

The Comparison of Paper Textbook Class and Electronic Textbook Class in Technology Rich Classroom

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Abstract: Electronic textbook has significantly potential to change the traditional ways of teaching and learning. In this paper, we conducted a research to examine the change from paper textbook class in Technology Rich Classroom (pTRC) to electronic textbook class in Technology Rich Classroom (eTRC) from the perspective of effective learning, by using a mix-method design of interview, questionnaire and on-site observation. There were 209 students and 12 teachers from six classes equipped with iPads from two primary schools were taken part in the study, and each class conducted 4 eTextbook sessions and 4 paper textbook sessions. We compared the 24 eTextbook sessions and 24 paper textbook sessions by analyzing class activity capacity, classroom behaviors and technology roles. The comparison shows: (1) There are significant differences in class activity capacity between eTRC and pTRC. The ratio of classes which effectively completed the learning activities as planned in eTRC is higher than in pTRC, and Learner Engagement Indicator (LEI) in eTRC is significantly higher than in pTRC. (2) There are significant changes in classroom behaviors between eTRC and pTRC. The allocated time for teachers in eTRC is significantly lower than in pTRC and engaged time for students in eTRC is significantly higher than in pTRC. Students participate in classroom learning activities significantly initiatively and positively in eTRC compared to in pTRC. (3) Students attitudes to technology and satisfaction in eTRC are significantly higher than in pTRC.

Keywords: electronic textbook class, paper textbook class, technology rich classroom, class activity capacity, classroom behaviors, technology roles, effective learning activity

1. Introduction

In recent years, the criticism of traditionally structured stand-and-deliver classrooms has been dominantly present in our pedagogical literature. The traditional instruction reflected an “old” style of instruction wherein “students sit quietly, passively receiving words of wisdom being lectured by the lone instructor standing in front of the class.” (Halpern, 1994). In this instructional style, it is expected that students will answer questions generated by their teachers. (Sungur & Tekkaya, 2006) Bowers & Flinders (1990) describe the teacher-centered model using an analogy from industrial production in which students become “products”. Students’ needs, interests, and abilities were neglected, the syndrome of boredom was intensively developed, and knowledge was not integrated but acquired partially. (Gary, 2005). Learning, however, rarely if ever occurs passively. Various issues of classroom instructional activities have been widely discussed owing to the rapid advancement of digital technologies.

Technology rich classroom is a technology enriched learning environment, which can range from simple computer classrooms to extravagantly appointed classrooms equipped with computers, projectors, Internet access, and communications technology allowing for distance and real time access to a vast array of resources (Ott, J., 2000). The use of computer and relevant digital devices has the potential to change physical and psychosocial classroom environments in either negative or positive ways. As students become increasingly more reliant and absorbed in technology, some researchers argue that the new generation students are different from the previous generation (Tapscott, 2009;

Prensky, 2010). Huang et al (2013, in press) also pointed out there is a gap between learning ways digital native preferred and what k-12 classes provided. The new technology roles in their lives have affected many aspects of their learning traits, such as they learn differently and approach schoolwork differently than students did even a few years ago. This impacts learning, and some school districts are addressing students' need to get answers instantly, to communicate as they learn, and to create information and share it with others. (Bebell & O'Dwyer, 2010) So, Learning is clearly in the midst of a dramatic transformation. From the incorporation of mobile devices with their "anywhere, anytime" access to information to the rapidly growing presence of tablet devices and digital books, clear challenges are being raised to existing models of how students' think, learn, and make decisions. (Michael, Priya, & Scott, 2011). News reports and studies confirmed that learning to collaborate with others and connect through technology are essential skills in an information-based society.

In fact, how to design new learning contents or curriculum to support 21st Century students learning is an emergency task for practitioners. In different ways the researchers have appealed to the theorists, and practitioners to understand that the challenge for our education system is to leverage technology to create relevant learning experiences that mirror students' daily lives and the reality of their futures. Many researchers pointed out that electronic textbooks (eTextbooks) were a good choice for adapting learning requirements of new generation students. The proliferation of multimedia in eTextbook has introduced new ways of conveying information, often involving an element of interactivity that could help students engage in learning activities. (McFall, Dershem, & Davis, 2008). The use of eTextbook provides for engaging and effective learning experiences for particular learners (either paced or tailored to fit their learning needs) or personalized, which combines paced and tailored learning with flexibility in content or theme to fit the interests and prior experience of each learner. These factors suggested that eTextbook would be more accepted in the future.

