A Cloud-based Awareness Classroom Learning Activity Portfolio System Based on iBeacon for Flipped Classroom

Hung-Hsu TSAI ^{a*}, You-Ming YONG ^b, Jie-Yan PENG ^c, Kuo-Ching CHIOU ^d& Pao-Ta YU^e

^{a b c} Department of Information Management, National Formosa University, Yunlin, Taiwan.
^d Department of Finance, Chaoyang University of Technology, Taichung, Taiwan.
^e Department of Computer Science and Information Engineering, National Chung Cheng University, Chiayi, Taiwan.

*thh@nfu.edu.tw

Abstract: The paper presents a cloud service system that builds students' awareness classroom activity portfolio. Here the system is call a classroom learning activity portfolio (CLAP) system. It utilizes iBeacon devices, a kind of wireless devices to connect without human intervention, as awareness functions in the learning environment construction. Also, it develops APPs for mobile devices to get students' classroom activity portfolio, and then to keep them in the cloud server of the system. Additionally, Apps offers web links for learning. There are several types of students' classroom activity portfolio including log data of recording students enter/leave classroom, responses to pushing information once students entered classroom, and distances from students' position (seat) in classroom to teacher' presentation location (for example, the front desk of the classroom). The CLAP system can offer analysis results of the classroom activity portfolio. Hence, it can help students who can readily send their records or responses on class in classroom. Moreover, they do not require in typing many data (for example, long URLs) for interacting with the portfolio collection system. Furthermore, the system can assist teachers in collecting students' classroom activity portfolio, and then to have analysis results of the portfolio. For instance, teachers can get the result that students entered classroom but they send less or no feedback in classroom to the cloud server. Experimental results demonstrate the CLAP system has high learning interests while applying it in flipped-classroom learning.

Keywords: iBeacon, Flipped Classroom, Bluetooth4.0, Classroom Learning, Classroom Activity Portfolio.

1. Introduction

Recently, e-Learning is becoming popular in our life. More and more courses are teaching over Internet via asynchronous and synchronous learning manners so as to enhance learning performance. However, how to increase high interaction among teachers and students during e-Learning is still a critical research topic. Therefore, it is an emerging popular issue to develop appropriate information technology for classroom learning (c-Learning) and then to blend c-Learning with e-Learning such that learning performance can be further promoted (Domingo & Gargante, 2016; Volk et al., 2017; López, 2010).

Nowadays, mobile devices (like smart phones and tablets) are widely used in our life (Moreira et al., 2016). Especially, how to increase high interactions for c-Learning via integrating wireless sensor technology with mobile devices in constructing awareness learning environments is an important research issue. Here the paper first presents the design of a learning awareness environment (LAE) based on wireless sensor technology, and then proposes the CLAP system based on the LAE, which provides functions to collect students' learning activity portfolio in traditional classroom via Apps, and also offers analysis results for these portfolios. According to the results, teachers can

quickly figure out students' learning performance for teaching contents students studied so that they may adjust their teaching strategy or method.

The CLAP system is able to support the so-call flipped classroom, a pedagogical strategy, when it is applied in learning in traditional classrooms. In this flipped-classroom instruction model, students study instructional contents (almost online video materials) outside of classroom. Hence teachers have more time to discuss with students on class for the instructional contents inside of classroom. Accordingly, a key issue is to develop information technology to promote high interaction while involving flipped classroom inside of classroom. The proposed system can aid the flipped-classroom instruction model. For example, the system offers teachers a function to post students' questions for readings or instructional contents teachers assign before class time. Once students entered classroom, APPs automatically get/display students' questions the system pushes. Then, students are encouraged to send responses with respect to the pushing information (students' questions) to the CLAP system. This way is capable of increasing more interaction between teachers and students in classroom.

In the paper, the CLAP system builds a LAE using iBeacon devices as wireless sensor facilities. Also, it offers APPs for mobile devices to acquire students' classroom activity portfolio containing several types of students' classroom activity portfolio: records that students enter/leave classroom, responses to pushing information once students entered classroom, and distances from students' seat to teacher' presentation location (for example, the front desk of the classroom). The CLAP system also can offer analysis results of the classroom activity portfolio. Finally, the paper presents evaluation results of using the CLAP system for flipped classroom instruction in classroom via a questionnaire survey for the learning interests scale. The results show that the CLAP system helps students to have high learning interests.

