
Computing student views on sustainability: a snapshot

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Abstract

UNESCO launched the Decade of Education for Sustainable Development for 2005 – 2014 with the aim of integrating Education for Sustainable Development (ESD) into all aspects of education and learning. The motivation for this study was to inform our decisions on embedding ESD into our teaching.

Incoming computing students (n=116) were surveyed to capture their views on sustainability before they engaged in formal learning and these views were compared to those of computing students at another institution. The study explored views on the relevance of sustainability to their study, sustainability priorities and knowledge, possible actions they could take, their capacity to take these actions and make a difference, and how they would deal with a challenging scenario.

Students were pro-ecological but did not believe they had the capability to make a difference. Significant variation was found in attitudes and values across the various ethnicities in our sample, suggesting that careful consideration should be given to this aspect.

This study adds to the emerging body of knowledge around sustainability perceptions and values of incoming students and informs curriculum for the embedding of ESD into education and learning.

Keywords

ESD, Sustainability, Practitioner, Teaching philosophy, Education.

Introduction

Sustainable development is meeting the needs of the present without compromising those of future generations. Education for Sustainable Development (ESD) aims to help people to develop the attitudes, skills and knowledge to make informed decisions for the benefit of themselves and others, now and in the future, and to act on those decisions. UNESCO launched the Decade of Education for Sustainable Development (DESD) for the decade 2005 – 2014 with the aim of integrating ESD into all aspects of education and learning. (UNESCO, 2004, 2005a, 2005b).

A working group at the Innovation and Technology in Computer Science Education (ITiCSE) conference in Madrid acknowledged the need for computing professionals to act in order to support sustainable living (Mann, Muller & Smith, 2008). In New Zealand, the National Advisory Committee on Computing Qualifications (NACCQ) has adopted a policy that promotes the concept of social, environmental and economic sustainability for students and academics. (NACCQ, personal communication, 4th July, 2008).

The same objective has been addressed by a proposed policy (Mann, Muller, Davis, Roda & Young, 2009) for the Association of Computing Machinery (ACM) which defines a framework for Computing Education for Sustainability (CE4S). The proposed framework informs educators how to integrate the principles and practices in the curriculum, encourages “distributed” integration of sustainability and development of ad-hoc resources.

In the New Zealand tertiary sector, Otago Polytechnic has committed to embed sustainability education in all their programmes. Other institutions, including ours, have been investigating how we can integrate education for sustainability into our programmes. Mann and Smith from Otago Polytechnic have articulated a vision of a collaborative approach to ESD for tertiary institutions in New Zealand and have provided leadership in this initiative.

As part of this initiative, they have published findings that contribute to the understanding of student attitudes towards sustainability and to the understanding of the requirements of curriculum development for computing graduates (Mann, Smith, Shephard, Smith & Deaker, 2009). Their research instrument combined the New Ecological Paradigm Scale (NEP) from Dunlap, van Liere, Mertig, & Jones (2000) with questions from a study into young people and the environment (Fien, Yenken, & Sykes, 2002) and a variation of the Personal Meaning Map (Storksdieck, Ellenbogen, & Heimlich, 2005). Within their study they compared the sustainability worldviews of incoming computing students to the wider institute intake. Our study complements this by comparing the worldviews of incoming computing students across institutions. We had two main aims for our study:

- To replicate the study carried out by Mann et al. (2009), comparing and contrasting our respective findings and thereby, hopefully, both supporting the generalisation of their study and contributing to the emerging body of knowledge around sustainability perceptions and values of incoming students.
- To investigate the variation of attitudes across the demographic profile associated with our institution's students.

The Sample

The target population was students enrolling in computing and information technology qualifications. Our institution organises "orientation" days for new students to welcome them to the institution and to help familiarise them with our staff, resources and processes. We chose to carry out the research at orientation sessions so that we could capture student attitudes before they had been exposed to formal instruction.

Students attending two orientation sessions (for semester 2, 2009 and semester 1, 2010) were invited to participate in this research. Participation was voluntary and involved completing an anonymous questionnaire. Approximately 92% of those attending the orientation sessions chose to participate. The characteristics of the sample (n=116) are summarised in table 1.

