3 月 24 日的寶島[註 1]。只是在進行這樣的教學前，是否要同時準備防寒的雪衣與消暑的泳衣?

Within one day, the temperature changed dramatically. It happened on Mar,24th, 2013 on Formosa. Do we need to prepare both snow and swimsuits at the same time before the course start?

（註 1 資料來源: http://tw.news.yahoo.com/玉山下雪-台東焚風-反常三月天-213000501.html）



合歡山飄雪、台東颳焚風／天公不作美 人造雨又失利

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〔記者邱奕統、張動擒、陳慈慈、陳鳳麗、陳賢義、劉力仁／綜合報導〕怪怪三月天！昨天台東颳焚風、合歡山飄三月雪，北部的石門、明德水庫實施人造雨作業，可惜效果不理想。

等了好幾天，昨天鋒面報到，終於有了營造人造雨的條件，清晨開始，石門水庫地區斷斷續續飄雨，水利署人員分別在下午兩點半、三、四點各施放兩支的ICE焰劑。

效果不如預期 擇期再實施

石門水庫施放第一波焰劑半小時後，苗栗縣明德水庫也展開人造雨作業，水利署人員陸續施放四支ICE焰劑，但降雨並不明顯，約僅十毫米。翡翠水庫雲層條件不夠，昨天並未實施人造雨。

水利署防災中心主任謝明昌表

台東颳起焚風帶來高溫，不僅民眾直呼受不了，就連狗狗也熱得跳進市區人工湖消暑。（記者陳賢義攝）

故事還沒結束，這群學生回到學校後，要面臨的挑戰是限制用水。

This is not the end of the story. Once returned the school, they faced the challenge of water using limit.

學校的用水來自於南方的石門水庫，由於今年冬季雨水不夠，若不再下雨，估計最快一個半月後水庫就會見底[註2]。這對於該校學生來說，這幾年來已經不算是新聞了，水庫不但有缺水的問題，長期以來水質也令人堪憂，但只要不缺水就讓人感恩的了。

The water that the school used comes from Shimen Reservoir. Due to lack of rain this winter, the reservoir will be empty in another 60 days. For the students, this news was not a fresh at all. There are many problems that the reservoir faced such as lack of rain and low water quality. If the least requirement, enough water supply is measured up, people will be thankful.

（註 2 資料來源:

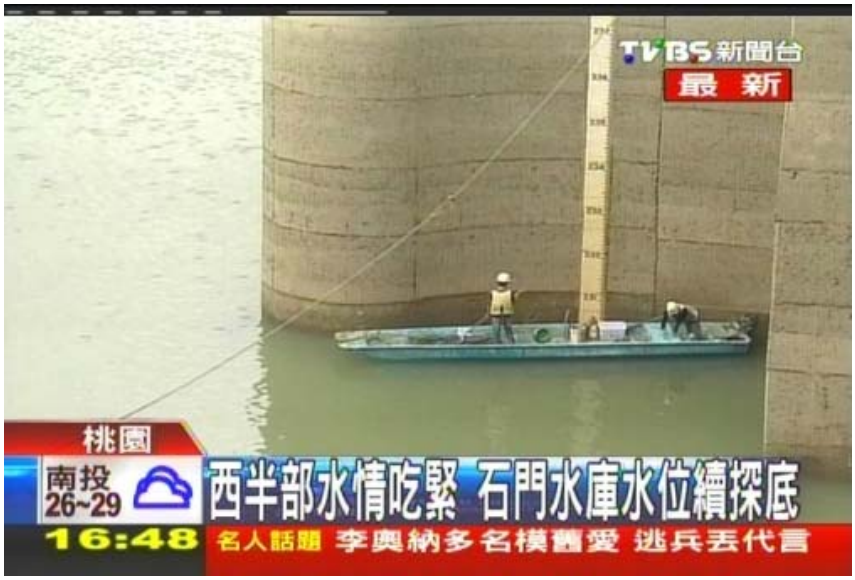
http://www.libertytimes.com.tw/2013/new/mar/25/today-life1.htm）

印象所及，前一年(2012 年)還算風調雨順，更前一年(2011 年)的四月，石門水庫的水位降至 224.54 公尺，蓄水的容量只剩下 35.64%，創該年蓄水的新低[註3]。

As far as our memories recalled, it was a quite favorable weather the year before (2012). During April, 2011, the water level was down to 224.54 meters high. The percentage of water stored decreased to 35.64% which was the lowest of that year.

（註 3 資料來源:

http://www.epochtimes.com/b5/11/4/19/n3232699.htm）



以上的場景，雖然學校旅遊是虛構的，但是所有的氣候數字都是來自確實的紀錄，反映我們這一代人所面臨的氣候現況。我們雖然無法精確的預測將來的氣候真正會變成甚麼樣子，但是卻可能看到氣候變遷的可能趨勢。

Not all the scenes described were fictional. The weather data were truly documented. The data reflected the climate situation which our generation has been facing. We cannot predict precisely what the weather will be, but we can foresee the possible trend of climate changing.

