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Assessing the Psycho-social Learning Environment of Technology-Supported Project Work Classrooms in a Singapore Secondary School

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ABSTRACT

This study sought to assess the technology-supported Project Work classroom learning environment for 68 Secondary Two (Express stream) students in a school. This Project Work classroom learning environment was unique as it adopted a blended approach – comprising of the regular classroom in which students worked in groups in a face-to-face setting, as well as an online technology-supported platform where students collaborated with overseas team mates on the project. In order to measure the students' perceptions of such a distinctive environment, a new learning environment questionnaire was developed. An attitude instrument was also developed to capture the students' attitudes towards Project Work. From the data collected, gaps in the learning environment were identified and the gender differences in the perceptions of the environment were also explored. The associations between the students' environmental perceptions and their attitudinal outcomes were investigated and the results revealed interesting outcomes. Group interviews were also conducted with small groups of students so as to gain insights into their learning experiences, approaches and problems faced in PW lessons.

Keywords: technology-supported Project Work classroom, learning environment, attitude

INTRODUCTION

Project Work (PW) forms an integral part of the primary, secondary and pre-university curriculum in Singapore education system. It provides students with opportunities to explore the inter-relationships and inter-connectedness of subject-specific knowledge (Jacobs, 1989). It serves to better equip students with creative and critical thinking skills, have their communication skills improved, their collaborative learning skills fostered, and their self-directed inquiry and life-long learning skills developed (Ministry of Education, 1999).

When PW was first introduced into the schools in 2000, most of the PW lessons took the form of a face-to-face setting. With the advancements of info-communication technologies in education,

some schools have begun to adopt the blended approach, where teachers and students collaborate with an external learning community using an online technology-supported project platform, in addition to the physical contact in classrooms. This study seeks to assess the PW classroom learning environment by using the students' perceptions about the blended approach PW classroom experienced by the students directly. Results obtained from such a study will provide useful information about the PW classroom learning environment to the teachers, school management, students and parents. Most importantly, such information will be beneficial for supervising teachers in the existing PW classrooms to reflect on their pedagogical knowledge, and develop effective strategies for more online collaborative projects among teachers as well as for students locally and overseas.

THEORETICAL BACKGROUND

The classroom is a critical milieu for students' cognitive and affective development. Research studies had shown evidence of the associations between students' perceptions of their learning environment and their outcomes, even when other variables such as student ability were controlled (Fraser, 1998; Haertel, Walberg & Haertel, 1981; Walberg & Anderson, 1968; Walberg, Fraser & Welch, 1986). In the last three decades, the field of learning environment research has made available a variety of research instruments. The original instruments were: the 'Learning Environment Inventory' (LEI) (Anderson & Walberg, 1968) and the 'Classroom Environment Scale' (CES) (Moos & Trickett, 1987). Over the years, these instruments were gradually refined to suit specific environments and these include Individualised Classroom Environment Questionnaires (ICEQ) for individualized open and inquiry-based education (Fraser, 1990), College and University Classroom Environment Inventory (CUCEI) for small-sized higher education classrooms (Khine & Goh, 2001), Science Laboratory Environment Inventory (SLEI) for science laboratory classes (Fraser, Giddings & McRobbie, 1995), and Constructivist Learning Environment Survey (CLES) for constructivist-oriented classrooms (Taylor, Fraser & White, 1994)

Learning environment studies began about 10 years ago in Singapore, with very few studies conducted on PW classroom learning environments. An example is a study conducted by Quek and Wong (2002) on 39 students and 1 teacher in an all-girls elementary school's Project Work

classroom using the My Class Inventory (MCI) (Fisher & Fraser, 1981) to assess if the classroom environment was conducive for student collaboration. A similar PW learning environment study was also conducted on a group of 270 students from seven secondary schools to measure their perceptions of their teacher-student interaction and whether their perceptions were related to their attitude towards PW learning (Quek & Wong, in press).

As technology advances in its capability, the teachers began to use information technology (IT) in teaching and learning. A study on the computer-supported PW classroom learning environment was conducted on 260 Secondary Two students and 26 teachers in seven co-educational secondary schools using the Web-Based Learning Environment Instrument (WEBLEI) (Chang & Fisher, 2003) to assess their actual and preferred perceptions of the learning environment (Quek, 2005).