The Instrument

Our questionnaire was based on that used by Mann, *et al.* (2009). We made some minor changes to comply with our local ethical approval requirements, particularly relating to ethnicity.

The first section of this questionnaire comprised the New Ecological Paradigm instrument (Dunlap *et al.*, 2000) which identifies a participant's location on an anti-ecological to pro-ecological continuum.

The second section (priorities) set out a number of possible goals for New Zealand today and asked participants to identify and rank which they considered the top four.

Table 1: Sample characteristics

		Count	Valid	%
Gender	Male	76		68%
	Female	35		32%
	Missing		111	
			5	
			116	
Age	Under 20	61		55%
	20-29	34		31%
	30-39	7		6%
	40-49	6		5%
	50 or more	3		3%
	Missing		111	
			5	
			116	
Semester	S2, 2009	39		34%
	S1, 2010	77		66%
			116	
Ethnicity	NZ/Euro	29		29%
	Maori	13		13%
	Pasifika	31		31%
	Asian	17		17%
	Other	9		9%
	Missing		99	
			17	
			116	
Programme	Certificate	39		39%
	Diploma	34		34%
	Degree	27		27%
			100	
			16	
			116	

The third section (knowledge) asked how familiar participants were with a number of sustainability concepts.

The fourth section (making a difference) asked participants to rate their desire to be involved in improving the environment and their belief in their capability of making a difference.

The fifth section (actions) set out a list of possible actions that could be taken to improve the environment and asked them to indicate which they had done, which they would consider doing, and which they would not consider doing.

The sixth section (scenario) asked participants what they would do if asked by their manager to carry out a task that they believed was unsustainable practice. There is no right answer to this scenario.

The seventh section (relevance) asked participants how often they discussed sustainability issues and how relevant they believed sustainability was to their study.

The final section (meaning) asked participants to write down any words, ideas, thoughts, or images that came to mind from two captions and for any comments or suggestions they had on Education for Sustainability.

Ordinal scales were used for all sections except for the sixth (scenario) and the final section (meaning) which solicited open ended responses.

Method

We used a polytomous Rasch measurement model (Rasch, 1960; Andrich, 1978) to create interval level

variables from the ordinal categories; this is a stochastic model that identifies the maximum likelihood estimates of participant and item scale locations by simultaneous modelling of the location estimates and the uncertainty in their location. For consistency of interpretation, we standardised all of our scales to a range of 0 to 10, centred at 5, with positive measures indicating more of the named construct.

To enable direct comparison of the findings, we also calculated summated scales using the same methodology as Mann *et al.* (2009).

We chose a parametric approach for our analysis using the general linear model. We also carried out equivalent non-parametric tests for confirmation, but we do not report them here because the data met all the assumptions of the more familiar parametric tests.

We had no specific hypotheses to guide the analysis. Accordingly, to minimise spurious effects, we chose a confidence level of $p < .01$ rather than $p < .05$ for all measures. At this significance level, the minimum effect size that we could detect is approximately 6%.

Results

In this section we begin by commenting on the data screening we carried out and then present the results for each of the sections of the questionnaire.

For the Rasch model to extract the maximum information from a dataset, the scales should be uni-dimensional. We carried out a principal components analysis to verify this and show the results in table 2. All scales were multidimensional under Kaiser's criterion (Kaiser, 1960), suggesting that there is more

information in the dataset than will be extracted by the use of a Rasch measurement model. Although the last three scales have a smaller principal component than we would like, the remaining components are much smaller and the alpha measure is adequate, so there is no reason to doubt the model. The NEP is more problematic; we found five components with contributions ranging from 8 to 19% and marginal internal reliability ($\alpha = 0.68$), There is clearly a lot more going on here than is captured by our analysis.

Table 2: Dimensionality of scales

Scale	Cronbach's Alpha	Variance explained by Principal Component
NEP	0.6800	19%
Priorities	0.8177	40%
Knowledge	0.8474	35%
Actions	0.8673	43%

A key benefit of the Rasch model is that it is readily falsifiable. Standard fit statistics measure the fit between the model and the observed data, enabling identification of poorly fitting items. We present the main fit statistics in table 3.

