Technology-Rich Learning Environments in New Zealand ITPs

Kamani M Gunawardena
Manukau Institute of Technology
Otara Road
Auckland, New Zealand
+64 9 960 8000
kgunawar@manukau.ac.nz

ABSTRACT

This paper considers the technology-rich learning environments of students doing computer courses in Institutes of Technology and Polytechnics in New Zealand. In this study, the students' perceptions of their actual and preferred learning environments are investigated along with the gender differences. Quantitative data is collected using Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) from student volunteers of six institutions. Quantitative analysis of the data reveals that the students possess their own preferred environments, to the actually perceived ones and also reveal that there are no significant differences between the genders. Also, significant correlations exist among the responses to the questionnaire scales. The findings can be applied in teaching and learning tertiary computer courses in technology-rich learning environments. This study expects to benefit educators and future researchers who are interested in carrying out further research and attempts to contribute to the field of technology education in New Zealand.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]:

General Terms

Measurement, Human Factors.

Keywords

TROFLEI, technology-rich learning environments, perceptions, gender

1. INTRODUCTION

According to Berglund and Lister [1], "Teaching and learning in higher education are inextricably and elaborately linked. To teach is to make assumptions about what and how the student learns; therefore, to teach well implies learning about students' learning".

This study is extended from the previous researchers' reviews of technology-rich computer learning environments. The study is focused around teaching and learning of computer courses in Institutes of Technology (ITPs) and Polytechnics in New Zealand thus critiquing the pedagogical implications. The students in a cohort perceive their computer learning environments differently. This paper presents and analyses the students' perceptions of their computer learning environments. Furthermore, it explores the differences in the perceptions of their actual and preferred environments. The findings of this paper reveal aspects that are

noteworthy to educators which could help improve student outcomes.

ITPs and the polytechnics in New Zealand are considered to be comprised of technology-rich learning environments. Do the educators consider students' preferred learning environments over the students' perceived learning environments? Do they attempt to deliver the courses according to the students' preferences? It is questionable whether the ICT educators are considering the various aspects that impact students' learning in these environments when they teach in such environments.

Most of the students' learning time is spent in classrooms or computer laboratory learning environments. Past researchers have found that the classroom environments play a major role in students' learning approaches. Fraser [4, 5, 6] has stated that individual students perceive classroom environments differently thus affecting their academic achievement, resulting in a considerable amount of variance in the learning outcomes within a class. Also, research also has revealed that educators around the world generally pay more attention to student achievement and little attention to their learning environments [7].

The rapid advancement of technology has resulted in constantly changing technology-based learning environments [16]. Present day students favour learning by experience in technology-rich learning environments and prefer to be exposed to practical applications [14]. Zandvliet [17] established that the satisfaction of students' learning in technology-based learning environments depends on a combination of physical and psychological factors influenced by the use of technology in class rooms. Supporting this, Newby and Fisher [13] articulated that these factors affected student attitudes, satisfaction and achievements, which are applicable to students studying computer courses in computer laboratory environments.

Past researchers found that assessing learning environments were essential [5]. Research on learning environments began in the 1960s, initiated by Herbert Walberg and Rudolf Moos [10, 11, 12], and was later extended towards major research programs all over the world. Walberg developed the popular Learning Environment Inventory (LEI) for learning environment research and was widely used at that time (Walberg & Anderson, 1968, as cited in Fraser [6]). Furthermore, instruments for assessing elementary to tertiary education learning environments were developed [3]. This was followed by the development of instruments to suit different cultural backgrounds in Europe and Asia [8]. Subsequently, questionnaires were developed by researchers to incorporate students' actually perceived views and their individually preferred views of their learning environments. The findings revealed that, there is a significant variance between the outcomes of 'Actual' and 'Preferred' views [6]. Thus, Fraser

[6] articulates that the same classroom can be perceived differently by students of different genders, abilities and ethnic backgrounds.

2. BACKGROUND

This study involves six Institutes of Technology and Polytechnics across New Zealand. The learning environments of these institutions are considered technology-rich and outcomes focused.

The participants of this study are students in diploma and bachelor degree computer programmes in these institutions. The classes are comprised of students from diverse backgrounds, ethnicities and age groups. Furthermore, these classes consist of fewer females than males. Hence, the student cohort within one classroom shows diverse learning approaches, attitudes and expectations. It is also noted that there are obvious challenges faced by the educators in teaching in these learning environments besides advancing technology.