To meet the teaching and learning requirement from Chinese k-12 schools, Chen et al. (2012) stated that eTextbook was a special kind of eBook developed according to curriculum standards, which meets the students' reading habits, facilitates organizing learning activities, and presents its contents in accordance with paper book styles. Actually, eTextbook has been available to educational institutions for many years in developed countries. In Japan, the Ministry of Internal Affairs and Communications (MEXT) proposed the deployment of eTextbooks to all elementary and junior high school students by 2015, in the "Haraguchi -Vision", in late 2010. In Korea, the "Education and Human Resources Development Ministry" and the "Korea Education and Research Information Service Korea" have been developing digital textbooks under the policy of "Government's Plan to Introduce Smart Education". In the above policy, eTextbooks are scheduled to be introduced into elementary and junior high school by 2014. According to a report published in USA Today, the Obama Administration is advocating the goal of an eTextbook in every student's hand by 2017. With the emergence of utilizing eTextbook initiatives on the rise, it is promising that research has found that eTextbooks support significant opportunities for improvement within the educational setting. To date, however, studies of electronic textbook class have not provided adequate information in two areas: (a) descriptions of electronic textbook class that are effective for students' learning; (b) the effects of technology roles and classrooms instruction. In this context, the comparison between paper textbook class in Technology Rich Classroom (pTRC) and electronic textbook class in Technology Rich Classroom (eTRC) are worthy of being explored and discussed.

So, in this paper, an attempt was made to seek the answers to the changes in eTRC and pTRC settings with the following research questions:

- (1) Is there any change of class activity capacity between eTRC and the previous pTRC?
- (2) What changes transpired between the teachers' and students' behaviors that happened in eTRC compared to pTRC?
- (3) Is there any difference in the technology roles between eTRC and pTRC?

2. Research design

2.1 Defining eTextbook class (ETC) and paper textbook class(PTC)

For the purpose of this study, eTextbook was defined as texts that are digital and accessed through mobile handheld devices (Jeong, 2012). All of the eTextbooks examined in this study were displayed

on iPads. In this study, we define the eTextbook within iPads as the combination of handheld devices-assisted learning environment and curriculum contents that includes diverse learning tools, rich learning resources, and real-life learning contexts. Paper textbooks were print on paper and all of the paper textbooks examined in this study were publisher produced. During the Autumn 2012 semester, participants from six classes in Grade 4 in two primary schools were selected to take part in 4 classes that offered a paper textbook, content, activities, and assessments within each class were print on paper. Then they take part in 4 classes that offered an eTextbook. When they implement learning activities with eTextbook, content, activities, and assessments within each class were all displayed on handheld learning device (iPads).

2.2 Research Framework and Procedure

In this research we are trying to compare the changes from paper textbook class in Technology Rich Classroom (pTRC) to electronic textbook class in Technology Rich Classroom (eTRC) in three respects, including activity capacity, classroom behavior, and technology role, as shown in Figure 1. The differences of instructional process between the two settings are the types of textbooks.

The primary issue is to identify the three variables of the changes. So the variables can be defined as follows:

Class Activity Capacity (CAC): it refers to the amount of effective learning activities in a class, in which the effective learning activity for a student refers to the process the student completes learning tasks and achieves learning objectives within a certain period of time. So, a learning activity would be calculated if there are three components, such as learning tasks, learning methods and assessment inclusively, in its process.

Classroom Behavior (CB): it refers to action or action series in a classroom for both the teacher and the students. Basically, the classroom behavior consists of two categories related to teacher(s) and students respectively.

- **Technology Roles (TR):** it refers to the functions and benefits of technology involved in a class, which make the class different from the previous one. Herein the technology includes computer network, devices, supportive software, and digital resources in the classroom.

