

## Chapter 7

# RETRACTED CHAPTER: Affordances and Constraints of BYOD (Bring Your Own Device) for Learning in Higher Education: Teachers' Perspectives

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**Abstract** This paper reports on a study in the Scholarship of Learning and Teaching (SoLT) aiming at examining the affordances and constraints of BYOD (Bring Your Own Device) for varied pedagogical practices from teachers' perspectives in higher education to enhance students' learning. Seventeen teachers from eight departments and centers participated in the 1-year study. The affordances and constraints of BYOD were examined under the "framework of affordances and constraints in BYOD-supported learning environment." Data collection included class observations, class videos, field notes, resources on the BYOD Web site, and teaching plans. Content analysis was adopted in the data analysis. The research findings show that (1) seven types of BYOD conceptualized affordances were identified for varied pedagogical purposes; and (2) three types of technical, social, and personal constraints were singled out. The findings provide insights for teachers to make use of the affordances of BYOD for innovative practices.

**Keywords** Bring Your Own Device · BYOD · Affordance · Constraint  
Higher education

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## 7.1 Introduction

Mobile devices have been embedded in higher education settings. In Hong Kong, in 2014, over 90% of youth (15–29-year-olds) owns a smartphone (<http://www.globe.hk/blog/smartphone-usage-hong-kong/>). More and more students use their devices for learning-related information access and communication purposes (Dennen & Hao, 2014). Parallel with it are the increasing trials of adopted BYOD (Bring Your Own Device) model in higher education (e.g., Dennen & Hao, 2014; Kobus, Rietveld, & Van Ommeren, 2013). BYOD refers to a technology model where students bring a personally owned device to support their studies (Alberta Education, 2012). Academics are exploring effective ways of integrating BYOD into student study lives both in and out of classes to bridge the gap between formal and informal learning. However, frequently reported from these studies are the ethical and security issues related to BYOD use in higher education (e.g., Kobus et al., 2013). Few studies have reported what BYOD can offer and what are the constraints of BYOD other than the reported issues from the perspective of practitioners in higher education. Thus, this study in the Scholarship of Learning and Teaching (SoLT) aims at exploring the affordances and constraints of BYOD for pedagogical practices from a group of teachers who are involved in the teacher professional development to enhance students' learning. It is expected that the findings will enhance teacher capacity in attempting to employ pedagogical innovations supported by BYOD and conduct SoLT work.

## 7.2 Related Literature

### 7.2.1 *BYOD in Higher Education*

Mobile technologies have been widely adopted in higher education. Many studies have investigated student perceptions on learning with mobile devices (e.g., Gikas & Grant, 2013; Viberg & Grönlund, 2013). A few studies have examined the application of designed learning environment or tools on mobile devices borrowed from universities to teaching and learning (e.g., Kobus et al., 2013; Sølvsberg & Rismark, 2012). However, it is reported that teacher-led adoption of BYOD in higher education remains scant (Dennen & Hao, 2014). Moreover, a recent study reported that students' high mobile device ownership rates by no means imply their preference or support for university BYOD strategies (Kobus et al., 2013). To benefit student learning with mobile devices, teachers play key roles. Nevertheless, many teachers are reportedly reluctant to use new technologies in their teaching due to various issues such as lack of competency in terms of technology use and pedagogical design, resistance in technology use, and lack of technical support (Dennen & Hao, 2014; Song & Looi, 2012). Thus, it is important to develop a teacher community to explore the affordances of BYOD for teaching and learning.

## 7.2.2 *Affordances*

Ecological approach takes the interaction of agent with environment as fundamental. Gibson (1979), from an ecological perspective posits, “Affordances exist only within the context of an animal—environment system” (p. 2). They are relational properties between the agent and the environment. Kaptelinin and Nardi (2012) maintain that Gibson’s theory of affordances is constrained in animal and natural environment relationships that cannot go beyond its scope to address the technology affordances in human–computer interactions. Thus, Kaptelinin and Nardi (2012) propose understanding technology affordances from a social-cultural perspective as “possibilities for mediated human action (p. 975)” because according to Wertsch (1998), human actions and mind are mediated by tools, including technology tools people use. Based on the definition of technology affordances, in this paper, the authors define affordances of BYOD as “possibilities of adopting BYOD for mediated pedagogical practices” where pedagogical practices refer to teaching and learning activities.