The quantitative method was used to collect and analyse data. Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI), which had been previously developed and validated in similar learning environments, was found suitable to the objectives of this study, thus chosen to collect data.

3. OBJECTIVES

The following objectives were introduced to fulfill the aim of this study.

1. To validate Technology Rich Outcomes Focused Learning Environment Instrument (TROFLEI)) in tertiary classrooms in New Zealand.
2. To establish the reliabilities of the TROFLEI in tertiary classrooms in New Zealand.
3. To investigate students' perceptions of their actual and preferred learning environments.
4. To investigate any significant differences that existed between the actual and preferred learning environments of students.
5. To investigate if there were any differences between the genders to the responses of the questionnaire.

4. RESEARCH DESIGN

"Quantitative research is an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity." (Newman 1997, as cited in Cavana et al.[2]).

The quantitative method was selected as the research design in this study. Standardized information from or about the subjects being studied was gathered using the quantitative research method. These subjects can be individuals, groups of individuals, organizations, and communities etc., which are referred to the 'population' or a 'sample' for the research purpose, and surveys are used to gather information about characteristics, actions, or opinions of a population in this method [15].

Various types of questionnaires developed for a particular research were used in the quantitative research method. These questionnaires were tested for reliability and validity in a particular study. Also they have to be tested in similar environments before they can be reused.

5. METHODOLOGY

5.1 Sample and data collection

Three hundred and twenty two volunteering students from levels 5, 6 and 7 studying computer courses in six ITPs and Polytechnics in New Zealand participated in this study (2011- 2012). There were 248 males, 49 Females and 25 students who didn't declare their gender who participated in the data collection. TROFLEI was administered to the students at agreed times during the semester. Ethical approvals were obtained from each participating institution to collect data. The data collection was administered by a lecturer or an administrator of the institution. A participant information sheet was provided to each volunteering student and the aims of the research were explained, prior to collecting the data.

The descriptive statistics of the sample is displayed in Table 1.

Table1. Descriptive statistics of the sample

Institution	Respondents						
	L5	L6	L7	Tot	M	F	U
1	64	46	40	150	104	27	19
2	13	0	0	13	11	2	0
3	0	11	9	20	17	2	1
4	28	17	14	59	52	7	0
5	23	13	23	59	44	10	5
6	0	16	5	21	20	1	0
Tot	128	103	91	322	248	49	25

M = Male, F= Female, U = Unknown

5.2 Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI)

TROFLEI is a widely-applicable instrument, which measures the impact on student learning environments on their learning outcomes, which is suitable for carrying out investigations in ICT-rich learning environment in higher level education. TROFLEI was developed by Aldridge and Fraser, and proven validity and reliability in similar educational environments.

TROFLEI consists of 80 items. All the items were written to have positive scorings and contained no negative items. The items belonged to ten scales and each item contained an 'Actual' and a 'Preferred' column. The student's view of how often each practice actually takes place in the classroom is described by the 'Actual' column while, the student's view of how often the student would like each practice to take place in a classroom is described by the 'Preferred' column. Items are responded to, on a five point scale; Almost Never, Seldom, Sometimes, Often, and Almost Always. The responses to items scored 1, 2, 3, 4 and 5 respectively on a scale of 5.

Table 2 displays the descriptive information of the TROFLEI.

Table 2. Descriptive Information of the TROFLEI scales

Scale	Description	Sample Item
Student Cohesiveness	The extent to which the student collaborates with the fellow students in the class.	I work well with other class members. (+)
Teacher Support	The extent to which the teacher supports the students individually.	The teacher takes a personal interest in me. (+)
Involvement	The extent to which the student's ideas are acknowledged.	My ideas and suggestions are used during classroom discussions. (+)
Task Orientation	The extent to which the student is oriented towards the tasks done in class.	I know what I am trying to accomplish in this class. (+)
Investigation	The extent to which the student is being investigative about class work	I solve problems by using information obtained from my own investigations. (+)
Cooperation	The extent to which the students co-corporate with other students to do different tasks	I cooperate with other students on class activities. (+)
Equity	The extent to which the student is treated equally as the other students	I receive the same encouragement from the teacher as other students do.
Differentiation	If the student is given different tasks according to ability	I do work that is different from other students' work.
Computer Usage	The different tasks the student uses the computer on	I use the computer to find out information about the course.
Young Adult Ethos	The extent of independence given to the student towards own learning	I am encouraged to take control of my own learning.