如今我們在談整個氣候型態變化的情勢,必須先認識這十幾年來影響全球的減碳運動。簽署於 1997 年的京都議定書國際公約，到去年 2012 年面臨屆滿，但因為新的減碳公約還未形成共識，因此時效上又被延續到 2020 年。

Before talking about the situation of climate changes, we have to know the carbon emission reduction activities which have been influencing globally. Kyoto Protocol which had been signed in

1997 was due in 2012. However, new carbon emission treatments have not been settled down yet. Therefore, the protocol was extended to 2020.

而當初在說服各國簽署此公約的最大因素，是全球暖化的問題。在這十多年來，確實全球平均溫度有增高的趨勢，但往往在世界各地不單單遇到的是過熱的問題；在冬季所發生風雪更是常破紀錄，下雨也不均勻，不是旱災就是澇災。

Global warming was the very catalyzer that convinced every country to sign the protocol. Indeed, the average temperature was getting warmer and warmer during this decade. But overheat was not the only problem, we also faced weather situations such as record-breaking snow, uneven rain that led to drought or flood.

剛開始大家會說這是氣候型態的改變(climate change)，隨著大雨大旱、高溫低溫的發生頻率增加，更會聯想到的是極端氣候型態(extreme climate pattern)的形成。或許造成的災難的氣候紀錄，不見得每次就是破紀錄的新高，但如加上環境的變遷，往往經過我們所開發的環境，成為無法忍受極端氣候衝擊的安全環境，反而適得其反，把原有具有生態保護的功能，能減緩極端氣候的環境型態改造，使得環境更脆弱、更容易發生災害。譬如，河川旁的溼地空間，可以緩衝暴雨來的水量，一旦開發鋪上水泥，這個空間就沒有蓄涵水的功能，反而將水排到更低窪處，可能造成下游更大的水災壓力。

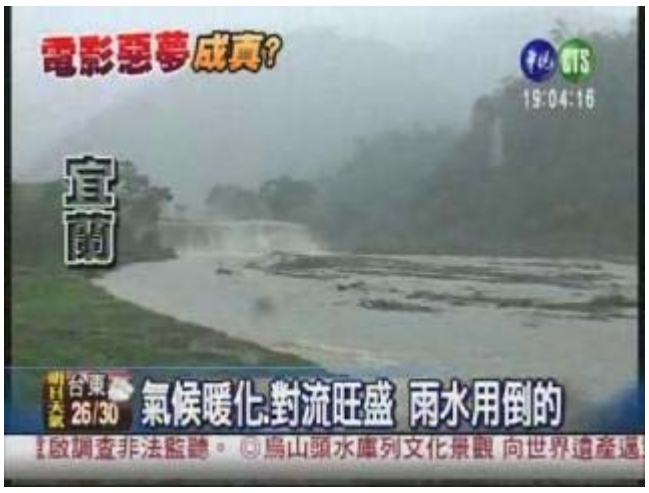
At the beginning, everybody would say the answer lies in climate change, because of frequent heavy rain, drought, high or low temperature. Moreover, people will blame it to extreme climate patterns. Perhaps, not all the disastrous weather documents are record-breaking. But if environmental changes are added, the so-called safe environments will not able to sustain the effects that extreme climate patterns bring about. The environments that human beings dwell in are purposefully developed. But the original functions such as biological sheltering and extreme climate patterns adjusting were the costs. Therefore, the environments are more fragile to nature disasters. For example, wetlands by the rivers can ease and store the rain water of sudden showers. Once the

wetlands are covered with concrete, the water-storing function is lost. Water will flow to lower areas which increase the chance of floods.

儘管憑著這幾年來的氣候變化，還不敢斷言暖化就是造成極端氣候的主因，有越來越多的科學家觀察到極端氣候在全球發生。如 2011 年是極端氣候盛行的一年，也是有紀錄以來最溫暖的 15 個年份之一，包括美國德州破紀錄的熱浪，英格蘭 11 月出現 300 多年來的第 2 高溫，以及泰國出現大水災等，全球暖化後益增極端氣候的出現機率[註 4]。

We cannot be100 percent sure that the climate changes in these years are mainly related to global warming. More and more scientists have observed extreme climate patterns taking place around the earth. For instance, 2011 is a year of frequent extreme climate patterns and the warmest data were thus recorded since 15 years ago, including record- breaking heat wave in Texas, U.S., the second highest temperature in England over the three centuries, and floods in Thailand. Global warming increases the frequency of extreme climate patterns.

（註 4 資料來源: http://www.libertytimes.com.tw/2012/new/jul/12/today-int7.htm）



台灣百年來氣候變化的趨勢：極端?還是溫和?

How is the climate changing trend for next hundred years, wild or mild?