## 7.2.3 *Affordances of Mobile Technologies in Education*

The concept of technology affordances has also been used in the area of information and communications technology (ICT) including mobile technology applications in education to explore the possibilities that the educational technologies provide for students in ICT-rich learning environments (e.g., Churchill, Lu, & Chiu, 2014; Klopfer & Squire, 2008; Song, 2011). Affordances of mobile technologies have been used in varied learning activities, including but not limited to a multimedia access tool for learning by exploring and reflecting; a multimedia collection tool for learning by visualizing and reflecting; communication tool for learning by conversing; connectivity tool for learning by sharing; representation tool for learning by visualizing; and knowledge construction tool for learning by constructing (Churchill & Churchill, 2008; Jonassen, Hernandez-Serrano, & Choi, 2000; Song, 2011). However, the majority of the studies have either explored the affordances of designed tools on mobile devices for learning (e.g., Dennen & Hao, 2014) or affordances of mobile devices from student perspectives (e.g., Song, 2011). Few studies have examined the affordances of BYOD from the perspective of teachers. Understanding the affordances of ICT and its evolution in pedagogic practices helps support learners as they learn, and teachers as they make decisions on the adoption of new technologies (Conole & Dyke, 2004).

### 7.2.4 Constraints

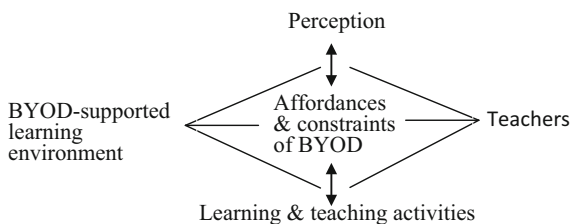
Gibson (1979) maintains that some affordances of the environment are beneficial and some are harmful. “Any one [technology] affordance can be considered to have both positive and negative connotations” (Conole & Dyke, 2004, p. 113). For instance, SMS can be used to send a message, and it can also limit the sending process if the message is a long text. Thus, Conole and Dyke (2004) argue that an affordance of the technology does not simply contribute to the intended use but also result in the unintended consequences. The affordances of ICT may not be exploited effectively without coping with these barriers. Norman (1998), from the perspective of a designer, points out three categories of action constraints of technologies. They are as follows: (1) physical constraints (the features of the technology); (2) logical constraints (the operation of technology system), and (3) cultural constraints (the way the technologies are used by conventions that are shared by a cultural group). Physical and logical constraints are all concerned with the device itself and thus can be considered technical constraints. In addition, cultural constraints should be addressed in a wider scope to include broader social factors such as institutional and community factors (Jonassen et al., 2008; Song, 2011). Finally, the user’s personal factors may also be a type of constraints in perceiving and acting on the affordances. Thus, the three categories of technical, social, and competence constraints are examined in this study when we investigate teachers’ perceptions of and actions on BYOD affordances.

### 7.2.5 Framework of Affordances and Constraints of BYOD in Higher Education

Affordances of BYOD cannot be perceived and used in isolation from what happens in the learning environment as a whole. Adapted from van Lier (2004)’s affordances in context framework (p. 96), we developed the framework of affordances and constraints in BYOD-supported learning environment (see Fig. 7.1).