Despite the efforts to conduct learning environments research in Singapore PW classrooms, studies into those which use a blended approach to PW teaching and learning, is still lacking. Thus, the current study undertaken the researcher is a worthwhile effort and can help give some significant insights into PW learning environments to fellow educators.

OBJECTIVES

- (i) To assess the psycho-social PW secondary classroom using a new instrument 'Project Work Classroom Learning Environment Questionnaire' (PWCLEQ),
- (ii) To identify differences in students' actual and preferred perceptions of the online PW learning classroom environment using the PWLCEQ, and
- (iii) To investigate the association between students' attitudes to PW, measured using a new instrument 'Project Work Related Attitudes Instrument' (PWRAI), and their perceptions of the actual classroom environment.

METHODOLOGY

Sample

The sample consisted of a total of 68 Secondary Two Express students (33 boys and 35 girls with an average age of 13 – 14 years) from two intact classes, with 34 students in each class, in a

typical Singapore government school. The students were exposed to the school's PW curriculum for 20 weeks. They were placed into heterogeneous groups of four or five which, as much as possible, ensured that the number of male and female students was balanced and the various ethnic races were represented. During the PW curriculum, the students had to work in their groups to complete the various tasks in their PW lessons. They used the internet to gather the information they needed, the online project platform to display their products and the chat room function in the project platform to engage in three online discussions with their overseas team mates. The teacher took on the role of a facilitator to scaffold the students' learning along the way. The project was eventually concluded with oral presentations by the students. After the completion of the programme, the students were then asked to complete the learning environment questionnaires and the attitude instrument. Group interviews were also conducted with the students to gather qualitative data which could help to better understand the students' PW learning experiences.

Instrument

With reference to different learning environment instruments and attitude instruments, the researcher designed the PWCLEQ to measure the students' perceptions of the actual and preferred learning environments of their PW classroom, and the PWRAI to assess the students' attitudes towards PW. The PWCLEQ contains six scales with a total of 27 items (see Table 1). There are either 4 or 5 items in each scale. The response format of the PWCLEQ is a five-point Likert rating scale consisting of Almost Always, Often, Sometimes, Seldom and Almost Never, which are scored 5, 4, 3, 2 and 1 respectively. The instructions for answering the actual and preferred forms differ, and the wording of each item varies slightly between the actual and preferred forms. For example, in the actual version of the PWCLEQ, the statement reads as "I actually experience that I have the opportunity to pursue my own interests while doing the group's project", but in the preferred version, the statement was modified to read as "I would have preferred that I have the opportunity to pursue my own interests while doing the group's project".

The PWRAI contained 12 items which were all written in the positive scoring direction, with the response format of a five-point Likert rating scale consisting of Strongly Agree, Agree, Not Sure,

Disagree and Strongly Disagree, scored 5, 4, 3, 2 and 1 respectively. The description of the finalised PWRAI is shown in Table 2.

Table 1
Allocation of items to scales and a sample item for each scale of the PWCLEQ

Scale Name	Number of Items	Item Number	Sample Item
Open-Endedness	4	1, 2, 3, 4	I have the opportunity to pursue my own interests while doing the group's project.
Instructor Support	4	5, 6, 7, 8	The teacher helps us to identify areas of improvement in the project.
Material Environment	4	9, 10, 11, 12	I find there are enough computers for me to use.
Organisation	5	13, 14, 15, 16, 17	The teacher provides instructions clearly so that everyone knows what to do.
Social Presence	5	18, 19, 20, 21, 22	I can feel the real online community made up of my team mates and my online project team mates.
Student Cohesiveness	5	23, 24, 25, 26, 27	I get on well with my team mates in the Project Work class.