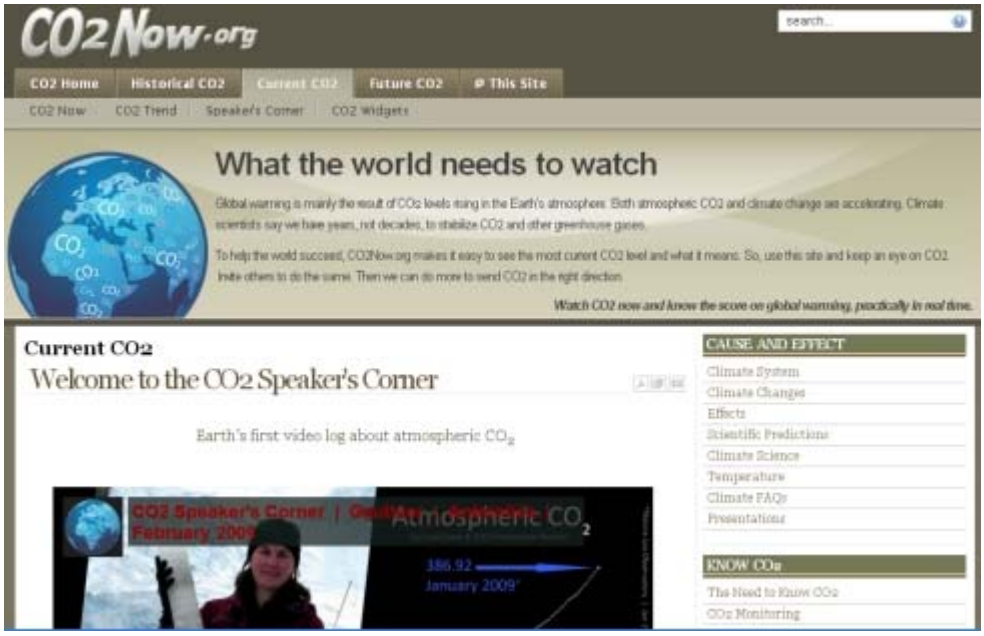
我們都知道，氣象預報在越短的時間內，就越容易準確。在現代的科技下，可以很高的預測明日的氣候型態，一週內的氣候準確度就比較不準；而一個月的氣候預報，其準確度就可能與久住當地的居民經驗接近。

We know the weather forecast of shorter period of time will be more accurate. With nowadays technology, we can predict the weather tomorrow precisely, but the accuracy decreases for a one-week weather forecast. As for monthly reports, the accuracy is similar to the local residents' experience.

因此我們在觀察氣候變遷時,很難能預期精準度,但我們可以觀察的是氣候趨勢:也就是氣候改變的方向。換言之，如果談到全球暖化，我們無法預測到今年就一定比去年熱，但是把時間軸拉長，或許每年平均溫度會有點起伏，如果能夠忍受稍微的不確定性，就可以看到長時間整個氣溫變化的趨勢。倒是造成暖化的大氣二氧化碳濃度變化，幾乎是每個月都可以看得到變化，一路攀升，還沒有一點下降的跡象[註5]。

As a result, while observing climate changes, it is hard to expect accuracy. What we can anticipate is the climate changing trend, the direction of change. In other words, talking about global warming, we cannot predict that this year will be hotter than last. However, if we lengthen the time axis, coexisting with slight changes of annual average temperature, acceptable uncertainty, the temperature of long time scale can be observed. One thing should be noticed. The rate of carbon dioxide emission to the atmosphere has been right-skewing without any signs of decreasing.

（註 5　全球大氣二氧化碳每月濃度可參考網站 http://co2now.org/）



台灣從上上個世紀所留下的氣象資料，讓我們可以看見台灣氣候型態的變化，中央氣象局的「近百年氣候變化報告」[註6]，從氣溫、降雨量與日照三個層面的紀錄，看台灣氣候型態的改變與可能的趨勢。

From the data which have been collected since 19th century, we can see Taiwan climate change patterns and possible trends.

（註 6 資料來源: 我的 E 政府 http://www.gov.tw/）

在平均溫度方面，近百年來台灣的整體平均氣溫上升了 0.8℃，惟平地的平均氣溫上升了 1.2℃，而大都會區更是上升 1.4 ℃[註6]，形成了所謂的「熱島效應」。所謂的熱島效應指的是，在同一時間中，都會區的溫度比周圍鄉村的溫度高。

For the temperature, it increased .8 ℃ on the average. The ground temperature has increased by 1.2℃, while that of the metropolitan areas increased by 1.4℃ and has formed heat island effect which states that the temperature of cities is higher than that of suburbs during the same period of time.

