Chapter 7
What Type of Pedagogy Is Required in Schools and Classrooms to Support Sustainable Green Growth? A Case Study of Hong Kong Within the International Context

Rupert Maclean and Margarita Pavlova

Abstract Schools are one of the major agents of socialisation in society along with the family, community, mass media and peer group. One of the important functions or purpose of education and schooling is to equip learners to live and work effectively in an ever-changing and evolving society. As new and growing challenges emerge which need to be met, such as concerns about environmental issues including destruction of the environment, global warming and an expanding carbon footprint, schools are one of the key agents of socialisation in society which seek to bring about changes in behaviour into more desirable directions.

This chapter reports on the results of a research study that examined whether the schooling provided in Hong Kong has been successful in actually getting learners to modify their behaviour in ways and directions which are likely to successfully promote improvements to the environment and sustainable development. The results show that although there was a perceived increase in knowledge of the selected environmental issues, with regard to behaviour changes, 29.4–50.6% of students believed that their environmental behaviour had not changed. The chapter then examines pedagogies that can be successful in changing students' behaviour and argues that to increase effectiveness of environmental studies, particular types of learning should occur, including discovery learning, systems thinking-based learning, critical thinking-based learning, interdisciplinary learning, problem-based learning and participatory/collaborative learning. Teachers should provide an opportunity to engage students in pro-environmental activities and address values that are going beyond an economic imperative.

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Introduction: The Purpose of Schools

An important purpose of schooling is that of nurturing knowledge, skills and understandings which develop appropriate behaviour in students with regard to citizenship and employment and helping to sustain their society so that it is sustainable in directions which are regarded as desirable, such as being an inclusive society which is peaceful and supports law and order and justice, equity and fairness in social, economic and political life and a society which is open-minded and kind. Education and schooling also seek to equip individuals to effectively address the main issues and concerns of its time. One such area concerns addressing environmental problems which help make life on planet Earth possible and sustainable over the long term.

One of the main problems faced by countries worldwide is that of environmental degradation, or the continuing pollution and destruction of the natural environment, as economic development continues to contribute to an increasing carbon footprint, global warming and the destruction of forests and other aspects of the environment which have a direct impact on the quality and functionality of the environment, where schools seek to help address and correct these problems to change the behaviour of learners through environmental education and education for sustainable development (Fien et al. 2002, 2009).

Schools are a part of a government's repertoire of policy initiatives to address the major education reforms and changes of the day. For example, schooling is a key aspect of achieving the Millennium Development Goals, reducing problems associated with youth unemployment, and can be a vehicle to help build a more just, equitable and fair society. At the international level, countries have joined together to support global initiatives in areas where there is a common belief that action in schools (and classrooms) is of great importance in helping to improve the ways in which societies operate, in order to promote equity, fairness, justice and a better life for all.

By 2015, four major global initiatives in development and education will be wrapped up and evaluated. They include:

- The Millennium Development Goals (MDGs) provide a set of clear development goals that can be measured, education being a significant input and indicator as to the achievement of these goals.
- Education for All (EFA) which focuses on identifying and implementing effective ways of ensuring that everyone has an opportunity to have a high-quality and relevant basic education.

- United Nations Literacy Decade (UNLD) which concentrates on promoting literacy as a key tool for all kinds of learning.
- Decade of Education for Sustainable Development (DESD), which promotes a set of basic values, processes and behaviours which should be part of learning in all circumstances.

These four major initiatives are targeted and focused; however, they share a number of concerns, such as the improvement of quality of life, promotion of human rights, participation of everyone in education and development and commitment to education and lifelong learning in all its forms, whether it be through formal, informal or non-formal means. All these initiatives highlight the role of education and schooling as a key to development, as a way of enabling people to fulfil their potential and take increasing control over decisions that affect them.

Although only one MDG, goal 7 is specifically aimed at achieving environmental sustainability; education for sustainable development provides learning goals for the MDGs; seeks to develop actions, competencies, values and behaviour necessary to address MDG issues; and develops critical thinking for evaluating MDG issues. By supporting ESD agenda, many countries introduced subjects or modules into school curriculum to address environmental issues. In Hong Kong environmental/sustainability module was introduced in the Liberal Studies curriculum in 2009. This chapter focuses on the results of this innovation as perceived by school graduates.

Case Study of Hong Kong: Does Teaching in Hong Kong Classrooms Help Change the Attitudes, Understandings and Behaviour of Learners in Ways That Are Compatible with Caring for the Environment?

As we have already noted, one of the important functions or purposes of education and schooling is to equip learners to live and work effectively in an ever-changing and evolving society. As new and growing challenges emerge which need to be met, such as concerns about environmental issues including destruction of the environment, global warming and an expanding carbon footprint, schools are one of the key agents of socialisation in society which seek to bring about changes in behaviour into more desirable directions.

The importance of behaviour change has been highlighted by the World Bank (2010) study that found huge discrepancies between intention and action in terms of pro-environmental behaviour. Figure 7.1 illustrates responses of 10733 individuals from 22 developed and emerging economies.