Table 2
Descriptive information for each scale in the PWRAI

Scale	Description of Scale	Item Number	Sample Item
Cognitive aspect	The statements describe the perceptual responses of the pupils. They are verbal statements of beliefs – what PW does and help in the cognitive development.	1, 2 ^b , 3	Project Work skills are helpful to us in the world outside of school.
Affective aspect	The statements describe the sympathetic nervous responses of the pupils. They are verbal statements of affect – the emotions and moods felt by the PW pupils.	4, 5 ^a , 6 ^a , 7 ^b , 8	I really enjoy going to Project Work class.
Behavioural aspect	The statements describe the overt actions demonstrated by the pupils. They are verbal statements concerning behaviour – what the pupils will do in PW.	9, 10, 11, 12	I will spend time to do my Project Work tasks.

^aItems adapted from TOSRA (Fraser, 1981). ^bItems adapted from ATSI (Young, 1998).

Procedure

The actual and preferred forms of PWCLEQ were administered to 68 students. When the students had completed the PWCLEQ, they were then given the PWRAI. Instructions were read to all students before they responded to the items in the PWCLEQ and PWRAI. They took about one hour to complete the questionnaires.

FINDINGS AND DISCUSSION

Internal consistency reliability

The Cronbach alpha coefficient for each PWCLEQ scale was calculated as a measure of internal consistency reliability. The individual was used as the unit of analysis. A summary of the internal consistency reliability for the PWCLEQ (actual and preferred versions) is presented in Table 3.

Table 3
Internal consistency (alpha reliability coefficient) for PWCLEQ

PWCLEQ Scale	No. of Items	Form	Alpha Reliability
Open-Endedness (OE)	4	Actual	0.779
		Preferred	0.915
Instructor Support (IS)	4	Actual	0.843
		Preferred	0.853
Material Environment (ME)	4	Actual	0.836
		Preferred	0.915
Organisation (OR)	5	Actual	0.839
		Preferred	0.938
Social Presence (SP)	5	Actual	0.902
		Preferred	0.880
Student Cohesiveness (SC)	5	Actual	0.888
		Preferred	0.873

N = 68

In Table 3 the alpha reliability ranged from 0.779 to 0.902 for the actual version of PWCLEQ and 0.853 to 0.938 for the preferred version of PWCLEQ. Generally, the PWCLEQ has demonstrated to be valid and reliable instrument for use among the secondary school students.

Comparison of students' actual and preferred perceptions on the PWCLEQ

In Table 4, the paired samples t-test (2-tailed) calculated for the results from the students' actual and preferred forms of the PWCLEQ showed significant differences in four out of six scales, namely the Open-Endedness, Material Environment, Social Presence and Student Cohesiveness dimensions. This suggested that improvement of the present PW classroom learning environment in the four dimensions were necessary in order to meet the students' needs and preferences.

Table 4
Item Means for the Actual and Preferred Versions of PWCLEQ

PWCLEQ Scale	No. of Items	Form	Item Mean
Open-Endedness (OE)	4	Actual	3.886**
		Preferred	4.272**
Instructor Support (IS)	4	Actual	4.438
		Preferred	4.553
Material Environment (ME)	4	Actual	3.985**
		Preferred	4.449**
Organisation (OR)	5	Actual	4.529
		Preferred	4.597
Social Presence (SP)	5	Actual	3.774**
		Preferred	4.306**
Student Cohesiveness (SC)	5	Actual	4.132**
		Preferred	4.471**

*N = 68, ** $p < 0.01$*

Students showed their preference for more Open-Endedness in their Project Work. This could be due to the structured format and strict adherence to the project timeline that had been emphasized by the teachers, which might not have been conducive enough for the students to try out their different ideas to complete the group project. A preference for better Material Environment was indicated as the students needed computers to access the online project platform to gather information, publish their work and communicate with their overseas team mates. Since the

project was very much reliant on IT, the students felt an acute need for the easy availability of well-maintained computers with internet access. The project required the students to learn about each other's countries through the exchange of information and ideas with their overseas team members. Hence, the students need much input from their overseas team members and a good degree of Social Presence would help make the learning process more engaging and motivating for the students. Greater cohesiveness was favoured by the students because they recognised the need for cooperative members to have good working relationships. In this way, the group would be more successful.

