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Transforming Environmental Values for a Younger Generation in Taiwan: A Participatory Action Approach to Curriculum Design

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Abstract

This research proposes sustainability-oriented foresight education as a transformative intervention for societies genuinely seeking to create economic and ecological well being for future generations. Taiwan has started to enter a critical stage in developing a more environmentally-minded and futures-oriented worldview. While related prior research mostly emphasizes macro-level institutional change, this study focuses on evaluating the possibilities for encouraging sustainability-consciousness among young citizens through higher education. Students of the course "Environmental Changes and Sustainable Futures" were the participants in a quasi-experimental research design with pre- and post-measurements, and using participatory learning, reflective journals, and scenario workshops as the tools of pedagogical intervention. The results suggest that through a process of integrative learning, a culture of forward-thinking and visioning for sustainable alternative futures is emerging. Most importantly, student participants show promise as potential change agents for creating alternative environmental values and sustainable behaviors.

Keywords: Sustainability, Curriculum Design, Integrated Scenarios, Environmental Values, Images of the Future.

Introduction

Taiwan and other emerging economic tigers in Asia have all been experiencing the awkward phase of cultural lag. In other words, wealth creation has not enabled them to reorient their goals from ensuring basic economic and physical needs to other non-material priorities. This trend must be reversed because Taiwan's environment has already surpassed its capacity to absorb waste, from plastic to nuclear, the by-products of economic growth.

This points to a major concern: Do values change over time and across societies? The world values survey developed by Inglehart and Baker (2000) has shown that shifts in values are not random, but are brought about by the socialization of successive birth cohorts in a context of economic and physical security. Over the last few decades a gradual increase has been seen in the so-called postmaterialist values, which emphasize individual

autonomy, self-expression and environmental stability at the expense of goals related to economic survival and physical security (Dalton & Welzel, ; Inglehart, 2008; Inglehart & Baker, 20002014; Welzel & Inglehart, 2010). The postmaterialist index in Figure 1 shows Taiwan in the bottom tier with a postmaterialist index of 1.64, in contrast to Hong Kong's 2.21, Singapore's 2.11 and South Korea's 2.05. Except for economic growth, Taiwan is far behind her competitive Asian partners in terms of transforming to sustainable futures.

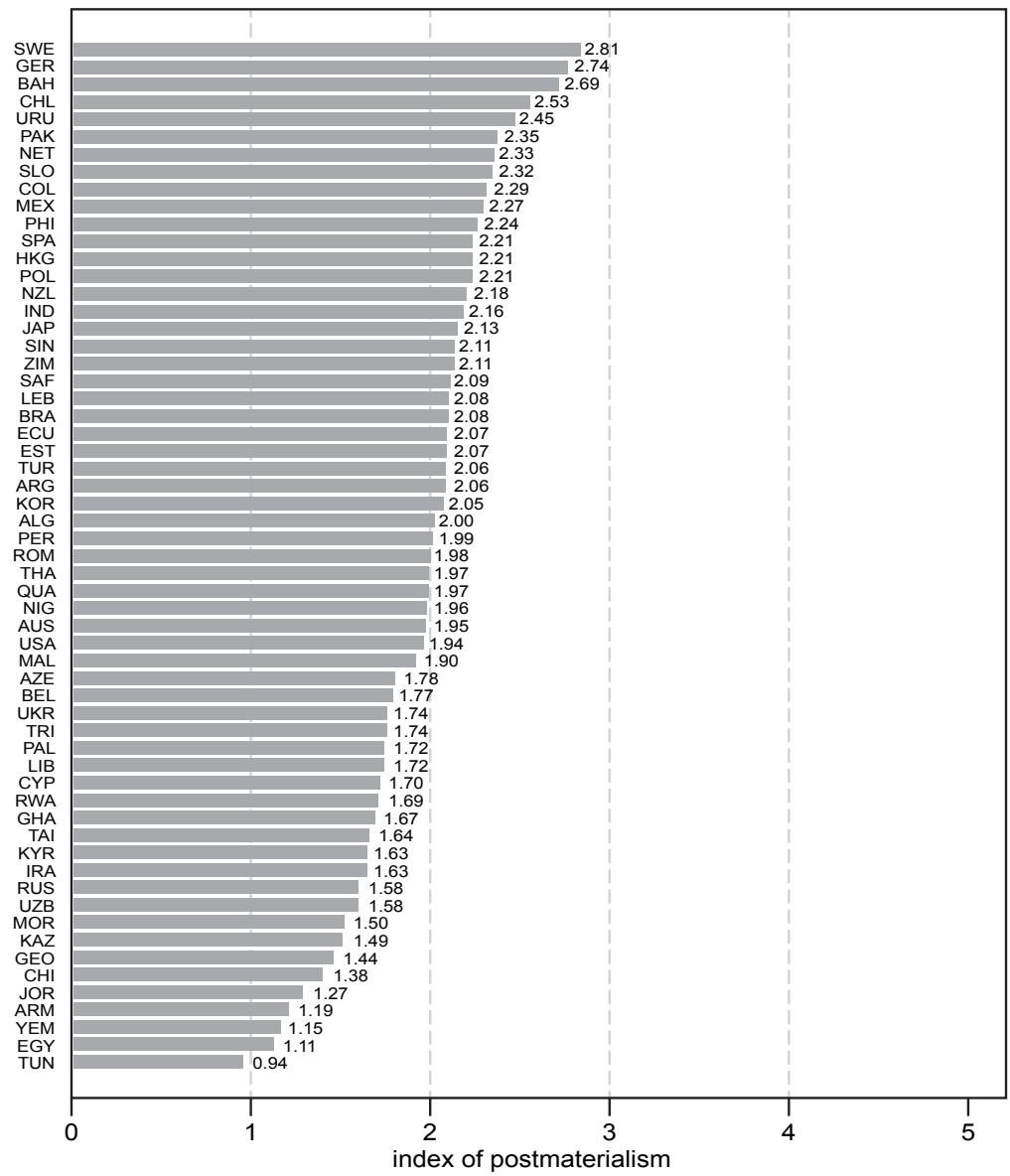

Figure 1. Postmaterialist orientation in 59 countries (mean of index of postmaterialism)

