

The Internet in B.C. Classrooms: Learning Environments in New Contexts

Special Issue: Leadership and Technology in Schools



Guest Editors:

Michele Jacobsen, University of Calgary

and

William J. Hunter, University of Ontario Institute of Technology

The Internet in B.C. Classrooms: Learning Environments in New Contexts

David B. Zandvliet and Laura Buker

dbz@sfu.ca

Simon Fraser University

Abstract

This article reports on a study of classroom environments in emerging Internet classrooms in British Columbia, Canada. The study involved an evaluation of the physical and psychosocial learning environments in these settings through a combination of case studies and questionnaires. This work focuses on the results obtained from the administration of a student questionnaire designed to measure aspects of the psychosocial learning environment in these settings and to relate these factors to students' satisfaction with learning and to other physical aspects of the learning environment. Versions of the What Is Happening in This Classroom (WIHIC) instrument and Computerized Classroom Environment Checklist (CCEC) were administered to 358 high school students in 22 classrooms from six schools around the province. Analysis of classroom environment data revealed that student autonomy/independence and task orientation are associated

with students' satisfaction with learning. Relating data to physical measures such as the workspace and visual environments demonstrated significant associations between the physical and psychosocial learning environment in technology-rich classrooms. Further qualitative data suggest that factors related to teaching styles, classroom design, and the learning environment interact to influence students' satisfaction with learning.

Background to the Study

This study describes the overall physical and the psychosocial learning environment associated with classrooms using new technologies. Importantly, it also attempts to explore the degree to which physical and psychosocial factors interact to either facilitate or constrain students' satisfaction with their learning similar to a productivity model such as that proposed by Walberg, Fraser, and Welch (1986). Physical and psychosocial factors should be considered in the context of whether or not they enable current ideas about teaching and learning. Factors that work to constrain these methodologies should be seen as unproductive, whereas factors that may facilitate or enable them should be viewed as desirable and productive. Most importantly, the study provides a broad and descriptive look into the emerging Internet classroom and gives some recommendations concerning what may or may not be working for B.C.'s classroom teachers.

Learning and Teaching with Information and Communication Technology

Considering the relationship between technology and instruction is an important way to begin talking about classroom teaching. Collaborative technologies have often been explored as catalysts for changing teacher practices, and introducing a variety of network-based tools can be an effective means of helping teachers develop a more student-directed, constructivist-learning environment. Further, student mentors can form an effective technical support group for teachers involved with implementing new technologies (Resta, 1998). Success with collaborative technologies requires extensive training and professional development, on-site support, easy access to technology, and strong school administrative support (Rice & Wilson, 1999; Shaw 1998). In the U.S., the delivery of the Internet to schools has become a national priority. As the U.S. Department of Education aims to meet the technology literacy challenge, computers have been described as "the new basic" of education, and the Internet as "the blackboard of the future" (U.S. Congress, Office of Technology Assessment, 1995, p. 3).