This section of the chapter reports and draws heavily on a recent research study "Effects of Liberal Studies on Hong Kong Students' Environmental Knowledge and

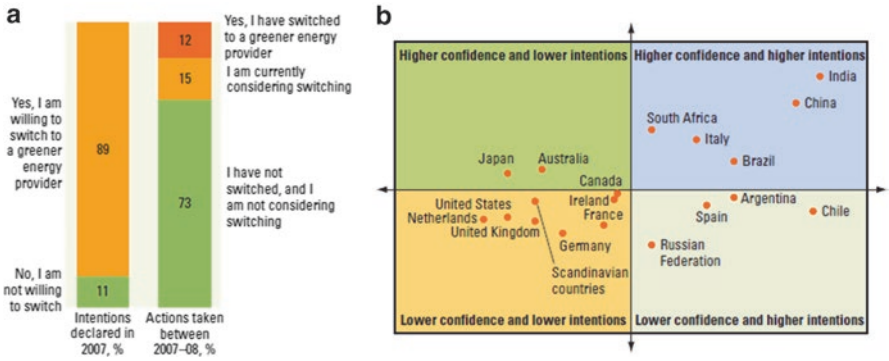

Fig. 7.1 Importance of Behavior Change shows that individuals' willingness to respond to climate change differs across countries and does not always translate into concrete actions. (**a**) Globally, individual intentions to act do not yet translate into concrete action. (**b**) In emerging markets people are more confident that climate change will be solved have higher intentions to act (Source: Accenture 2009 (Note: The 2009 Accenture Climate Change Survey was conducted with a sample of 10733 individuals in 22 developed and emerging economies. The sample was representative of the general population in developed countries and urban populations in developing countries. Panel a: Respondents were asked about their willingness to switch to a greener energy provider if the provider offered services that help reduce carbon emissions. Intentions did not translate into action, with most respondents staying with their old energy provider. Panel b: Based on the questionnaire, countries were ranked on two criteria – confidence and intention. Confidence measured the individual's optimism about the ability of individuals, politicians and energy providers to find a solution. Respondents in emerging economies generally were more optimistic about humankind's ability to take action to solve global climate change) taken from the World Bank (2010), p. 324

Behaviour" conducted in Hong Kong (Zhu et al. 2014)[1] which sought to ascertain whether schooling has been effective in enhancing the knowledge and understanding of learners in Hong Kong concerning major environmental problems being confronted at the current time. It examines whether the schooling provided in Hong Kong has been successful in actually getting learners to modify their behaviour in ways and directions which are likely to successfully promote improvements to the environment and sustainable development.

The study followed up on recent curricular reforms in Hong Kong schools and classrooms, which introduced a new compulsory environmental/sustainability module into the Secondary Liberal Arts curriculum in 2009.

The purpose of the research was to help Hong Kong policymakers and educators gain hard evidence regarding the possible effects of the reforms on student

[1]This research study was funded from resources provided by the Department of International Education and Lifelong Learning (IELL) in the Hong Kong Institute of Education to Rupert Maclean as the Director of the Centre for Lifelong Learning Research and Development in the Hong Kong Institute of Education. Will Douglas was largely responsible for designing and administering the questionnaire, Mr. Zhu undertook the statistical analysis, and Tamara Savelyeva, Zhu and Will Douglas undertook the overall analysis, interpretation and write-up of the results. This chapter draws heavily on the write-up of the results of that study, with due acknowledgement to Savelyeva, Zhu and Douglas.

perceptions, after 3 years of implementation of the new curriculum in secondary schools. Another aim was to connect Hong Kong secondary education with a global curricular movement, which promotes sustainable development in diverse educational systems, and is concerned with enriching students' knowledge, skills and understandings regarding addressing environmental concerns and to also change their behaviour in this regard.

Evidence exists from other parts of the world as to the extent to which learning in schools and classrooms about environmental matters impacts on students' knowledge and concrete behaviour regarding environmental matters. For instance, in the USA, a study of middle school students has shown that environmental education in classrooms in relation to climate change improved students' knowledge and actions, although significant misconceptions remained (Bofferding and Kloser 2014). In Canada, the results of two case studies showed that students believed that environmental study programmes can affect environmental change but with "real-world" constraints in terms of enacting this change (Breunig et al. 2014). In Israel, an experimental study showed similarly that the environmental education programmes influenced students' behavioural intentions and personal norms.

Studies in Greece have shown that only a few students believed that environmental education acutally influenced their environmental behaviour (Liarakou et al. 2011). Additionally, no significant differences were found in pro-environmental behaviour (Gottlieb et al. 2013). However, a cross-national (UK, Australia, Brunei, Greece, India, Korea, Oman, Singapore, Spain, Turkey and the USA) study showed that sociocultural characteristics might influence students' pro-environmental actions (Boyes et al. 2014). The effect of environmental education programmes on Hong Kong students' environmental knowledge and behaviour remains unclear, and so this pilot study sought to shed light on this matter.