Source: WVS VI (2016)

Tibbs (2011) argues that there is a recognition that global civilization is unsustainable in its present form and must change significantly to survive in the long term. He also illustrates how

changes in cultural values could contribute to achieving sustainability. In order to anticipate change, the younger generation of Taiwanese will need to foster a deeper understanding of the nature of change, including emerging issues that specifically characterize environmental change, and the forces that create and drive such change. Sterling (2001) states it well: sustainability education is a transformative learning response that subsumes education about sustainability (facts) and education for sustainability (values and capacities) into a "reflective and participatory process." Novy, Smith and Katrnak (2017) find that postmaterialist values are inversely correlated with age; younger respondents are more postmaterialist than older respondents. Furthermore, a university education strongly encourages postmaterialist values, which supports their hypothesis that the feeling of existential security is crucial for preferring postmaterialist goals (McNamara, 2010). Accordingly, our own hypothesis is that pedagogical intervention, an educational approach to building young students' environmental values, might create a positive contribution to Taiwan's alternative sustainable futures.

Education for Sustainable Foresight

To further adapt to sustainable futures, Taiwan needs to transform its environmental values to enter the critical stage of a more alternative, environmental and cultural-spiritual, future generation-orientation. The situation could become more complex still if we have to go through a chaotic progression of Image Lag, a concept coined by Markley and Harman in 1982. Theirs was the first known formal study applying Thomas S. Kuhn's ideas about 'paradigm change' to a whole society, and in which it envisioned a paradigm change from the guiding image of economic growth to something more ecologically sustainable—a vision that seems increasingly needful, but that is probably not actionable until societal crises necessitate it. When images 'lead' social development they are anticipatory, and provide direction for social change. When images are in this relation to society they exert what Polak (1973) termed a 'magnetic pull' toward the future, influencing the social decisions which will bring them to realization (See Figure 2).

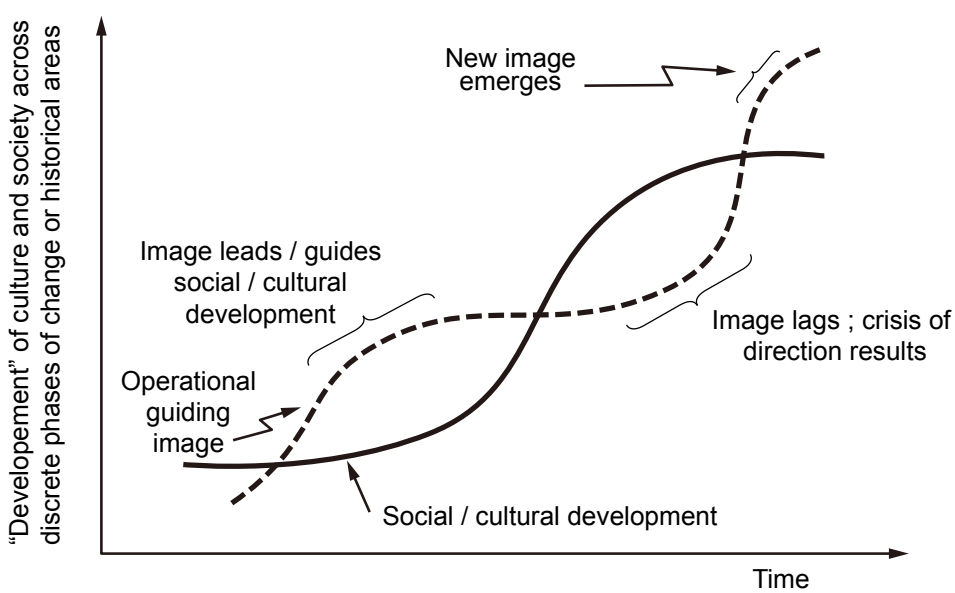

Figure 2. Hypothesized time/phase relationship between images and social/cultural development

Source: Markley and Harman, 1982, *Changing Images of Man*, p.5

Young Taiwanese high school students were concerned about what follows after achieving the economic miracle, and appeared willing to transform the current poor political ecology in Taiwan (Chen, 2016). Liu and Lin (2016) also found that many Taiwanese students would like to see a future based on greater environmental awareness and actions involving techno-scientific advancements. Moreover, their findings suggested that students desire better environmental quality (e.g. clean air and water), presence of nature, and the use of harmonious technologies (e.g. green energy, underground transportation systems) in support of comfort and livability, including positive attitudes regarding environmental factors such as trees over buildings, global warming awareness, and alternative energy sources. Liu (2019) concluded that, as the incorporation of futures thinking in science and environmental education remains relatively underexamined, more research along these lines is needed to provide the basis for curricular and instructional development.

Nonetheless, several other studies indicate that young people tend to be more pessimistic regarding our capacity to solve environmental problems. Strife (2011) found that urban children in the US mostly held negative views of the Earth's future, especially through apocalyptic visions of natural disasters. Fleer (2002) investigated attitudes of Australian children and found that the older the children, the less positive they felt about the future environment. Ojala's research (2012) with Swedish young people revealed that students' hopes for solving environmental problems may be based on denial, which in turn becomes a barrier to pro-environmental behavior. A study conducted among Finnish ninth grade students investigating their knowledge and perceptions of bioenergy (Halder, Pietarinen, Havu-Nuutinen, & Pelkonen, 2010) found a lack of in-depth knowledge about renewable energy sources, including bioenergy, as well as critical perceptions of it.