The remainder of this paper is organized as follows. Section 2 briefly reviews related flipped classroom and iBeacon. Section 3 describes the CLAP system. Section 4 shows the experimental results. Conclusions are drawn in Section 5.

2. Literature Review

2.1. Flipped Classroom

Nowadays, flipped classroom is a widespread pedagogical strategy, which is learner-centered instead of teacher-centered. Learning is not limited in classroom, on the other hand, it can be extended to outside of classroom. Due to learning on-line teaching materials outside of classroom, learning inside classroom time can be used more efficiently (Gilboy, Heinerichs, & Pazzaglia, 2015). For example, student can share or discuss their thoughts that not learning in the class with others via teachers' guidance (Diller, 2015). This makes short and rigid class time for learning to be more effective and efficient. That is, it has more time for discussions or other activities in class time (Obradovich, Canuel, & Duffy, 2015). Moreover, studying outside classroom learning results in that students evaluate their study situation by themselves. That is, if students deem that they still need more time to further study teaching materials, they can repeatedly study these materials through outside classroom learning (Evseeva & Solozhenko, 2015).

2.2. iBeacon

Apple iBeacon is a protocol for connecting wireless devices without human intervention, which provides location service and pushing notification. Apple iBeacon adopts Bluetooth Low Energy (BLE) technology broadcasting near field signal (about 100 meters) within an interval area. Many smart mobile devices were added iBeacon functionality in their operation system. Hence the smart mobile device plays a role as a reader device, which either scans for nearby iBeacons devices or connects to such iBeacon devices to retrieve or exchange information (Radhakrishnan, Misra, Balan, & Lee, 2015). Many iBeacon-based applications taking smart mobile devices as readers were proposed, for instance, indoor location tracking (Chen, Zhu, Jiang, & Soh, 2015). Some attributes iBeacon devices offers, for instances, UUID, RSSI, TX Power, Major, and Minor, can be used in

device identification and distance estimation. UUID is employed to differentiate a large group of related iBeacon devices. One important feature of using iBeacon devices is to calculate distance from an iBeacon device to smart mobile devices by getting iBeacon's RSSI attribute (signal strength). TX Power is exploited to compute proximity (distance) between iBeacon devices and smart mobile devices. Major and Minor are employed in distinguishing a smaller subset of iBeacon devices and identifying individual iBeacon devices in the subset, respectively.

3. System Description

3.1. Building a LAE in classroom

Figure 1 shows the design concept of building a LAE in a traditional classroom. The LAE contains iBeacon devices inside classroom, students' smart mobile devices installed APPs, a cloud server, a database server, and wireless network utility. The CLAP system collects students' classroom learning activity portfolios via APPs. Once APPs query iBeacon devices, the target iBeacon device send the corresponding action to APPs. Subsequently, APPs automatically display pushing information to students due to pushing information being get from the cloud server. Therefore, students can response these information via sending their responses to the cloud server. Meanwhile, APPs automatically send proximity distance between students' locations and iBeacon devices to the cloud server by connecting to wireless sensing technology. The pushing information teachers create in the paper consists of bulletins, key points of courses, students' questions for studying teaching contents outside classroom, and supplementary teaching materials. The pushing information can be made before class or in-class time.

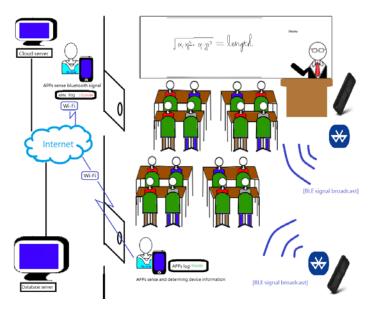


Figure 1. The design concept of building a LAE in traditional classroom.

3.2. The CLAP System Structure

Figure 2 displays the structure of the CLAP system, which consists of three main components: teachers' web APPs (implemented by Responsive Web Design, RWD), students' mobile devices with APPs, and cloud services. The system offers teachers pushing information management and query learning performance which can be obtained by calculating students' learning activity portfolio in classroom. Students' mobile devices can automatically read iBeacon's BLE signal, and APPs in mobile devices can get related location information for iBeacon devices, and send the location information to the cloud server. Meanwhile, APPs trigger the corresponding action which was set up in the cloud server. Subsequently, APPs exhibit pushing information for students, and then students

send responses for pushing information to the cloud server. Several data for students' learning activity portfolio in classroom are kept in database server, which include pushing information, responses for pushing information, location information, log of entering/leaving classroom, distance from lectern, etc.

