AN APPLICATION OF THE TROFLEI IN SECONDARY SCIENCE CLASSES IN NEW ZEALAND

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ABSTRACT

This paper describes the validation in New Zealand of actual and preferred forms of a pre validated classroom environment instrument – the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI). The 80-item TROFLEI assesses 10 classroom environment dimensions: Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, Equity, Differentiation, Computer Usage and Young Adult Ethos. The validity and reliability of the TROFLEI were established. Also, the data obtained were used to investigate associations between students' perceptions of the learning environment and their attitudes toward science, attitudes toward computer use and academic efficacy. Differences in students' perceptions of their actual and preferred learning environments were also shown and gender and year level differences were further computed. The sample contained 1,027 high school student responses from 30 classes.

BACKGROUND TO STUDY

Information and Communication Technology (ICT) and Education

Rapid developments in technology have influenced the evolution of student centred learning environments (Strommen & Lincoln, 1992). Emerging information systems, such as the World Wide Web, support varied student-centred approaches in a variety of settings (Shotsberger, 1996). Integrated multimedia platforms are now common place, providing powerful systems for developing and using highly sophisticated learning environments. Software innovations have also been prominent. Numerous studies over the years, summarized by Bialo and Sivin-Kachala (1996), report other benefits enjoyed by students who use technology. These benefits involve attitudes toward self and toward learning.

Use of ICT in classroom can also be called E – learning which is "learning and teaching that is facilitated by or supported through the smart use of information and communication technologies." (Ministry of Education, 2006a). Integration of ICT can be limited by existing pedagogical approaches. A need to move from a teacher-focused to a learner-focused learning environment, class size and curriculum requirements have been seen as limiting factors in its integration (OECD, 2005). ICT integration into the classroom has also not been fully realised due to existing pedagogical approaches, in particular seeing ICT as being an optional add on to curriculum delivery. On the other hand, ICT is now seen as a way of ensuring efficiency in implementing a formative assessment approach and as a way to engage 21st century learners through the development of on-line learning environments and the linking of these to Student Management Systems (SMS's) in order to support, for example, the feedback aspect of formative assessment (Ministry of Education, 2006b)

Encompassing of digital technology resources in schools and classrooms, educators are rethinking the nature of teaching and learning (Owston, 1997). Today's learners must think critically, analyze and synthesize information to solve technical, social, economic, political, and scientific problems, and work productively in groups (Grabinger & Dunlap, 1996). To create teaching and learning environments that enable students to become effective and highly-skilled technologists, problem solvers, researchers, and communicators requires powerful, high-end technologies in the classroom as well as teachers adroit in utilizing these technology tools.

Current research on learning suggests that the real power of technology in the classroom is embedded in its potential to facilitate basic changes in the way teaching and learning occurs. The effective and appropriate integration of technology in the classroom creates a dynamic learning environment where students are active participants in the learning process. There are indications that this style of learning results in improved academic achievement, improved attendance, and improved behaviour (e.g., see Dwyer, 1995; Mann & Shafer, 1997). Schacter (1999) analyzed several large-scale studies on the impact and effectiveness of instructional computing and found positive gains in student achievement on researcher constructed tests, standardized tests, and national tests. Studies also suggest that students in technology-infused classrooms are better able to perform multiple

problems and carry out complex reasoning tasks (e.g., see Hopson, Simms, & Knezek, 2002; Van Dusen & Worthen, 1995; Wiburg, 1995).

Technology needs to be matched with the chosen objectives of instruction in lesson plans and units of study (Ediger & Rao, 1996). After the use of technology in teaching and learning situations, the teacher should measure what pupils have learned. The role of technology in bringing about a revolution in every aspect of education cannot be undermined.

In 2009, the Ministry of Education released a draft curriculum in New Zealand. The curriculum was to be gradually implemented with full implementation in 2010. Within the new draft curriculum learning theories (constructivism, conceptual change, social constructivism and connectivism) were evident, as is best practice in the use of formative assessment and ICT (Ministry of Education, 2006b).