Above all, educational settings including colleges and universities are responding to this call for leadership by starting or expanding environmental research programs. McNamara (2010) completed a thorough research project across 86 colleges and universities in the United States that have implemented sustainability initiatives. This investigation concluded with a list of recommended strategies and suggested methods for implementing them. Two are particularly relevant to this research: to build a strong student commitment and engage more people; and to try including everyone to be part of a continuing effort. However, the perceptions of academics and students towards embedding Education for Sustainable Development (ESD) into undergraduate degree programmes were found to be conflicting (Jones, Trier, & Richards, 2008). The results indicated general support for the embedding of ESD in the curriculum, but also considerable uncertainty concerning how this can best to be done.

Curriculum and Research Design

Educational intervention

This research attempts to apply an anticipatory learning and futures design approach to educational intervention to explore the possible effects of transforming young students' environmental values. Chen and Hoffman (2017) have successfully applied an experimental and innovative game-based curriculum design in enhancing college students' learning capacity outside their major subjects. Applying reflective journals as a core pedagogical intervention, Kelly (2006, 2010) provided constructive insights that students' actions and attitudes, in a tertiary educational system, are transferable to a less economically driven, peaceful and spiritually oriented way of living.

"Environmental Changes and Sustainable Futures" is an elective general education course. Its core objective is to inquire into students' preferred futures, and to further explore alternatives and possibilities along their desired trajectories, by linking foresight strategies with long-term socio-cultural prospects of the society. Accordingly, this course was designed as one educational intervention to evaluate the effects of environmental futures thinking, and as an attempt to bridge

the gap between environmental attitudes and ecological behaviors. The following stimuli were introduced during the 18-week course:

1. *Thematic discussions* on emerging issues (time horizon 2030) of ecology, population, food and water resources, minerals and energy, air, water environment and waste, transportation, natural resources, regional environment, etc. This preparation phase aimed to arouse students' environmental consciousness.
2. *Reflective journals*. Students were asked to write reflectively after class, addressing several questions: a) Which issue has touched your mind most deeply? b) What images/discussions have challenged your viewpoint/perspective? c) What are the most effective ways to ensure sustainable development of the world? d) Would you be eager to read more related news/discussions concerning natural resources and ecology? e) Would you be willing to go outside to experience and learn more about the natural environment?
3. *Environmental volunteering*. Students were also asked to form groups (5-7 people) to take part in an environmental protection activity for half a day during the second half of the class (See Figure 5). Each having a concrete ecological goal in mind, activities included beach cleaning, tree planting, resource recycling, waste reduction and reuse, wetland preservation, alternative uses of disposable tableware, protecting mangrove forest, experiencing vegetarianism, and biking in nature.
4. *Presentations and scenario workshops*. Students presented their 'field volunteering activities' in four major dimensions: 1) Why is the chosen environmental activity important to people of the future? 2) How did we plan and organize it? 3) What were the major findings from the research? 4) What were the key learnings? Discussions and scenario workshops envisioning students' changing knowledge, values and behaviors for future generations followed their presentations.

Figure 3. Students' environmental volunteering activities in the wetland and forest

Figure 4. Group discussions and workshops

Research questions

Young citizens of global society are a vital stakeholder group, perhaps more receptive to new concepts and able to be activated as change agents to promote environmental values. What takes place in the future depends on how the instruments developed today are used, and on the planning that is done in the present for years ahead. Consequently the research aimed to explore possible transformations of attitudes and roles through pedagogical stimulus in sustainable foresight, guided by four major questions:

1. What are university students' general attitudes toward environment and sustainable futures?
2. Do their attitudes change significantly with pedagogical stimulus of sustainable foresight?
3. What are the images and scenarios of their preferred future environments?
4. Do the interventions help them become more aware and able to think critically and assume responsibility for themselves and their environmental impact?

Evaluation, Results and Discussion

Methods

The research design was quasi-experimental with pre- and post-measurements, but without control group/random assignment of experiment group. Students who took the general education course "Environmental Changes and Sustainable Futures" were the participants. The quantitative data used in this research was collected in the years 2015-2016, through surveys of environmental changes and sustainable futures. A total of 40 items was included, 8 addressing socio-demographic characteristics and general knowledge questions, and 32 items using a 5-point Likert scale, scored from 1 (totally disagree) to 5 (totally agree) and 3 indicating 'neutral'. The reliability of the 32 items was tested by using Cronbach's alpha, which showed a satisfactory level of internal consistency (alpha=0.71); a reliability coefficient of 0.70 or above is usually considered acceptable (Taber, 2018).

The research applied a multi-method and participatory learning approach to triangulate the investigation. Major findings of the quantitative surveys, including pre- and post-testing, were followed by qualitative data gathered from students' reflective journals. Possible scenarios generated from workshops will be discussed at the end.

Socio-demographic characteristics and general environmental knowledge

A sample of 223 student respondents was included for the analysis, coming from a wide range of majors. As Table 1 shows, respondents are equally distributed in terms of gender (51 percent female, 49 percent male) and ages ranging from 18-22. Most of the respondents (88 percent) live in the Taipei metropolitan area, mostly with family (71 percent). In terms of energy awareness, unsurprisingly, solar and hydro gain nearly 85 percent of attention. While Taiwan has abundant wind power and great bioenergy potential, both are relatively underestimated. Respondents' self-rated

knowledge levels regarding bioenergy lean toward poor, with only 14 percent responding 'good', and none at all responding 'very good'.