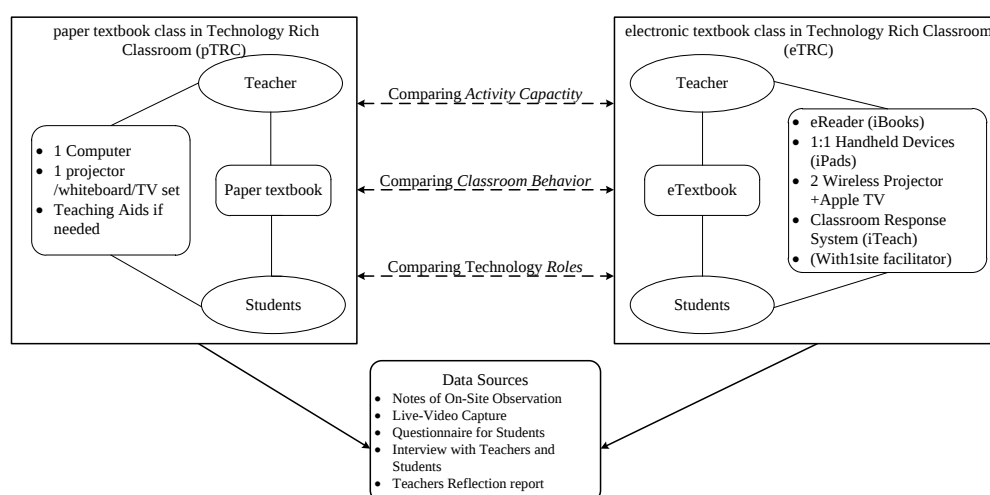


Figure1. Research framework for comparing between eTRC and pTRC

2.3 Targeted classes

There are six classes in Grade 4 from two elementary schools in Beijing taking part in the research. 12 teachers (5 from Chinese subject, 3 from English subject, 2 from Science subject and 2 from Math subject) and 209 students from six classes are involved in this research. Since selecting class is a big challenge of comparability, we identified all the lessons with new contents taught and the contents with same or similar types in comparison pair of eTextbook class and paper textbook class. For each teacher, we collected 2 pTRCs and 2 eTRCs. The class settings are shown in Figure2. Finally, we collected 24 eTRCs and 24 pTRCs.



Figure2. The class settings in the two elementary schools

2.4 Data collection and analysis

2.4.1 Class Activity Capacity

We developed a checklist for on-site observation. It helps the observers to focus on how many effective learning activities happened in a class and how many students are engaged in each learning activity.

For effective learning activity: The necessary conditions for a learning activity are of learning tasks, learning methods and learning outcomes which should be observable and assessable in a class. We calculate the number of learning activities which were completed by students and the number of learning activities which were not completed by students in a class respectively. We also calculate the number of classes in which learning activities were effectively completed. A class in which learning activities were completed is scored “1” and a class in which learning activities were uncompleted is scored “0” by the observers.

For Learner Engagement Indicator (LEI) in a class: The Learner Engagement Indicator for a class refers to the ratio of the weighted sum of the student amount with different number of effective learning activities to the CAC (number of effective learning activities for a class), as is shown in the following formula(A):

$$LEI = (X_1 + 2 \cdot X_2 + \dots + L \cdot X_L) / (L \cdot N) \quad (A)$$

Where X_i denotes the number of students whose amount of effective learning activities were completed.

L denotes the Class activity capacity, i.e. the number of effective learning activities in the class.

N denotes the number of students in the class.

For example, in one class, the target students are selected using a sampling method, which includes 6 girls and 6 boys. According to our on-site observation, 5 learning activities are carried out within a class period. The number of students whose amount of effective learning activities was completed is calculated respectively. That is to say, for the 12 target students, there is 1 student engaged in one learning activity, 2 students engaged in two learning activities, 3 students engaged in three learning activities, 5 students engaged in four learning activities and 1 student engaged in five learning activities. So, according to formula (A), $LEI = (5 \cdot 1 + 4 \cdot 5 + 3 \cdot 3 + 2 \cdot 2 + 1 \cdot 1) / (5 \cdot 12) = 0.65$.

Actually, The scorers sat in the back or the side of the classroom, sometimes scorers were required to move around to observe the content of the work in which a particular target student was engaged.

