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A Pilot Study Comparing Secondary School Students' Perception of Smart Classrooms in Hong Kong and Beijing

Bao Ping LI[a*], Siu Cheung KONG[b]

[a]*Faculty of Education, Beijing Normal University, Beijing, China*
[b]*Department of Mathematics and Information Technology, The Hong Kong Institute of Education, Hong Kong, China*
libp@bnu.edu.cn[a]; sckong@ied.edu.hk[b]

Abstract: This pilot study compared the difference in secondary school students' perception of smart classrooms between Beijing and Hong Kong using the Smart Classroom Scale (SCS). The study found that students in Beijing had more advanced requirement in physical construction of smart classrooms, while students in Hong Kong had higher expectation on pedagogical activities and deep technology usage in smart classrooms to their counterparts in Beijing. There were significant differences in scales of physical design, learning experience, flexibility, learning data, differentiation, investigation, and cooperation in the SCS. These differences were related to the investment on information technology infrastructure, and pedagogical conception of learning and teaching in smart classrooms which guide the design of learning and teaching activities. The results indicated that the students' perception to smart learning environment was affected by both educational technology investment and classroom pedagogical culture backgrounds. Both Beijing and Hong Kong students had the lowest score in learning data scale, this indicated that the smart use of learning data for pedagogical purpose was not yet thoroughly understood by secondary school students in smart classrooms.

Keywords: learning environment, smart classroom, smart classroom scale, students' perception

1. Introduction

Many researches like Lizzion, Wilson and Simons (2002) supported the view that learning environments could influence students' learning outcome and learning performance, so students' perceptions of learning environment had been studied by many researches. Trickett and Moos (1973) described the classroom environment through three dimensions as system maintenance and change, personal development, and relationship. With information technology integrated into the classroom, digital classrooms have obviously changed in above two dimensions, namely system maintenance and change, and personal development. Some new instruments like Technology-rich Outcomes-focused Learning Environment Inventory (TROFLEI) (Aldridge, Dorman, and Fraser, 2004), Technology Integrated Classroom Inventory (TICI) (Wu, Chang, Guo, 2009) for assessing students' and teachers' perceptions of digital classrooms have been developed. The instruments focused on computer usage and digital learning activities like individual learning, and inquiry learning in the classrooms.

With the introduction of richer and more diversified types of information technology in classrooms, this type of classroom is classified as smart classroom. Smart classrooms support students' learning in virtual and physical learning environments; support students' hands-on learning experiences; extend students' learning experiences outside classrooms; and give students adaptive learning help through massive learner data analysis. (Li zhang, Marco Gillies, Kulwant Dhaliwal, and et al, 2009; Minchi C. Kim, Michael J. Hannafin, 2011). Therefore, this type of classroom is considered to be conducive to cultivating students' learning skills which are needed in the 21st century. Many countries and regions have designed and constructed the cyber schools and smart classrooms to cope with the trend of e-learning development in the 21st century.

Beijing and Hong Kong are two renowned international cities. In recent years, a considerable number of primary and secondary schools in Beijing were invested with a substantial amount of budget for building cyber schools and constructing smart classrooms. Numerous teachers had accepted systematic development to change their traditional pedagogical conception such as changing the teacher-centered pattern to student-centered paradigm. Hong Kong is one of the financial centers in the world, the primary and secondary students in the city have more cross-cultural background in their daily life. Hong Kong also has a long-term influence from UK in its education system, educational culture, and learning and teaching approach. The diversity of educational investment in Hong Kong did make a different between the investment in building cyber schools and constructing smart classrooms between Beijing and Hong Kong.

Welch, Cakir, Peterson & Ray (2012) make cross-cultural validation of the TROFLEI in both Turkey and the USA in order to allow the comparison of classroom environments across these two cultures. They stated that comparison of educational practices, beliefs and attitudes of two countries provides deep insights into their relative positions. As there are a number of significant differences between the education systems in Beijing and Hong Kong as well as their cultural background, this pilot study is interested in the comparison of students' perception of smart classrooms in the two cities. The pilot study aims to investigate whether the differences in investment, the learning and teaching approach, as well as the cultural background are also reflected in students' perception of smart classroom. The results of the pilot study will be helpful for us to control the external factors which influence students' perception of the smart classroom environment. Li, Kong and Chen (2014) revised the details of the classroom environment of the three dimensions proposed by Trickett and Moos (1973) and developed and verified the Smart Classroom Scale (SCS) based on the current features of technology-rich classrooms. Therefore, this pilot study conducted the survey for students' perception of smart classrooms between a secondary school in Beijing and a secondary school in Hong Kong using SCS.