Table 1. *Respondents' socio-demographic characteristics and general knowledge (N=223)*

Variables	Categories	Frequency	Percentage
Gender	Male	109	48.9
	Female	114	51.1
College	Literature	23	10.3
	Engineering	81	36.3
	Business/Management	76	34.1
	Foreign Language	43	19.3
Class level	Freshman	2	0.9
	Sophomore	83	37.2
	Junior	105	47.1
	Senior	33	14.8
Residence	Urban	130	58.3
	Suburb	66	29.6
	Rural	27	12.1
Living with whom	Apartment with family	117	52.5
	House with family	41	18.4
	Alone apartment	41	18.4
	Friends apartment	24	10.8
Most important renewable energy	Solar	98	43.9
	Wind	1	0.4
	Hydro	90	40.4
	Bio	34	15.2
Taiwan's Major source of energy	Oil	38	17.0
	Coal	60	26.9
	Hydro	36	16.1
	Wind	4	1.8
	Nuclear	85	38.1
Knowledge of Bioenergy	Very good	0	0
	Good	32	14.3
	Cannot say	102	45.7
	Poor	82	36.8
	Very poor	7	3.1

The results show students exhibiting strong misconceptions about Taiwan's major energy sources. Over a third (38.1 percent) believe nuclear to be the main source; whereas according to Taiwan Power Company, in 2016 oil and gas accounted for 40 percent of the total energy consumption in Taiwan, followed by coal at 37 percent, nuclear energy at 13 percent, and 10 percent from various renewable sources (see Figure 5).

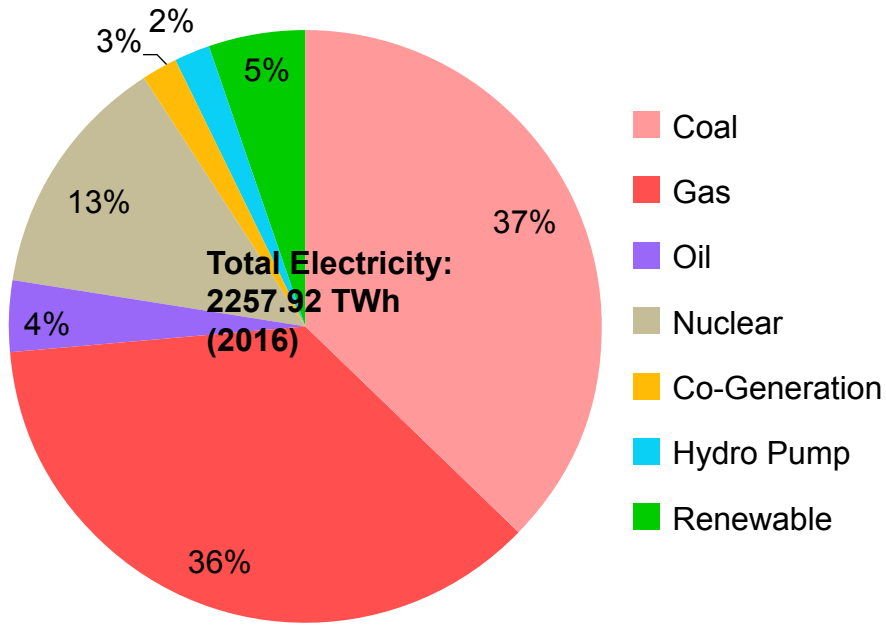

Figure 5. Taiwan's electricity generation, 2016

Source: Taiwan Power Company

General environmental attitudes, values and behavior intentions

At the very beginning of the class, the students were provided with a 32-item Likert scale survey to measure (pre-test) their general attitudes toward sustainability and the environment. Three questions were stated negatively (items 23, 25, 32) to reiterate similar perceptions and enhance reliability. The results are shown in Figure 6. The most encouraging finding, contrary to respondents' relatively low levels of environmental knowledge, is that students exhibit a sense of agency (item 31, mean=3.25), believing that change is possible, and that good ecological futures can be created by changing their behaviors. Similarly, they do not believe that the problems facing sustainability are too complex to be resolved (item 32, mean=2.08, negative statement). Four items show strong positive responses (mean >4) toward better environmental futures:

Q2. Efficient use of energy can cut carbon emission and save the earth (4.18)
Q6. Carbon taxes are fair and justified (4.16)
Q13. We should not produce bioenergy by means of deforestation (4.31)
Q15. The Taiwanese government should support research and development of bioenergy (4.07)

Two other negatively-stated questions show equally important results:

Q23. Natural resources are not important to me (1.61)
Q25. Economic development and survival issues are far more important than protecting endangered species (2.07)