在日照時數方面，全台大部分地區均呈現減少的趨勢。如台北 1901-1930 年的全年平均日照時數為 1648 小時，而最近 10 年(1999-2008 年)的全年平均日照時數則為 1431 小時，約減少了 200 小時[註6]。我們往往會理解溫度是與日照成正比，中午日

正當中最熱，但如與前面的年平均溫來比較，前者有增溫升高的趨勢；但奇怪的是，年日照量卻是減少的趨勢，這又該如何解釋？

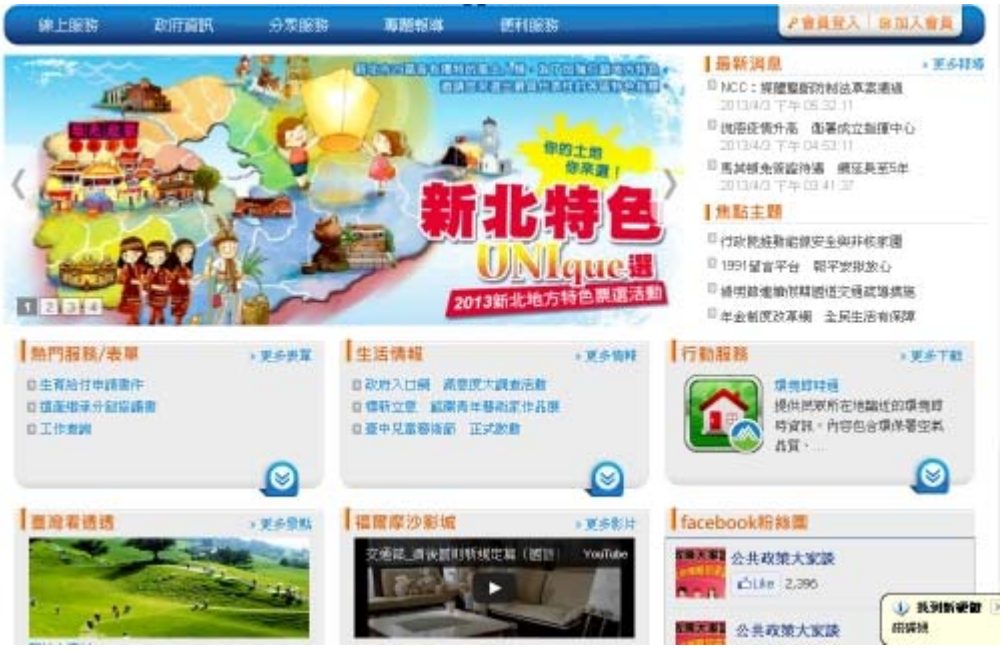
The sunshine hours of most areas in Taiwan decrease. Taking Taipei for example, the number of hours in this decade was less about 200 hours than that of the early 20th century. We may perceive that temperature is in proportion to sunshine exposure. But, how can we explain the relation between rising temperature and decreasing of sunshine hours?

在降雨量方面，則各地降雨時數均呈現減少現象，但在降雨量卻無明顯減少，表示降雨強度(單位時間內降雨量)有增強趨勢[註6]。換言之，有形成「平時不下雨，要下就下很大」的趨勢。

For precipitation, it showed the hours of rain decreased, but the precipitation remained which indicated the chance of heavy rain increased.

科學家試圖在研究解釋這些氣象變遷的現象，但由於規模太大，充滿了各種變因的挑戰，慢慢得到這樣的解釋說明：「全球溫度若上升 1 度，空氣中的水蒸氣就增多 7%」；「而空氣中的水蒸氣增加時，降雨強度增加 2~3 倍」[註7]。暖化所造成空氣中的水蒸氣量增加，可能解釋日照的時間縮減。而同時水蒸氣的含量增加，卻又造成下雨強度的增強。**(註 7 資料來源:中央研究院劉紹臣博士等)**

Scientists tried to explain the phenomenon of weather changes, but the scale was huge with challenging variables. We gradually come to the conclusion that if the temperature rises by 1℃, the water steam in the air will increase by 7%. Meanwhile, the density of rain will be doubled or even tripled. Global warming increases the amount of water steam in the air. This may explain the situation that shortening of sunshine hours. At the same time, increasing steam in the air strengthens the density of rain.



從暖化到極端氣候型態

From global warming to extreme weather patterns

近十幾年來世界各國都在談節能減碳，會造成這樣全球化的運動，曾任世界銀行的首席經濟學者，英國的尼古拉斯史登爵士(Sir Nicholas Stern)扮演著非常重要的角色。

For decades, every country has been discussing about energy saving and carbon emission reduction. Sir Nicholas Stern who had been the leading economist of the World Bank, played an important role.

史登團隊在 2006 年所發表的《史登報告：氣候變遷對於經濟的影響》(The Stern review on the economics of climate change)，倡言如果不去控制氣候變遷，將會造成的經濟的嚴重影響和風險，其所造成的影響程度，相當於 20 世紀初期的世界大戰與經濟大蕭條，因此應立即採取行動，每年付出全球 GDP 的 1%，用來減緩氣候變遷，避免因變遷所造成全球 GDP 約 20%損失的風險[註8]。這個論述促成許多國家的節能減碳宣告，其具體的呈現是以國家主體，加入京都議定書的減碳目標。

（註 8 資料來源:《全球氣候變化的因應之道: 回應史登報告》英國貿易文化辦事處）

Stern and his colleagues reported The Stern Review on the Economics of Climate Change. They indicated if people do not try to control weather change, it will cause severe effects of economy to the extent like World Wars and the Great Depression in early 20thCentury. Therefore, immediate action must be taken. One percent of global GDP will be paid to ease the weather changes and to avoid the potential threat of 20% GDP loss after weather changes. This statement accelerates the legitimacy of carbon emission reduction in many countries.