2.4.2 Classroom Behavior

We developed a classroom behavior inventory consisting of two categories with five items. The first three items, such as BT1, BD2 and BD3, which were adopted from the teachers' categories proposed by Zhong & Cui (2008) and Bower, Hedberg and Kuswara (2010), the other items, such as BI4 and BC5, which were revised from a Classroom Observation Tool (ICOT) developed by ISTE(2009), as shown in Table1. To assess the validity of the coding scheme, it was examined by three experts and two teachers. The classroom behavior inventory helps the observers to calculate the duration of the teacher's behavior and students' behavior accurately and respectively.

We have done the reliability analysis before analyzing the data. Two scorers did the on-site observation and video analysis separately with the reliability analysis formula adopted from Hsu &

Hsu (2009), the level of reliability between scorers was over 90%, which meets the requirement of content analysis.

Regarding the validity, analysis results were sent to teachers who taught those courses for verification. They would check whether there was omission of important content or whether it met the requirement of this research.

Table 1. Coding scheme for analyzing classroom behavior in a class

Item	Description	Coding
Transmission (T)	Lecturing; criticizing or justifying authority; modeling.	BT1
Directing (D)	Giving directions or suggestions	BD2
Dialogue (D)	Asking questions; accepting feelings; accepting or using ideas of students; praising and encouraging; talking simultaneously; response (individual); response (group) ; response (whole class); initiation.	BD3
Individual learning (I)	Exercises and quiz, Reading textbooks, Listening and repeating from textbooks, creating /sharing works	BI4
Cooperative learning (C)	Discussing with peers, Exercises and quiz, Role-play in the group, Info. Analysis, creating /sharing works	BC5

2.4.3 Technology Roles

We adopted a framework, SMART model, which was developed by Yang & Huang (2013, in press) in order to investigate the technology roles in a class from teachers' perspective. We compared eTRC and pTRC according to the five components, including Showing Content, Managing Environment, Accessing Resources, Real-time Interacting and Tracking Learning Process. We recorded the technology roles from the above five dimensions during all the classes when doing on-site observation. Meanwhile, reflection forms were given to teachers to collect the level of their attitudes towards eTRC and pTRC from the above five dimensions.

We developed a questionnaire that consisted of two parts with 11 items to collect students' opinions. The first part of the questionnaire consisted of 5 items with students' satisfaction in the two class settings, which were adopted from the USE Questionnaire developed by Lund (2001) and validated by Huang et al. (2012). The second part of the questionnaire consisted of 6 items, about the students' attitudes towards technology and motivation, which were designed by the researchers. All the items used a five-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree". To assess the validity of the questionnaire, it was examined by three eTextbook experts and two teachers. The internal consistency and reliability were tested by means of the Cronbach's alpha coefficient, and the result for the sample as a whole was 0.91. We sent out questionnaires to 209 students and acquired 164 effective questionnaires, with 78 from boys and 86 from girls. The recovery rate of questionnaires was 78.47%.

3. Results and Discussion

3.1 Changes on Class Activity Capacity

One of the objectives of this study was to examine whether there is any change of class activity capacity between an eTRC and a pTRC or not. According to the necessary conditions for a learning activity (learning tasks, learning methods and learning outcomes) in a class, we calculated the numbers of classes in which learning activities were effectively completed as planned. Table 2 displays the descriptive statistical analysis of the ratio of classes which effectively completed the learning activities in eTRC and in pTRC respectively. In pTRC, there were 12 out of 24 classes in which learning activities were effectively completed, which account for 50% of all the paper textbook classes. In eTRC, there were 17 out of 24 classes in which learning activities were effectively completed, which account for 71% of all the eTextbook classes. The ratio of classes which effectively completed the learning activities as planned in eTRC is higher than in pTRC, which increased by 21%.

In addition, this study also examined the Learner Engagement Indicator in a class. Table2 also shows students were more engaged in learning activities in eTRCs compared to in pTRCs ($\text{Min}_{\text{eTRC}}=0.65>\text{Min}_{\text{pTRC}}=0.26$).