Linacre (2002) gives some standard interpretations of these fit statistics as "productive" for measurement, "non productive (but not degrading)", "degrading", "over fitting". With this terminology, all items in all scales were classified "productive for measurement". We conclude that there is an acceptable fit between the model and the data.

Table 3: Rasch model fit statistics

Scale	Infit Min	Infit Max	Outfit Min	Outfit Max
NEP	0.842	1.209	0.837	1.222
Priorities	0.795	1.110	0.738	1.109
Knowledge	0.795	1.349	0.799	1.354
Actions	0.695	1.267	0.706	1.244
Acquiescence	0.724	1.175	0.779	1.189

Acquiescence bias is a tendency to agree with a statement rather than to disagree. The NEP aims to control for this by balancing the direction of endorsement across the instrument. Endorsement of odd numbered statements represents a pro-ecological stance and endorsement of even numbered statements an anti-ecological position. There are 8 pro-ecological statements and 7 anti-ecological statements offered for endorsement.

To test the level of acquiescence bias, we formed a scale in which the first 14 questions were all coded in the direction of agreement. We designed this scale to have a range of 0 to 10, centred at 5 with values above 5 representing an acquiescence bias and those below 5 a tendency to disagree with statements. A one sample t-test suggested ($t_{(115)}=12.7304$; $p<.0001$) that the mean value of acquiescence bias was significantly greater than 5; the confidence interval of the estimate was $CI_{.99} = (5.6980 \leq bias \leq 6.0577)$. We conclude that there was significant acquiescence bias in our sample.

No significant correlation was found ($r_{(114)}=0.0138$; $p=0.8554$) between this acquiescence bias and the overall NEP scale. This suggests that the scale balancing was working as designed and gives us no reason to question the validity of the overall NEP scale itself.

This level of bias does, however, raise doubts about the validity of the five sub-scales of the instrument for our sample since each sub-scale consists of 3 questions and is inherently unbalanced. For example, we found a significant ($r_{(114)}=-0.2962$; $p=0.0014$) correlation between acquiescence bias and the *rejection of exemptionalism* subscale. Moreover, the internal consistency of these sub-scales seems quite low (see table 4).

Table 4: Dimensionality of scales

Variable	Cronbach's Alpha
NEP	0.6800
Factor 1: limits to growth	0.2947
Factor 2: Antianthropocentrism	0.3413
Factor 3: nature's balance	0.4171
Factor 4: non exemptionalism	0.3225
Factor 5: Possibility of ecocrisis	0.3523
Acquiescence bias	0.4793

We note that the authors of the NEP caution that the dimensionality of the instrument will depend on the extent to which individual beliefs and values are organised into a coherent belief system and they

predict that the factors will be variable and sample dependent. We also note that Hurd (1999) suggests that acquiescence bias may be associated with uncertainty. One interpretation of the level of bias is that there might have been an overall lack of familiarity with many of the concepts presented, suggesting the lack of a coherent belief system, and hence doubt about the stability of the factors.

In consequence, we have chosen for the rest of the paper to use the overall NEP scale to illustrate some of the results, but not to pursue the subscales further. We found no significant association between any of the study variables and the orientation session. We have therefore chosen to combine the two sessions into a single dataset for the rest of the analysis.

NEP rating

A one sample t-test suggests ($t_{(115)}=8.0614$; $p<.0001$) that the mean value of *new ecological paradigm scale* (NEP) is significantly greater than 5; the confidence interval of the estimate is $CI_{.99} = (5.4846 \leq NEP \leq 5.9483)$. We conclude that participants in our sample were pro-ecological. The mean NEP score, calculated with the same methodology as Mann *et al.* (2009), was 2.634. There is no significant difference between this score and their score of 2.627 for Otago Polytechnic students.

We found no significant association between the NEP score and gender or ethnicity but there was a significant association with age. A Pearson correlation analysis suggests ($r_{(114)}=0.2913$; $p=0.0017$) that higher values of NEP are associated with higher values of age. We conclude that older students are more pro-environment.

Priorities

The second section of the questionnaire presented participants with a list of possible goals for NZ and asked them to *number the four most important issues* 1 to 4. We found analysis of this section of the questionnaire to be problematic. Although many participants completed the question as intended, others chose to give multiple issues the same ranking, sometimes ranking all items.