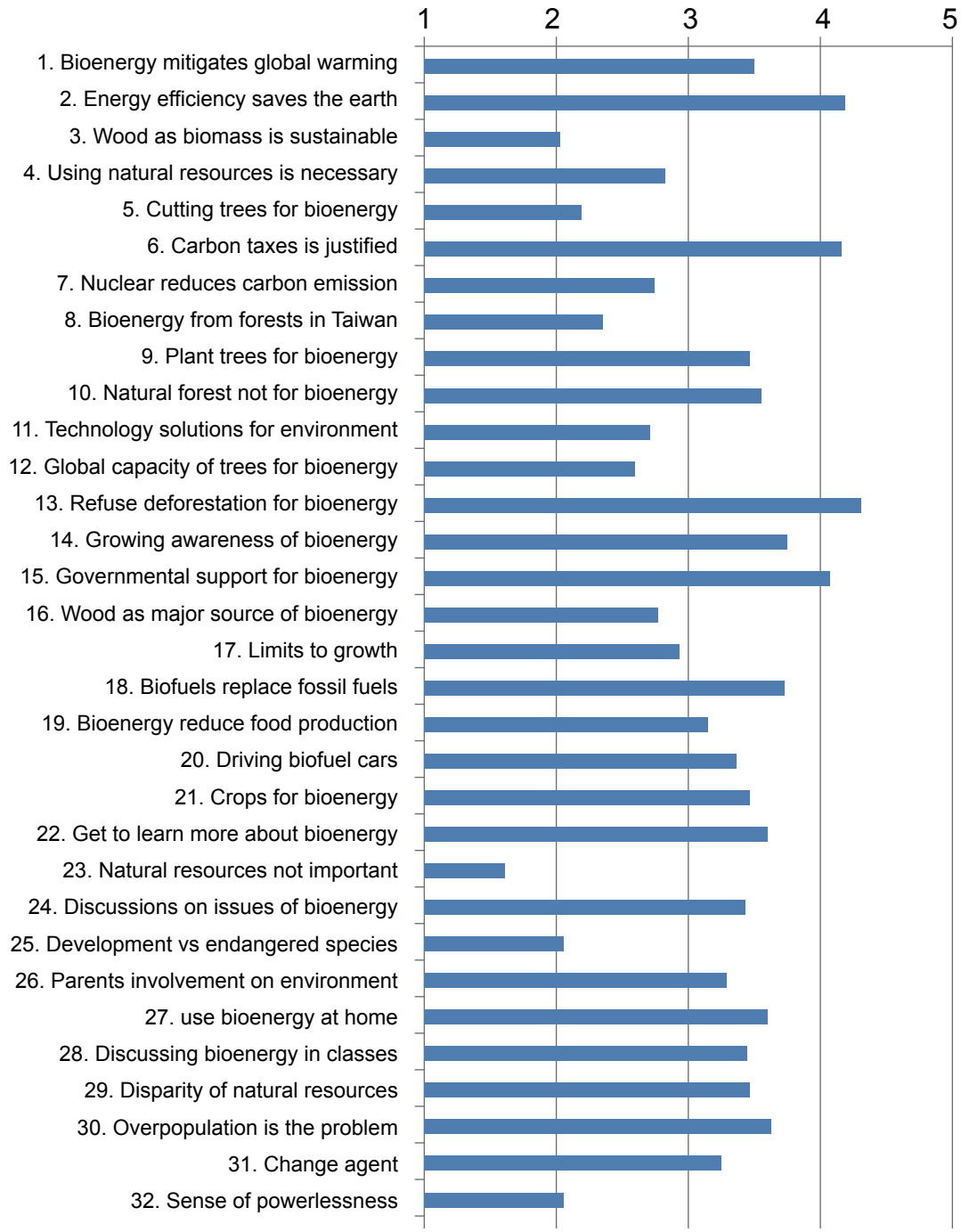

Figure 6. Mean scores of respondents' environmental attitudes

Socio-demographic differences on environmental attitudes and values

To further determine whether there were statistically significant differences according to gender (male=1, female=2), college (literature, language and business=1, engineering=2) class level (junior

and senior=1, freshman and sophomore=2), and living area (urban=1, suburb and rural=2), on the students' attitudes and values of environment and sustainability, an independent sample t-test was applied. The results are presented in Table 2. One of the most consistent findings reported in the public opinion literature since the 1970s is that women are more opposed to nuclear power than men. Brody (1984) found that, compared with men, women tend to believe that nuclear plants are less safe, and evaluate a number of problems with nuclear power as being more serious, particularly those involving danger to hearth and human life. A more recent survey (Burroughs, 2015) found that a plurality of female respondents, 42 percent, oppose increasing the use of nuclear power to generate electricity in the United States; while 38 percent support it. A strong majority of men, 70 percent, support using more nuclear power, while 23 percent oppose. Clearly, the male-female gap is particularly wide on this issue of energy preference.

To explore gender-based differences between the students surveyed, this research tested the question statement, "To reduce carbon emissions, it is reasonable and necessary to develop nuclear power." Our results show that males have a higher approval mean than females (2.84/2.65); yet the difference is not statistically significant (p=.141). Statistically significant results were found in three question statements: 1) Cutting trees for energy production is justified (t=1.95, p<.05), with a male/female mean score difference of 2.32/2.09; 2) Economic development and survival issues are far more important than protecting endangered species (t=2.87, p<.01), with males exhibiting a much stronger tendency to support economic development over endangered species (2.28/1.87); and 3) Female students tend not to believe that the problems facing sustainability are too complex to be resolved (t=2.53, p<.05), while conversely, male students reported a much higher sense of powerlessness in facing environment and sustainability issues (2.26/1.91).

A comparison was also applied across students' academic focus areas. As Kelly (2010) suggests, engineers' attitudes are significant because their discipline has enormous impacts on the global environment; they are often regarded as narrow-minded thinkers operating within a paradigm of domination over nature, which has led to complicity in unsustainable projects with little concern for ecological or human impacts. This study categorized respondents of literature, language and business college into non-engineering (recoded as 1) comparing with students from the engineering college (recoded as 2). The results show statistically significant findings in five question statements. As hypothesized, non-engineering students show stronger agreement that efficient uses of energy can cut carbon emissions and save the earth (t=2.82, p<.01); they also considered carbon taxes to be fair and justified (t=2.60, p<.01) and that we should not produce bioenergy by means of deforestation (t=2.52, p<.05). Engineering students tend to support the statement that sustainability problems are too complex to be resolved (t=1.93, p<.05), and show a much higher sense of powerlessness when facing environment and sustainable issues (t=-2.3, p<.05).

