The Role of Equity and Lifestyles in Education about Climate Change: Experiences from a Large-scale Teacher Development Program

Manfred Lenzen, The University of Sydney New South Wales & Joy Murray, New South Wales Department of Education and Training, Australia

Abstract

The industrialised nations represent 20% of the world population, but cause 75% of global greenhouse gas emissions. While developing nations can more or less remain where they are, industrialised nations need to reduce emissions by 85% in order to achieve sustainability and provide everyone with an equitable share of the global greenhouse gas "budget." Such reductions have drastic bearings on lifestyles. While adults may find it hard to deal with changes, students seem more accepting, but may not have the skills to critique complex arguments, or the understanding necessary to make sustainable lifestyle choices. This paper describes a large-scale teacher development program, and a personal greenhouse gas calculator and supporting teacher and student resources that have been included in the program as a major component.

Résumé

Les pays industrialisés représentent 20 % de la population mondiale, mais ils sont responsables de 75 % des émissions de gaz à effet de serre. Tandis que la situation des pays en développement peut plus ou moins demeurée la même, les pays industrialisés doivent réduire leurs émissions de 85 % afin d'atteindre à la durabilité et d'assurer à chacun une part équitable du « budget » planétaire des gaz à effet de serre. De telles réductions ont une influence considérable sur les styles de vie. Les adultes peuvent éprouver de la difficulté à s'adapter. Les élèves semblent plus résignés, mais ils n'ont peut-être pas les compétences voulues pour critiquer des arguments complexes ou la compréhension nécessaire pour faire des choix de styles de vie durables. Ce document décrit en premier lieu un

programme de perfectionnement des enseignants à grande échelle et deuxièmement un calculateur personnel des gaz à effet de serre et des ressources à l'appui, à l'intention des enseignants et des élèves, qui constituent une composante majeure du programme.

Climate change is one of the most pressing environmental problems today. Because of its long-term effects, it could bear drastic consequences for future generations. The education of young people therefore plays a crucial role in grappling with the problem of reducing greenhouse gas emissions. It is maybe the global and therefore abstract nature of climate change, which explains the lack of effective abatement by the main contributors—people in industrialised countries. To complicate matters, climate change is also linked to the problem of the considerable inequity between industrialised and developing countries. Environmental education needs, therefore, to concentrate on relating these global and abstract issues to students' personal spheres, in other words, their lifestyles.

An educational tool that can link climate change with lifestyles is a personal greenhouse gas calculator. Because it can be facilitated in the classroom by using technological means such as electronic worksheets, it is ideally suited for inclusion in the New South Wales Department of Education and Training's technology in learning and teaching (TILT) Plus teacher development program.

The TILT Plus program, the design and implementation of the greenhouse gas calculator, and first experiences of its use are the subject of this article, which is organised in three parts:

- Part one presents the TILT Plus Science program. TILT Plus Science provides a context in which to address the issue of climate change in relation to students' lived experiences. It provides teachers with an understanding of critical literacy so that they can assist students to critique complex texts dealing with climate change.
- Part two first discusses climate change in terms of equity and sustainability in a global context, illustrating the complex issues with which students are asked to grapple. It focuses on two aspects that are often not taught in the context of climate change: the North-South issue and consumerism. Second, it is shown how these aspects can be incorporated into an educational tool: a personal greenhouse gas calculator.

- Part three describes the inclusion of the personal greenhouse gas calculator in the TILT Plus Science program in order to assist students and teachers in understanding their own contribution to greenhouse gas emissions and to make national comparisons while providing activities and discussion topics to make global and abstract concepts more accessible to classroom life.

The TILT Plus Program

The Technology in Learning and Teaching (TILT) Plus program is a New South Wales State Labor Government initiative (1999-2003). It builds on the successful TILT program (1995-1999), which won state and federal awards for its training of 15,000 teachers in basic computer skills and classroom uses of computer technology (Murray, 2000). TILT Plus is being provided for up to 15,000 teachers, school executive and specialist support staff who are more confident in the use of technology. It provides a number of options to support a range of needs. One of these options is the TILT Plus Science program which is available to New South Wales science teachers.