The school in which this research took place has made formative assessment and use of ICT a focus of professional development. Formative assessment is a key component in Ako (Programme adopted in New Zealand), an innovative learning programme that aims to better enable students to understand how they learn, and the school also currently has an ICT professional development contract with the Ministry of Education whose goal is the professional development of its teachers in the use of ICT in teaching and learning. The third author of this paper was involved as a teacher in the development of an e-learning pedagogy in this setting and it provided the opportunity to investigate a more complete model of the integration of the curriculum, formative assessment and ICT in science (Figure 1).

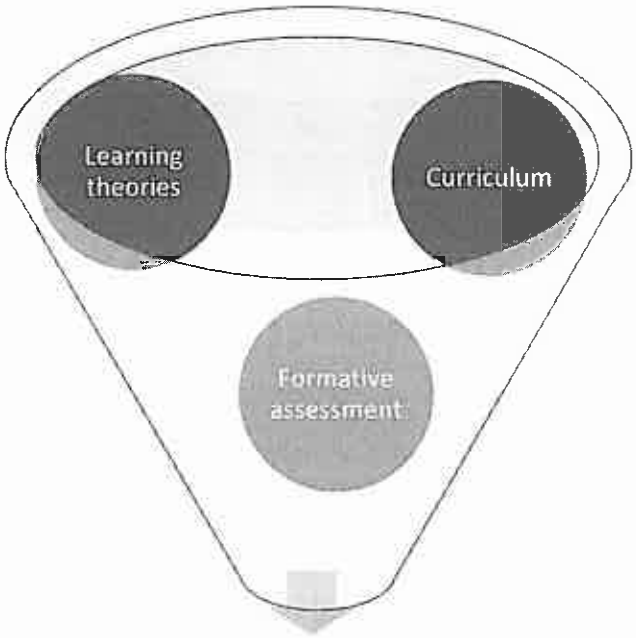

Figure 1. (Modified from (Trinidad, 2003)Trinidad in Fisher & Khine, 2003)

Learning Environments

The notion that a learning environment exists which mediates aspects of educational development began as early as 1936 when Lewin (Lewin, 1936) recognised that the environment and the interaction of the individual were powerful determinants of behaviour and introduced the formula, B=f(P,E). Stern (1970) further expounded this person-environment fit in education. Walberg (1991) proposed a model of educational efficiency in which educational environments are one of the nine determinants of student outcomes. Since Lewin's time, international research efforts involving the conceptualisation, assessment, and investigation of perceptions of aspects of the classroom environment have firmly established classroom environments as a thriving field of study (Fraser, 1994, 1998a; Fraser & Walberg, 1991).

During the last four decades learning environments research has proved to be an established area of research receiving increased attention by all the stakeholders. Learning environment research traditions, conceptual models and research methods were taken into consideration while carrying out the research described in this paper.

One of the strengths of the research into learning environments has been the development of questionnaires that assess students' perceptions of their learning environment. Interest in technology-rich environments and the new New Zealand science curriculum led to the selection of the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Aldridge & Fraser, 2003).

Assessing students' perceptions of their learning environment on the scales of the TROFLEI would allow us to monitor the use and impact of ICT in education. Although, the TROFLEI has been reported to be a reliable and valid instrument for assessing the impact of the integration of ICT on the learning environment, none of the study has been carried out in New Zealand. Present study reports on the validation process of this instrument and examines the existing learning environments in technology rich classes.

The TROFLEI consists of 80 items assigned to 10 underlying scales (8 items per scale) Table I presents scale descriptions and a sample item for each scale. Seven of the 10 TROFLEI scales are from the What is Happening in this Class? (WIHIC) instrument which is a well-established and widely-used questionnaire in classroom environment research (see Aldridge & Fraser, 2003; Koul & Fisher, 2005). The TROFLEI scales are: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Investigation, Cooperation, Equity, Differentiation, Computer Usage and Young Adult Ethos.

The TROFLEI comes in two forms: the Actual Form assesses students' perceptions of their actual classroom environment whereas the Preferred Form asks students for their perceptions of the classroom environment they would prefer or see as in ideal. Having the two forms allows comparisons between students' perceptions of their preferred classroom environment and what it is actually like. A feature of learning environment research has been the evidence that students, achievement improves the closer their actual environment is to what they would prefer (Fraser & Fisher, 1982).