Comparisons in terms of class level show significant results for three questions. Freshman and sophomore students (recoded as 2) agree more with the statements that efficient use of energy can cut carbon emission and save the earth (t=-2.3, p<.05) and that cutting trees for energy production is justified (t=-2.1, p<.05), while juniors and seniors agree more with the statement that economic development and survival issues are far more important than protecting endangered species (t=2.16, p<.05). The dimension of where students live (recoded urban=1, suburb and rural recoded=2) produces the least statistically significant results, merely showing contrasting perceptions around the statement that natural forests should not be used to produce energy (t=2.84, p<.01); urban-residing students tend to care more about sustaining forests.

Table 2. *Comparisons of attitudes of sustainable foresight by socio-demographic characteristics*

Scale questions	T-test statistics (two-tailed test)							
	Gender		College		Class level		Living area	
	t	Sig.	t	Sig.	t	Sig.	T	Sig.
Bioenergy mitigates global warming	.082	.934	.864	.389	-.878	.381	.641	.522
Energy efficiency saves the earth	-1.70	.090	2.82*	.005	-2.3*	.020	-1.06	.287
Wood as biomass is sustainable	.396	.692	-1.13	.256	-1.16	.247	1.248	.213
Using natural resources is necessary	1.35	.178	.133	.895	-.735	.463	-.461	.645
Cutting trees for bioenergy justified	1.95*	.050	-.445	.656	-2.1*	.038	-1.47	.252
Carbon taxes is justified	-.618	.537	2.60*	.010	-.206	.837	.417	.677
Nuclear reduces carbon emission	1.48	.141	-.675	.500	-.939	.349	-1.13	.259
Bioenergy from forests in Taiwan	-.691	.490	-.737	.462	-.429	.668	-.833	.406
Plant trees for bioenergy	-1.77	.078	1.290	.198	-.521	.603	-1.02	.311
Natural forest not for bioenergy	.309	.758	-.029	.977	.336	.737	2.84*	.005
Tech solutions for environment	1.477	.141	-.084	.933	.719	.473	-.811	.418
Capacity of trees for bioenergy	-.617	.538	.243	.808	-.196	.844	-1.81	.072
Refuse deforestation for bioenergy	-1.68	.094	2.52*	.012	-1.28	.202	.177	.860
Growing awareness of bioenergy	-.090	.928	1.133	.258	-.495	.621	.781	.435
Governmental support for bioenergy	-1.64	.101	1.130	.260	-.271	.787	-.235	.815
Wood as major source of bioenergy	.496	.621	-.171	.864	1.736	.084	-1.75	.081
Limits to growth	-1.42	.155	.514	.608	1.250	.212	-1.45	.150
Biofuels replace fossil fuels	1.266	.207	-1.33	.185	-.540	.590	.072	.943
Bioenergy reduce food production	1.058	.291	.428	.669	-1.66	.099	.037	.971
Driving biofuel cars	1.354	.177	.637	.525	-.790	.430	.346	.730
Crops for bioenergy	-.531	.596	.261	.794	-.121	.904	.813	.417
Get to learn more about bioenergy	-.001	.999	-.389	.698	-1.14	.256	1.312	.191
Natural resources not important	1.560	.120	-1.25	.212	.232	.816	-.047	.962
Discussions on issues of bioenergy	-.312	.755	1.157	.249	1.248	.213	1.698	.091
Development vs endangered species	2.87*	.004	-1.63	.105	2.16*	.032	-1.47	.155
Parents involvement on environment	-1.42	.155	.533	.595	-.095	.924	.980	.328
Use bioenergy at home	-1.58	.115	1.491	.137	.846	.398	-.260	.795
Discussing bioenergy in classes	-.288	.772	.019	.984	.177	.860	1.143	.254
Disparity of natural resources	.597	.551	1.639	.103	-1.12	.266	-.629	.530
Overpopulation is the problem	.951	.342	.093	.926	1.083	.280	.970	.333
Change agent	-1.16	.245	1.93*	.050	.130	.897	.939	.349
Sense of powerlessness	2.53*	.012	-2.3*	.026	.786	.433	.065	.948

*Significant, p<.05

Assessing the influences of educational stimuli on sustainable foresight

Pre- and post-testing was conducted in an effort to evaluate possible changes in students' environmental attitudes and values owing to the educational interventions. These can be grouped into two dimensions (Table 3). The first is students' environmental values, which we tie to the potential for a macro-cultural change in the long term, with the study of alternative futures emphasizing agency; that is, young people's sense of their own capacity to affect social change. The results on this front suggest that students do seem to be more oriented to the positive exercise of agency in relation to environmental challenges. By the end of the semester, more students appear to believe that the sustainability problems are *not* too complex to be resolved ($t=2.56$, $p<.05$). Additionally, they report a lower sense of powerlessness (or to state it the other way around, an increased sense of empowerment) when facing environment and sustainability issues, with nonsignificant t-value, but mean scores dropping from 2.08 to 2.0. Nonetheless, more students agree less with the idea of discussing bioenergy issues with professors ($t=-2.686$, $p<.01$). The second dimension more specifically concerns energy and natural resources, with results showing that students agree more with the statement that production of energy from wood is environmentally friendly ($t=2.489$, $p<.05$). On the other hand, they tend not to approve tree plantations being established for bioenergy production ($t=-2.253$, $p<.05$). Finally, it is worth noting that the statement "We should have set limits to economic growth in developing countries to protect future environment of earth" shows a nearly significant result ($t=1.824$, $p=.069$).