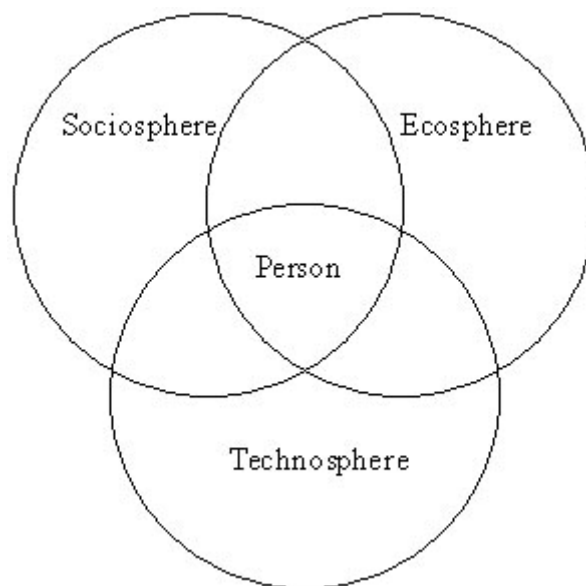
Learning Environments and ICT

Although the introduction of ICT into schools in the form of infrastructure, professional development, and new curricula is important in implementing ICT in our schools, it is also important to continue research in this area in order to determine what are the tangible results of this investment in a new (and relatively unproved) educational resource. One promising methodology, which can be used to investigate both the effects and affects of the integration of ICT into school classrooms, is found in an area of the literature described as the study of "learning environments" (Fraser, 1994; 1998a; 1998b). Studies describing psychosocial learning environments have demonstrated much about the factors that may influence or determine learning in computerized classrooms (Chionh & Fraser, 1998; Khoo & Fraser, 1997, Maor and Fraser, 1996; Teh and Fraser, 1995), and educators are adding their findings to the body of

research within the fields of psychology, sociology, physiology, architecture, and engineering (Knirk, 1992). In part, the interdisciplinary nature of learning environment research points to the diversity of factors involved. These include many psychosocial factors, including student perceptions of independence, cohesion, motivation, and so on, but can be expanded to include a variety of physical or material factors, such as classroom dimensions, classroom densities, and lighting.

Gardiner (1989) describes a general framework for thinking about the pressures that may be driving change in our altogether human, though technological, environments. Gardiner's model consists of three overlapping spheres of influence that he describes as the *ecosphere*, the *sociosphere*, and the *technosphere*. The ecosphere relates simply to a person's physical environment and surroundings, whereas the sociosphere relates to an individual's net interactions with all other people within that environment. Finally, the technosphere is described as the total of all the person-made things (present and future) in the world. The model is presented in Figure 1.

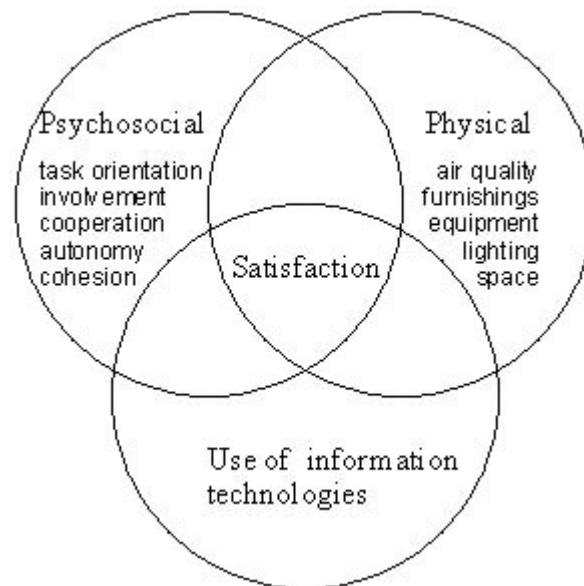
Figure 1. A conceptual model for studying systematic change



Gardiner described the individual person located in the centre of the model as the most complicated component in the system. Located at the intersection of these three spheres, people are subjected to all three influences. As in previous studies in technological settings (e.g., Zandvliet & Fraser, 1998), we use a conceptual model adapted from this model to conceptualize

learning environments and the methodologies used in describing them. The factors described below relate to Gardiner's original conception of the joint influence of the sociosphere, ecosphere, and technosphere on individuals. We conceive of these, respectively, as the psychosocial and physical learning environments, and teachers' pedagogical intent when using new information and communications technology (ICT).

Figure 2. Conceptual model of potential factors influencing student satisfaction



Note. Figure adapted from Gardiner (1989).

The conceptual model developed here considers what are potentially the most important factors as they relate to technology use in schools. The model was used to organize several important aspects of the study, including directing the theoretical framework, aiding in the selection and development of appropriate research methodologies and, finally, providing an organizer for categorizing and presenting results. Importantly, our study uses this model to begin a holistic evaluation of the educational use of new information technology.