To enable investigation of associations between the learning environment and outcomes, three attitude scales, namely, Attitude to Subject, Attitude to Computers and Academic Efficacy were also employed in the present study. Attitude to Subject and Attitude to Computers (TOSRA: Fraser, 1981). Responses were recorded on a five-point format ranging from 1 (Disagree) to 5(Agree).

Perceived Academic Efficacy refers to students' judgments of their ability to master academic tasks that they are given in their classrooms. An 8-item scale based on the research of Midgley, Maehr, Hicks, Roeser, Urdan, Anderman and Kaplan (1996); Roeser, Midgley and Urdan (1996) was used to assess perceived academic competence at science class work. Items were modified to elicit a response on academic efficacy in science.

RESEARCH DESIGN

This paper reports on the reliability and validity of a pre-validated generally-applicable instrument designed to monitor the evolution of technology-rich, outcomes-focused science learning environments. Differences between students' perceptions of actual and preferred classroom environments were investigated along with gender and year differences. Associations between learning environment and attitude to science, attitude to computers and student self efficacy were also examined. The objectives of the study were as follows:

Table I. Description and Example Item for the Scales Used in Study

Scale	Scale Description	Sample Item
Student Cohesiveness	The extent to which students know, help and are supportive of one another.	I am friendly to members of this class.
Teacher Support	The extent to which the teacher helps, be friends, trusts and is interested in students.	The teacher considers my feelings.
Involvement	The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class.	I explain my ideas to other students.
Task Orientation	The extent to which it is important to complete activities planned and stay on the subject matter.	I know how much work I have to do.
Investigation	The extent to which skills and processes of enquiry and their use in problem solving and investigation are emphasised.	I carry out investigations to test my ideas.
Cooperation	The extent to which students cooperate rather than compete with one another on learning tasks.	I share my books and resources with other students when doing assignments.
Equity	The extent to which students are treated equally by the teacher.	I get the same opportunity to answer questions as other students.
Differentiation	The extent to which teachers cater for students differently on the basis of ability, rate of learning and interests.	I do work that is different from other students' work.
Computer Usage	The extent to which students use their computers as a tool to communicate with others and to access information.	I use computer to take part in on-line discussions with other students.
Yong Adult Ethos	The extent to which teachers give students responsibility and treat them as young adults.	I am encouraged to take control of my own learning.
Attitude to Subject	The extent to which students are interested in, enjoy and look forward to lessons in that subject.	I look forward to lessons in this subject.
Attitude to Computers	The extent to which students show a positive attitude towards the use of computers.	I'm good with computers.
Academic Efficacy	Students' judgments of their capabilities to organize and execute courses of action to attain designated types of educational performances	I find it easy to get good grades in this subject.

Objectives

1. to validate the TROFLEI, and measures of attitude to science, attitude to computer use, and academic efficacy for use in science classes in New Zealand;
2. to investigate differences between students' perceptions of actual and preferred learning environments;
3. to investigate differences between students' perceptions in terms of year levels and gender; and
4. to investigate associations between students' perceptions of their science classroom learning environments and their attitude and self efficacy outcomes.

Sample

The sample in this study was comprised of 30 Science classes across Year 7 to 13 in a coeducational secondary school in New Zealand. A total of 1,027 students responded to the TROFLEI. Table II describes the sample.

Table II. Description of sample

Gender	Sample Size							
	Year7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Total
Male	53	57	95	92	92	76	53	518
Female	54	40	107	79	107	81	41	509
Total	107	97	202	171	199	157	94	1027

RESULTS

Validation of the TROFLEI

Data collected from 1027 students from 30 classes in a New Zealand high school were analysed in various ways to establish the validity and reliability of both Actual and Preferred versions of the TROFLEI.

Principal components factor analysis followed by varimax rotation confirmed a refined structure of the actual and preferred forms of the instrument comprising of 80 items in 10 scales. All the 80 items have a loading of at least 0.30 on their priori scales. Factor analysis results can be seen in Table III.