Table 3. *Measurement of pre- and post-test of attitudes of sustainable foresight*

Scale questions	Independent t-test statistics (two-tailed test)					
	Mean		SD		t	Sig.
	Pre-	Post-	Pre-	Post-		
Bioenergy mitigates global warming	3.50	3.45	1.21	1.20	-.409	.683
Energy efficiency saves the earth	4.18	4.04	1.03	1.12	-1.465	.143
Wood as biomass is sustainable	2.03	2.27	1.04	1.03	2.489*	.013
Using natural resources is necessary	2.83	2.80	1.10	1.12	-.231	.817
Cutting trees for bioenergy	2.20	2.26	0.92	1.10	.576	.565
Carbon taxes is justified	4.16	4.21	1.11	1.09	.492	.623
Nuclear reduces carbon emission	2.74	2.76	0.99	0.98	.179	.858
Bioenergy from forests in Taiwan	2.37	2.24	1.08	1.13	-1.281	.201
Plant trees for bioenergy	3.67	3.46	1.01	1.03	-2.253*	.025
Natural forest not for bioenergy	3.55	3.56	1.03	1.08	.149	.881
Tech solutions for environment	2.72	2.69	1.03	0.98	-.334	.739
Capacity of trees for bioenergy	2.61	2.48	1.08	1.16	-1.207	.228
Refuse deforestation for bioenergy	4.31	4.19	0.94	1.18	-1.137	.256
Growing awareness of bioenergy	3.75	3.61	0.96	1.05	-1.477	.140
Governmental support for bioenergy	4.07	3.99	0.97	1.07	-.884	.377
Wood as major source of bioenergy	2.78	2.87	0.93	0.96	.970	.333
Limits to growth	2.94	3.11	0.96	1.06	1.824	.069

Biofuels replace fossil fuels	3.73	3.67	0.83	0.93	-.700	.484
Bioenergy reduce food production	3.15	3.19	0.87	0.97	.537	.592
Driving biofuel cars	3.37	3.40	0.94	0.99	.285	.776
Crops for bioenergy	3.46	3.40	0.84	0.91	-.771	.441
Get to learn more about bioenergy	3.60	3.51	0.88	0.91	-.987	.324
Natural resources not important	1.61	1.72	0.86	1.08	1.253	.211
Discussions on issues of bioenergy	3.44	3.23	0.81	0.83	-2.686*	.008
Development vs endangered species	2.07	2.18	1.07	1.04	1.098	.273
Parents involvement on environment	3.29	3.25	0.87	0.92	-.412	.681
Use bioenergy at home	3.60	3.60	0.76	0.90	.068	.946
Discussing bioenergy in classes	3.45	3.40	0.87	0.96	-.531	.596
Disparity of natural resources	3.47	3.61	1.16	1.20	1.298	.195
Overpopulation is the problem	3.63	3.62	1.07	1.08	-.082	.935
Change agent	3.25	3.50	1.02	1.07	2.564*	.011
Sense of powerlessness	2.08	2.00	1.03	1.12	-.797	.426

*Significant, p<.05

Qualitative environmental attitude and values

Applying quantitative analysis, these results show the surveyed university students' general attitudes toward environmental issues and sustainable futures, and indicate that some of their attitudes change significantly with the pedagogical intervention themed around sustainability and foresight.

In addition to the above, this research design also sought to probe students' images of their preferred future environments in a qualitative mode, exploring how they become more aware and able to think critically and assume responsibility for themselves and their impact on the environment. The results reported here come from the reflective journals and workshop discussions. Students' opinions and voices can be generally summarized into four dimensions:

1. Outdoor experience is a catalyst for the desire to learn more about nature

Most of Taiwan's university students are confined during their learning to indoor classrooms, and their daily class schedule is relatively tight. As some students put it:

> *My life goes on in a fast-forward mode and I have to rush into the next thing, day in and day out. Suddenly, after a most impressive journey into nature, I realized that there are lots of people devoted to the important idea of sustainable development…*
>
> *Activity-based learning is really a great way of learning. I can share and feel what we can do to the environment.*

Others start to reflect back and admit that their lack of knowledge was a great barrier to greater engagement with the nature. Considering their scarce leisure time, some students even state that "I would not mind having outdoor classes on weekends." One concludes:

> *It really was a shocking and amazing experience when we were biking along the river to actually enter the mangrove forest. I was so touched, seeing bouncing fish, fiddler crabs, and egrets with my own eyes, rather than on a screen. Embracing nature does bring me great happiness that I have rarely experienced.*

2. Linking motivation with reflexive thinking

The digital-native generation was born at a time when change — technological, cultural, spiritual, ecological — is endemic. In particular, a major change in environmental awareness is necessary. Some of their thoughts are quite profound:

> *Technological advancement will never catch up with humans' powers of environmental destruction.*
>
> *My worldview was broadly expanded knowing that environmental protection requires a global effort.*

The field experience not only transformed students' minds, but also touched their hearts. Seeing what past generations have done to replace natural environments and plant and animal habitats with drastic expansion of highways, skyscrapers, and urban metropolitan area, their perceptions change:

> *Compared to the precious natural resources we have in Taiwan, Taipei 101, the tallest building, is nothing to be proud of. There are a lot of things that are more worth pursuing than high-tech and wealth.*
>
> *We all have to look at the sustainable earth from a much different angle. I would not mind retaking the class and leading the discussions.*

3. Agency and social responsibility

The capacity for creating new ecological futures requires a that change be considered possible — that students have agency, and that good futures can be created. The quantitative measures show a strong and positive momentum for change, supporting the hypothesis that capacity for agency may be strengthened via futures-oriented educational interventions. In students' words:

> *I like the idea of corporate social responsibility. It is a win-win solution not only to the economy but also feedback to nature.*
>
> *We all need to maintain the perception of sustainability, and preserving nature is not just the responsibility of environmental protection groups. Each one of us is never too small to make a difference.*
>
> *After knowing that livestock farming is seriously harming water resources and increasing risk of global warming, I am willing to eat less meat and hopefully the government policy will adapt to changes.*