6. RESULTS AND DISCUSSION

6.1 Data Entry and Analysis

Data collected using the questionnaire were entered into SPSS statistical software and analysed using the appropriate statistical tests.

6.2 Internal Consistency (Alpha Reliability) for the TROFLEI scales

The internal consistency of the actual and preferred scales of TROFLEI was tested using Cronbach's Alpha reliability test, on the student responses to both the actual and preferred scales. Cronbach's Alpha values between 0.73 and 0.94 were yielded, proving satisfactory internal consistency for both the actual and the preferred scales of TROFLEI. This indicates that the instrument is appropriate for use in the New Zealand tertiary environment.

The results of the reliability tests are displayed in Table 3.

Table 3. Alpha Reliability (Internal consistency) for Actual and Preferred scales of the TROFLEI

Scale	No of items	Version	Alpha Reliability
Student Cohesiveness	8	Actual	0.85
		Preferred	0.87
Teacher Support	8	Actual	0.88
		Preferred	0.90
Involvement	8	Actual	0.89
		Preferred	0.92
Task Orientation	8	Actual	0.89
		Preferred	0.87
Investigation	8	Actual	0.90
		Preferred	0.93
Cooperation	8	Actual	0.89
		Preferred	0.81
Equity	8	Actual	0.93
		Preferred	0.94
Differentiation	8	Actual	0.73
		Preferred	0.81
Computer Usage	8	Actual	0.81
		Preferred	0.86
Young Adult Ethos	8	Actual	0.88
		Preferred	0.91

6.3 Validity of the TROFLEI

The discriminant validity and the mean correlations tests are performed on the 'Actual' scales of the TROFLEI in order to test the validity of the instrument. The results show reasonably high mean scores, which prove that the TROFLEI for use in the New Zealand environment under this study.

The results of the reliability tests are displayed in Table 4.

	A-Student Cohesiveness	A-Teacher support	A-Involvement	A-Task Orientation	A-Investigation	A-Cooperation	A-Equity	A-Differentiation	A-Computer Usage	Mean Correlation
A-Student Cohesiveness										0.34
A-Teacher support	.31**									0.34
A-Involvement	.47**	.50**								0.46
A-Task Orientation	.38**	.36**	.56**							0.44
A-Investigation	.25**	.32**	.62**	.54**						0.38
A-Cooperation	.57**	.33**	.46**	.55**	.38**					0.42
A-Equity	.24**	.46**	.43**	.53**	.37**	.44**				0.39
A-Differentiation	.21**	.20**	.43	.28**	.38**	.31**	.23**			0.28
A-Computer Usage	.30**	.30**	.40**	.42**	.35**	.40**	.34**	.41*		0.36
A-Young adult Ethos	.34**	.31**	.29**	.42**	.23**	.37**	.49**	.12*	.40**	0.33

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level
N = 322

6.4 Interpretation of the correlations among TROFLEI scales (Actual)

Table 4 displays that the variances in correlations for all the scales of TROFLEI range from 0.12 to 0.62 indicating that the scales of TRFLEI instrument measure distinct elements in this study.

The highest mean correlations are shown in A-Involvement (0.46), A-Task-Orientation (0.44) and A-Corporation (0.42), indicating that the above three scales have a noteworthy impact on the rest of the TROFLEI scales. The lowest mean correlation is shown in A-Differentiation (0.28) revealing that this scale has the least impact on the rest of the TROFLEI scales.

6.5 Correlations of TROFLEI scales

Table 5 displays correlations of the TROFLEI scales. The results reveal that, all the scales of the TROFLEI had significant inter-correlations.