Comparison of gender differences in the actual and preferred perceptions on the PWCLEQ

The analysis of the gender differences in the actual and preferred perceptions is shown in Table 5. The boys and girls differed significantly in actual perceptions for two PWCLEQ scales, namely Instructor Support and Organisation. Both the boys and girls concurred that there was noticeable amount of Instructor Support and Organisation, but the girls perceived their Project Work teachers to be more responsive and their learning environment to be more organised. As for the preferred perception scores, there was no significant difference.

Figure 5

Item Means for the Actual and Preferred Versions of PWCLEQ for both Boys and Girls				
PWCLEQ Scale	No. of Items	Form	Item Mean	
			Boy	Girl
Open-Endedness (OE)	4	Actual	3.811	3.957
		Preferred	4.371	4.179
Instructor Support (IS)	4	Actual	4.212**	4.650**
		Preferred	4.508	4.593
Material Environment (ME)	4	Actual	3.902	4.064
		Preferred	4.462	4.436
Organisation (OR)	5	Actual	4.315**	4.731**
		Preferred	4.600	4.594
Social Presence (SP)	5	Actual	3.769	3.863
		Preferred	4.273	4.337
Student Cohesiveness (SC)	5	Actual	4.109	4.154
		Preferred	4.479	4.463

N = 68, ***p* < 0.01

Associations between Project Work classroom learning environment and students' attitudes towards Project Work

To meet the last objective of this study, associations between the Project Work classroom learning environment and the students' attitudes towards Project Work were studied and the results are shown in Table 6. The simple correlation analyses showed that all the environment dimensions had statistically significant positive associations with the attitudinal outcomes. The multiple regression analysis revealed that two scales, Instructor Support and Social Presence, contributed significantly to the variance in the students' attitudes using the individual as the unit of analysis. These two environment domains deal with the "Relationship" category in Moos' scheme for conceptualising human environments. This indicated the impact of the human factor in Project Work if the Project Work lessons were to be effective and rewarding for the students. This is in congruence with the nature of Project Work as Project Work lessons are primarily student-centred, with the teachers taking on the role of facilitators. It also ascertained the utmost importance of teacher-facilitation in Project Work (Deemer, 2004; Koistinen, 2002; Postholm, Pettersson, Flem and Gudmundsdottir, 2002; Quek, 2005). The statistical results lend support to past research studies which also reported statistically significant associations between certain dimensions of the learning environment and students' attitudinal outcomes (Goh & Fraser, 1995; Wong & Fraser, 1996; Khine & Goh, 2001; Quek, 2001; Quek & Wong, 2002, Quek et al., in press).

Table 6

Simple Correlations (r), Multiple Correlations (R), Standardized Regression Coefficients (β) between the scales of the PWCLEQ and the Attitudinal Outcome

Scale	Environment-Attitudinal Outcome Associations	
	Simple Correlation (r)	Standard Regression Coefficient (β)
Open-Endedness (OE)	0.368 **	0.156
Instructor Support (IS)	0.536 **	0.459 **
Material Environment (ME)	0.313 **	0.045
Organisation (OR)	0.483 **	0.172
Social Presence (SP)	0.418 **	0.301 **
Student Cohesiveness (SC)	0.414 **	0.127
Multiple correlation (R)	0.610 **	
R^2 coefficient	0.372**	

** $p < 0.01$

The individual pupil score was used as the unit of analysis.

Students' qualitative reflections about Project Work

Small group interviews were conducted with students to gain insights into their learning experiences, approaches and problems faced in PW lessons. The students were positive about the fruitful learning processes of their project and the personal development they had experienced as a result of the activities in the project. They had remarked that they became reflective learners and were pleased with the outcomes of the project.

...learn to communicate, network with other people... also learn time management...

We can use the presentation skills learnt here in other projects.

...learn planning skill and set targets for ourselves.

There is room for my team to think of ideas and put them to work.

On the other hand, there were ambivalent and less upbeat comments about Project Work made. The issue of time constraints faced by the students during the conduct of the project was very clearly manifested in their feedback and this made them feel dissatisfied because they experienced conflicts in task prioritization.

It can be a chore... because have to do other work and have to squeeze it into our schedule”

The duration was too short.

It's stressful... we need to race against time.