Figure 7.1 shows that teachers, the BYOD-supported learning environment, perception, learning and teaching activities, and affordances and constraints of BYOD are all relational. In addition, perception of the teachers in the

**Fig. 7.1** Framework of affordances and constraints in BYOD-supported learning environment



BYOD-supported learning environment for specific learning and teaching activities influences the adoption of affordances of BYOD to mediate pedagogical practices and the encounters with constraints; on the other hand, specific learning and teaching activities in the BYOD-supported learning environment may also influence the teachers' perception of the adoption of affordances of BYOD and consideration of constraints. In this study, affordances of BYOD to mediate teaching and learning and constraints of BYOD are examined from teachers' perspectives under this framework. The research questions to be addressed are as follows:

1. What are the affordances of BYOD for learning and teaching in higher education from teachers' perspectives?
2. What are the constraints of BYOD encountered in learning and teaching in higher education from teachers' perspectives?

### **7.3 Research Methods**

This study situates in a 2-year research project "BYOD (Bring Your Own Device) for reflective engagement of learners in digital classrooms." This paper reports on the research results obtained from the first year's study.

#### **7.3.1 *Participants***

Participants were recruited through the institute-wide e-mail invitation for voluntary participation in the project. In the first semester, 13 teachers joined the project, and in the second semester, another 4 teachers joined the project. Thus, there were 17 teachers in total as BYOD project members involved in the first-year project. The teachers numbered from 1 to 17 were from different departments or centers at a higher education institute (see Table 7.1). Four teachers had 1–3 years' experience in teaching with mobile technologies. The rest had no prior experiences. They took 22 courses in total involving 520 students. A few teachers took more than one course in the project. A BYOD Web site was designed for community building and BYOD implementation support, where an introduction to the project, featured activities, and BYOD resources (sample teaching schemes, BYOD class video clips, and various apps for BYOD) was provided.

**Table 7.1** Profile of the 17 teachers numbered from 1 to 17

Teacher	Department/Center	Teaching experience in mobile technology use
1	Mathematics and Information Technology	Mobile-supported pedagogy for 3 years
2	Mathematics and Information Technology	Mobile and seamless pedagogy for 2 years
3	Curriculum and Instruction	New trial use
4	Mathematics and Information Technology	New trial use
5	Mathematics and Information Technology	New trial use
6	Health and Physical Education	New trial use
7	Health and Physical Education	New trial use
8	Mathematics and Information Technology	New trial use
9	Linguistics and Modern Language Studies	Mobile-supported pedagogy for 2 years
10	Mathematics and Information Technology	New trial use
11	Literature and Cultural Studies	New trial use
12	Chinese Language Studies	New trial use
13	Science and Environmental Studies	New trial use
14	Language in Education	Mobile-supported pedagogy for 1 year
15	Language in Education	New trial use
16	Mathematics and Information Technology	New trial use
17	Mathematics and Information Technology	New trial use

### 7.3.2 *BYOD-Supported Learning Environments of the 17 Teachers*

Learning environment, in a broad sense, relates to almost everything in the pedagogical practices. In this paper, regarding the BYOD-supported learning environments, we focus on the physical facilities (e.g., WiFi), the courses taken by the teacher, and the BYOD apps or learning platform that the teacher adopted for different purposes. The BYOD-supported learning environments of the 17 teachers are shown in Table 7.2. Among the 17 teachers, except Teacher 14 and Teacher 15, all the other teachers took different courses, but some of them adopted the same apps. For example, 8 teachers chose Moodle and 6 teachers chose Edmodo as the learning management platform and social learning platform respectively. In addition, Google Drive and QR code apps were also adopted by a few teachers.