Table 5. Correlations of TROFLEI scales (actual) and interpretations

Scale (Actual)	Correlations	Interpretation
A-Corporation/A-Task-Orientation	0.55**	a)
A-Corporation/A-Student Cohesiveness	0.57**	
A-Equity/A-Task-Orientation	0.53**	b)
A-Equity/A-Teacher Support	0.46**	
A-Equity/ A-Young Adult Ethos	0.49**	
A-Involvement/A-Student Cohesiveness	0.47**	c)
A-Involvement/A-Teacher Support	0.50**	
A-Involvement/ A-Task-Orientation	0.56**	
A-Involvement/A-Investigation	0.62**	
A-Young Adult Ethos/ A-Differentiation	0.12** (lowest)	d)

N= 322

6.6 Interpretations of the correlations of the scales displayed in Table 5

a) A-Corporation, A-task Orientation, A-Student Cohesiveness:

The value of the correlations of these scales can be interpreted as that discussions and collaborations with peers are influenced when the students corporate and collaborate adequately with each other and the tutor. This improves student-cohesiveness and task-orientation.

b) A-Equity, A-task Orientation, A-Teacher Support, A-Young Adult Ethos:

The value of the correlations of these scales can be interpreted as that the teachers are extending fair support which facilitates negotiations of the students' abilities. Also, the students feel that they are treated equally within the classroom. They also believe that they get equal opportunities to express their views and to participate in class discussions. The students feel that the support of the teacher is essential towards getting their tasks done. The students have an affirmative sense towards equity according to the correlation results. Equity is considered imperative to the students as young adults, to gain autonomous learning.

c) A-Involvement, A-Student Cohesiveness, A-Task-Orientation, A-Investigation:

The results in table 5 for the above scales indicate that the students demonstrate cohesiveness in doing the tasks related to their lessons that improved involvement with peer students. This helps the students to acquire new knowledge.

Teacher support is perceived important to influence in involvement in student group activities that help them share knowledge among the peer students. This improves students'

individual investigations and brings about additional knowledge. Also, teacher support is observed important to students towards achieving their goals and the outcomes.

d) A-Young Adult Ethos, A-Differentiation

The students who are subjected to the learning environments under this study differ in age substantially. Their ages can vary from 18 to 40 years and they are supposed to be engaged in collaborative learning. However, student responses reveal that they expect further recognition as young adults who brought prior knowledge to these learning environments. They also preferred to be given different tasks according to their abilities.

Table 6. Descriptive statistics for Actual and Preferred Learning Environments of the TROFLEI

Scale	Version	Mean	Standard Deviation	t-value	*p* value
Student Cohesiveness	A	3.75	0.68	-10.542	0.000
	P	4.07	0.70		
Teacher Support	A	3.43	0.75	-11.080	0.000
	P	3.85	0.78		
Involvement	A	3.15	0.75	-10.934	0.000
	P	3.56	0.83		
Task Orientation	A	4.00	0.73	-13.209	0.000
	P	4.46	0.80		
Investigation	A	3.24	0.86	-13.204	0.000
	P	3.78	0.93		
Cooperation	A	3.74	0.76	-8.705	0.000
	P	4.06	0.86		
Equity	A	4.00	0.81	-6.670	0.000
	P	4.22	0.83		
Differentiation	A	3.06	0.67	-8.462	0.000
	P	3.35	0.82		
Computer Usage	A	3.94	0.71	-5.437	0.000
	P	4.12	0.76		
Young Adult Ethos	A	4.15	0.73	-4.121	0.000
	P	4.27	0.85		

A = Actual,   P = Preferred

6.7 Differences in actual and preferred scales of the TROFLEI

Table 6 and Figure 1 display the descriptive statistics of the actual and the preferred scales of the student responses to the TROFLEI scales. The results indicate any existing differences among the responses towards the two versions.

6.7.1 t-values

The means of each of the actual and preferred responses of the TROFLEI are further compared using the independent samples t-test which explores the differences in their mean values. The results demonstrate negative t-values for all actual and preferred scales (see Table 6), indicating that the students always have their preferred learning environment as opposed to their actually perceived environment for all the TROFLEI scales.

High negative t-values yielded in the responses to Student Cohesiveness, Teacher Support, Involvement, Task Orientation and Investigation indicates that the student responses towards the actual and preferred scales vary significantly.

Differentiation and Corporation show moderately negative t-values indicating that the students sought their preferred learning environments to a reasonable degree, in these scales.