Methodology

The type of classroom identified for the purposes of this study can be described as the "technologically rich" classroom, identified as having a number of networked computers installed, with the general availability of Internet resources for students and their substantial use in the delivery of curriculum. For each classroom, a general profile of the learning environment was constructed by evaluating a number of selected psychosocial and physical factors and then validating the results by intensely investigating a subset of the original sample. A number of

different methodologies were used to accomplish this: first, the use of questionnaires and ergonomic inventories/checklists to be completed for a wide number of technological classrooms; and second, the use of semi-structured interviews conducted with selected teachers working in these settings. Student satisfaction is seen as the major dependent variable for the study, as it has been shown to be a good predictor of learning in school settings (Zandvliet & Fraser, 1998) and in addition has been shown to be an important predictor of productivity in commercial settings (see Grandjean, 1988; Kroemer & Grandjean, 1997).

The psychosocial measures in the study were obtained by administering five scales selected and adapted from the What Is Happening in This Classroom (WIHIC) learning environment instrument (Fraser, Fisher, & McRobbie, 1996), which has been shown to have high reliability and validity in educational settings. Specifically, the scales measuring cohesiveness, involvement, autonomy, task orientation, and cooperation were selected for this study, as they are viewed as consistent with the goals of current reform efforts aimed at individualizing curriculum and instruction and increasing student interactions. These constructs are also consistent with variables considered important by ergonomists. The “actual” form of the questionnaire was administered in each setting to students, and they were asked to reflect on their perceptions of the classroom environment as they experienced it. The unit of analysis for the questionnaire measure was the individual classroom. As an additional (though conceptually different) measure, the questionnaire also included the items by which students provide their rating of satisfaction with learning in that particular environment—this scale was adapted from the “Satisfaction with learning” scale from the Test of Science Related Attitudes (Fraser, 1981).

The study also investigated a selection of physical environmental factors through the use of a general ergonomic evaluation and a related questionnaire developed specifically for this purpose. The inventory employs a hierarchical rating scale (scored out of five) that allowed the researcher to objectively determine a classroom's “degree of fit” within currently published ergonomic standards. It includes a variety of general physical variables discretely measured or noted by the researcher, and then grouped into the overall physical domains of workspace, computer, visual, and spatial environments, and a rating of overall air quality. In order to ensure consistency, the inventory was completed by the same observer in each setting and, as with the questionnaires, the unit of analysis was the classroom. In addition to this, a related computerized learning environment checklist (CCEC) was administered to students in order to investigate the student perceptions of these same physical factors operating in the classrooms studied. The checklists included statements related to student perceptions of the comfort levels of the physical environment, including furniture and seating, computer equipment, lighting, spatial floor plans, and air quality. Together, the evaluations and questionnaires give a rich description of the physical characteristics of the various learning spaces and configurations observed, and is the method is consistent with techniques we have used to study physical learning environments in other jurisdictions (see Straker, Harris, & Zandvliet, 2000; Zandvliet, 2002; Zandvliet and Straker, 2001).

Following the initial quantitative portion of the study, a number of teachers asked to participate in a series of semi-structured interviews as part of the case study method for each school location. These interviews were conducted immediately following the lab evaluations described in the previous section. Teachers were invited to respond individually or in small focus groups to

a series of open-ended interview questions that corresponded roughly to the learning environment factors (both physical and psychosocial) that were investigated by the initial questionnaire. The time allotted for each interview session was approximately one hour. The interviews were tape recorded and then later transcribed for analysis. The primary purpose of these open-ended questions was, first, to obtain data about classroom practices and clarification as to the nature of students' technology-based assignments in each classroom. Second, it was intended that interview data would be used to triangulate results from the initial survey portion of the study with these qualitative data, providing a richer, more humanistic description of the classroom routine and learning environment. The teacher interviews also provided a great deal of anecdotal information that helped describe each classroom setting for the purposes of the case study descriptions.