**Table 7.2** The BYOD-supported learning environments of the 17 teachers

Teacher	Course	Apps/platforms and their uses for different purposes in WiFi covered environments
1	E-learning in primary schools	Edmodo for online discussion, ideas sharing, and reflection
	E-learning in a Green and Cloud Computing Environment	
2	Mobile Technology and Society	Moodle, Google Drive, and QR code for Mobile learning and seamless learning using project-based approach
	The Phenomena of Internet and Digital Cultures	
3	General Education Foundation Course—Making Sense of Facebook; Smartphones, Tablets, WhatsApp and iEverything	Edmodo for polling
4	Honors Project	Edmodo, MindMeister, iPad Camera for polling, mind maps and presentation
	Web Database Design and Implementation	
5	Information Technology in Education	Edmodo, TotalRecall and Mindjet Maps for mobile learning and collaborative learning
6	Integrative Nutrition	Moodle for lunch recipe critique
7	Health Behaviors—Theory and Program Planning	Google Drive for student presentation and peer evaluation and reflection
8	Web Services Fundamentals	Moodle and Google Drive for Project outline construction/peer review
9	Introduction to Linguistics	Moodle, WiKiBook, Google Translate, Natural Reader, Dvolver, and Moviemaker for mobile language learning
10	Understanding Numbers	Edmodo for polling and in-class exercise submission
	E-Learning in a Green and Cloud Computing Environment (2014/02)	Lino for field trip planning
11	Creative Writing	Moodle for Collaborative poem construction exercise
12	Cantonese and Local Culture	Chinese Text Project ( <a href="http://ctext.org/zh">http://ctext.org/zh</a> ) for Cantonese phrase exercise
13	General Education Foundation Course Tutorial	Facebook, Google Drive and QR code for online discussion, ideas sharing and ICT tools exploration
14	English for General Academic Purposes	Moodle, Socrative and Google Drive for reading and writing exercises
	Subject Specific English Enhancement	
15	Subject Specific English Enhancement	Google Drive for reading exercises
16	Web Intelligence	Schoology for student presentation and peer assessment
17	Managing and Teaching in an IT-rich Environment	Moodle, Google Map and QR code for mobile learning

### 7.3.3 Data Collection

Data collection includes class videos, teacher interviews, field notes, teaching plans, and resources on the BYOD Web site. The BYOD project members were suggested providing at least one teaching plan for a lesson for class observation and video-taping in the first year, where field notes were taken. Some teachers were observed and video taped more than one lesson. There were totally 22 class videos and field notes collected. In addition, 17 individual teacher interviews were conducted to understand teachers' perceptions of BYOD for teaching and learning. The teacher interview included questions in the three categories: BYOD advantages for learning and teaching, BYOD constraints, and teacher attitudes toward using BYOD for learning and teaching. Teaching plans were collected from teachers prior to their enactment of the BYOD lesson. The BYOD Web site includes data such as sample teaching schemes and BYOD class video clips.

### 7.3.4 Data Analysis

All the teachers' class videos were reviewed, focusing on examining the affordances of BYOD and constraints in pedagogical practices. Drawing on pattern clarification strategies for identifying themes and patterns (Huberman & Miles, 1994), categories of affordances and constraints were coded. All the teacher interviews were transcribed to understand the teachers' perceptions of the affordances and constraints of BYOD for learning and teaching. The affordances and constraints of BYOD were triangulated by teaching plans, teacher interviews, field notes, and resources on the BYOD Web site. Table 7.3 shows the data collection and analysis for addressing the research questions.

**Table 7.3** Data collection and analysis

Data	No.	Q1. affordances	Q2. constraints
Class videos	22	x	x
Teaching plans	22	x	x
Field notes	22	x	x
Resources on BYOD Web site	<sup>a</sup>	x	x
Teacher interviews	17	x	x

<sup>a</sup>Resources on BYOD Web site cannot simply be counted as they have different categories



## 7.4 Results

Both the affordances and constraints of BYOD were examined under the “framework of affordances and constraints in BYOD-supported learning environment” as shown in Fig. 7.1. The results are reported in this section.

### 7.4.1 *Affordances of BYOD for Learning and Teaching*

Seven types of affordances of BYOD were conceptualized for varied learning activities. They are as follows: resource access tool, communication tool, resource collection tool, resource submission tool, knowledge construction tool, resource sharing tool, and representation tool. The description of the tools and learning activities are shown in Table 7.4.

Table 7.5 shows that resource access is the mostly reported uses of BYOD affordances for varied learning and teaching activities (9 reported cases); and representation is the least reported use (3 reported cases).