Table IV indicates that significant correlations ($p < 0.01$ & $p < 0.001$) were found among scales used in the instrument. Analyses were also completed to explore the inter-scale correlation in the TROFLEI. The results on this study show that most scales of TROFLEI are having statistically significant positive correlation to each other except for the Correlation between the scales of Attitude to Computer Use with the Differentiation and Computer Usage.

Further to factor analyses two more indices of scale reliability were generated for both actual and preferred versions of the TROFLEI. To determine by the degree to which items in the same scale measure the same aspects of students' perceptions of the scales of TROFLEI, attitude to subject, attitude to computers and academic efficacy, a measure of internal consistency, the Cronbach alpha reliability coefficient (Cronbach, 1951) was used. The cronbach alpha reliability coefficient was used as an index of scale internal consistency. Analysis of variance (ANOVA) results were used as evidence of the ability of each scale in the actual form to differentiate between the perceptions of students in different classrooms.

The internal consistency reliability was determined for two units of analysis. Table V reports the Cronbach alpha coefficient for the actual and preferred versions of each of the 10 TROFLEI scales for two units of analysis (student and class mean). Using the student as the unit of analysis, scale reliability estimates for different scales range from 0.75 to 0.93 for the actual form and from 0.82 to 0.95 for the preferred form. Generally reliability figures are even higher with the class means as the unit of analysis (from 0.78 to 0.96 for actual form and from 0.81 to 0.97 for the preferred form).

An analysis of variance (ANOVA) was used to determine the ability of the actual version of each TROFLEI scale to differentiate between the perceptions of students in different classes. The one-way ANOVA for each scale involved class membership as the independent variable and the individual student as the unit of analysis. ANOVA results show that all the ten TROFLEI scales and all three attitude scales used in this study differentiate significantly between classes ($p<0.001$). Thus students within the same class perceive the classroom environment in a relatively similar manner. The eat^2 statistic (an estimate of the strength of association between class membership and the dependent variable ranges from 0.04 to 0.18 for different scales of TROFLEI.

The results obtained for the internal consistency (alpha reliability) and the ability of each scale to differentiate between the perceptions of the students in different classrooms (eat^2 statistic from ANOVA) can be considered acceptable. Since all the reliabilities for the scales of TROFLEI were consistently above 0.75 the instrument developed is reliable for use ((De Vellis, 1991).The data presented in Table III and Table IV, support the contention that the TROFLEI is a valid and reliable classroom environment instrument for assessing students' perceptions of their psychosocial environments at high school level in New Zealand.

Actual and Preferred Differences

Table VI reports scale means and standard deviations. Test of Variance (ANOVA) described above was performed on the data. Univariate t-test for each scale of TROFLEI revealed statistically significant differences between actual and preferred scores. For ten scales, mean preferred scores were higher than mean actual scores. Effect sizes for each of these ten comparisons were computed using Cohen's (1977) d (the difference between scale mean score per full sample standard deviation) as an accepted index. These values vary from 0.25 for the scale of Cooperation to 4.16 for Student Cohesiveness. These effect sizes are low to very large and indicate substantial differences between actual and preferred responses.

Gender Differences

The associations between the students' perceptions on the scales of the TROFLEI and the gender of the students were analysed. The gender differences in students' perceptions of classroom learning environment were examined by splitting the total number into male (518) and female (509) students involved in the study. To examine the gender differences in students' perceptions of the classes, the within-class gender subgroup mean was chosen as the unit of analysis, which aims to eliminate the effect of class differences due to males and females being unevenly distributed in the sample. In the data analysis, male and female students' mean scores for each class were computed, and the significance of gender differences in students' perceptions of science classroom culture were analysed using an independent t-test. Table VII shows the scale item means, male and female differences, standard deviations, and t-values. The purpose of this analysis was to establish whether there are significant differences in perceptions of students according to their gender.