2. Method and Procedure

2.1 Instrument

The SCS was derived from a number of existing digital classroom instruments. They are TROFLEI, TICI, and Computerized Classroom Ergonomic Inventory (CCEI). SCS was validated as a reliable instrument by involving more than 300 students in primary and secondary schools in Shenzhen and more than 200 students in Beijing to answer to the scale. Finally ten scales and 39 items are included in the SCS which focus on the physical appearance, learning and teaching activities, and ecology of smart classroom (Li, Kong and Chen, 2014). The details of the SCS are summarized in table 1.

Table 1: A detailed description of the Smart Classroom Scale with sample of item in each scale.

Scale	Description	Sample of Item
Physical Design (PD)	The extent to which the spatial area, furniture equipment, and information technology infrastructure of smart classrooms.	I have adequate workspace for putting textbooks, tablet PCs and other resources.
Flexibility (FLE)	The extent to which the flexible support for users by classroom environment.	The classroom can be a theater, a group working place or other scenes for different learning purposes.
Technology Usage (TU)	The extent to which learners use information technology as a tool to learn and to access information.	I deal with my assignments using computer or other digital devices.
Learning Data (LD)	The extent to which the information technology was used to acquire and analyze the learning data of the users.	I can find out my learning history, like my homework, and discussions in the last semester.
Differentiation (DIF)	The extent to which teachers cater for learners differently on the basis of ability, rates of learning and interests.	I can learn at my own pace.
Investigation (INV)	The extent to which skills and processes of inquiry and their use in problem solving and investigation are emphasized.	I carry out investigations to test my ideas.

Cooperation (CO)	The extent to which learners cooperate with one another on learning tasks.	I can cooperate with somebody through internet when doing assignment work.
Learner Cohesiveness (LC)	The extent to which learners know, help and are supportive of one another.	I always help other students in the class.
Equity (EQU)	The extent to which learners are treated equally by the teacher.	The teacher gives as much attention to my questions as to other learners' questions.
Learning Experience (LE)	The extent to which learners' satisfaction and some special learning experience in smart classrooms.	The devices and software help me to get hands-on experience with the learning objects or learning context.

2.2 Sample

A secondary school which was an e-Learning Pilot School in Hong Kong and a secondary school which had solid information technology infrastructure in Beijing were selected for this pilot study. Seventy-one students with age from 13 to 15 years old in the secondary school in Hong Kong, and 76 students with age from 13 to 15 years old in the secondary school in Beijing were invited to respond to the SCS. Table 2 shows the demographic data of the students in these schools. All students in these two schools had experiences of conducting e-learning inside and outside the technology-rich classrooms.

Table 2: The demographic feature of students in the two secondary schools.

School	Age			Gender	
	13	14	15	Female	Male
Beijing	44	30	2	36	40
Hong Kong	17	46	8	36	35

2.3 Procedure

With the consensus of the school administrators, a questionnaire survey was distributed to the targeted students for collecting perceptions of students in the two cities. The questionnaire contained a cover sheet about the details of the participants such as age and gender, and the questionnaire. The questionnaire contains all the questions of the SCS. It asked students about their perception to the learning environment of smart classrooms. All questions asked students in a positive scoring direction and the 5-point Likert-type scale with anchors from almost never (scored as 1) to almost always (scored as 5) were used in the SCS. The students were provided with sufficient time to respond to the questions in the SCS.

2.4 Data Analysis

Data were analyzed using descriptive statistics including exploratory factor analyses, Independent-Samples T-test, and Cohen's d. The descriptive statistics such as means, standard deviations and Cronbach's alpha coefficient (as an index of internal consistency reliability) for each of the 10 scales of SCS were also calculated.

3. Results

Internal reliability was tested using the individual student as a unit of analysis for the Cronbach's alpha coefficient. The overall Cronbach's alpha coefficient is 0.93. A principal components analysis with varimax with Kaiser Normalization rotation yielded 10 scales for the existing form of SCS with total variance explained 69.31%. The Cronbach's alpha values and the exploratory factor loading results of the 10 scales of the SCS were shown in table 3.