We also summarized the 17 teachers’ perceptions of the affordances of BYOD in 13 categories, namely BYOD can be used for (a) communication within and beyond the classroom; (b) project-based learning within and beyond the classroom; (c) engaging students in a large-size lecture; (d) bridging the gap between lectures and tutorials; (e) tracking students’ learning process within and beyond the classroom; (f) motivating students to learn; (g) designing collaborative activities; (h) planning authentic learning activities beyond the classroom; (i) planning authentic learning activities within and beyond the classroom; (j) student access of learning resources and information within and beyond the classroom; (k) student sharing of their work within and beyond the classroom; (l) student review and comment on others’ work within and beyond the classroom; and (m) student continuity of their work after class.

By comparing the perceptions of the teachers with the affordances of BYOD they used in the BYOD-supported learning environment, it is noted that the teachers’ perceptions are consistent with the affordances of BYOD adopted in their pedagogical practices. It is noted that Teachers 1, 2, 9, and 14 perceived very positively about how to adopt the affordances of BYOD to mediate their pedagogical practices not just in one lesson but in the entire course they taught. Teacher 1 reported that with BYOD, he was able to be connected with the students on Edmodo social network platform, and engage them in learning activities anytime, anywhere throughout the course; in addition, the online learning activities mediated by BYOD left “footprints” that helped students with their reflective learning and helped teachers with the refinement of pedagogical designs. Teacher 2 reported that with BYOD, she could enact mobile and seamless learning using project-based learning approach more effectively in the whole course on the learning management platform—Moodle and using different apps such as Google Drive and QR code as tools for varied teaching and learning purposes. Teacher 9 reported that he had been

**Table 7.4** Seven conceptualized BYOD affordances for varied learning and teaching activities

Affordance	Learning activities	Description
Resource access	Instructional	Accessing online/downloaded resources in order to improve various skills such as English/Chinese listening, reading, speaking, and writing skills
	Referential	Accessing online/downloaded resources as a reference to complete various learning tasks
	Reflective	Assessing course materials on learning platforms for course review and reflection such as accessing online/downloaded recorded lectures, lecture handouts, and other course-related materials to improve one's understanding of the course concepts
	Explorative	Accessing the Internet to explore useful online resources to formulate research questions or identify research problems
	Collaborative	Accessing information shown on the mobile device together with peers for collaborative learning
	Interactive	Decoding QR code to interact with the content presented in text, images, or a Web link which leads to the learning resources
Communication	Socializing	Communicating for socializing purposes on social network platforms
	Collaborative	Communicating for the purposes of discussing and sharing certain things and working together on learning management platforms of social network platforms
	Informative	Communicating for informing others' information about study or current events
Resource collection	Reflective	Capturing notes and images for later review and reflection; collecting survey data for reflective learning and teaching
Resource submission	Submitting	Uploading learning-related resources such as assignments and useful information
Knowledge construction	Constructive	Creating, editing, or drafting documents, such as assignments and reports using Word Mobile, Google Drive, or other downloaded software
Resource sharing	Collaborative	Facilitating collaborative work by sharing files via varied apps such as NFC, Google Drive, and QR code.
	Reflective	Sharing work and providing reflective comments for peers on varied learning platforms
Representation	Visualizing	Creating visualization and representations that demonstrate thinking and knowledge such as representing images or video clips on the mobile device to improve one's understanding of the concept or idea

using the affordances of mobile devices in his pedagogical practices for over 2 years, including the sample lesson provided for us. In his course, he always encouraged students to use BYOD to access the learning platform—Moodle and apps such as Moodle, Wiki Book, Google Translate, and Moviemaker to access,