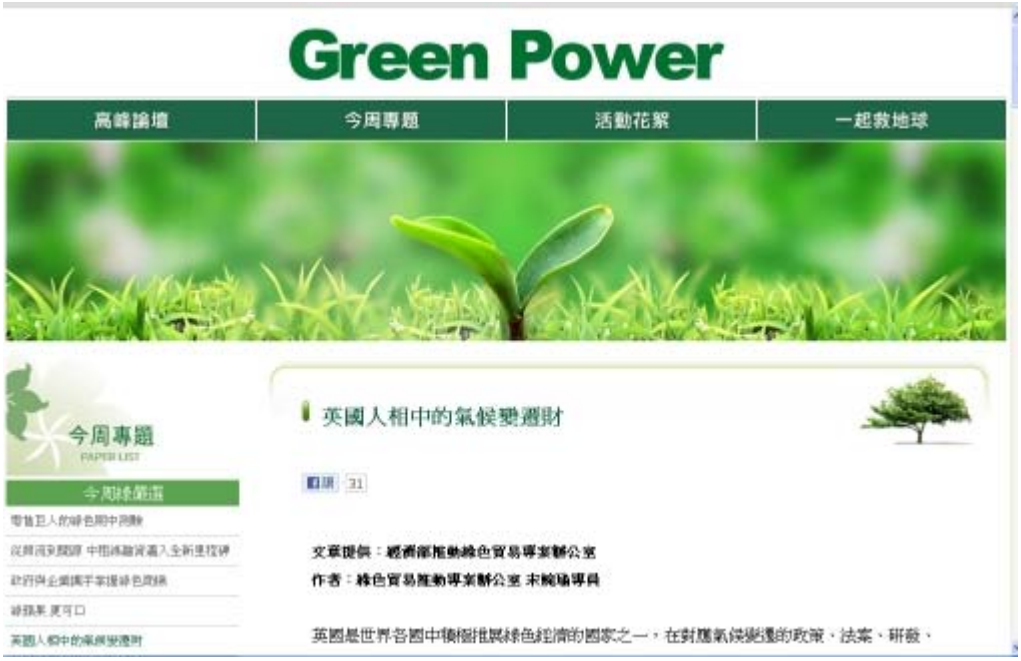
減碳或節能減碳的過程，不外乎是先盤點機構或國家整體排碳量，設定減碳的目標量，將此目標量分配到各項技術層面，並逐年採取各項減碳行動，再進行盤查檢視減碳的成果，修正或加強減碳的行動直到目標的達成。而英國作為減碳行動的發源國，確實也達到目標，甚至領先的局面，2011 年英國減碳的成果已經比 1990 年基準線減少 26.4%[註 9]，成為全球 G8 工業國的減碳翹楚。

The steps of energy saving and carbon emission reduction are:

1. measuring the total amount of carbon emission of ones' organization or nation
2. setting up the goal of carbon emission
3. distributing the target quantity to each technical phase
4. activating every carbon emission control program annually
5. examining the results of these programs
6. modifying each program till the goal is reached

U.K. as a leading roles of carbon emission reduction, did measure up to the target and was ahead of G8 countries.

(註 9 資料來源: http://event.businesstoday.com.tw/GreenPower/Topic/Article/36)



節能減碳的背後在於發展國家的綠色經濟，減少對化石能源的依賴。這兩樣都是台灣所需求的，台灣高達 98%的能源來自進口，等於是命脈掌握在他人的手上，而風能、太陽能，這些可再生能源除了是台灣自身所擁有的，其知識經濟更是將來促成台灣經濟轉型的重要關鍵。

The true meaning of energy saving is to develop the national green economy, reduce the reliance of fossil energy. Both of the ideas are critical for Taiwan. More than 98% percent of energy is imported from other countries, which means our nation’s neck is choked by others’ hands. The turning point of Taiwan economy is on the reproducing energy such as wind power and solar power. More important, knowledge economy is the key during the economy transforming process.

但是，從整個綠色經濟的發展來看，其發展的趨勢恐怕無法追得上氣候變遷所造成影響，以致於進一步的調適(adaption)的呼籲聲興起。兩者的差距，在於減緩(mitigation)往往是在舊有的基礎上，作調整或是改善的行動，而希望能對環境有所改變，減緩極端氣候的發生；而調適則意指著有面對環境的變遷，儘管變遷還未發生，則事前有所準備，類似防災的行動。

Nevertheless, from green economy development view point, the progress may not be able to keep up the pace with climate changes. As a result, the attention is drawn to the topic of adaption.