The HK study also elaborates on the findings of another local research study (Cheung et al. 2014), which suggests that both traditional and digital media – websites and digital social network – might play an important role in disseminating environmental knowledge.

Research Method

First year students at EdUHK, who took the Hong Kong Diploma of Secondary Education (HKDSE), were invited to complete an anonymous questionnaire regarding their attitudes and actions on environmental issues. The questionnaires were completed on paper, with the data input manually and being independently checked for errors.

Four hundred and fifteen students answered the questionnaire; three returns were excluded because the respondents had not taken the HKDSE. In the sample, there were 293 (71.1%) female students, 116 (28.2%) male students and 3 (0.7%) students who did not indicate their gender (Table 7.1).

Table 7.1 Sample distribution by gender

	Frequency	Percent (%)
Female	293	71.1
Male	116	28.2
Not specified	3	0.7

The questionnaire included five scales and a background question on gender. Three scales were designed to measure students' perceptions of the effect of the Liberal Studies programme on their environmental knowledge (eight items; the Cronbach's alpha = 0.939), environmental behaviour (nine items; the Cronbach's alpha = 0.937) and active participation in environmental group activities as a result of the LS (three items; the Cronbach's alpha = 0.949). Another scale measured students' participation (three items; the Cronbach's alpha = 0.668), and the last scale measured students' perceptions of other influences that might affect their understanding of environmental issues (six items; the Cronbach's alpha = 0.749).

Descriptive analyses using SPSS (version 21) were conducted to illustrate students' ratings on each item of each scale. Confirmatory factor analyses (CFA) with covariate (gender) were conducted using Mplus software (Muthén and Muthén 2012) to examine any gender differences in the variables for this study.

Results

Students' Perceptions of the Effect of Liberal Studies Programme on Environmental Knowledge

The perceived level of students' knowledge of environmental issues has increased as a result of the Liberal Studies programme. This knowledge increase scale (KIS) was measured using eight items. These items were "Climate change", "Air quality", "Waste disposal", "Biodiversity", "Nature conservation", "Industrial pollution", "Renewable energy" and "Ozone layer depletion". There were four response categories to indicate an increase in knowledge: "No change", "Slightly more", "More" and "Much more". The average rating and percentage distribution for these items are presented in Table 7.2, and the cumulative percent bar charts are presented in Fig. 7.2.

Students considered their knowledge increased most on three environmental issues: Renewable energy (q17, mean 2.60, "More" or "Much more" to 60.6%), Waste disposal (q13, mean 2.43, "More" or "Much more" to 54.5%) and Nature conservation (q15, mean 2.36, "More" or "Much more" to 49.1%). The three issues on which students considered their knowledge increase least were Ozone layer depletion (q18, mean 2.17, "More" or "Much more" to 39.1%), Biodiversity (q14, mean 2.19, "More" or "Much more" to 39.8%) and Air quality (q12, mean 2.31, "More" or "Much more" to 47.0%). All items in the knowledge increase scale had

Table 7.2 Percent distribution and means of knowledge increase scale

Item	No change (%)	Slightly more (%)	More (%)	Much more (%)	Mean (%)	S.D. (%)
Q18 Ozone depletion	26.2	34.7	34.5	4.6	2.17	0.873
Q14 Biodiversity	26.2	34.0	34.5	5.3	2.19	0.887
Q12 Air quality	21.4	31.6	41.7	5.3	2.31	0.866
Q11 Climate change	20.9	30.1	42.2	6.8	2.35	0.885
Q16 Industrial pollution	19.7	33.7	38.3	8.3	2.35	0.888
Q15 Nature conservation	19.2	31.8	42.5	6.6	2.36	0.865
Q13 Waste disposal	18.2	27.3	47.4	7.1	2.43	0.868
Q17 Renewable energy	15.5	23.8	45.6	15.0	2.60	0.924

Note: Response scale was coded as *1* = No change, *2* = Slightly more, *3* = More and *4* = Much more. *Ozone* ozone layer depletion, *S.D.* standard deviation. Percentage within each item might not add to 100% because of rounding error

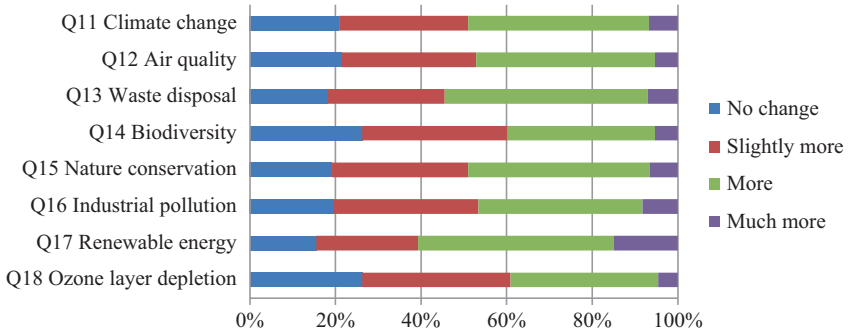

Fig. 7.2 Cumulative percent bar chart of knowledge increase scale

39% or more of students indicating "More" or "Much more". In addition, 26.2% or fewer students considered their knowledge on the items had not changed.