We felt that the only aspect we could analyse with confidence was to assume that participants believed that 1 was more important than 2 etc. Accordingly, we treated the ratings as an ordinal scale (1, 2, 3, 4 and unrated) and coded all responses above 4 as unrated. The resulting priorities are shown in figure 1. Lower numbers represent higher priorities, and the vertical bars an estimate of uncertainty.

Given the different interpretations of the question by participants, we are unable to present a direct comparison between these results and those of Mann *et al.* (2009). We note that the overall pattern is broadly similar. For example strong defence forces is the least preferred in both and protecting the environment is the most preferred. One action is noticeably different between the two. Reducing unemployment is in second place for our students, but in eighth place for the Otago Polytechnic students. This might represent a shift in overall perceptions as the employment consequences of the global recession continue to worsen or might just represent a regional difference, since unemployment is relatively high in our region.

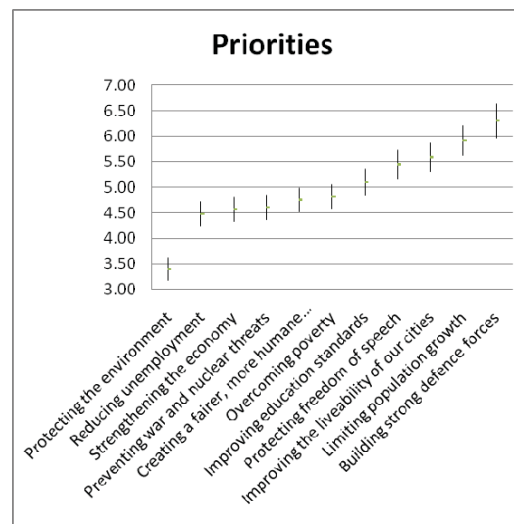


Figure 1: Priorities

Knowledge

The next section of the questionnaire asked participants how familiar they were with a number of sustainability concepts. Table 5 sets out the percentage of our students (MIT) who had never heard of it, compared with the equivalent figures from Otago Polytechnic (OP).

Overall, computing students at MIT were slightly less familiar with the concepts than those at Otago Polytechnic (40% unfamiliarity compared with 35% unfamiliarity). However, this may be partly due to the different timing of data collection. MIT students were surveyed prior to any class contact time, and OP students were surveyed slightly later, after some exposure to course material that embeds sustainability

concepts. The overall pattern of unfamiliarity was very similar with a correlation of 0.982.

Table 5: unfamiliarity with concepts

Description	MIT	OP
The ozone layer	4%	2%
Renewable resources	6%	0%
The greenhouse effect	9%	2%
The carbon cycle	21%	11%
Ecology	26%	10%
Sustainable development	27%	5%
Interdependence	30%	25%
Biodiversity	32%	26%
Carrying capacity	40%	41%
Intergenerational equity	61%	58%
The precautionary principle	66%	71%
The Aotūroa worldview	73%	78%
The Papatūānuku worldview	77%	78%
The Pūtaiao worldview	82%	86%
Average	40%	35%
Correlation	0.982	

Making a difference

Students were asked to rate their desire to be involved in improving the environment/community (D01) and to self-assess whether they had the skills and knowledge to bring about change (D02). We also created a

variable which we termed **empowerment**. We defined this as capability (D02) less desire (D01). Negative values are thus associated with disempowerment – a desire to be involved in positive change without the necessary skills and knowledge to achieve it.

For comparison with the Otago Polytechnic dataset, we created a simple summated scale for questions D01 and D02, ranging from 0 to 10 and centred at 5. We found a significant difference in desire between the datasets ($t_{(112)}=3.7399$; $p=0.0004$) with students in our dataset expressing stronger desire to be involved, but no significant difference in capability ($t_{(111)}=-0.5062$; $p=0.6197$)

For our own dataset, a one sample t-test suggests ($t_{(115)}=4.5310$; $p<.0001$) that the mean value of *desire to be involved in improving the environment/community* (D01) is significantly greater than 5; the confidence interval of the estimate is $CI_{.99} = (5.5338 \leq D01 \leq 6.9827)$. We conclude that participants endorsed a desire to be involved.