It's time consuming if I want to do a good job.

Opinions about the use of IT in PW were also given by the students. They felt that the lack of frequent access to computers posed a problem to some students when doing their assigned tasks for the group as they did not own a computer and/or did not have internet connection at home.

The unenthusiastic views about the PW learning held by the students helped to explain the poorer attitudes of some students towards PW, and also provide the avenues for further improvement. In view of the time constraints, PW teachers should look into the project demands so that the project remains manageable. This can help to make learning more enjoyable and provoke positive perceptions of PW learning.

During the interview, the approaches towards PW taken by students to remain engaged during PW lessons were also revealed. Interestingly, some individuals felt that they should immerse

themselves in PW lessons because they were the Express stream students and thus, should have good student behaviour such as being involved in lessons. Some students also believed that they had to work conscientiously in PW if they wanted to be given good credits during assessment. An insight gained from the interview was that the assigned group roles could play a part in determining the students' degree of involvement, and this was revealed by comments such as:

Some of us are involved because we are the team leaders. We must be attentive so that later on we can tell our team members what to do, or when our team members ask us questions, we know how to answer or help them.

Therefore, the qualitative data seemed to indicate that the students are involved in their PW lessons because they had a strong concept of self-efficacy and self-accountability which spurred them to remain engaged. The assigned group roles can also affect the students' decision to remain focused in the lessons.

The students shared several methods they had used to cooperate with their team members. Most teams distributed tasks based on the nature of the tasks and the tools required, for example, tasks that needed the use of computers would be assigned to team mates who had available computers to use. Each team member also made an effort to complete their assigned task promptly so as not to delay the team's progress. Then, there were also helpful members to give gentle reminders to one another or offer assistance to fellow team members. When the team discussions were not fruitful, the members either agreed to follow their team leader's instructions or tried to seek consensus. Lastly, they would take initiative to put aside time after school to communicate and discuss with their team members, or work on completing the project tasks. The methods employed by the students provided evidence that students were able to practise good project management skills and PW was an excellent stage for the demonstration of such abilities. PW is therefore a learning activity worth conducting for students.

LIMITATIONS OF THE STUDY

The sample comprised of 68 Secondary Two Express students in two intact classes who had the experience of working collaboratively with overseas students for their PW subject over a period of one school semester. The sample is therefore small and unique. In addition, the possible effect

on the study's results due to the Differences in school ethos, traditions and environment would need to be taken into account. Hence, the findings cannot be generalised to all Express-stream PW classes or PW students in the other academic streams in Singapore.

IMPLICATIONS AND CONCLUSION

This study set out to assess the technology-supported project-based learning classroom environment in a co-educational secondary school. By using the perceptual information provided by the students, the gaps that exist in the Open-Endedness, Material Environment, Social Presence and Student Cohesiveness dimensions could be addressed to help improve the delivery of PW lessons and the students to learn better.

The environment-attitudinal outcome associations shed light on the important determinant factors in the PW classroom learning environment affecting students' attitudes towards PW. Both the Instructor Support and Social Presence dimensions were strong predictors of students' attitudes in this study and these two dimensions are the "Relationship" domain of Moos' concept of human environment. This result highlighted the crucial role of human interaction in PW lessons. Teachers play a critical role in creating classrooms that encourage students to be active and self-motivated learners (Deemer, 2004; Swan et al., 2000). The results of this study should encourage the PW teachers to reflect on their pedagogical practices in the classrooms. Teachers should be well-prepared to conduct PW lessons, and this can be achieved by equipping teachers with the necessary skills through training. It is therefore suggested that schools should ensure that the teachers deployed to teach PW are adequately trained so that the students' learning experiences are positive.

Generally speaking, the quantitative and qualitative data collected helped to provide a better understanding of the students' perceptions of the online PW learning environment and their learning experiences. Through this study, we hope that teachers, school leaders (Butler, 1995), stakeholders and any other individual in the teaching profession would take the necessary steps to help the students enjoy project-based online learning lessons.