Students' Perceptions of the Effect of Liberal Studies Programme on Environmental Behaviour

The change in students' environmental behaviour as a result of the Liberal Studies programme (behaviour change scale (BCS)) was measured using two sets of items. The "Recycle" set has three items with a common theme of "As a result of what you learnt in the Liberal Studies Programme, do you recycle more". The items are "Recycle paper", "Recycle metals" and "Recycle plastic". There were four response categories: "No change", "Slightly more", "More" and "Much more".

Table 7.3 Percent distribution and means of behaviour change scale

Behaviour change scale	No change (%)	Slightly more/less (%)	More/less (%)	Much more/ less (%)	Mean (%)	S.D. (%)
Q35 Spend on clothes	50.6	28.4	18.1	2.9	1.73	0.857
Q22 Recycle metals	47.3	30.9	19.4	2.5	1.77	0.845
Q36 Spend on electronics	49.9	26.2	20.5	3.4	1.78	0.890
Q31 Use air conditioning	43.8	30.6	22.0	3.7	1.86	0.886
Q32 Use water	39.0	33.3	23.8	3.9	1.93	0.884
Q23 Recycle plastic	40.9	28.4	26.7	3.9	1.94	0.912
Q21 Recycle paper	38.4	27.9	27.9	5.9	2.01	0.948
Q33 Waste food	34.3	26.0	30.9	8.8	2.14	0.994
Q34 Use plastic bags	29.4	28.7	28.9	13.0	2.25	1.020

Note: Response scale was coded as *1* = No change, *2* = Slightly more/less, *3* = More/Less and *4* = Much more/less. *S.D.* standard deviation, *Spend on clothes* spend money on clothes, *Spend on electronics* spend money on electronic goods. Percentage within each item might not add to 100% because of rounding error

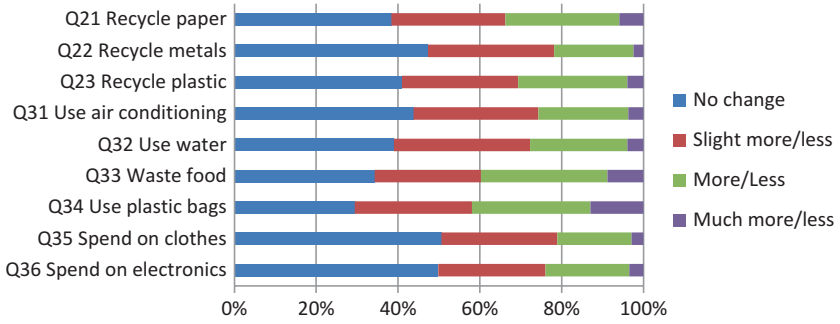

Fig. 7.3 Cumulative percent bar chart of behaviour change scale

The "Protection" set has six items with a common theme of "As a result of what you learnt in the Liberal Studies Programme, do you do less of the following:". The items are "Use air conditioning", "Use water", "Waste food", "Use plastic bags", "Spend money on clothes" and "Spend money on electronic goods". The four response categories were "No change", "Slightly less", "Less" and "Much less". Therefore, the same coding method was used for these two parts, that is, No change was coded as 1, and Much less or Much more was coded as 4. The average rating and percentage distribution for the items of behaviour change scale are presented in Table 7.3, and the cumulative percent bar charts are presented in Fig. 7.3.

Table 7.4 Percent distribution and means of group participation scale

Group participation scale	No (%)	Yes (%)
Q43 Worked in an environmental organisation	76.0	24.0
Q41 Donated money	75.8	24.2
Q42 Joined an environmental group	74.6	25.4

Note: *Donated money* donated money to an environmental group

Students considered their behaviour changed most on three environmental activities: Use plastic bags (Q34, mean 2.25, Less or Much less to 41.9%), Waste food (Q33, mean 2.14, Less or Much less to 39.7%) and Recycle paper (Q21, mean 2.01, More or Much more to 33.8%). The three issues on which students considered they changed least were Spend money on clothes (Q35, mean 1.73, Less or Much less to 21.0%), Recycle metals (Q22, mean 1.77, More or Much more to 21.9%) and Spend money on electronic goods (Q36, mean 1.78, More or Much more to 23.9%). All items in the behaviour change scale had over 21% of students indicating "More/less" or "Much more/less". In addition, 50.6% or fewer students considered their environmental behaviour had not changed.

Students' Environmental Group Activity Participation

Students' environmental group activity participation (group participation scale) was measured by three items with a common theme of "Have you done any of the following:". The items were "Donated money to an environmental group? (e.g. Friends of the Earth, Green Power, etc.)", "Joined an environmental group?" and "Volunteered or been paid for work in an environmental organisation". There were two response categories: "Yes" and "No". The average rating and percentage distribution for the items of group participation scale are presented in Table 7.4. Around 25% of students had participated in environmental group activities in some form.