As can be seen in the Table VII, out of ten scales of the TROFLEI and three Attitude scales, the gender differences in the perceptions of males and females were found to be statistically significantly different on nine scales. According to the results, female students generally perceived their technology related learning environment more positively

Year Level Differences

One of the aims of the study was to investigate the differences in the perceptions of the scales of the TROFLEI and three attitudes scales in students from different year levels. This was explored by splitting the students in their year groups (yr 7 = 107, yr 8 = 97, yr 9 = 202, yr 10 = 171, yr 11 =199, yr 12 = 157, yr 13 = 94). The results of the analyses are shown in Table IX. In the data analysis, mean scores for each of the seven year groups were computed. Table IX shows the scale item means and F values of the scales of the TROFLEI with the perceptions of students from the seven year groups in the study. The purpose of this analysis is to establish whether there are significant differences in the perceptions of students according to their year groups.

As can be seen in Table VIII, the differences in the perceptions of students on the scales of the TROFLEI and Attitude, all the 13 scales are statistically significant confirming that year level does impact significantly on students' perception of their classroom.

Table III. Factor Loadings for the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI)

	Factor Loadings																			
Item No	Student Cohesiveness		Teacher Support		Involvement		Task Orientation		Investigation		Cooperation		Equity		Differentiation		Computer Usage		Young Ethos	Adult
	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref
1	.65	71																		
2	.63	66																		
3	.53	61																		
4	.75	77																		
5	.56	66																		
6	32	.45																		
7	.66	68																		
8	.47	32																		
9			.71	.72																
10			.72	.71																
11			.69	69																
12			.65	.59																
13			.71	71																
14			.74	67																
15			69	70																
16			.54	.52																
17					.73	.68														
18					.81	.75														
19					.51	.67														
20					.63	.71														
21					.56	.54														
22					.61	.64														
23					.45	47														
24					.53	.59														
25							.71	.71												
26							.69	.71												
27							58	.61												
28							.67	.68												
29							.58	.67												
30							.65	67												
31							.64	.70												
32							.61	.71												
33									.67	62										
34									.61	.60										
35									.75	.74										
36									62	.62										
37									.72	.76										
38									.76	.77										
39									.73	.77										
40									.69	.73										

Factor Loadings

Item No	Student Cohesiveness		Teacher Support		Involvement		Task Orientation		Investigation		Cooperation		Equity		Differentiation		Computer Usage		Young Ethos	Adult
	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref
41											.60	.55								
42											.58	.57								
43											.59	.56								
44											.65	.69								
45											.69	.69								
46											.75	.76								
47											.66	.70								
48											.63	.64								
49													.63	.58						
50													.67	.61						
51													.70	.68						
52													.72	.66						
53													.69	.66						
54													.74	69						
55													68	65						
56													.74	.67						
57															.42	.31				
58															44	.59				
59															.64	.69				
60															.71	.71				
61															.32	44				
62															75	71				
63															.71	.71				
64															.69	.69				
65																	55	.56		
66																	76	75		
67																	.73	.76		
68																	69	71		
69																	72	.78		
70																	72	78		
71																	.71	72		
72																	52	51		
73																			62	69
74																			.62	67
75																			.56	65
76																			.75	77
77																			71	74
78																			71	72
79																			61	61
80																			.57	60

TABLE IV: Inter-Scale Correlation for the scales of TROFLEI

Scale	Student Cohesiveness	Teacher Support	Involvement	Task Orientation	Investigation	Cooperation	Equity	Differentiation	Computer Usage	Yong Adult Ethos	Attitude to Subject	Attitude to Computer Use	Academic Efficacy
Student Cohesiveness	1	.44**	.54*8	.39**	.28**	.64**	.37**	.12**	.08*	.39**	.19**	.16**	.21**
Teacher Support		1	.57**	.46**	.41**	.43**	.63**	.19**	.25**	.53**	.44**	.11**	.26**
Involvement			1	.42**	.46**	.49**	.44**	.25**	.27**	.37**	.32**	.17**	.38**
Task Orientation				1	.51**	048**	.52**	.17**	.19**	.55**	.49**	.24**	.38**
Investigation					1	.42**	.39**	.31**	.31**	.39**	.36**	.14**	.36**
Cooperation						1	.48**	.18**	.17**	.46**	.27**	.18**	.25**
Equity							1	.13**	.17**	.64**	.44**	.17**	.25**
Differentiation								1	.46**	.11**	.16**	-.005	.15**
Computer Usage									1	.26**	.19**	.03	.21**
Young Adult Ethos										1	.44**	.18**	.32**
Attitude to Subject											1	.16**	.39**
Attitude to Computer Use												1	.15**
Academic Efficacy													1