Table 3: Cronbach's alpha values and exploratory factor loading results of the SCS.

Scale	Cronbach's alpha	Factor Loading				
		Item1	Item2	Item3	Item4	Item5
PD	0.69	0.73	0.68	0.74	0.63	
FLE	0.26	0.74	0.55	0.87		
TU	0.83	0.83	0.81	0.77	0.77	
LD	0.68	0.79	0.83	0.78	0.64	
DIF	0.87	0.74	0.85	0.80	0.82	
INV	0.86	0.80	0.70	0.67	0.79	0.65
CO	0.86	0.78	0.57	0.62	0.75	
LC	0.84	0.74	0.80	0.78	0.79	
EQU	0.84	0.78	0.90	0.83	0.75	
LE	0.80	0.75	0.80	0.82		

The Mean, Standard Deviation (SD), T-test, and Cohen's d in both schools in Beijing and Hong Kong were shown in table 4. Cohen's d is an effect size used to indicate the standardized difference between two means.

Both Beijing and Hong Kong students had the highest score (4.07 for BJ and 4.00 for HK) in Learner Cohesiveness (LC) and lowest score (2.23 for BJ and 3.04 for HK) in Learning Data (LD). In Beijing, the scales of Flexibility (FLE), Learning Data (LD), Differentiation (DIF), Innovation (INV), and Cooperation (CO) were lower than average level 3.00. In Hong Kong all the 10 scales were higher than 3.00. Except the two scales for relationship as Learner Cohesiveness (LC) and Equity (EQU), all other eight scales had significant differences in students' perception between the two secondary schools in Beijing and Hong Kong.

Table 4: The mean, SD, T-test and Cohen's d of the SCS of schools from Beijing and Hong Kong.

Trickett and Moos Schema	Scale Name	No. of Items	Mean		SD		T-test	Cohen's d
			BJ	HK	BJ	HK		
System maintenance and change	PD	4	3.52	3.37	3.86	3.43	-2.04*	0.04
	FLE	3	2.52	3.44	2.90	4.41	3.50**	-0.24
	TU	4	3.65	3.71	3.65	3.11	10.52***	-0.02
	LD	4	*2.23*	*3.04*	3.54	3.89	4.86***	-0.22
Personal development	DIF	4	2.37	3.31	4.75	3.26	6.69***	-0.23
	INV	5	2.82	3.55	4.56	2.89	4.90***	-0.19
	CO	4	2.70	3.54	5.58	3.65	4.82***	-0.18
Relationship	LC	4	*4.07*	*4.00*	3.79	3.04	-1.86	0.02
	EQU	4	3.80	3.66	5.09	2.90	-1.32	0.03
	LE	3	3.61	3.62	3.79	2.40	2.54*	0.01

Notes: $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

4. Discussion

Based on Trickett and Moos schema, secondary school students' perception of smart classrooms between Beijing and Hong Kong had significant difference in both system maintenance and change, and personal development. As shown in figure 1, students' perception of Physical Design (PD) and Learning Experience (LE) in Beijing school are higher than those in Hong Kong. The study attributes these to the large amount of information technology infrastructure investments in primary and secondary schools in China during the past decade. Early in 2000, China carried out a series of projects in primary and secondary schools for digital schools construction in the mainland, such as connecting internet into every school. Beijing is the capital of China; there were a substantial amount of financial inputs to the construction of infrastructure in schools every year. Many schools in Beijing have equipped with tablet PCs, interactive desks, and large surface interactive screens, which enable it to precede in smart schools pilot programs in China.

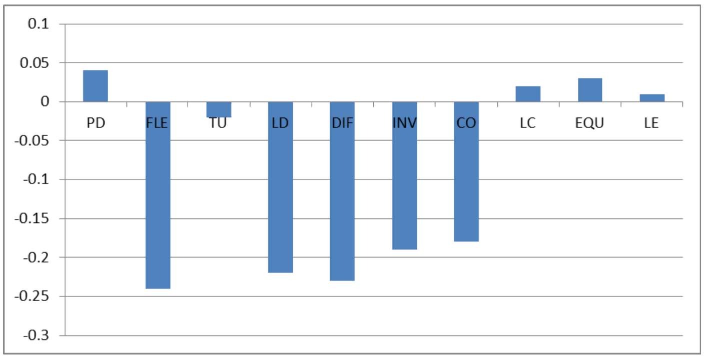

Figure 1. Cohen’s d of two schools in Beijing and Hong Kong.