**Table 7.5** Affordances of BYOD and their uses by the 17 teachers

Teacher	Affordance	Resource access	Communication	Resource collection	Resource submission	Knowledge construction	Resource sharing	Representation
1		Reflective referential	Collaborative informative		Submitting		Reflective	
2		Explorative interactive		Reflective	Submitting	Constructive	Collaborative	Visualizing
3			Collaborative	Reflective				
4				Reflective	Submitting			Visualizing
5							Collaborative	Visualizing
6		Referential				Constructive		
7							Collaborative reflective	
8		Referential					Collaborative reflective	
9		Explorative			Submitting	Constructive	Collaborative	
10			Collaborative			Constructive	Collaborative	
11								
12		Referential						
13			Socializing collaborative					
14		Instructional referential collaborative		Reflective	Submitting	Constructive		
15		Collaborative				Constructive		
16							Reflective	
17		Referential collaborative						

construct, create, and share their artifacts. Teacher 14 had been keen on mobile technology use to engage students in their language learning for over 1 year. In the sample lesson, she utilized the affordances of Moodle, Google Drive, and Socrative to mediate various pedagogical practices. This indicates that Teachers 1, 2, 3, and 4 perceived the pedagogical value of BYOD and had the motivation and capabilities to use a range of affordances in their practices in the BYOD-supported learning environment.

While, the other 13 teachers, also perceived and acted on affordances BYOD for learning and teaching, but centered on using an app or a platform for task-based activities as a trial teaching practice without continued intention, perception and action on the BYOD affordances to mediate learning and teaching activities.

### 7.4.2 Constraints of BYOD Encountered in Learning and Teaching

Teacher perceived constraints of BYOD in pedagogical practices are identified in three areas: technical, social, and personal constraints with descriptions (see Table 7.6).

**Table 7.6** Perceived constraints of BYOD in learning and teaching

Perceived constraints		Description
Technical	App functionality	<ul style="list-style-type: none"> <li>• Some versions of mobile applications are not functioning well and students encounter problems when using the apps to complete tasks</li> <li>• The design of the learning management system is not very mobile-friendly and students have to log in a few times when completing a learning task</li> <li>• The Web browser mobile apps cannot properly display some of the uncommon Chinese characters</li> </ul>
	Screen size limits	<ul style="list-style-type: none"> <li>• The screen size of some devices is very limited, and it is difficult for students to use smartphones to complete tasks that involve a large amount of typing actions, e.g., to construct an e-questionnaire, to read and draw</li> </ul>
	WiFi infrastructure	<ul style="list-style-type: none"> <li>• WiFi network on campus is not stable, which makes the adoption of BYOD challenging for both teachers and students. The teacher has to come up with a backup plan, and students have to spend much time waiting for loading contents</li> </ul>
	Lack of recharge facility	<ul style="list-style-type: none"> <li>• There were inadequate power outlets for students to recharge their devices, and it was problematic when their devices run out of battery</li> </ul>
	Computing power: desktop versus BYOD	<ul style="list-style-type: none"> <li>• In some IT courses, students may rely on desktops in computer laboratories since those computers are more powerful and the keyboard is more comfortable to work with compared to mobile devices</li> </ul>

(continued)

**Table 7.6** (continued)

Perceived constraints		Description
Social	Equity	<ul style="list-style-type: none"> <li>When students bring different mobile devices into the classroom, how to leverage the differences between powerful and less powerful devices so as to ensure learning equity becomes a concern</li> </ul>
	Teaching support	<ul style="list-style-type: none"> <li>When adopting BYOD, more support needs to be provided in class both for teachers and students</li> </ul>
	Less face-to-face communication	<ul style="list-style-type: none"> <li>The use of mobile devices may reduce face-to-face interaction between students and teachers</li> </ul>
Personal	Technical competence of teaching staff	<ul style="list-style-type: none"> <li>It may be hard for teachers who do not have an IT background to teach with mobile technology</li> </ul>
	Technical competence of students	<ul style="list-style-type: none"> <li>Students need time to get used to utilizing mobile devices for learning in class (e.g., typing out an equation in mathematics learning)</li> </ul>
	Unwillingness to use BYOD	<ul style="list-style-type: none"> <li>There are still teachers who are not interested in or uncomfortable with using mobile devices to teach, so it would be hard to make BYOD sustainable in the school when only some teachers are willing to adopt them</li> </ul>
	Time consuming	<ul style="list-style-type: none"> <li>To carry out learning activities with the use of mobile devices may be time-consuming</li> </ul>
	App choices for BYOD	<ul style="list-style-type: none"> <li>Students bring in different types of devices running various operating systems, so the teacher has to leverage these differences when choosing which apps to use</li> </ul>
	Pedagogy	<ul style="list-style-type: none"> <li>BYOD does not fit in every course or every topic. Teachers have to evaluate whether it is appropriate to integrate BYOD into learning and teaching activities because sometimes it would make teaching less effective</li> </ul>

In order to better understand the constraints, we present the identified constraints reported by the 17 teachers in Table 7.7.