A follow-up question to each item of the group participation decision scale was asked whether the Liberal Studies programme had influenced students' environmental group activity participation (group participation decision scale). The common theme for these questions was "If 'yes' to any of the above, was this decision as a result of the Liberal Studies programme you studied at school?" There were two response categories: "Yes" and "No". The average rating and percentage distribution for the items of group participation decision scale are presented in Table 7.5. Among the students who participated in environmental group's activities, 38.4–45.2% had made the decisions as a result of the Liberal Studies programme.

Based on the data from group participation scale and follow-up questions, students can be classified into three groups for each listed activity: have not partici-

Table 7.5 Percent distribution and means of effects of Liberal Studies on group activity participation

Group participation decision scale	No (%)	Yes (%)
Q51 Donated money	61.6	38.4
Q53 Worked in an environmental organisation	59.8	40.2
Q52 Joined an environmental group	54.8	45.2

Note: *Donated money* donated money to an environmental group

Table 7.6 Percent distribution of students' group activity participation

Activities	Not participated (%)	Participated (NLSP) (%)	Participated (LSP) (%)
1. Donated money	75.8	14.9	9.3
2. Joined an environmental group	74.6	13.9	11.5
3. Worked in an environmental organisation	76.2	14.2	9.6

Note: *Donated money* donated money to an environmental group, *Participated (NLSP)* participated not as a result of Liberal Studies programme, *Participated (LSP)* participated as a result of Liberal Studies programme

pated, participated not as a result of Liberal Studies programme and participated as a result of Liberal Studies programme. Table 7.6 illustrates the results. From 9.3 to 11.5% of students participated in the listed activities because of the Liberal Studies programme they study at school.

Students' Perceptions of Other Influences on Their Environmental Understanding

Students' perceptions of other influences that had increased their understanding of environmental issues (other influence scale) were measured by six items with a common theme of "Have other influences increased your understanding of environmental issues?" The items are "Other school lessons or activities", "TV", "Newspapers/magazines", "Internet", "Family" and "Friends". There were two response categories: "Yes" and "No". The average rating and percentage distribution for these items are presented in Table 7.7.

The three influences that students considered most to increase their understanding of environmental issues were TV (Q62, 82.3%), Internet (Q64, 81.9%) and Newspapers/magazines (Q15, 74.9%). The three influences that students considered least to increase their understanding of environmental issues were Family (Q65,

Table 7.7 Percent distribution and means of other influence scale

Other influence scale	No (%)	Yes (%)
Q65 Family	55.3	44.7
Q66 Friends	54.1	45.9
Q61 Other school lessons or activities	34.0	66.0
Q63 Newspapers/magazines	25.1	74.9
Q64 Internet	18.1	81.9
Q62 TV	17.7	82.3

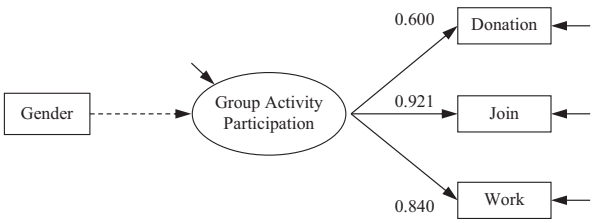

Fig. 7.4 CFA for students' environmental group activity participation (Note: All estimated parameters were standardised (STDYX). Significant effects were shown as an *arrow* with a *solid line*; non-significant effect was shown as *arrow* with *dotted line*. Female was coded as 0 and male as 1. *Donation* donated money to an environmental group, *Join* joined an environmental group, *Work* volunteered or been paid for work in an environmental organisation)

44.7%), Friends (Q66, 45.9%) and Other school lessons or activities (Q61, 66.0%). All items in the other influence scale had a positive response from 44% of students. In addition, 55.3% or fewer students considered their understanding of environmental issues was not increased by the listed influences.

Gender Differences in Students' Environmental Group Activity Participation

Confirmatory factor analysis (CFA) with gender as covariate for students' environmental group activity participation fits the sample data well: CFI = 1.000, TLI = 1.000 and RMSEA = 0.000 (90% C.I.: 0.000–0.086, P value of RMSEA $\leq$0.05 = 0.774); chi-square value for the finale model was 1.284 (d.f. = 2, P = 0.5262). Figure 7.4 depicts the result of final CFA; there is no significant gender difference in students' environmental group activity participation (R-squared of group activity is 0.001).

Gender Differences in Students' Perceptions of the Influences on Environmental Knowledge, Behaviour and Decisions to Participate

Confirmatory factor analysis (CFA) with gender as covariate for students' perceptions of the effects of the influences on their environmental knowledge, environmental behaviour and decision of environmental group activity participation fits the sample data well: CFI = 0.988, TLI = 0.987 and RMSEA = 0.051 (90% C.I.: 0.045–0.056, P value of RMSEA $\leq$0.05 = 0.420); chi-square value for the finale model was 630.847 (d.f. = 308, P = 0.000). Although the chi-square values for the final model remained statistically significant, it was substantially lower than that for the baseline mode (28301.812, d.f. = 351); given the sensitivity of chi-square to sample size (N = 409 in this study, three cases were excluded because of not indicating their gender), the model-data discrepancies are acceptable (Byrne 2012). Figure 7.5 depicts the result of final CFA.