Table V. Cronbach Alpha Relaibility and and ability to differentiate between Classrooms (ANOVA Results) for the TROFLEI

Scale	Unit of Analysis	Alpha Reliability		ANOVA (eta^2)
		Act	**Pref**	
Student Cohesiveness	Student	0.81	0.91	0.05*
	Class Mean	0.84	0.94	
Teacher Support	Student	0.91	0.91	0.14*
	Class Mean	0.96	0.94	
Involvement	Student	0.86	0.87	0.06*
	Class Mean	0.92	0.87	
Task Orientation	Student	0.88	0.92	0.1*
	Class Mean	0.91	0.94	
Investigation	Student	0.9	0.95	0.06*
	Class Mean	0.94	0.96	
Cooperation	Student	0.88	0.91	0.06*
	Class Mean	0.91	0.92	
Equity	Student	0.93	0.95	0.11*
	Class Mean	0.95	0.97	
Differentiation	Student	0.75	0.86	0.17*
	Class Mean	0.79	0.89	
Computer Usage	Student	0.84	0.88	0.13*
	Class Mean	0.88	0.91	
Young Adult Ethos	Student	0.9	0.92	0.16*
	Class Mean	0.93	0.95	
Attitude to Subject	Student	0.75	0.78	0.18*
	Class Mean	0.78	0.81	
Attitude to Computer Use	Student	0.8	0.82	0.04*
	Class Mean	0.83	0.85	
Academic Efficacy	Student	0.83	0.83	0.07*
	Class Mean	0.88	0.86	

$P<0.001$

Table VI. Scale Mean, Standard Deviation, Internal Consistency

Scale		Mean		St. Dev		Difference	
		Actual	Preferred	Actual	Preferred	Effect Size *r*	t
Student Cohesiveness	Student	3.9	4.35	0.63	0.60	0.73	-28.23*
	Class	3.92	4.38	0.10	0.12	4.16	-15.85*
Teacher Support	Student	3.27	3.85	0.93	0.82	0.66	-23.99*
	Class	3.33	3.89	0.31	0.23	2.05	-13.22*
Involvement	Student	3.09	3.55	0.82	0.87	0.54	-21.32*
	Class	3.14	3.6	0.21	0.20	2.24	-24.38*
Task Orientation	Student	3.83	4.35	0.79	0.71	0.69	-27.86*
	Class	3.87	4.39	0.22	0.2	2.47	-36.11*
Investigation	Student	2.86	3.35	0.86	0.92	0.55	-28.9*
	Class	2.86	3.58	0.1	0.12	6.52	-38.82*
Cooperation	Student	3.79	4.21	0.81	0.75	0.25	-23.17*
	Class	3.8	4.23	0.16	0.15	2.77	-15.67*
Equity	Student	3.81	4.30	0.97	0.73	0.57	-20.7*
	Class	3.84	4.33	0.26	0.19	2.15	-14.9*
Differentiation	Student	2.77	3.31	0.75	0.89	0.66	-24.58*
	Class	2.81	3.32	0.33	0.40	1.39	-10.49*
Computer Usage	Student	2.27	2.99	0.89	1.07	0.73	-23.95*
	Class	2.33	3.00	0.33	0.21	2.42	-8.34*
Young Adult Ethos	Student	3.75	4.22	0.89	0.76	0.56	-20*
	Class	3.79	4.23	.35	0.24	1.47	-7.6*
Attitude to Subject	Student	3.13		0.76			
	Class	3.64		0.26			
Attitude to Computer Use	Student	4.03		0.72			
	Class	4.13		0.08			
Academic Efficacy	Student	2.89		0.79			
	Class	3.07		0.11			

n=1027 *p<0.001

Table VII. Item Mean and Standard Deviation for Gender Differences in Students' Perceptions on the scales of the TROFLEI .