Table2. Descriptive statistics of classes in eTRC and in pTRC

Teachers	pTRC					eTRC				
	C1	L	C2	L	% of Total(C1+C2)	C1	L	C2	L	% of Total(C1+C2)
1 Ms.Rong	1	0.63	0	0.48	50%	1	0.93	1	0.93	100%
2. Ms. Zhou	1	0.46	0	0.40	50%	1	0.94	1	1.00	100%
3. Ms. Guo	1	0.59	0	0.58	50%	1	0.89	0	0.73	50%
4.Ms.Yang	1	0.55	0	0.45	50%	1	0.75	1	0.95	100%
5.Ms.Zhang	1	0.43	1	0.49	100%	1	0.78	1	1.00	100%
6. Ms.Lu	1	0.68	0	0.79	50%	1	0.89	0	1.00	50%
7. Ms.Wang	1	0.45	0	0.77	50%	1	0.84	0	0.70	50%
8. Ms.Liu	1	0.56	1	0.57	100%	1	0.82	0	0.69	50%
9.Mr.Li	0	0.36	1	0.27	50%	1	0.89	1	0.89	100%
10.Mr.Zhang	1	1.00	0	0.71	50%	1	0.86	0	1.00	50%
11.Ms.Li	0	0.94	0	0.67	0%	1	0.65	0	1.00	50%
12.Ms.Wang	0	0.35	0	0.26	0%	1	0.90	0	0.95	50%
Total	9		3		50%	12		5		71%

Notes : C1= classes from the first time; C2= classes from the second time; 1= classes in which learning activities were effectively completed; 0=classes in which learning activities were uncompleted; L= Learner Engagement Indicator.

Table3. Independent sample t-test between eTRC and pTRC

	Classes	N	Mean	S.D.	t
Learner Engagement Indicator	pTRC	24	0.56	0.19	-7.027**
	eTRC	24	0.87	0.11	
Ratio of classes in which learning activities were effectively completed	pTRC	24	0.50	0.51	-1.479
	eTRC	24	0.71	0.46	

** $p<0.01$

Table 3 shows the independent sample t-test results between eTRCs and pTRCs. It can be seen that the class activity capacity in eTRCs made significant progress in “Learner Engagement Indicator” during all the 48 classes with $p < .01$. This finding complies with what has been reported by researchers, that students have more extensive opportunities to be engaged in the learning activities if their instructors adopt student-centered learning mode and select appropriate multimedia materials in order to promote effective learning activities for students. (Ching-Kun Hsu¹ &Gwo-Jen Hwang, 2013). And for “Ratio of classes in which learning activities were effectively completed”, there was no significant difference between eTRCs and pTRCs.

In addition, from the interview results, we found that technical issues, the complexity of learning tasks, the articulation of learning methods, the engaged time (time students actually engage in learning tasks) are the main factors to influence the classes in which learning activities were completed.

Therefore, there are changes of class activity capacity between eTRCs and pTRCs. It can be derived that the ratio of classes which effectively completed the learning activities as planed in eTRC is higher than in pTRC, teachers and students completed the learning activities with the help of eTextbooks and digital devices which provided by technology rich classroom. Further, Learner Engagement Indicator (LEI) in eTRC is significantly higher than in pTRC.

3.2 Changes on Classroom Behavior

This study further examined whether there is any change in classroom behavior between eTRC and pTRC or not. With regarding to changes of teachers’ behaviors, there are significant differences in the

items of the total time for transmission and the total time for directing behaviors between eTRCs and pTRCs during all the 48 classes with $p < .01$, as shown in table 4. The total time for transmission behavior was shorter in eTRCs compared to in pTRCs. The total time for directing behavior of teachers went higher when using eTextbook in the classes, compared to using paper textbooks. There was no significant difference regarding to the total time for dialogue between teachers and students in all the classes.

So, it can be derived that the allocated time (time scheduled by the teacher for a particular lesson) and the actually used for instructional activities is less in eTRC than in pTRC. The time is under the direct control of the teacher has been changed, which make the teacher behavior has been changing from transmission to dialogue and directing.

Table 4. T-test of the time for teachers' behaviors between eTRC and pTRC (units: minute)

	Classes	N	Mean	S.D.	t
Transmission	pTRC	24	10.47	2.04	9.929**
	eTRC	24	6.07	0.74	
Dialogue	pTRC	24	13.16	1.30	2.455
	eTRC	24	12.47	0.76	
Directing	pTRC	24	1.57	0.52	-7.099**
	eTRC	24	2.75	0.63	

** $p < 0.01$

Regarding to changes for students' behaviors, the total time for students' behavior was longer in eTRCs compared to in pTRCs. Further, there are significant differences in the items of the time for individual learning and time for cooperative learning between eTRC and pTRC, ($p < .01$), as shown in table 5.