As shown in Fig. 7.5, there is no significant gender difference in students' perceptions of the effect of the Liberal Studies programme on their environmental knowledge or environmental behaviour. Significant gender differences in students' perceptions of the effect the Liberal Studies programme on their environmental group activity participation and students' perceptions of the effect of other influences on their understanding of environmental issues were found.

As mentioned above, only students who participated in the listed environmental group activities answer the follow-up questions on whether they thought the Liberal Studies programme affect their environmental group activities. Results of these studies showed significant differences between the perceptions of these students. Male students were found to agree more (standardised coefficient = 0.263, with female students coded as 0, male students coded as 1) that their decisions of the participation were results of Liberal Studies programme that effect; however, female students were found to agree more that (standardised coefficient = −0.129, with female students coded as 0, male students coded as 1) other influences increased their understanding of environmental issues (R-squared of Knowledge Increase, Behaviour Change, Group Participation and Other Influences are 0.000, 0.005, 0.069 and 0.017, respectively).

The correlation between students' perceptions of the effect of Liberal Studies on their environmental knowledge, environmental behaviour and decision to participate in environmental group activities is all significant, with the correlation coefficient ranging from 0.335 to 0.686.

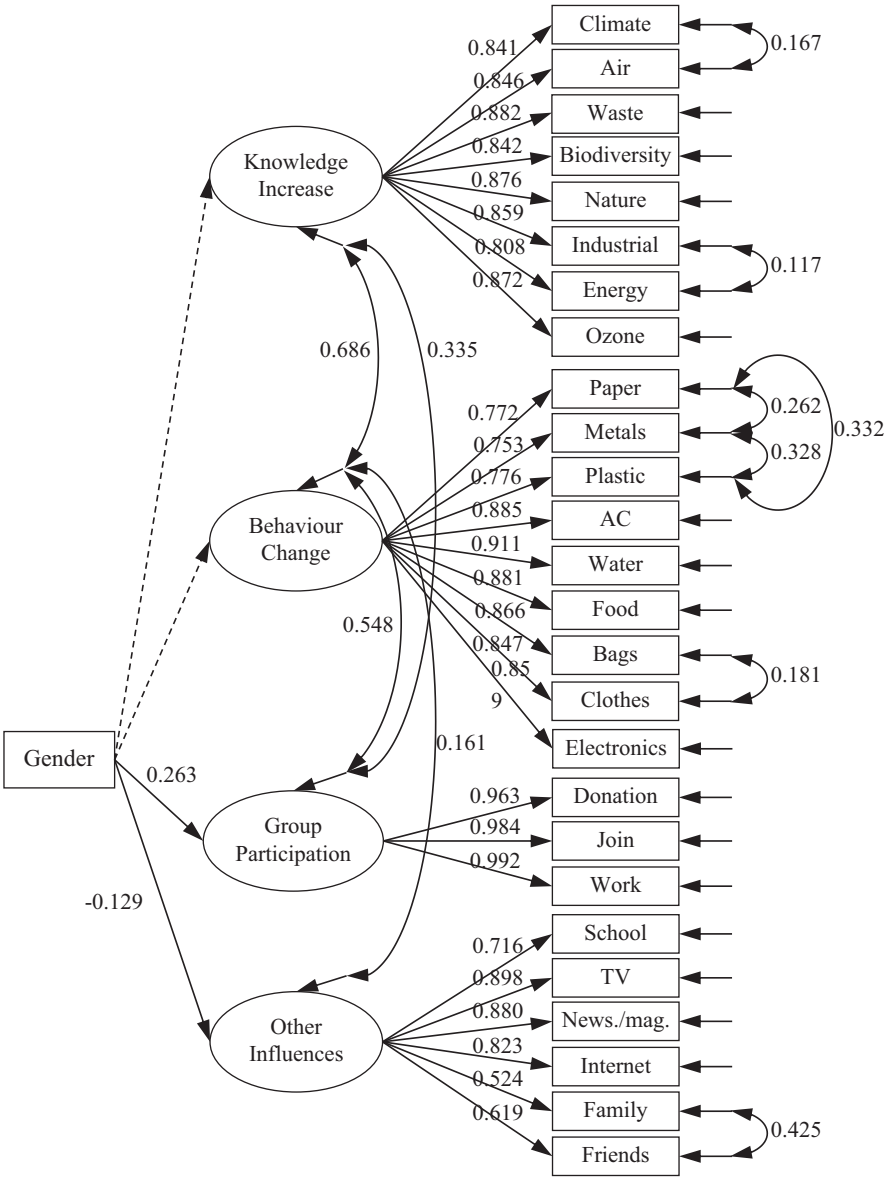

Fig. 7.5 Confirmatory factory analysis (CFA) for students' environmental group activity participation (Note: All estimated parameters were standardised (STDYX). Significant effects were shown as *arrow* with *solid line*; non-significant effect was shown as *arrow* with *dotted line*. Non-significant correlation coefficients for the latent variables were not shown. Female was coded as 0 and male as 1. *AC* use air conditioning, *Donation* donated money to an environmental group, *Join* joined an environmental group, *Work* volunteered or been paid for work in an environmental organisation, *School* other school lessons or activities, *News/Mag.* newspapers/magazines)

Discussion

As we noted in the introductory part of this chapter, one of the important roles of schools (and classrooms) is to effectively prepare learners to participate fully and appropriately in sustainable development of their societies. Part of this preparation involves assisting them to gain the knowledge, skills, understandings and behaviour appropriate to their particular society and to learn how to cope with contemporary problems confronting their particular society and the world.