Based on existed foundation, mitigation means adjustment and improvement of changing the environments, reducing the chances of extreme climate. On the other hand, through adaption, people face the environmental changes in advance such as the precaution of nature disasters.

以荷蘭為例，世人皆知荷蘭與海爭地，但在氣候變遷下，海平面增高與風浪增強，對其海堤的防護形成更強烈的挑戰，與其發展更好更強的築堤技術，或是想減緩自然的威脅，荷蘭人想得是還土於海，以技術去調適未來環境與氣候的變遷，如製造可漂浮的房子，當潮水進來時，房子會跟隨著海平面上升，而不至於被浪潮所淹沒。

For instance, we know that Dutch people claim their living areas from the sea. Under the circumstances of climate changes with the rising sea level and the strengthening waves, they will face more challenges to build the levees. Rather than developing higher techniques of building levees, Dutch people would adapt themselves to the environmental and climate changes in ways like designing floating houses.

當傳統上的風調雨順已經慢慢消失，氣候型態在改變，甚至極有可能朝極端氣候的形態發展: 高低溫溫差大、下雨不均時，我們應該如何去學習調適未來的氣候型態?

When traditional favorable weather is gradually diminishing and climate patterns changing or even resulting in extreme climate patterns, how can we learn to adapt ourselves to future climate patterns?

建立對微氣候與環境的感知能力

Building up the awareness to micro-weather and environment

既然環境與氣候都在改變中，首當其衝者是不動或少動者，如居住者與生長在土地上的植被。感受氣溫可以是應用在生活所需，如每日上學的衣著量與攜帶雨具與否，相較以往的硬性規定穿制服年代，現在的氣溫更是瞬息萬變，在春季交替時，許多地區一天內可能氣溫改變超過 10 度以上。劇烈變化下的溫度，不單是個人的身體健康受影響，也容易造成感冒傳染性疾病的流行。

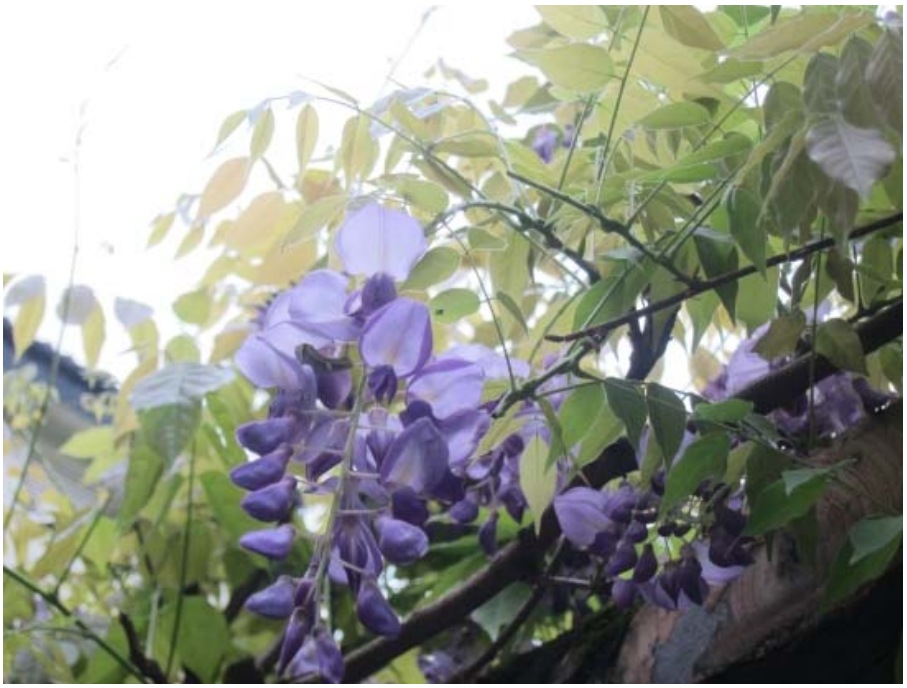
The plants are the first objects suffering from environmental and weather changes. Knowing the change of temperature is necessary for daily life, so that people can prepare clothes or rain gears. Comparing with several generations before, the weather now changes more rapidly. During the seasons turning, the temperature of many areas changes dramatically. Severe weather changes will affect people's health and speed up flu spreading.