The lowest negative differences of the *t*-values are displayed in Equity, Computer Usage and Young Adult Ethos. These values reveal that the students are somewhat satisfied with their actually perceived learning environments around these scales.

6.7.2 Standard deviations

The standard deviations for the actual and the preferred versions of the TROFLEI scales indicate that there is a considerable variation in the responses to all the scales. These results indicate that the individual students have their own perceptions of their actual and preferred learning environments. There is a noteworthy variation of this factor among individual students.

Low standard deviation values indicate that the data responses lean towards the mean. High standard deviation values indicate that the data responses are spread out over a large range of values (see Table 6).

The standard deviations for the preferred columns are higher than that of the actual columns. These prove that the students have their own preferred learning environments to the currently perceived actual environments in all the scales.

6.7.3 Mean values

Mean values of Table 6 reveal that significant differences exist between the responses to all the actual and the preferred scales of TROFLEI. The overall mean values for the preferred columns show higher values than the actual column in all the scales (see Figure 1). These indicate that the students always prefer more favourable learning environments than their currently perceived ones.
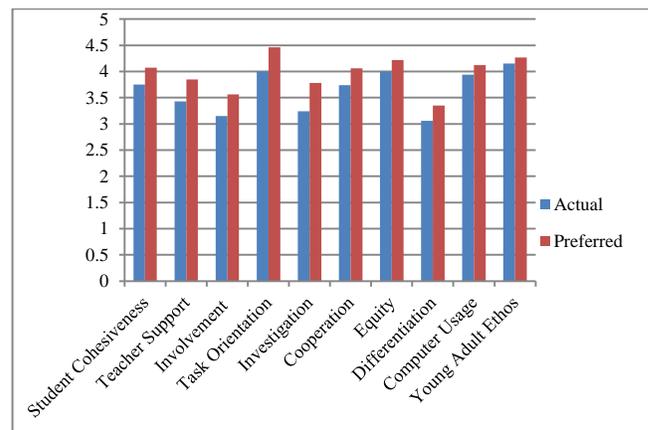

Figure 1. Mean values for Actual & Preferred learning environments of the sample

6.7.4 Gender differences for the questionnaire scale responses

No major differences in the responses are found between the males and females to the scales of the two questionnaires revealing that over all there were no significant differences between males and females, in the way they perceived their technology-rich leaning environments (see Table 7).

However, Table 7 indicates that, in Computer Usage (M = 3.90, F = 4.12) and Task Orientation (M = 3.98, F = 4.11), females scored higher means than the males. These values indicate that the female students prefer to be involved in course related computer tasks such as doing assignments, online communication with peers and the teacher and to find further information online more

than the male students. Also, the results reveal that the awareness of the female students about the importance of their classes, goal setting, be attentive during their lessons the class and getting their work done on time, were noteworthy compared to male students.

Usefulness of Computers, Enjoyment, A-Equity and A-Young Adult Ethos display high mean scores all above 4.0 for both genders. These values indicate that there are no differences between the genders of their perceptions to these scale (see Table 7).

Table 7. Means and Standard Deviations for gender differences

Scale	Gender	N	Mean	Std Deviation
Usefulness of Course	M	233	3.62	0.58
	F	53	3.52	0.49
Anxiety	M	233	3.99	0.96
	F	53	3.83	1.01
Usefulness of Computers	M	233	4.12	0.56
	F	53	4.12	0.54
Enjoyment	M	233	4.12	0.62
	F	53	4.12	0.60
A- Student Cohesiveness	M	242	3.76	0.67
	F	55	3.67	0.73
A- Teacher Support	M	242	3.42	0.73
	F	55	3.44	0.86
A- Involvement	M	240	3.16	0.72
	F	55	3.03	0.91
A-Task Orientation	M	240	3.98	0.73
	F	55	4.11	0.77
A- Investigation	M	239	3.21	0.88
	F	55	3.24	0.83
A-Cooperation	M	241	3.72	0.78
	F	55	3.80	0.72
A-Equity	M	239	4.00	0.83
	F	55	4.02	0.77
A- Differentiation	M	223	3.07	0.68
	F	54	3.02	0.66
A-Computer Usage	M	239	3.90	0.72
	F	55	4.12	0.62
A-Young Adult Ethos	M	236	4.14	0.72
	F	55	4.12	0.62

7. CONCLUSIONS

This paper has identified the areas that are noteworthy with regards to student perceptions of their Technology-Rich Outcomes-Focused Computer Learning Environments in Institutes of technology and Polytechnics in New Zealand. It also has identified the students' perceptions of their actual and preferred learning environments. Consequently the findings revealed that the students always had their preferred learning environment as opposed to the actually perceived environments. Furthermore, this paper has identified differences in the genders displayed towards certain scales in their perceptions of these learning environments. However, findings of most scales showed no significant differences between the genders.