The Hong Kong study reported in this chapter sought to illustrate the effects and impact of compulsory environmental education as a result of the introduction of the new senior secondary curriculum in Hong Kong. The results of the study show that there was a perceived increase in knowledge of the selected environmental issues, with over 39% of students reporting "More" or "Much more" knowledge and 26% or fewer students reporting "No Change" in their knowledge.

With regard to behaviour changes, 21% of students indicated "Less" or "Much less" in terms of positive changes to recycling or resource wastage. 29.4–50.6% of students considered their environmental behaviour had not changed. Moreover, around 75% students have not participated in environmental group activities, such as donating money, joining an environmental group or working in an environmental organisation. Over 38.4% (i.e. 9.3% of the sample) of students who participated in these activities agreed that their decision was a result of the Liberal Studies programme. These results indicate that the effect of Liberal Studies on students' perceived environmental knowledge is greater than the effect on their actual behaviour. The correlation between students' perceptions of the effect of Liberal Studies on their environmental knowledge, environmental behaviour and decision of environmental group activity participation was all significant (over 0.335), and this is consistent with finding of the study conducted in the USA (Levy and Marans 2012), which might suggest the effect of students' environmental knowledge on students' environmental behaviour.

In addition to the Liberal Studies programme, it is clear that other "agents of socialisation" outside the school and classroom also influence the knowledge and understanding of students with regard to environmental matters and influences such as TV, Internet, newspapers/magazines, family and friends. In addition other school lessons or activities apart from the compulsory environmental education as a result of the introduction of the new senior secondary curriculum in Hong Kong might also affect students' environmental understanding. This was indicated to be the case by over 44.7% students. More than 74% students reported that media, including TV, Internet and newspapers/magazines, increased their understanding of environmental issues.

Gender differences were only found in students' perceptions of the effect of Liberal Studies on their decision to participate in environmental group activities and

other influences affect their understanding of environmental issues. Further work in this area is recommended.[2]

To increase the probability of behaviour change, classroom-based learning and pedagogies that are employed are particularly important to consider, and international practice of implementing education for sustainable development could provide some guidelines.

Impact of Schools and Classrooms on Student Knowledge and Behaviour Regarding Sustainable Development Issues: Overview of International Perspectives

With regard to changing classroom practice (UNESCO 2012), a noteworthy pedagogical shift seems to be occurring in ESD, as the DESD has unfolded, as has been noted during the recent end of Education for Sustainable Decade in Nagoya (UNESCO 2014). It is marked by a rise in alternative/innovative forms of teaching and learning. Literature review of publications on teaching and learning within the framework of education for sustainable development identified four key processes underpinning ESD (Tilbury 2011):

- Processes which stimulate innovation within curricula as well as through teaching and learning experiences.
- Processes of active and participatory learning.
- Processes which engage the "whole system."
- Processes of collaboration and dialogue (including multi-stakeholder and intercultural dialogue).

These processes should be mainly facilitated at the school level. At the classroom level, the global monitoring and evaluation survey (GMES) distinguished nine types or forms of learning associated with ESD. Some can be considered conventional (e.g. transmissive learning and disciplinary learning) and some more cutting edge (e.g. multi-stakeholder social learning and systems thinking-based learning). They are described briefly below:

- *Discovery learning* – learners are immersed in a rich context where they encounter some element of mystery; they become curious and begin to make sense of their experience through their own exploration.

[2] One note of caution needs to be mentioned when interpreting these findings. This concerns the fact that students are self-reporting on their own knowledge, understandings and behaviours regarding environmental matters, and so we cannot be sure that their perceptions are accurate and so whether their perceptions coincide with actual realities. In addition, the research reported here is very much a case study involving just 400 learners, and so it cannot be assumed that these findings are generalisable to senior secondary school students in Hong Kong as a whole.