Table 7.7 shows that technical constraints were mostly reported by the teachers, which account for 58% (21) of the total reported constraints (36), followed by personal factors and social factors. Among the technical constraints, WiFi infrastructure problems were the mostly identified constraints for teaching and learning practices. In this study, all the teachers reported that they encountered various difficulties in terms of technical, personal, and social constraints while adopting the affordances of BYOD. The most reported constraints were technical constraints of unstable WiFi infrastructure followed by the constraints of app functionality across different operating systems and screen size limits. The social constraints identified by Teachers 1, 9, and 14 were concerned mainly with equity issues that the quality of BYOD brought by the students might be different. The personal constraints reported by Teachers 11, 15, and 17 were about the pedagogy concerns. To them, in many cases, conventional teaching such as lecturing was more effective than

**Table 7.7** Constraints encountered by teachers of the study

Perceived constraints of BYOD in trial teaching	Teacher																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Technical (21)	App functionality	✓									✓						
	Screen size limits		✓						✓								
	WiFi infrastructure		✓	✓	✓					✓			✓		✓	✓	✓
	Lack of recharge facility					✓											
	Limited computational power							✓									
Social (5)	Equity	✓							✓					✓			
	Teaching support									✓							
	Less face-to-face communication													✓			
Personal (10)	Technical competence of teaching staff	✓					✓										
	Technical competence of students									✓			✓				
	Unwillingness to use BYOD			✓													
	Time consuming					✓											
	App choices for BYOD							✓									
Pedagogy constraint										✓				✓		✓	

innovative practices due to technical constraints of technologies. Many teachers reflected that due to the unstable Internet connection and the slow data transmitting speed, they felt disappointed, even annoyed when using BYOD in their pedagogical practices. This slowed down the lesson progress and discouraged them to use BYOD in class. However, some teachers also came across technical difficulties and they were able to cope with the constraints and explore new possibilities.

## 7.5 Discussions

The results of this study show that the 17 teachers from different departments designed different learning activities in BYOD-supported learning environments using different apps, they had different perceptions of the adoption of BYOD in teaching and learning, and the affordances of BYOD employed by the teachers are diverse. It is noted that some teachers adopted a range of affordances of BYOD in learning and teaching; while others only adopted one or two affordances. Some teachers experienced only technical constraints; while others also experienced personal and social constraints. The rest of this section will discuss the interplay between teacher perceptions, BYOD affordances and constraints, and mediated teaching and learning activities in BYOD-supported learning environments.

Firstly, BYOD affordances can be perceived and used on conditions of the learning environments supports the BYOD use; and the teacher has the intention and capability of taking pedagogical actions. This study shows that to perceive and actualize the BYOD affordances to mediate learning and teaching activities, on the one hand, the environment needs to enable the BYOD to be employed in the environment; on the other hand, the intention and capabilities of the teacher in taking the pedagogical actions are also critical (Jonassen et al., 2000; Song, 2011). According to the statistics of smartphone usage in Hong Kong in 2014, over 90% of youth (15–29) have the ownership of it and 96% of smartphone users use their phone to go online (<http://www.go-globe.hk/blog/smartphone-usage-hong-kong/>). This indicates that nowadays the learning environments are most likely supportive for BYOD use with Internet connections despite of the unstable WiFi connection problems, the big challenge is how teachers can be motivated to explore more possibilities of making use of BYOD for innovative pedagogical design. Nevertheless, Dennen and Hao (2014) report that teachers are reluctant to accept mobile technology-supported innovative approaches because these are deemed complex and contradictory to their routine pedagogical designs. Thus, teacher professional development is needed in this regard to empower teachers in innovative practices with new technologies.