The mean of the capability variable (D02) was 5.0585 which is not significantly different from 5 ($t_{(115)}=0.2165$; $p=0.8122$).

A one sample t-test suggests ($t_{(115)}=-4.7802$; $p<.0001$) that the mean value of empowerment is significantly less than 0; the confidence interval of the estimate is $CI_{.99} = (-1.8545 \leq \text{Empowerment} \leq -0.5450)$. We conclude that the participants had an overall perception of disempowerment; their desire for change was not matched by a belief that they had the necessary skills and knowledge to bring about change, even in a small way.

We found no significant difference in desire between the genders, but female participants reported a significantly ($F_{(1, 109)}=7.73$; $\eta^2=6.62$ %; $\omega^2=5.71$ %; $p=0.0064$) higher belief in their capability to effect change.

We found no significant differences in desire or capability across the age groups. However, we did find some differences across ethnicities. There was no significant difference in perceived capability, but we found significant differences in desire for change ($F_{(1, 97)}=7.99$; $\eta^2=7.61$ %; $\omega^2=6.59$ %; $p=0.0057$) and in empowerment ($F_{(1, 109)}=7.73$; $\eta^2=6.62$ %; $\omega^2=5.71$ %; $p=0.0064$) between NZ/European/Other ethnicities and Pasifika/Maori/Asian ethnicities.

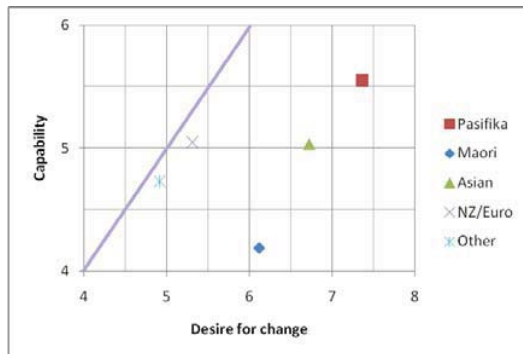


Figure 2: Empowerment by ethnicity

Figure 2 shows the relationship between desire for change and perceived capability for each of the major ethnic groups. In this figure, the solid line represents a balance between desire and capability. The overall mean and the mean of each ethnic group all fall to the

right and below this line, representing a degree of disempowerment. The extent of this disempowerment is represented by the distance from this line and is greater for the Maori, Pasifika and Asian groups than for NZ/European and other groups.

Actions

Participants were given a number of possible actions and asked to state for each whether they *had done* this, *would consider* doing, or *would not consider* doing. Our measurement placed the possible actions on a scale ranging from the easiest to consider doing to the most difficult. We also coded these on a points scale to enable comparison with the Mann *et al.* (2009) findings. We present these actions in table 6.

In this table *Beta* represents the difficulty of endorsing the action and *See* the standard error of this estimate. The MIT and OP columns represent scores for our institution and Otago Polytechnic calculated on a scale where 0 represents "would not consider" and 10 represents "have done".

Actions are presented in order of increasing difficulty of endorsement. The order of these actions is very similar for the two institutions with a correlation of 0.966 between the scores.

We found no significant association with age or gender. No significant association was found with ethnicity apart from *making a gift or donation to an environmental or conservation group*. We found that Pasifika students were significantly more likely to endorse this as a possible action ($F_{(1, 94)}=14.93$; $\eta^2=13.71$ %; $\omega^2=12.68$ %; $p=0.0003$).

Table 6: Endorsement of possible actions

	Beta	See	MIT	OP
Deciding for environmental reasons to re-use or recycle something instead of throwing it away	2.42	0.22	7.65	8.15
Growing food in your own garden	3.98	0.20	6.52	6.65
Choosing household products that are better for the environment	4.27	0.20	6.13	6.40
Trying to encourage someone else to change an activity or practice that you thought was harmful to the environment.	4.53	0.19	5.95	5.70
Making an effort, for environmental reasons, to reduce water consumption	4.69	0.19	5.79	4.95
Trying to get information for your own interest on some topic that you thought was relevant to protecting the environment	5.37	0.20	5.18	4.90
Making a report or complaint about something that you thought was bad for the environment	5.76	0.20	4.70	3.80
Taking part in a clean-up campaign or anti-litter scheme of some kind	5.85	0.20	4.66	4.20
Taking part in a tree-planting scheme	5.85	0.20	4.61	4.85
Making a gift or donation to an environmental or conservation group	6.01	0.19	4.20	3.60
Writing a letter, or signed a petition, or attended a meeting etc, with the aim of protecting or improving the environment	6.09	0.19	4.05	3.65