The consultative development process adopted by TILT Plus is a crucial element in the program's acceptance and hence its adoption by teachers. The structure and content of the whole program emerged out of a two-day meeting of representatives of TILT participants and facilitators, school districts and state office, parent and principal organisations, and teacher professional associations who considered suggestions from over 5000 TILT participants collected as part of the ongoing evaluation of TILT (New South Wales Training and Development Directorate, 1995-1999). Individual TILT Plus programs (e.g., Mathematics, Science, Computing, History) were then developed by teachers identified as exceptional practitioners working with the Department of Education and Training's subject consultants and members of the TILT team. In Semester 1, 2000 TILT Plus Science was piloted by 60 teachers in 10 of the state's 40 school districts. Piloting was followed by an evaluation meeting and some re-writing in response to teacher and workshop leader feedback. In Semester 2, 2000 it was further piloted by 79 teachers in 18 districts. Since February, 2001 the program has been available statewide.

TILT Plus Science is a 30 hour program over one semester. The program includes a video showing good classroom practice, a folder containing workshop materials and participant learning journal, a CD-ROM containing support materials and resources, and a web site with participant

communication and resource sharing facilities (http://www.-tdd.nsw.edu.au/tilt/training/tiltplus/index.htm). Teachers participate in four workshops supported by a trained workshop leader. In addition they are provided with two relief days during which time they may invite the workshop leader to work with them in their own school on a one to one or small group basis. In this way the program can be tailored to meet the needs of individual participants.

Helping teachers to help students understand and evaluate (multi)media texts

The TILT Plus Science workshops consist of a core component providing an action learning/action research framework (Dick, 1997) and an introduction to constructivist learning and teaching theory (Murphy, 1997). This is followed by a component dealing with information skills and the internet in which teachers learn internet search strategies, an information skills process (defining, locating and selecting information) and the application of critical literacy strategies to internet texts. This component is an abridged version of the online program Net Returns Online (http://-www.tdc.nsw.edu.au/netreturns.htm) based on the publication Making the Net Returns Worthwhile: Information Skills and the Internet (Department of Employment, Education, and Training, 1996).

Both the information skills component of TILT Plus and *Net Returns Online* grew out of the need for an extension of the concepts of critical literacy to cover multimedia texts. Critical literacy, once the province of Media Studies teachers, was more widely adopted in Australia in the 1990s through the work of Comber (1993) Luke, O'Brien and Comber (1994) and Lankshear (1994). It provides strategies for teachers to assist students in interrogating factual texts. In the context of the TILT Plus Science program these strategies can be applied to texts dealing with climate change. Critical literacy poses such questions as:

- Who published this text?
- What is their authority?
- How current is the information?
- What is the purpose of the text?
- Who is the intended audience?
- How does it position me, the reader?, and
- What is its bias?

These questions have been complemented by other questions such as:

- What does the URL tell me?
- How do I determine the credentials, qualifications and expertise of the author?
- What links are provided?
- Where do they lead me?
- For what purpose?, and
- How do I check the accuracy of this material?

Feedback from *Net Returns Online*, which has been running since 1997 with a completion rate of 85% indicates that teachers recognise a need for these skills in an internet environment. An in depth understanding of how texts work enables teachers to help students to understand and evaluate complex media texts dealing with issues of climate change. If students are to become discerning users of information with the skills necessary to locate, select, and critique information delivered via continually more complex and intrusive information systems then such programs are essential for teachers.

Students need sophisticated literacy skills to be able to uncover the equity and lifestyle issues embedded in the climate change literature. Without this ability the arguments outlined below may well remain blurred within the rhetoric of organisations with a vested interest in presenting only one side of the picture.

Equity and sustainability in the context of climate change

The Intergovernmental Panel on Climate Change (IPCC) has acknowledged that "the balance of evidence suggests a discernible human influence on the global climate" (IPCC, 1995). Climate change is now considered to be one of the most serious threats to the environment (Watson, Zinyowera, & Moss, 1996). Models suggest that a stabilisation of atmospheric CO_2 concentrations at today's level can only be achieved through a reduction in net emissions by more than 50% in the next 40 years and further reductions thereafter. Even then, a global sea level rise of more than 25 cm must be expected over the next 100 years (Houghton, Meira Filho, Griggs, & Maskell, 1997).

The wealthy 20% of the world's population causes about three-quarters of the global greenhouse gas emissions. Average per-capita emissions in North America, Australia, Europe or Japan are about ten times higher than those in South Asia or China (United Nations, 1996). The key factor for the level, distribution, and increase of global greenhouse gas emissions and for environmental degradation in general is the increasing material standard

of living in the industrialised world (World Commission on Environment and Development, 1987). The influence of population growth in the developing world on emissions is at present considerably lower (Parikh, 1996). Paradoxically, while the "South's" population issues have been the subject of international negotiations on climate change, the "North's" unsustainable and unfair consumption has never been adequately acknowledged (Parikh & Painuly, 1994). Moreover, participation in climate change research and discussions is heavily skewed in favour of Northern institutions, resulting in Southern participants perceiving negotiations to revolve around Northern interests and policy positions (Hyder, 1992; Kandlikar & Sagar, 1999). It is therefore not surprising that the wealthy North is being accused of appropriating yet another global commons and thus exercising environmental colonialism (Agarwal & Narain, 1991).