地理地形與居住環境會對微氣候產生影響，譬如台灣冬季盛行東北季風，北部沿海未受地形屏障的學校，就更會面臨冬季鋒面變化的影響，冬季保暖就會是重要的議題。相對地在暖化高溫的影響，衝擊大的是溫帶居民，無法忍受酷暑造成休克等現象。這種現象也可能發生在處於市中心，熱島效應高的校區，如該校綠化量不夠，微氣候氣溫偏高，一樣會影響學習的情緒。

Geographic features and living surroundings will post influence on micro-weather. For example the north-eastern monsoon is prosperous in winter Taiwan. It will affect those northern seaside schools, especially for those without natural barriers. Keeping warm in winter becomes important issue. Likewise, the influence which global warming and high temperature cause will be posted greatly on the temperate zone dwellers. People may not bear the hot summer and go into shock. The same situation can occur in the downtown areas. Students' learning will be affected if there are fewer trees planted on the campuses which suffer frequently from heat-island effects.

我國國民教育自小學五年級起，才開始學習氣候相關知識。但氣候變遷的影響是年年日日發生，在學習上應融入更低年級的生活教育中，而各校的微氣候型態不同，師長可將其長久居住的經驗，簡化成學生的知識與行動，更重要的是賦與學生應變的能力，也是傳統的答案式教學，如果 A 則 B、是 C 則 D。

Not until the 5th grade do our students begin to acquire weather related knowledge. But weather changes in any second. Consequently the knowledge should be integrated into lower graders' everyday education. Based on different micro-weather patterns, teachers can use their own living experience to internalize the students' learning.



探索氣候變遷的影響

Exploring the influence of climate pattern changes

氣候型態的變遷會影響動植物，也逐漸形朔出新的生態環境。如植物的成長與花期都直接受氣候型態變遷的影響，處於農漁業生產區的學校，更容易觀察到這些由氣候變遷對生態(動植物)的影響，而這些影響會對經濟與社區構成消長因素，探索原因比較適合高年級學生的學習。

Climate pattern changes will also influence plants and form new biological environments. The growth of plants and bloom of flowers are directly influenced by climate pattern changes. Students of schools located at the farming-fishing areas can observe these changes more obviously. And this course is more suitable for high graders.

而處於都會區的學校，可以由消費型態來探索氣候變遷的影響。人類的消費型態不離生態法則，在都市中，人處於消費的頂端，為維持生活不外乎是獲取物質與能源。氣候變遷所造成的影響，如極端氣候「平時不下雨、要下就下暴雨」的下雨不均勻，嚴重影響水資源的取得，也是台灣如何善用水資源的挑戰。在能源方面，學

生如觀察家庭與學校的整年用電量，就可以清楚，氣溫與使用能源的關連，進而思考其關連的原因。

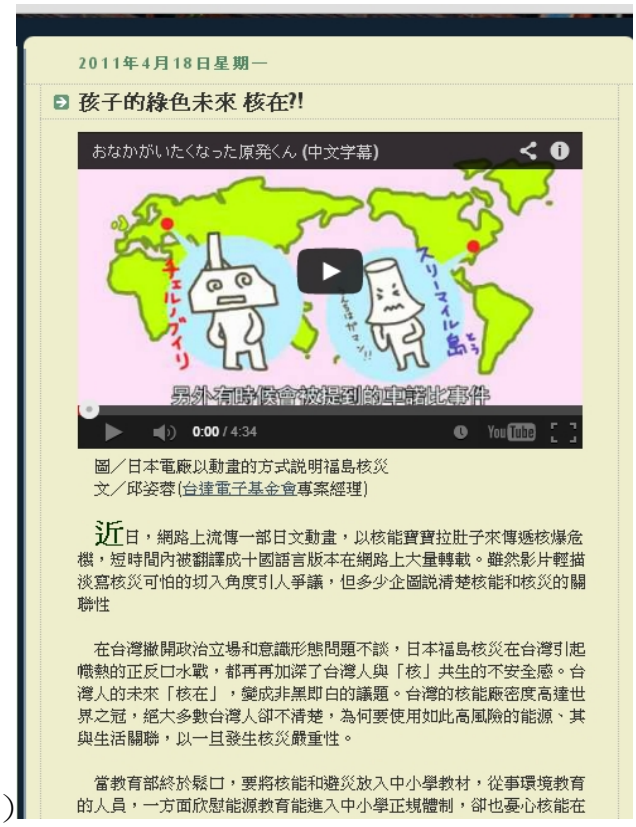
For schools of metropolitan areas, we can discuss the influence of climate changes through consuming styles. Human beings' consuming styles have everything to do with biological laws. In cities, people are at the top of the consumption pyramid. People have to survive with material and energy. The influence such as unsteady rain that climate change may bring makes water resources hard to obtain. This is also the challenge for Taiwanese to deal with water resources. When it comes to energy, if students document the annual electricity consumption, they can understand the connection between temperature and energy consumption and further discuss the reason.