Scenario

Participants were asked what they would do if asked by their manager to carry out a task that they believed was unsustainable practice. There is no right answer to this scenario. We analysed responses using the same categories used in the Mann *et al.* (2009) study. We found the classification task challenging and felt a tension between bringing out the richness of our

participants' responses and maintaining compatibility with that study.

For example, we coded the responses "Research on why use unsustainable, come out with findings and proceed to apply corrective measures." and "Build a website that unsustainable practice is about etc." as "no idea" because these responses did not address the

inherent power balance issue and the conflict between personal ethics and the need for employment..

If we were devising our own classification, we would have coded these responses as "Compensatory action". However we felt that, for this study, it was more important to maintain compatibility. We would caution that some of the variation between the two institutions may be attributable to our coding of the responses.

We present in table 7 the respective proportions of responses, excluding those coded as "no idea". This table also shows, for the MIT students, the mean NEP score for each response category and the mean location on the *desire to be involved in improving the environment* scale.

Table 7: Scenario responses

Response	OP	MIT	NEP	Desire
Do it, say nothing	33%	14%	2.82	2.80
First talk alternatives	46%	26%	2.33	6.49
Talk and do it	8%	44%	2.43	7.35
Don't do it	12%	16%	2.48	5.35
No Idea			2.76	6.32

Across the response categories, we found a significant ($F_{(4, 111)}=4.33$; $\eta^2=13.5\%$; $\omega^2=10.31\%$; $p=0.0028$) difference of NEP scores and a significant ($F_{(4, 111)}=3.58$; $\eta^2=11.42\%$; $\omega^2=8.17\%$; $p=0.0089$) difference in desire to be involved. The "do it, say nothing" category was associated with a low desire to

be involved (2.8) and the least pro-environmental NEP score (2.82). The highest desire and most pro-environmental (low NEP score) ratings were associated with discussion rather than refusal to carry out the task.

Relevance

Participants were asked to rate the relevance of sustainability to their programme of study. The overall rating was medium (4.84 on a scale of 0 to 10) and not significantly different from the mid-point of 5. The summated scale equivalent was 2.83, very similar to the 2.77 that Mann *et al.* (2009) found for the Otago Polytechnic students.

We found no significant, variation by gender or age. However, there was significant ($F_{(4, 94)}=6.74$; $\eta^2=22.29\%$; $\omega^2=18.83\%$; $p=0.0001$) variation across categories of ethnicity. The mean endorsement by ethnicity is set out in table 8.

Table 8: Relevance by ethnicity

Category	Mean	N	Variance
Asian	5.8862	17	8.0058
Maori	6.2695	13	10.4009
NZ/European	3.0710	29	10.7837
Other	2.5254	9	8.5727
Pasifika	6.3336	31	8.5228

In this table, means above 5 indicate positive endorsement of relevance and higher values denote greater relevance. Pasifika participants saw the most relevance, followed by Maori and Asian students. There was a substantial gap between these students and those of NZ/European and other ethnicities. We

conclude that the Pasifika, Maori and Asian students in our sample regarded sustainability as relevant to their studies, but students of NZ/European and other ethnicities saw little relevance.

Discussion

Our study had two main aims: to replicate the study by Mann *et al.* (2009) and to investigate variation across our institution's demographic profile. We begin our discussion by identifying some threats to validity; then we compare our findings to those of Mann *et al.* (2009); finally we discuss the demographic variation.

We found a substantial level of acquiescence bias in our sample. As mentioned earlier in this paper, this might suggest a lack of familiarity with many of the concepts presented (Hurd, 1999). Endorsement of some items might therefore represent an element of "that seems plausible" rather than agreement with the statements.