- *Transmissive learning* – using didactic skills (e.g. presenting, lecturing, storytelling) and supporting materials (e.g. workbooks, instruction or code of conduct) is transferred to the learners.
- *Participatory/collaborative learning* – although not identical, both emphasise working together with others and active, not passive, participation in the learning process, which tends to focus on resolving a joint issue or task.
- *Problem-based learning* – focused on solving real or simulated problems, to better understand the issue or find ways to make real-life improvements. Issues are either identified by the learners or predetermined (e.g. by teachers, experts, commissioning bodies).
- *Disciplinary learning* – taking questions of a disciplinary nature (e.g. geographical and biological) as a starting point, to better understand underlying principles and expand the knowledge base of that discipline.
- *Interdisciplinary learning* – taking issues or problems as a starting point, then exploring them from different disciplinary angles to arrive at an integrative perspective on possible solutions or improvement.
- *Multi-stakeholder social learning* – bringing together people with different backgrounds, values, perspectives, knowledge and experience, from both inside and outside the group initiating the learning process, to set out on a creative quest to solve problems that have no ready-made solutions.
- *Critical thinking-based learning* – exposing the assumptions and values that people, organisations and communities live by and challenging their merit from a normative point of view (e.g. animal well-being, ecocentrism, human dignity, sustainability) to encourage reflection, debate and rethinking.
- *Systems thinking-based learning* – looking for connections, relationships and interdependencies to see the whole system and recognise it as more than the sum of its parts and to understand an intervention in one part affects other parts and the entire system (pp. 25–26, UNESCO 2012).

Figure 7.6 shows the number of times GMES respondents (n = 213) from 102 countries ticked the forms of learning described above. Discovery learning, systems thinking-based learning, critical thinking-based learning, interdisciplinary learning, problem-based learning and participatory/collaborative learning were mentioned the most.

Discovery learning, systems thinking-based learning, critical thinking-based learning, interdisciplinary learning, problem-based learning and participatory/collaborative learning provide an opportunity to discuss environmental issues and engage students in pro-environmental activities. The classrooms that encourage these learning should be based on the principle that *ethical development is a core business of education* (Pavlova 2013a, b). The formulation of this principle is a result of global studies in education that aimed to establish consensus among experts across different regions, on a framework for curriculum development that is "multinational in origin, perspective, and aim and that … [is] responsive to a crisis-laden, interconnected world" (Parker et al. 1999, p. 120). These studies examined undesirable trends and forecasted social realities and the competencies that help citizens to

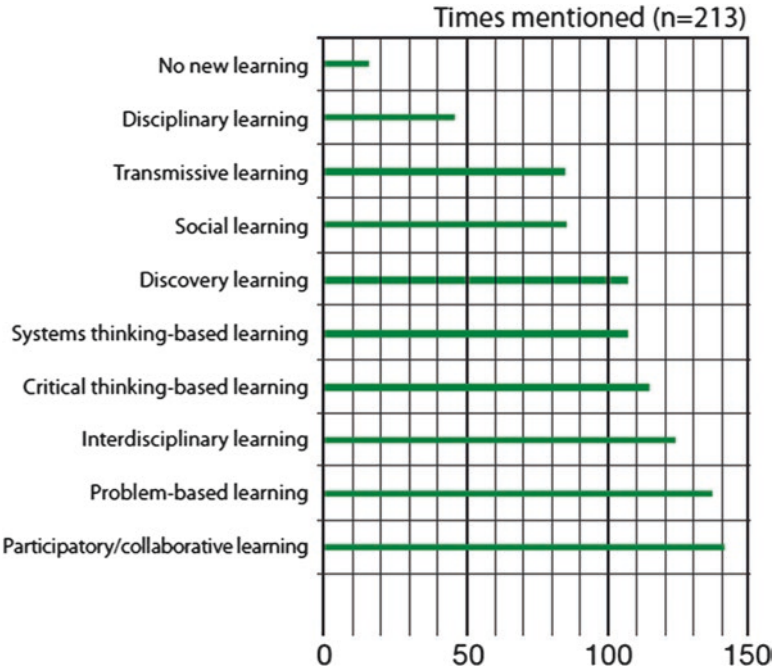

Fig. 7.6 Types of learning associated with ESD as identified through the GMES (Source: UNESCO (2012). Shaping the Education of Tomorrow: 2012 Report on the UN Decade of Education for Sustainable Development, Abridged. Paris: UNESCO. p.26)

deal with these trends and the pedagogical means that could help teachers to develop particular qualities in students. Participants of the Campbell et al. (1992) study argued that the results of education are "caring, just, morally responsible, compassionate and ecologically aware individuals" (p. 38). These individuals are committed members of society ready and willing to take part in collaborative action in order to achieve desirable futures. This education should make it possible to move towards "a planetary transition toward a humane, just and ecological future" (Raskin et al. 2002). It should help us to revise our ways of living together on this planet.

Conclusion

In this chapter we have examined the matter of environmental education and education for sustainable development and the extent to which senior secondary schools in Hong Kong have been successful in enhancing knowledge and changing behaviour with regard to key aspects of environmental education. The authors argue that to increase effectiveness of environmental studies, particular types of learning should occur, including discovery learning, systems thinking-based learning,

critical thinking-based learning, interdisciplinary learning, problem-based learning and participatory/collaborative learning. Teachers should provide an opportunity to engage students in pro-environmental activities. They also should emphasise the importance of particular values, ones that are related not to an economic rationalism imperative but to valuing of the other person, moral responsibility and establishing of a nonmechanistic relationship with nature.

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