Table 5. T-test of the time for students' behaviors between eTRC and pTRC (units: minute)

	Classes	N	Mean	S.D.	t
Individual learning	pTRC	24	7.36	1.49	-4.123**
	eTRC	24	8.79	0.82	
Cooperative learning	pTRC	24	6.92	1.78	-9.273**
	eTRC	24	11.20	1.41	

** $p < 0.01$

Specifically, in terms of "individual learning", there are significant differences in the items of "Listening and repeating from textbooks" and "creating /sharing works" between eTRC and pTRC with $p < .01$, as shown in table 6. In eTRC, students are more engaged in sharing works to achieve high level learning objectives. There were no significant difference regarding to the "Exercises and quiz" and "Reading textbooks" in all the classes. So, it can be derived that students have changed their learning ways in the classroom, from passive receiving presentation information to active participating in various of learning activities.

Table 6. T-test of the individual learning behaviors between eTRC and pTRC (units: minute)

	Classes	N	Mean	S.D.	t
Exercises and quiz	pTRC	24	3.32	1.50	1.539
	eTRC	24	2.69	1.32	
Reading textbooks	pTRC	24	2.56	1.35	-0.225
	eTRC	24	2.63	0.78	
Listening and repeating from textbooks	pTRC	24	0.00	0.00	-4.839**
	eTRC	24	1.30	1.31	
creating /sharing works	pTRC	24	1.29	0.96	-3.940**
	eTRC	24	2.27	0.76	

** $p < 0.01$

In terms of "cooperative learning", there are significant differences in the items of "Discussing with peers", "Info. Analysis", "Creating /sharing works" between eTRC and pTRC with p

< .01, as shown in table 7. In eTRC, students could complete their learning activities with peers and carry out more kinds of learning activities with the help of the handheld learning device. There were no significant difference regarding to the “Exercises and quiz” and “Role-play in the group” in all the classes. So, it can be derived that students finished effective learning activities through cooperative ways more frequently in eTRCs compared to pTRCs.

Table 7. T-test of the cooperative learning behaviors between eTRC and pTRC (units: minute)

	Classes	N	Mean	S.D.	t
Discussing with peers	pTRC	24	1.31	1.08	-2.969**
	eTRC	24	2.41	1.42	
Exercises and quiz	pTRC	24	2.85	1.45	-0.392
	eTRC	24	3.00	1.24	
Role-play in the group	pTRC	24	1.97	1.49	0.116
	eTRC	24	1.92	1.56	
Info. Analysis	pTRC	24	0.00	0.00	-2.937**
	eTRC	24	1.36	2.27	
Creating /sharing works	pTRC	24	1.04	0.92	-5.671**
	eTRC	24	2.37	0.69	

** $p < 0.01$

From the analysis results of classroom behavior, it could be concluded that the total time for teachers’ behaviors in classes was shorter than that of students’ behaviors. eTRCs could boost the shifting of classroom instructional structure from the teacher-centered to the student- centered. Further, the interviews with teachers and students revealed the following findings:

The teachers have the willingness to utilize technology to support teaching and change their teaching behaviors.

Students are motivated to finish learning activities more initiatively in eTRCs, than that in the pTRCs, such as discussing with teachers and classmates; showing works, doing exercises and quiz.

There for, significant changes on classroom behaviors were found from the study, including the total time for teachers’ behaviors in eTRCs was shorter than that of teachers’ behaviors in pTRCs. Students participate in classroom learning activities significantly initiatively and positively in eTRC compared to in pTRC.

3.3 Differences of Technology Roles

In addition, this study also examined whether there is any difference in technology roles between an eTRC and a pTRC. The results of interviewing with teachers and students revealed the findings as shown in Table8. It can be seen that both teachers and students are highly dependent on technology for implementing and administrating learning activities in eTRCs.