Scale	Gender	Item Mean	Mean Difference (F-M)	Std. Deviation	t	Effect Size r
Student Cohesiveness	Females	4.01	.21	.59	-5.5*	.17
	Males	3.8		.65		
Teacher Support	Females	3.37	.19	.88	-3.23*	.1
	Males	3.18		.96		
Involvement	Females	3.05	-.12	.79	1.37	-.04
	Males	3.12		.84		
Task Orientation	Females	3.91	.16	.76	-3.2*	.1
	Males	3.75		.81		
Investigation	Females	2.89	.06	.82	-1.21	.03
	Males	2.83		.89		
Cooperation	Females	3.93	.28	.75	-5.69*	.17
	Males	3.65		.84		
Equity	Females	3.9	.18	.96	-2.94*	.09
	Males	3.72		.97		
Differentiation	Females	2.71	-.12	.70	2.72*	.08
	Males	2.83		.79		
Computer Usage	Females	2.23	-.09	.81	1.58	.05
	Males	2.32		.97		
Young Adult Ethos	Females	3.9	.29	.84	-5.16*	.16
	Males	3.61		.91		
Attitude to Subject	Females	3.08	-.09	.76	1.95**	.05
	Males	3.17		.75		
Attitude to Computer Use	Females	4.02	-.02	.70	0.57	.03
	Males	4.04		.73		
Academic Efficacy	Females	2.81	-.15	.80	2.81*	.09
	Males	2.96		.79		

*p<0.01, **p< 0.05 n male =518, female =509

Associations between Attitude Scales and the Scales of the TROFLEI

Next students' perceptions on the technology used in class and how it affects his/her attitude towards classes was investigated. Associations between the perceptions of the scales of the TROFLEI and students' attitudes were explored using simple and multiple correlation analyses. The results of the analyses are shown in Table X. Only four scales out of ten scales of the TROFLEI have positive and statistically significant associations.

The multiple correlations (R) between the set of the TROFLEI scales and attitude to subject, attitude to computer use and academic efficacy were 0.58, 0.27 and 0.49 respectively. The R^2 value which indicates the proportion of variance that can be attributed to students' perceptions of technology class was 34%, 8% and 24% for the three respective attitude scales. To determine which of the TROFLEI scales contributed most to this association, the standardized regression coefficient ( ) was examined for each scale. It was found that only

eight scales of TROFLEI out of ten, retained their significance and were positively and significantly associated with attitude to subject. Results of this analysis can be seen in Table IX.

Table VIII. Item Mean for Year Level Differences in Students' Perceptions Measured by the TROFLEI (Actual) Scales

Scale		YEAR LEVEL							F Value
		7th N=107	8th N=97	9th N=202	10th N=171	11th N=199	12th N=157	13th N=94	
Student Cohesiveness	Mean	3.91	3.99	3.93	3.76	3.81	3.97	4.08	4.04*
	St Dev	0.61	0.48	0.59	0.66	0.69	0.67	0.58	
Teacher Support	Mean	3.42	3.37	3.13	2.93	3.09	3.54	3.87	16.52*
	St Dev	0.74	0.94	0.92	0.94	0.98	0.79	0.74	
Involvement	Mean	3.23	3.35	3.13	2.9	2.82	3.11	3.41	10.30*
	St Dev	.64	.63	.82	.92	.81	.77	.84	
Task Orientation	Mean	4.1	3.94	3.93	3.53	3.62	3.93	4.18	12.31*
	St Dev	.63	.78	.76	.91	.84	.68	.55	
Investigation	Mean	2.88	2.93	2.97	2.66	2.81	2.95	2.84	2.64*
	St Dev	.81	.83	.90	.91	.86	.81	.77	
Cooperation	Mean	3.71	3.81	3.92	3.59	3.62	3.94	4.03	6.57*
	St Dev	.67	.77	.77	.91	.81	.84	.71	
Equity	Mean	3.80	3.75	3.86	3.55	3.58	4.05	4.3	9.91*
	St Dev	.82	.92	.97	1.03	1.07	.82	.81	
Differentiation	Mean	3.17	3.34	2.83	2.67	2.61	2.58	2.44	23.85*
	St Dev	.66	.70	.75	.75	.68	.73	.56	
Computer Usage	Mean	2.69	2.79	2.42	2.11	1.81	2.25	2.26	22.82*
	St Dev	.88	.69	.96	.80	.78	.88	.82	
Young Adult Ethos	Mean	3.48	3.78	3.79	3.49	3.50	4.08	4.42	21.23*
	St Dev	.82	.65	.83	.88	.97	.81	.65	
Attitude to Subject	Mean	3.38	3.21	3.11	2.93	2.85	3.21	3.63	17.28*
	St Dev	.64	.69	.77	.75	.77	.67	.65	
Attitude to Computer Use	Mean	3.87	4.11	4.13	3.99	4.06	4.00	4.00	1.78*
	St Dev	.74	.68	.66	.74	.74	.71	.77	
Academic Efficacy	Mean	2.93	2.85	3.06	2.77	2.78	2.94	2.84	3.25*
	St Dev	.71	.71	.79	.87	.81	.74	.82	