Results and Discussion

The "What Is Happening in This Classroom" (WIHIC) questionnaire was selected for use in this study because it had already proved to be a reliable and valid instrument in an earlier study conducted in Australian and B.C. classrooms (Zandvliet & Fraser, 1998). Questionnaires were distributed in class sets to teachers who were working in computerized settings. The resulting sample consisted of a total of 358 high school students grouped in 22 classes from six schools located around the province. Individual scores for each scale were obtained by averaging the responses to the items in each. Mean scores for each class were then calculated using individual scale scores and aggregating the data by class. This analysis yielded a number of descriptive statistics for the psychosocial learning environment in the studied classes. Similarly, the class means on the student Satisfaction scale were calculated. These data are presented as Table 1 and Figure 3.

Table 1. Descriptive Statistics for Learning Environment Scales (WIHIC) and Student Satisfaction (TOSRA) for Student Responses

Questionnaire and Scale	Mean Score	Standard Deviation	Minimum Score	Maximum Score
<i>WIHIC</i>				
Student Cohesiveness	3.47	0.63	1.4	5.0
Involvement	3.20	0.67	1.1	5.0
Autonomy/Independence	2.63	0.72	1.0	4.7
Cooperation	3.68	0.65	1.6	5.0
Task Orientation	3.37	0.72	1.2	5.0
<i>TOSRA</i>				
Satisfaction	3.24	0.77	1.3	4.5

Note. *N* = 22 classes.

Figure 3.



Interpretation of the student questionnaire data yielded one perspective on the learning environment in networked classrooms. Although there was considerable variability in the scores, overall, students perceived most aspects of their learning environments to be positive and characterized them as higher in Student Cohesiveness and Task Orientation than in other scales. The scale measuring Autonomy/Independence scored lowest (less than three) of the five learning environment scales. Finally, students rated their level of Satisfaction with learning in these environments as generally positive. Statistical analysis of the data suggested independent associations between Satisfaction and each of the psychosocial scales of Autonomy/Independence and Task Orientation when the influence of other factors was controlled. Of these associations, Task Orientation had the strongest individual association with student Satisfaction. These data are presented below in Table 2.

Table 2. Associations between Five WIHIC Scales and Student Satisfaction in Terms of Simple Correlations (r) and Standardized Regression Coefficients (β)

WIHIC Scale	r	β
Student Cohesion	0.314*	0.115
Involvement	0.271*	0.003
Autonomy/Independence	0.341*	0.255*
Task Orientation	0.455*	0.396*
Cooperation	0.276*	0.089
Multiple Correlation (R)		0.528*

Note. $N = 22$ classes. * $p < .01$.

The Computerised Classroom Environment Checklist (CCEC) was administered to students at the same time as the WIHIC. Although there was also considerable variability in the ratings for the former, these data show that students generally rated the computing environment as very positive (mean score of 4.32 on a scale of 5), whereas other factors in the learning environment such as the visual environment (quality of lighting) and air quality were rated poorly (mean scores of 2.91 and 2.53, respectively). The spatial environment (quality of the space) was also rated marginally (3.08 on a scale of 5). In addition to the questionnaire data, ergonomic evaluations were conducted by the researchers in 13 different settings as part of the overall case study methodology. These evaluations consisted of actual measurements and ratings taken on location, including an examination of the workspace, computer, visual, and spatial environments as well as an estimate of air quality at each location. Similar to the questionnaires, these data show considerable variability in the physical learning environment from location to location. In particular, the workspace environment (quality and adjustability of furnishings) was the most problematic (these data are presented as Table 3 and Figure 3).

Table 3. Descriptive Statistics for Physical Factors (CCEC) According to Student Responses on Questionnaire

Questionnaire and Scale	Mean Score	Standard Deviation	Maximum Score	Minimum Score
Workspace Environment	3.78	1.18	5.0	0.0
Computer Environment	4.32	0.88	5.0	0.0
Visual Environment	2.91	1.06	5.0	0.0
Spatial Environment	3.08	0.93	5.0	0.0
Air Quality Rating	2.53	0.94	5.0	0.0

Note. $N = 22$ classes.