Overall, there was a great deal of similarity between our results and those of Mann *et al.* (2009). Direct comparison was possible on five measures: NEP, Relevance, Knowledge, Actions and Making a difference

- The mean NEP score in our sample was 2.634. This was not significantly different from the score of 2.627 found for Otago Polytechnic IT students. Both groups were equivalently pro-ecological.
- The mean relevance score in our sample was 2.83. This was not significantly different from the score of 2.77 in the comparative sample. Neither group endorsed strong relevance.
- The mean unfamiliarity with concepts in our sample was 40%, compared to 35% at Otago Polytechnic. Correlation between familiarity with the various concepts across the two datasets was very high ($r=0.982$).

- A similar pattern was found in the endorsement of the various possible actions presented with a high correlation ($r=0.966$)
- Within "making a difference", we found a significant difference between the two datasets in *desire to be involved in improving the environment/community* with students at MIT expressing a stronger desire. This may be partly understood by the demographic variations discussed below. We found no significant differences in participants' perceived ability to bring about change.

We were less able to make a direct comparison on two measures:

- Not all participants in our study interpreted the question on priorities in the manner intended so we were unable to make a direct comparison. However, the overall pattern of responses was broadly similar.
- We found the analysis of scenario responses to be problematic. Differences found might be due to our coding of the responses.

Overall, we believe our findings support those of Mann *et al.* (2009) and lend weight to the proposition that the findings could apply to the computing student intakes of other tertiary institutions.

There are differences however, and we believe these can be best understood by exploring the variability across our institution's demographic profile.

We did not find females to be more pro-ecological than males in our sample. This contrasts with the Mann *et al.* (2009) study which found females to be significantly more pro-ecological. To understand this discrepancy we would point out that our study was within a single discipline and their study was across multiple disciplines, which in turn exhibited different ecological worldviews. We could reconcile these findings by the

proposition that *after controlling for differences in worldviews associated with a student's chosen discipline*, there is no significant difference between the genders. This proposition is consistent with a recent national representative household survey carried out by Research New Zealand on behalf of the Ministry for the Environment (2008) which found no significant gender differences in pro-ecological stance.

We found a significant association between age and pro-ecological views, as measured by the NEP, with older students more pro-ecological. This is also consistent with the Ministry for the Environment (2008) survey mentioned above which found that older participants were significantly more pre-ecological.

We found considerable variability associated with ethnicity and there seems to be a difference between the worldviews of Pasifika, Maori and Asian ethnicities, and NZ/European and other ethnicities. The Pasifika, Maori and Asian students:

- See sustainability as more relevant to their studies.
- Perceive greater disempowerment: a desire for change not matched by their perceived capacity to bring about change.

For statistical reasons, we have grouped together many individual ethnicities. However, we would caution against treating these groups as homogeneous. For example, there are many Pasifika ethnicities, each of which may have unique worldviews. Our study suggests that these groups share a level of perceived disempowerment, not that the worldviews are the same.

A key goal of education is to reduce disempowerment by helping students gain the necessary skills and

knowledge to achieve what they desire in life. From this perspective, our findings give support to embedding ESD into our teaching. The variation of worldviews and empowerment across ethnicities is a key finding that needs further investigation.

Finally, we note that although we asked participants about the relevance of sustainability (which was strongly endorsed across world views) to their study, we could look at this question the other way round and ask how relevant their study is to their worldview.

Conclusion

Our first aim was to replicate the study carried out by Mann *et al.* (2009), comparing and contrasting our respective findings and thereby, hopefully, both supporting the generalisation of their study and contributing to the emerging body of knowledge around sustainability perceptions and values of incoming students. We believe that our findings are consistent with those of Mann *et al.* (2009) which suggests that the worldviews presented may apply to other students starting their educational journey in computing qualifications. We hope that our findings will provide a useful point of comparison for others researching this area.

We also wanted to investigate the variation of attitudes across the demographic profile associated with our institution's students. We believe that our major finding here is the level of disempowerment, especially that perceived by Pasifika, Maori and Asian ethnicities. We cannot say from this sample whether this disempowerment is specific to sustainability issues or is symptomatic of a more general feeling of disempowerment. In either case, embedding Education

for Sustainability into our teaching may have a part to play in reducing this disempowerment.

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