Primary and secondary schools in Hong Kong put more effort to develop pedagogy adopting constructivist’s approach than their counterparts in Beijing, and class activities in schools in Hong Kong tend to put more effort in the student-centered approach in learning and teaching practices. For example, the selected school in Hong Kong is taking part in the pilot scheme on e-learning in schools. It uses the ICT to improve teaching and learning qualities, and to develop the learner-centered learning mode. In their learning process, it focus on inspiring students’ creativity, cultivating students learn to analyze, learn to cooperate and learn to integrate ICT in their problems solving. With this regard, students in Hong Kong are more familiar with individualized, constructive, and collaborative learning. Therefore, perceptions of students in Hong Kong were much higher in the scale of differentiation (DIF), investigation (INV), and cooperation (CO) scales.

As all students involved in the survey are all having the learning experience in the technology-rich classroom, so the scores of Hong Kong students were a little bit higher than those of Beijing students in Technology Usage (TU) scale. Scores of Flexibility (FLE) and Learning Data (LD) in Hong Kong were much higher than those in Beijing; the study attributes these to the differences in the culture of using technology for more learner-centered learning for schools in Hong Kong.

Students in Beijing and Hong Kong are both influenced by traditional culture of Chinese like solidarity and friendliness, therefore both Beijing and Hong Kong students’ perception to Learner Cohesiveness (LC) and Equity (EQU) had no statistical significant differences.

The differences in students’ perception of each scale in smart classroom give ample evidence for the issue that the investment for ICT infrastructure in school, the teaching and learning approach in classroom, and pedagogical culture of the city do have some correlation with students’ perception of learning environments.

Besides the differences, the study also found some similarities between the two secondary schools in Beijing and Hong Kong. The highest three scales in both schools are LC, EQU, and TU, the lowest scale in both schools is LD. The results indicated that in the technology-rich classroom the ICT technology do not change the traditional student-student and student-teacher relationship too much, but it give students more opportunities to use the devices and subject matter tools in learning. So in this survey both students in two different cities have highest perception of the three scales. Well, smart classroom is the higher level of digital classroom (Huang, et al, 2012), some new features, like learner analysis, are emerged. The students need time to adapt to the innovation learning style which based on the massive learning data analysis. So both students got the lowest score in the scale.

Conclusion

This pilot study conducted a survey to students of a secondary school in Beijing and a secondary school in Hong Kong using the SCS for studying students’ perception of smart classrooms. The study found that students in Beijing had more advanced requirement in physical construction of smart classrooms, while students in Hong Kong had higher expectation on pedagogical activities and deep technology usage in smart classrooms to their counterparts in Beijing. Li and Kong (2014) indicated that smartness of learner data is one of important smartness towards smart classrooms, the survey found both schools’ students have lower perception of Learning Data (LD) scale, this indicated that the smart use of learning data for pedagogical purpose were not yet thoroughly understood by secondary school students in smart classrooms in both cities. The result gave ample evidence for the conclusion that the students' perception of learning environments were effected by financial investment, pedagogical culture, teaching and learning approach in schools, and their own culture background. The conclusion inferred that physical equipment is the basic element for smart classrooms, and students have the most intuitive perception of its change and its usage in classrooms. But the change of the students' perception of the constructive learning activities, learning data based learning support are relative indirect. The innovation of smart teaching and learning activities, and cultivation the technology enhanced learner-centered pedagogical culture in schools are the bridge to improving the students' perceptions of the smart learning environment, as well as the students' learning outcomes.

The secondary school in Beijing should pay more attentions on how to improve students' participation and interaction in their classroom through its advanced information technology infrastructure for e-learning to improve students' perception of the learning activities in the whole smart learning environments. Both secondary schools in Beijing and Hong Kong should develop more teaching and learning modes based on massive learner data to guide the students' deep understanding for the importance of learner data in smart learning environments.

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