Figure 4

Overall, the evaluations of the ergonomics or physical environmental factors in the classrooms studied showed a number of problematic issues for students. Although they generally rated the quality of the computer resources as positive, students perceived deficiencies in the visual environment of their classrooms, which indicated that there might be issues with inadequate lighting or perhaps reflective glare when they are working with the computers. In addition, they perceived problems with the air quality in these classrooms, suggesting perhaps problems with inadequate ventilation. These findings would indicate similar issues that have arisen in earlier studies and have demonstrated that few resources are directed towards creating a positive and safe learning environment in computerized classrooms, as the bulk of resources are allocated for the purchase of computer hardware and software (see Zandvliet, 2001). Although no statistical links were found between students' satisfaction and the measured perceptions of students on the physical factors described in the questionnaire, a tentative link ($r = .6355, p < .001$) was identified between the psychosocial measure of task orientation and the physical factor of spatial environment. An earlier study linked positive psychosocial learning environments with the provision of positive physical spaces (Zandvliet & Fraser, 1998). In this, the provision of a

positive physical environment becomes an educational issue. Students preoccupied with negative aspects of their surroundings can become distracted from their main task: learning.

Case Study Data

Teacher comments provided further qualitative details describing the unique contextual elements of the individual learning environments investigated through this study. These were summarized as case studies to describe in detail each of the studied locations. The case study data described a great deal about the context of these emerging computer networked classrooms. First, it described a range of ways in which these settings were being used by teachers across a range of subject disciplines. Second, it highlighted variations and potential deficiencies found in these environments (in both the physical and psychosocial senses). Interviews with teachers also indicated that the Internet medium is being used largely to assist with projects, research, and individualized assignments. Also, teachers largely felt positively about their learning environments, but expressed a number of concerns about physical factors such as room layout, workstation height, and the temperature and air quality in these settings. A more complete and detailed description of this case study research is reported elsewhere (Zandvliet, in press).

Conclusions

Educational institutions are continuing to implement a wide range of instructional technologies in the classroom. With the advent of Internet technologies, the pace of this technological change has become quickened and its implementation has become more costly. Meanwhile, societal pressures to implement these technologies have continued to increase. In considering the new technological classroom, this study makes a case for the closer integration of information technology, curriculum, and instruction and the design of suitable physical learning spaces. In future, all educators will need to be more involved in both the design and implementation of new technologies, the devising of new curricula and teaching methods and, finally, the physical design of schools and of classrooms themselves.

This study describes the learning environment in computerized classrooms as being a complex system in which many competing and interrelated physical, psychosocial, and contextual factors are at work that need to be fully considered in shaping good instruction. Although many aspects of the computerized and networked classrooms in this study were evaluated as being positive, many physical factors, such as workspace environments, lighting levels, and air quality, showed marked deficiencies, and students also perceived their degree of autonomy and independence as being less than ideal. All of this points to the fact that educational implementations of IT can and should be improved. This may involve diverting some of the resources currently allocated for equipment purchase towards other neglected areas.

Most importantly, if the considerable potential of the new ICT is finally to be realized, coherent guidelines must be developed to ensure the technology's effectiveness as a learning tool. This study would suggest that, minimally, such guidelines would include consideration of physical and psychosocial factors (with their potential ability to influence outcomes) and give concrete suggestions for the suitable installation and configuration of this equipment in classroom environments. Optimally, plans for the implementation of ICT in schools would also include a

detailed consideration of the professional development needs of teachers, in response to the new duties and responsibilities expected of them as they continue to shape the physical and psychosocial environments within the changing context of our increasingly technological classrooms.

References

Chionh, Y.H., & Fraser, B.J. (1998, April). *Validation of the "What Is Happening in This Class" questionnaire*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego.

Fraser, B.J. (1981). *Test of science related attitudes*. Melbourne: Australian Council for Educational Research.

Fraser, B.J. (1994). Research on classroom and school climate. In D. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 527–564). New York: Macmillan.

Fraser, B.J. (1998a). Science learning environments: Assessments, effects, and determinants. In B.J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 1–61). London: Kluwer.

Fraser, B.J. (1998b). Classroom environment instruments: Developments, validity and applications. *Learning Environment Research: An International Journal*, 1, 7–33.