4. Vision and dream of the future society

The qualitative results show students constantly questioning not just their values and empirical views of the nature of the world, but also the paradigms that inform these positions. They are integrated, seeing the links between the external world and the internal world, individual and society. A few students pessimistically observe that "the earth might be better without us." But most

others seem to be inspired by the dreams of artists and community leaders, asking for nature-based classrooms, more participation, and more opportunities for their voices to be heard:

> *I was deeply inspired by the documentary film, The Man Who Plants Trees. It is about a young Taiwanese artist who learned the dream from Paris and determines to plant trees along Tropic of Cancer in southern Taiwan to enrich life with nature in local communities.*
>
> *We have to explore alternative and renewable resources on the condition that the natural environment will not be harmed.*

Integrated visioning and scenarios of sustainable foresight

The present research incorporates the 'integrated' scenario generation and visioning method (Inayatullah, 2015), which analyzes and integrates various dynamic elements in the development of visions of the future. The method's value is in surfacing aspects of our thinking and action that are currently 'disowned' or rejected; and in bringing these back explicitly into the development of an 'integrated' vision of the future (a preferred scenario; the world we want), where owned and disowned are united in a complex fashion. The last is the 'outlier', a future outside of these categories.

Preferred future: Nature-based partnership learning

'Nature-based partnership learning' is the preferred future for students. The students simply cannot be satisfied with exam-based traditional assessment and curriculum design based on jobs from the past. Traditional classroom education doesn't provide ways for students to actually see, feel and know environment around them, hence they would prefer to see courses designed with vibrant foresight and flexible pedagogical styles. Partnership learning emphasizes taking the views and voices of students seriously. In a world full of disruptive change and future surprises, the desires and dreams of the younger generation deserve abundant opportunities to flourish. This emerging class desires images beyond safety and security, pursuing a niche in which they can excel and really experience ecological ways of life. Most importantly, they wish to co-create futures with the nature surrounding them.

Disowned future: Just follow the rules

'Just follow the rules' is the disowned future. As one student said, "the future and natural wonders are two things that I have cared about the most, but I am not used to appreciating them in combination." Similarly, most of the students found the effects of traditional education somewhat unreal, and that it reduces the ability to learn. Another expressed concern about wasting time and energy going from class to class without a clear learning goal. Face-to-face interaction and participatory action learning are the most important thing. Some students are feeling quite powerless to negotiate with previous generations. The world outside of them is still in the industrial mode of knowledge, and appears mostly to cater to the needs of their parents (safety, security and elite status). On the other hand, students are trying to express their own needs; joining with the natural environment, the freedom of pursuing their dreams, and the exercise of social responsibility in sustainable ways of life.

Integrated future: A HEALTHIER society

'A HEALTHIER society' is the integrated future. Lowe's vision (2008) corresponds perfectly to students' perceptions of responsible sustainability: it is a vision that is Humane, takes an Eco-

centric approach, adopts Long-term thinking, uses our natural resources responsibly, is Informed about the fragility of our natural systems, is Efficient in turning resources into the services we need and is Resourced from natural flows of energy. During the workshops many students expressed their worry that we are consuming the future: if we and generations to come do not adopt a radical re-thinking of the way we live, our society is doomed. Lowe further explains that we need to tackle this problem head-on and develop far-reaching solutions to our environmental and social crisis. This does not just require technical innovation; it also demands fundamental changes to our values and social institutions.

Outlier future: A postmaterial society

A postmaterial society is the outlier. It took a few decades for East Asian countries to move up the economic ladder, at great expense to natural resources, the environment, and quality of life. Worst of all, the present game of economic competition only guarantees that everybody loses in the long run. Therefore, the stories guiding sustainable environment and development have to make a disruptive shift. Inayatullah (2018) suggests that this story shift is not just historical, from the agricultural worker to industrial worker to the gold-collar knowledge worker, but archetypal; to the wanderer, creating value through novel insight. The young students engaged in this study reflect that what most stimulated their thinking was facilitated by the society of wilderness, by direct encounters with nature itself. Their stories were of sharing, action and change appear to promise great help and support to future wanderers in their quest to create new dreams.

Conclusion

The major objective of the futures curriculum design, and the multi-method research approach described here, was to explore the ambitious possibility of encouraging an emerging culture of sustainable foresight via the conscious design of educational stimuli for students. The undergraduates who took the course "Environmental Changes and Sustainable Futures" were the major participants in our quasi-experimental research design, with pre- and post-measurements, and without control group/random assignment of experiment group. Applying a participatory action learning approach, the use of educational intervention tools was multifold, incorporating environmental volunteering activities, reflective journalling, and scenario workshops. The core research question was, "Do students become more aware and able to think critically and assume responsibility for themselves and their impact on the environment?"

The most encouraging result was that through the interventions these students do indeed appear to develop an alternative mindset, playing positive-agency oriented roles: by the end of semester they significantly agree that the sustainability challenges are not too complex to be resolved, and their sense of powerlessness diminishes in relation to environmental issues. The study also finds that they are optimistic and enthusiastic regarding better environmental futures, and that they are eager to learn sustainable foresight and alternative futures. All of this appears to equip them to more effectively challenge the current development paradigm with environmental values.

Results of the qualitative participation- and discussion-based portion of the study also indicated that the research participants are enabled through their engagement with futures to envision an integrated, healthier society, and take steps toward becoming designers of their preferred futures, seeking to co-create sustainable futures with nature. It is crucial to cultivate the younger generation's preference for postmaterialist values and goals over economic and materialist gain. Through foresight-based educational intervention, the youth of today appear better able to articulate and pursue their preferred visions, a critical capability for any society genuinely seeking to foster economic and ecological well-being for future generations.

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