Whilst this paper has identified the student perceptions in technology-rich, outcomes-focused learning environments, it has not covered ways to address these challenges faced by educators teaching in these environments. However, the findings of this paper would facilitate identifying the challenges faced by the educators when teaching in such learning environments.

The paper does not attempt to propose a possible teaching framework to suit these learning environments in response to students' perceptions of their learning environments. Also, implications for teaching, and issues concerning implementations were not covered in this study and are left for future research.

8. ACKNOWLEDGMENTS\

9. REFERENCES

1   Berglund, *A*. and Lister, R. 2007. How do students understand computer network protocols? In *proceedings of the 20th National Advisory Committee on Computing Qualifications conference* (Wellington, New Zealand, 2007).

2   Cavana, R.Y., Delhaye, B.L. and Sekaran, U. 2000. *Applied Business Research: Qualitative and quantitative methods*, John Wiley and Sons, New York.

3   Clarke, J. A. 1994. *Tertiary students' perceptions of important events that occur in their learning environment*. ERIC Document Reproduction Service No. ED369749, Queensland University of Technology, Queensland.

4   Fraser, B. J. 1994. Research on classroom and school climate. *Handbook of research on science teaching and learning,* D. Gabel, Ed. MacMillan, New York, 493-541.

5   Fraser, B. J. 1998. Science learning environments: Assessment, effects and determinants. In *International Handbook of Science Education,* B. J. Fraser and K. G. Tobin Eds. Kulwer Academic Publisher, Dordrecht, 527-564.

6   Fraser, B. J. 1998. Classroom environment instruments: Development, validity and applications. *Learning Environment Research: An International Journal,* 1, 7-33.

7   Fraser, B. J. 2001. Twenty thousand hours. *Learning Environment Research: An International Journal*, 4.

8   Fraser, B. J. 2002. Learning environments research: yesterday, today and tomorrow. In *Studies in educational learning environments: An international perspective,* 1-25.

9   Maor, D. and Fraser, B. J. 1996. Use of classroom environment perceptions in evaluating inquiry-based computer assisted learning. *Journal of a study of learning environments, 18*, 401-421.

10 Moos, R. H. 1974. Systems for the assessment and classification of human environments: An overview. In *Issues in Social Ecology: Human Milieus*, R. H. Moos and P. M. Insel Eds. Consulting Psychologists Press*,* Palo Alto, California, 5-28.

11 Moos, R. H. 1974. *The social climate scales: An overview*. Consulting Psychologists Press. Palo Alto, California.

12 Moos, R. H. 1979. *Evaluating educational environments: Procedures, measures, findings and policy implications.* Jossey Bass, San Francisco.

13 Newby, M. and Fisher, D. L. 1997. An instrument for assessing the learning environment of a computer laboratory. *Journal of Educational Computing Research*, 16, 179-190.

14 Newby, M. 2003. Computer laboratory environments: Providing a suitable practical learning experience. In *Technology-rich learning environment: A future perspective,* M. S. Khine and D. Fisher Eds. World Scientific Publishing, Singapore, 187-207.

15 Pinsonneault, A. K. and Kenneth, L. 1993. Survey research methodology in management information systems: an assessment. *Journal of Management Information Systems,* 10, 2, 75.

16 Rickards, T. 2003. Technology-rich learning environments and the role of effective teaching. In *Contemporary approaches to research on learning environments: World views,* D. Fisher and M. S. Khine Eds. World Scientific Publishing, Singapore, 115-132.

17 Zandvliet, D. 2003. Learning environments in new contexts: Web-capable classrooms in Canada. In *Technology rich learning environment: A future perspective,* M. S. Khine and D. Fisher Eds. World Scientific Publishing, Singapore, 133-156.