Fraser, B.J., Giddings, G.J., & McRobbie, C.J. (1995). Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environments. *Journal of Research in Science Teaching*, 32, 399–422.

Gardiner, W.L. (1989). Forecasting, planning, and the future of the information society. In P. Goumain (Ed.), *High technology workplaces: Integrating technology, management, and design for productive work environments* (pp. 27–39). New York: Van Nostrand Reinhold.

Grandjean, E. (1988). *Ergonomics in computerized offices*. London: Taylor & Francis.

Khoo, H.S., & Fraser, B.J. (1997, April). *The learning environments associated with computer application courses for adults in Singapore*. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Knirk, F. (1992). Facility requirements for integrated learning systems. *Educational Technology*, 32(9), 26–32.

Kroemer, K., & Grandjean, E. (1997). *Fitting the task to the human: A textbook of occupational ergonomics* (5th. ed.). London: Taylor & Francis.

Maor, D., & Fraser, B.J. (1996). Use of classroom environment perceptions in evaluating inquiry-based computer assisted learning. *International Journal of Science Education*, 18, 401–421.

National Center for Education Statistics (2000, September). *Teacher's tools for the 21st century: A report on teachers' use of technology*. Washington, DC: U.S. Department of Education.

Resta, P. (1998). *Collaborative technologies as a catalyst for changing teacher practices*. Washington, DC: U.S. Department of Education.

Rice, M., & Wilson, E. (1999). How technology aids constructivism in the social studies classroom. *Social Studies*, 90, 28–34.

Shaw, D. (1998). *Report to the President on the use of technology to strengthen K-12 education in the United States: Findings related to research and evaluation*. Washington, DC: Panel on Educational Technology.

Straker, L., Harris, C., & Zandvliet, D. (2000, August). *Scarring a generation of school children through poor introduction of IT in schools*. Paper presented at the triennial meeting of the International Ergonomics Association, San Diego, California.

Teh, G., & Fraser, B.J. (1995). Development and validation of an instrument for assessing the psychosocial environment of computer-assisted learning classrooms. *Journal of Educational Computing Research*, 12, 177–193.

U.S. Congress, Office of Technology Assessment. (1995). *Teachers & technology: Making the connection*. ED386155. Washington, DC: U.S. Government Printing Office.

Walberg, H.J., Fraser, B.J., & Welch, W.W. (1986). A test of a model of educational productivity among senior high school students. *Journal of Educational Research*, 79, 133–139.

Zandvliet, D.B. (2002, August). Learning environments in technology-rich classrooms. In G.S Chiew & M.S. Khine (Eds.), *Studies in educational learning environments: An international perspective* (pp. 49-72). Singapore: World Scientific.

Zandvliet, D.B., & Fraser, B.J. (1998, April). *The physical and psychosocial environment associated with classrooms using new information technologies*. Paper presented at the annual meeting of the American Educational Research Association, San Diego.

Zandvliet, D.B., and Straker L. (2001). Physical and psychosocial ergonomic aspects of the learning environment in information technology rich classrooms. *Ergonomics*, 44, 838–857.

Zandvliet, D.B. (in press). Learning environments in new contexts: Internet capable classrooms in BC. In D.L. Fisher & M.S. Khine (Eds.), *Technology-rich learning environments: Learning environments of the future*. Singapore: World Scientific.

Author Notes

David B. Zandvliet is an Assistant Professor in the Faculty of Education and former Director of the Faculty's Centre for Educational Technology. His research interests lie in the areas of science, technology and environmental education with a focus on students perceptions of their learning environment as it is described in a range of educational settings. He has completed ecological studies of IT-rich learning environments in Australia, Canada and Malaysia.
Email: dbz@sfu.ca

Laura Buker is a Lab Instructor in the Centre for Educational Technology at Simon Fraser University , Faculty of Education. Her research interests are in the areas of First Nations education and integrating technology into teaching and learning resources. She works extensively with the Professional Development Program and with the First Nation Language Teacher program, the Developmental Standard Term Certificate.