In contrast, apportioning the same right to emit to everybody on the planet and at the same time reducing emissions by 50% yields an equitable and sustainable greenhouse gas "budget" of about 3.5 tonnes of carbon dioxide equivalents per capita (t CO_2-e/cap; see Lenzen, 1997; Byrne, Wang, Lee, & Kim, 1998). In order to achieve international equity and sustainability, industrialised nations need to reduce emissions by about 85%, while developing nations can more or less remain at the present levels. Even more drastic reductions would be required under intergenerational equity, where industrialised nations are held accountable for cumulative historical emissions (Den Elzen, Janssen, Rotmans, Swart, & De Vries, 1992; Neumayer, 2000).

Linking lifestyles with responsibility for equitable and sustainable emissions

"Many in the South feel that climate change is an issue of lifestyles" (Kandlikar & Sagar, 1999, p. 131). In order to support the life of an average Australian, for example, about 25 t CO_2-e are emitted annually, which is more than 7 times the equitable and sustainable level (Lenzen & Smith, 2000). About 20% of these emissions are caused by household energy and private car use, while the remaining 80% are required for the provision of consumer goods, and commercial and public services (Lenzen & Smith, 2000). In most industrialised countries, emissions are mainly driven by income growth (Melanie, Phillips, & Tormey, 1994; Hamilton & Turton, 1999). The latter, along with increasing women's participation in the workforce, influences lifestyle choices such as family size, home type, floor space and location, comfort through appliance ownership, mobility through car ownership, out-of-home leisure, and holiday travel. These choices affect greenhouse gas emissions from households as well as from the

transportation, manufacturing, and commercial services sectors in a stronger way than energy efficiency measures or fuel mix changes (Schipper, 1998).

Despite the fact that lifestyles play a key role for inequity and unsustainability of greenhouse gas emissions, they are often not addressed in information and education materials. Most school resources published in the Australian states of New South Wales and Victoria, for example, do not mention goods and services consumption at all (Lenzen & Smith, 2000). As a consequence, only household energy and private car usage are commonly perceived by Australians as areas of individual responsibility (Stokes, Lindsay, Marinopoulos, Treloar, & Wescott, 1994; Australian Bureau of Statistics, 1997). As a result, effective means of reducing greenhouse gas emissions through individual action such as sharing or borrowing household items, buying second-hand, or engaging in low resource-use activities, are foregone.

Lifestyle changes can effectively complement political and technological abatement measures that, on their own, do not seem to be achieving equity and sustainability (Trainer, 1997). Individual awareness and concern are a prerequisite for, but do not necessarily lead to such changes. Trust in information sources, institutional and infrastructural support, response knowledge, and belief in the efficacy of pro-environmental behaviour are only a few of the conditions for translating awareness into corresponding action (Eden, 1993; Kempton, 1993; Harrison, Burgess, & Filius, 1996; Hinchliffe, 1996). Moreover, while promoting lifestyle changes has proven successful in cases where alternative, environmentally friendly products are available (for example ozone depletion), climate change is posing greater barriers to consumer action, because it requires "rethinking [how to] achieve life satisfaction and express one's social status and personal worth" (Kempton, 1993, p. 236).

While adults in general may be lacking in taking overt action for the environment, current research suggests that younger people are more likely to be more accepting of radical changes. A survey of South Australian school students showed that only about 20% thought that "the only way to solve environmental problems is through scientific and technological means," but more than 80% believed that "the ultimate solution for environmental problems depends on drastic changes in our life-style" (Worsley & Skrzypiec, 1998, p. 215).

A comprehensive personal greenhouse gas calculator for the classroom

Educators can assist value shifts by demonstrating the relevance of lifestyle choices for greenhouse gas emissions. A simple yet powerful means to link the global problem of climate change with elements of individual lives is the idea of a personal greenhouse gas budget. Assessing personal emissions and comparing these with the previously introduced equitable and sustainable level of 3.5 t CO_2-e per year can be enlightening and it questions, who is actually willing to make the changes that a rigorous policy would entail (Proops, Faber, & Wagenhals, 1993).