P<0.01

Table IX. Associations between the TROFLEI Scales and three Attitudes Scales in terms of Simple Correlations (r), Multiple Correlation (R) and Standardised Regression Coefficient β

Scale	Attitude to Subject		Attitude to Computer Use		Academic Efficacy	
	r	β	r	β	r	β
Student Cohesiveness	0.19**	-0.14*	0.16**	0.04	0.21**	-0.05
Teacher Support	0.44**	0.15*	0.11**	-0.07*	0.26**	-0.04
Involvement	0.32**	0.05	0.17**	0.08*	0.38**	0.26*
Task Orientation	0.49**	0.27*	0.24**	0.15*	0.38**	0.2*
Investigation	0.36**	0.06*	0.14**	0.01	0.36**	0.12*
Cooperation	0.27**	-0.04	0.18**	0.04	0.25**	-0.03
Equity	0.44**	0.06*	0.17**	0.03	0.25**	-0.05
Differentiation	0.16**	0.03	-0.00**	-0.05	0.15**	-0.02
Computer Usage	0.19**		0.03**	-0.00	0.21**	0.06*
Young Adult Ethos	0.44**	0.13*	0.18**	0.03	0.32**	0.12*
Multiple Correlation R		0.58		0.27		0.49
R^2		0.34		0.08		0.24

CONCLUSION

This chapter has documented and reported on further validation of a questionnaire designed to assess students' perceptions of their classroom learning environments in technology-rich, outcomes-focused curriculum. The reliability and validity of the questionnaires used in the study was established and their associations with learner outcomes like attitude towards science, academic efficacy and academic achievement were assessed. Two versions namely, actual and preferred of the questionnaire were used. This study has been significant as it builds on previous studies to include students' perceptions of ICT-rich outcomes-focused learning environments. The main objective of this study was to understand the impact of the use of technology in teaching science at the secondary level in the school, where study was conducted by understanding the psychosocial learning environments in a technology-supported classroom and to determine its effectiveness in terms of selected learner outcomes. The methodology of the study can be described as being descriptive statistical in nature in which the questionnaire survey method has been extensively employed and the use of inferential statistics has been made to deduce results. The sample for the study consisted of 1,027 students from 30 science classes from grades seven to 13. Gender differences were also studied in a technology-supported learning environment.

The results of this study will feed directly into the action research being undertaken at the school and has provided the quantitative data, on which to base decisions on the development of the e-learning pedagogy. The study also supports the development of an e-learning pedagogy by feeding its results into the action research being undertaken by the school ensuring that decisions are evidenced based. This supports ministry requirements detailed in the action plan 'Enabling the 21st century learner'. Its aim is to: "Contribute to the Government's overarching goal to build an education system that equips New Zealanders with 21st century skills, through the increased use of e-learning in schools (Ministry of Education, 2006b).

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