我們可以想像得到面對環境氣候的變遷,倡導節能減碳與低碳生活的行動不會是單一的議題，大家所面對的是一前所未有的複雜多元的問題，其本質是「混雜的(messy)」，然而傳統的教育偏重在「馴服與訓練(tame)」。適應環境變遷的教育本質將會是人的再工程議題（re-engineering ），換言之，要體認到先前在學校所受的教育知識是不夠的，更要擴展到社會與生活環境中去探索學習[註10]。這樣的無標準答案的教學並不容易，但是在探索的過程，學生學習的是從生活中提出疑問，擷取知識，統合思考後，並討論與推論出可能的結果。有好的結果固然是人人所想獲得的，但過程更是學習能力的取得。

While facing climate or environment changes, it is not a single phase issue just to promote the idea of carbon emission reduction and energy saving, but a rather complicated and multi-dimensional problem to our great concern. The essence of the problem is messy. Nevertheless, traditional education emphasizes on taming and training. The innate nature of adaption of environmental changes will be re-engineering of human beings. In other words, one should understand that what they have acquired in school is not enough. Moreover, they should broaden their scope of knowledge to the extent of societies and everyday lives. This kind of education with non-standard answers is not easy. But, students' learning will be assured during the exploring process. With the questions originated from their daily lives, students acquire knowledge, after digesting and internalizing then

forming possible answers. Excellent results can be desirable, but the processes weigh much more during learning.

（註 9 資料來源:《環境教育 如何解決氣候困境？》，2010/05/12，低碳生活部落格）



減緩與適應的教育行動

近 20 年來，我們在中小學所努力的垃圾分類回收教育，以及 10 年來所提倡的節水節電教育，這些環保的教育，加上防災教育，都在幫助我們可以過著更永續性的生活。問題是這些生活中的教育是否能像語文、數理、藝術等，成為國民教育中永續的領域？

We have been keen on trash recycling education for 20 years, and energy as well as water resource saving education for 10 years. These ways of environmental protection including recently added disaster prevention education help us to lead a more ever-lasting life. The question is: can daily life education last as much longer as other subjects such as language, math and art to be life-long learning fields in our curriculum?

當我們認識氣候變遷的現象與可能原因後，能有助於我們去調適未來的氣候變遷。學習面對環境所導致的問題，討論可以實踐的行動。這樣的學習過程，會是跨學科領域的、也會是從感知學習到內化與行動的。這樣的教育，可能不會有預訂的標準答案，卻會有統合與創新的環境行動結果，而無論行動的結果多寡，將可以成為正向的影響，回饋強化此行動內容，並擴散影響到他人。

When we understand the possible reasons for climate changes, we can be more able to adapt ourselves to future climate changes. We can learn about problems which may be detrimental to environments and discuss practical action. The learning process is cross subjects or learning fields and will be internalized through action. There might not be standard answers but results in integrating and innovating environmental action. All of the results can be active influence to infect other people.

譬如，當台灣的人口居住分布朝都市化集中，就表示有更多的居民會面對「熱島效應」的議題；而居住的時間如超過 80% (每天超過 19 個小時)都在屋內時，我們怎能不關心居住的室內環境甚至校園環境？又譬如設計與建構綠建築等的議題，是整合科學(science)、技術(technology)、工程(engineer)與數理(mathematics)等領域，此 STEM 即為英國所提出的國民基礎教育，或許也提供該國成為全球減碳大國的教育基礎，我們可以預期英國接下來會輸出此種概念與行動，成為其永續經濟的一環。

For example, more population in cities, more people will face heat-island effect. Meanwhile, how can we not care about indoor and campus environments, if we stay more than 19 hours in the buildings? Furthermore, designing and constructing green buildings is a fusion of science, technology, engineer and mathematics. This STEM was brought by U.K. to be the foundation of their national curriculum. We can foresee that U.K. will export this notion and action and make it one part of their everlasting economy.

環境與氣候的變遷既然是複雜多元的，且途徑充滿了不確定性，唯一的解決之道是作了就對了，在邊作邊學的情況下，慢慢建構出能夠反應環境需求的知識系統，學習如此，教學也可以如此。

Environment and climate changes are complex and various. The only solution to this problem is taking action. Through action, we can learn and construct enough knowledge to approach the necessities dealing with the problem. Learning can be achieved in this way and so can teaching.

在全市許多師生的努力下，新北市的環境教育與教育行動已領先全國。如在教育方面，進行了三年的節能減碳教材網，由老師產出教育現場的教材與教案；在環境管理方面，低碳校園標章的設立與實施。無論是教學或經營行動都具有環境反應與系統行動的特色，也可以看出新北市的教育已正朝向調適氣候的行動邁進。

With many students and teachers' efforts, environmental education of New Taipei City is ahead of other counties in Taiwan. We have set up the teaching material website of energy saving and carbon emission reduction for more than 3 years which collected teachers teaching materials and plans. Talking about environments management, we established low-carbon campus marks. Education in New Taipei City is head its way of climate adapting action.

只是新北市的幅員廣闊、地理環境多樣化，仿如台灣環境的縮影，在全面普及化與永續化仍需更多努力，但其成果將價值無限，給整個台灣的氣候調適教育開拓出一條道路。

However, we should work much harder so that fruitful harvest can be sown. By doing so, we can carve out a bright future for the climate adapting education in Taiwan.