There are existing greenhouse "savers" or "scorecards," which attempt to assess the greenhouse gas responsibility of individuals, but they concentrate mostly on household energy and the private car, thus ignoring goods and services consumption (Lenzen, 2001). An early but excellent example for a comprehensive greenhouse gas calculator is the personal CO_2 questionnaire of the Aktion Klimaschutz in Zürich, Switzerland (Hofstetter, 1992), which accounts for direct as well as all embodied CO_2 emissions. It shows that, in Switzerland, about 50-60% of personal CO_2 emissions are embodied in goods and services, including food. This portion is lower than in Australia (80%), because of the relatively high direct emissions due to space heating in Swiss buildings. This questionnaire states an equitable and sustainable annual emissions target of 2 t CO_2/cap, and provides a list of per-capita emissions in other countries. Experiences with an electronic version of the questionnaire have been documented by Schlumpf, Behringer, Dürrenberger and Pahl-Wostl (1999). It was found that users were readily able to operate the calculator without longer technical explanations. However, they felt that accompanying background information about climate change was essential. Important features were that the calculator "strongly helped citizens to link the abstract topic of CO_2 emissions and climate change to their living-world realities," and that "comparisons triggered interesting discussions and insights" (p. 9).

Based on the Swiss example, a comprehensive personal greenhouse gas calculator in the form of an electronic spreadsheet was developed for Australia. Its design closely adheres to the following guidelines obtained from recent studies of consumer behaviour (De Young, 1996; Brown & Cameron, 2000), and from experiences with an environmental household account project (Lund, 1998) and with existing consumer guides (Schlumpf, et al., 1999; Mackay & Probert, 2000):

- It is easily accessible (http://www.physics.usyd.edu.au/apphys/-greenhouse/greenhouse.html, downloadable files).
- It contains a short, easy-to-handle personal budget sheet (Figure 1), which provides direct feedback through instantaneous budget re-calculation after each change of entry.
- It contains a normative part (equity and sustainability) and states a benchmark (3.5 t CO_2-e).
- It contains comparisons and graphical presentations (Figs. 2 and 3).
- It contains a short, easy-to-read explanation of the problem and its importance, strategies for action, and a reference for further information (Figure 4).
- The normative part and action strategies foster pro-environmental values by referencing to social norms (fairness, conservation) and by promoting a creative life instead of earning and consuming, or low resource-use instead of high resource-use activities.
- It suggests classroom debates and activities that raise the issues of quality of life and consumption and help students to make comparisons (through research and direct contact with students in other countries) and informed choices about local action (Figure 5).
- It motivates reduced consumption through intrinsic satisfaction. This satisfaction is brought about by direct participation, that is, in allowing users to find their own areas, reasons, and procedures for conserving behaviour, and to become interested in the task and challenged by the benchmark.
- It underwent an independent peer review and was "test-run" by non-academic users.

The main task of the calculator is to translate lifestyles into greenhouse gas emissions. This can be achieved by multiplying amounts of personal consumption of various items with corresponding "greenhouse prices," thus arriving at personal emissions. These calculations are presented in the form of an automatically updated spreadsheet with boxes for user entries (Figure 1). Greenhouse prices for the consumer items such as food, conventional electricity, gas, goods and services were derived from Lenzen and Murray (2001), organic waste from Environment Australia (1997), renewable energy from Lenzen (1999a), transport from Lenzen (1999b), and trees from the Australian Academy of Science (1995). Average Australian emissions were calculated from these greenhouse prices and consumption data in the Australian Household Expenditure Survey (Australian Bureau of Statistics, 1995).

Figure 1. Budget worksheet of the personal greenhouse gas calculator. All figures are valid for 1995. The amounts entered represent the consumption of one of the authors.

Figure 2. Worksheet "Australian comparison."

Figure 3. Worksheet "Global comparison."

Figure 4. Worksheet "More information."

Figure 5. Worksheet "Classroom activities."

Decisions had to be made with regard to consumption units. In the case of household energy, physical units (kWh and MJ) were chosen, because they appear on most of consumers' bills and are a better proxy for emissions than cost. Private car usage was expressed in vehicle-km rather than passenger-km in order to enable users to allow for different occupancies. Finally, the greenhouse price of beef products is an average over domestically consumed and exported beef. Even though current land clearing occurs predominantly for exports, no distinction was made in the calculator, because it was feared that a low greenhouse price for domestically consumed beef would draw attention away from the immense degradation and biodiversity loss caused for Australia's environment by land clearing for cattle grazing (Glanznig, 1995).