REFERENCES

- Butler, E.D. (1995). *Improving school learning environments: A resource manual of knowledge and strategies*. TN: Memphis University. Center for Research in Educational Policy. (ERIC Document Reproduction Service No. ED 386 787)
- Chang, V. & Fisher, D. (2003). The validation and application of a new learning environment instrument to evaluate online learning in higher education. In M.S. Khine & D. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp.1-18), Singapore: World Scientific.
- Deemer, S.A. (2004). Classroom goal orientation in high school classrooms: revealing links between teacher beliefs and classroom environments. *Educational Research*, 46(1), 73-90.
- Fisher, D.L., & Fraser, B.J. (1981). Validity and use of the My Class Inventory. *Science Education*, 65, 145-156.
- Fraser, B.J. (1981). *Test of Science-Related Attitudes*. Melbourne, Australia: Australian Council for Educational Research.
- Fraser, B.J. (1990). *Individualized Classroom Environment Questionnaire*. Melbourne, Victoria: Australian Council for Educational Research.
- Fraser, B. J. (1998). Science learning environments: Assessment, effects and determinants. In B. Fraser & K. Tobin (Eds.), *International handbook of science education Part I* (pp. 527-564). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- 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(4), 399-422.
- Goh, S.C. & Fraser, B.J. (1995). *Learning environment and student outcomes in primary mathematics classrooms in Singapore*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Haertel, G.D., Walberg, H.J., & Haertel, E.H. (1981). Socio-psychological environments and learning: A quantitative synthesis. *British Educational Research Journal*, 7, 27-36.
- Jacobs, H.H. (1989). *Interdisciplinary curriculum: Design and implementation*. USA: Edwards Brothers, Inc.
- Khine, M.S. & Goh, S.C. (2001). *Investigation of tertiary classroom learning environment in Singapore*. Paper presented at the Annual Conference of the Australian Association for Research in Education, Fremantle, Australia.

- Koistinen, K. (2002). *Towards virtual academy – Teacher's changing role*. Paper presented at the International Congress, Washington DC, USA.
- Ministry of Education (1999). *Project work guidelines*. Singapore: Curriculum Planning & Development Division (CPDD) & Testing & Assessment Branch (TAB).
- Moos, R.H., & Trickett, E.J. (1987). *Classroom Environment Scale manual* (2nd ed.). Palo Alto, CA: Consulting Psychologists Press.
- Postholm, M.B., Pettersson, T., Flem, A. & Gudmundsdottir, S. (2002). *The teacher's role when pupils use ICT during project work*. Paper presented at the ISCAR Conference in Amsterdam, 18-22 June 2002.
- Quek, C.L. (2001). *Laboratory classroom environment and teacher-student interaction among gifted chemistry students in Singapore secondary schools*. Unpublished Ph.D. thesis, Science and Mathematics Education Centre, Curtin University of Technology, Perth, Western Australia, Australia.
- Quek, C.L. (Ed.). (2005). *Engaging in Project Work*. Singapore: McGraw-Hill.
- Quek, C.L. & Wong, A.F.L. (2002). Is my Project Work classroom environment conducive for student collaboration? *Teaching and Learning*, 23(2), 107-118.
- Quek, C.L. & Wong, A.F.L. (in press). *Secondary school students' perceptions of teacher-student interaction and students' attitude towards Project Work*.
- Swan, K., Shea, P., Fredericksen, E., Pickett, A., Pelz, W. & Maher, G. (2000). Building knowledge building communities: Consistency, contact and communication in the virtual classroom. *Journal of Educational Computing Research*, 23(4), 359-383.
- Taylor, P.C., Fraser, B.J. & White, L.R. (1994). *CLES: An instrument for monitoring the development of constructivist learning environments*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans.
- Walberg, H.J. & Anderson, G.J. (1968). Classroom climate and individual learning. *Journal of Educational Psychology*, 59(6), 414-419.
- 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(3), 133-139.
- Wong, A.F.L., & Fraser, B.J. (1996). Environment-attitude associations in the chemistry laboratory classroom. *Research in Science and Technological Education*, 14, 91-102.
- Young, T. (1998). Student teachers' attitudes towards Science (STATS). *Evaluation and Research in Education*, 12(2), 96-111.