Secondly, the capabilities for perceiving and acting on BYOD affordances can be increased in the pedagogical practices. This study shows that the teacher's capabilities of perceiving and acting on the BYOD affordances can be increased when she/he is increasingly involved in the innovative pedagogical practices because the affordances adopted in the earlier events can be employed to transform

the nature of later events (Song, 2013). It is noted in this study that resource access tool was used more frequently than any other tools. However, some teachers such as Teachers 1, 2, 9, and 14 adopted more types of affordances for a range of learning and teaching activities. The four teachers had 1–3 years' teaching experiences in using mobile technologies in their pedagogical practices. Their intention of adopting BYOD affordances in this study did not end with one lesson, but spanned over the whole course; while the other 13 teachers could not sustain the use of the affordances of BYOD in other lessons due to their unwillingness or lack of technological and pedagogical competence in sustained practices. This indicates that teachers need to be exposed to more BYOD-mediated pedagogical practices to enable them to perceive and employ the more affordances.

Thirdly, affordances and constraints of BYOD coexist in the learning and teaching activities. Affordances and constraints are coupled (Conole & Dyke, 2004). A number of constraints have been identified in this study, especially in terms of WiFi infrastructure and app functionality across different platforms. These constraints suggest that before making large-scale applications of BYOD in higher education, WiFi infrastructure needs to be improved to make Internet connection stable and fast, which is crucial for successful BYOD applications; and more and more apps across different operating systems should also be developed. In addition, some teachers pointed out the pedagogical constraints in using BYOD. A recent study reported that students' enthusiasm for using BYOD for learning anytime, anywhere might be reduced as time goes on (Rinehart, 2012). Thus, the use of the technology alone would be insufficient to foster learning and teaching without the adoption of appropriate pedagogies (Ertmer & Ottenbreit-Leftwich, 2013). For example, Teacher 9 reported, "BYOD does not fit in every course or every topic. Teachers have to evaluate whether it is appropriate to integrate BYOD based on the course content." This indicates that teachers need to improve their pedagogical approaches and intentionally adopt innovative pedagogy with technology through professional development. As for some teachers' concerns that BYOD strategies may affect the students in lower economic status which has also been expressed in the existing literature (e.g., Margaryan, Littlejohn, & Vojt, 2011), Kobus et al. (2013) argue that all students nowadays have a high probability of owning a mobile device powerful enough to support their studies. Thus, the constraints will become less and less evident with time goes on.

## 7.6 Conclusion and Implications

This study reported a study involving 17 teachers' perceiving and acting on affordances of BYOD for pedagogical practices, and conceptualized 7 affordances of BYOD for varied learning purposes. Three types of constraints were identified in the teachers' pedagogical practices. This research study is exploratory in nature and is by no means meant for generalization. Nevertheless, the research findings render



theoretical and practical implications for BYOD-mediated pedagogical practices in higher education.

Theoretically, this study developed the framework of affordances and constraints in BYOD-supported learning environment, which is useful for understanding the factors that influence teachers' perception and action on the affordances of BYOD for pedagogical practices. In addition, the conceptualized affordances and constraints of BYOD expand the dimensions in studying the advantages and limitations of the adoption of BYOD in higher education, which help extend learning outside the classroom and remove the dichotomy between formal and informal learning.

Practically, the affordances of BYOD can be further developed through a large-scale study in more fine-grained details in an attempt to set up an "affordance bank" with "best practice scenarios" to support SoLT work and staff capacity building for innovative practices. It can benefit more teachers to make flexible use of the affordances to design learning activities to achieve intended learning outcomes across different settings; it can also empower teachers to make use of the online learning trails on BYOD to assess students learning process, and identify their learning problems to make pedagogical refinement, where it is necessary to realize a paradigm shift from teacher-centered instruction to student-directed learning.

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