A first version of the calculator was trialed in a two-page handout (budget and information sheets only) on World Sustainable Energy Day on 4 March 1999 during a renewable energy exhibition event at Sydney Town Hall. Most people introduced to the handout at the School of Physics information stall felt in some way responsible for emissions that were caused because of their goods and services consumption, a fact which motivated further development. First, comments and suggestions from interested readers were received in response to a submission of the calculator to a Senate Inquiry into Australia's response to global warming (Senate, 2000a, 2000b), and following newspaper articles (Crabb, 2000). The calculator was then trialed once more, this time in form of an electronic worksheet, by about 90 3rd-year university students enrolled in the Environmental Science Graduate Diploma course at the University of Sydney. At the same time, it was considered for inclusion in the New South Wales Department of Education and Training's TILT Plus Science teacher development program as an important area for teacher investigation.

First Experiences: Getting Beneath the Surface

The TILT Plus Science program developers requested that an electronic version of the personal greenhouse gas calculator be made available on the Internet (http://www.physics.usyd.edu.au/apphys/greenhouse/greenhouse.html) as downloadable files for various types of computers. The site has so far had 988 visitors. Use of the calculator was then written into the TILT Plus Science workshop materials as an example of technology use in the Science classroom. Feedback from workshop leaders and those teachers who chose to work with the greenhouse gas budget calculator in semester 1, 2000 was incorporated into further development of the site. In

addition teachers requested resources to support the larger debate of "quality of life" so that students could understand the kinds of choices that lifestyle changes implied. A link was added to Eckersley (2000) to help facilitate this discussion. Teachers also requested more support in assisting students to come to their own realisations of the consequences of climate change and their own participation in the process. They suggested class and group activities to add to the web site's list of possible personal responses to the issue of climate change (Figure 4). Teachers felt it was important for students to know that they could take action and make a difference especially in the light of a national opinion poll of 800 young Australians indicating that 63% expected the year 2010 to bring "a fast-paced, internationally competitive society, with the emphasis on the individual, wealth generation and enjoying the 'good life'" even though 81% would prefer "a 'greener' [living in harmony with the environment, including greater use of alternative and renewable resources], more stable society, where the emphasis is on cooperation, community and family, more equal distribution of wealth, and greater economic self-sufficiency" (Eckersley, 1999, p. 79). As a result, in consultation with teachers, some suggested activities were added to the calculator in a separate "Classroom Activities" worksheet (see Figure 5).

An understanding of the issues involved in adopting changes to a personal greenhouse gas budget is an important part of the total change process. These ideas for class discussion, projects, debates and activities provide opportunities for students to take control of their learning, and come to personal, in-depth understandings of complex global issues. Students are helped to realise that climate change is not an abstract concept. For example in stimulating links between students in the developed and developing world, and in addressing facets of daily lives, the classroom activities achieve a linking of the questions of lifestyles with the problem of global inequity, which expresses itself in contributions to climate change. Anything less than an immersion in the emotions (by building relationships) as well as the intellect (through reading, reflection and discussion) is compromising learning and selling students short (see for example Gibb, 1996; LeDoux, 1994; and Sylwester, 1995 for a discussion of the role of emotions in learning). Anything less will leave students without the necessary arguments for a sustained and intelligent approach to what will certainly become a major issue of their generation.

Conclusions

Long-term partnerships between teachers, students, academics, education systems and parent groups are crucial to the success of projects like the one above. Programs that address the issue of climate change and the notion of a personal greenhouse gas budget need to be developed with teachers and students rather than imposed on them if there is to be any chance of their being implemented in the classroom and carried forward into students' individual action and lifestyle choices. Teacher development programs need to have inbuilt feedback mechanisms (as above) so that they can be constantly adjusted and improved and teachers need to be confident that they will be listened to (TILT was evaluated by participants each semester and changes were regularly made to the program). Partnerships made up of those who are concerned about the issue of climate change and optimistic about translating awareness and concern into action that can make a difference need to seek out long-term, mainstream avenues for embedding the necessary skills and strategies in the education of school students. Ongoing monitoring of the impact of the program will reveal if TILT Plus Science is making a difference in student learning. We are optimistic that the ongoing monitoring of climate change will indicate that educating our students about climate change makes a difference to the life of our planet and ultimately to the lives of all of us.

Notes on Contributors

Manfred Lenzen grew up in the Rhineland, Germany, and studied physics in Bonn. After completing a Ph.D. he started working at the University of Sydney. He carried out experimental work on nuclear detectors and highly-insulating windows, as well as theoretical modelling of the interaction between the economy and the environment.

Joy Murray is manager of the Technology in Learning and Teaching (TILT) and TILT Plus teacher development programs for the New South Wales Department of Education and Training. Her particular interests are in literacy and technology. She has undertaken numerous state and federal research projects related to literacy and more recently, literacy and technology.

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