This finding also complies with what has been reported by researchers, that there are a few important benefits of technologies for students in a class, including holding their attentions, motivate students to take actions, increase their interests for learning, and make learning easier (R.K. Samanta,1991).

Table 8. Differences of technology roles in eTRC and pTRC

Technology Roles	eTRC	pTRC
Showing Content	• More beneficial to show the contents continuously since at least two screens can be open at the same time when presenting the teaching materials • More clarity when the students receive the presentation • Showing learning materials instantly (students’ eTextbooks, works.) on the screen via AirPlay	• Only one screen for presenting the teaching materials with PPT • Learning materials only be showed through discourse and physical projection
Managing Environment	• A more flexible layout of the chairs and desks, such as, semicircle, parallel, straight rows. • Easier to distribute the teaching materials	• Mainly straight rows for chairs and desks • Distributing teaching materials

		one student at a time
Accessing Resources	• More rapid access to digital resources with iPads since it is integrated with eTextbook • Digital resources are more adaptive to personalized learning	• Taking more time to access to digital resources, since it is separate from the paper textbook • The digital resources do not match the students' requirements with personalized learning.
Real-time Interacting	• More flexible human computing interaction in real time, e.g. student-teacher interaction with iPads is instant; student-student interaction with iPads is instant.	• Mainly real time interaction between teachers and students via discourse, role-play.
Tracking Environment /Learning Process	• Beneficial for testing the learning environment, including sound effects, lighting, circuitry. • Beneficial for testing the learning processes, including monitoring the students' note-taking behaviors, degree of engagement.	• Difficult to monitor the learning environment and learning processes, • Challenging for creating a personalized learning environment

Table 9. Independent sample t-test of Student perceptions toward technology roles in eTRC and pTRC

	Classes	N	Mean	S.D.	t
Attitude to technology	pTRC	164	3.63	0.57	-3.277**
	eTRC	164	4.21	0.72	
Motivation	pTRC	164	3.86	0.75	-0.969
	eTRC	164	4.06	0.80	
Satisfaction	pTRC	164	3.70	0.50	-2.561*
	eTRC	164	4.20	0.80	

* $p < 0.05$, ** $p < 0.01$

This study paid special attention to the students' perceptions of technology roles in eTRC and pTRC, including attitudes towards technology, motivation and satisfaction. Therefore, Table 9 shows the T test results of students' perceptions toward technology roles in eTRC and pTRC. The scores of students' perceptions toward technology roles in eTRC are higher than 4.00 on averages. Students' attitudes to technology and satisfaction in eTRC are significantly higher than in pTRC. Regarding of motivation, there is no remarkable difference in eTRC and in pTRC. This means that students agreed with and had positive perceptions of technology roles when using eTextbooks in Technology rich classroom. Further, various technologies are used as learning tools for enhancing learning performance in order to meet the diversity of students.

4. Conclusion

In this study, we conducted a research on the changes of a class utilizing eTextbooks in K-12 schools initiatively, by using a mix-method design of interviews, questionnaires and on-site observation. We compared activity capacity, classroom behaviors and technology roles between eTRCs and pTRCs. The results and analysis above showed:

There are significant differences in class activity capacity between eTRC and pTRC. The ratio of classes which effectively completed the learning activities as planed in eTRC is higher than in pTRC, and Learner Engagement Indicator (LEI) in eTRC is significantly higher than in pTRC.

There are significant changes in classroom behaviors between eTRC and pTRC. The allocated time for teachers in eTRC is significantly lower than in pTRC and engaged time for students in eTRC is significantly higher than in pTRC. Students participate in classroom learning activities significantly initiatively and positively in eTRC compared to in pTRC.

Teachers are highly dependent on technology for implementing and administrating learning activities in eTRCs. Students' attitudes to technology and satisfaction in eTRC are significantly higher than in pTRC.

This is a tentative research on exploring the changes between eTRC and pTRC in K-12 schools, which need to be investigated on a larger scale incorporation more samples, and more evidence needs to be collected to confirm the findings of this research. Beijing Municipal government has sponsored a program that will conduct more research in the near future. The program will be done Beijing Digital School (BDS).

Acknowledgements

This research work is supported by Beijing Normal University research project “eTextbooks development technologies and its applicability research” and BDS program.

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