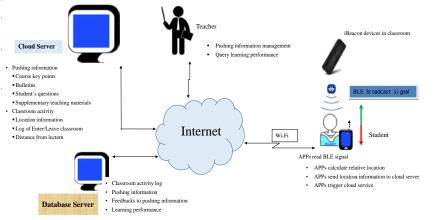


Figure 2. The structure of the CLAP system.

3.3. A flipped-classroom learning process using the CLAP system

The CLAP system can be used to support c-Learning in traditional classrooms while applying flipped classroom for learning in traditional classrooms. The CLAP system can help teachers and students to have high-interaction learning activity on class time in classroom. Figure 3 draws the process of using the CLAP system to collect students' awareness classroom activity portfolios. First, teachers manage push information, for example, creating students' questions for reading on-line teaching materials. Then, students' mobile devices automatically sense iBeacon devices when students enter classroom on class time. APPs in mobile devices send log data of entering classroom and trigger corresponding cloud services. For instance, APPs display students' questions teachers create before class time. Subsequently, students can send responses for pushing information to the cloud server. This way of sending what kinds of responses can be used to measure students' level to learn on class time.

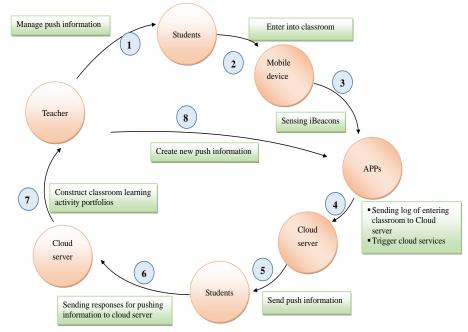


Figure 3. The process of using the CLAP system to collect students' awareness classroom activity portfolios.

In Figure 3, the process of using the CLAP system to collect students' awareness classroom activity portfolios is briefly described as follows. Suppose students had finished to study on-line teaching materials and teachers also got their questions from learning management systems or other learning platforms.

- Step 1. Teacher creates pushing information before class time.
- Step 2. Students' smart mobile devices get ready before entering classroom.
- Step 3. Students' smart mobile devices automatically query iBeacon devices in classroom while entering classroom.
- Step 4. Once iBeacon device is read, APPs get position information for target iBeacon devices. Apps send students' position information to the cloud server, and also trigger corresponding cloud services which are specified in advance associated with iBeacon devices.
- Step 5. The corresponding cloud services is to push information to Apps.
- Step 6. Students utilize APPs to send responses for these pushing information to the cloud server. Some students may do nothing for the pushing information.
- Step 7. The cloud server collect records sent by APPs, which including students enter/leave classroom, responses to pushing information once students entered classroom, and distances from students' seat to teacher' presentation location (for example, the front desk of the classroom. It construct these types of records to form students' classroom activity portfolios. Subsequently, it also can offer analysis results of the classroom activity portfolios when teachers query the results.
- Step 8. Teachers may create or update pushing information on class time for interacting with students. The system can perform high interaction on class time due to having time limits for sending responses for pushing information. The process is repeated starting Step 3 until students leave classroom or class closed.

4. Evaluation Results

Thirty-nine students (29 males and 10 females) participated in the experiment, who are in a university of science and technology in the middle of Taiwan. They have smart phones with Android system. In the experiment, only Android version of APPs is developed. Student survey of using the CLAP system for the class, "Business Data Communications" adopting flipped-classroom pedagogical design. These students receive the use of the CLAP system and the process of classroom activity mentioned in Subsection 3.3., as shown in Figure 3. The students voluntarily answer the questionnaire. The questionnaire has 11 items for learning interests. The items (questions) of learning interests were reedited according to (Hwang & Chang 2011) such as "In the Business Data Communications class use CLAP system APPs are fun". The questionnaire is written in Chinese. The questionnaire adopts five-point Likert scale. Each item has five options, from 1 "strongly disagree" to 5 "strongly agree." The higher score means the higher perception of effectiveness for the case of exploiting the CLAP system. The validity of the items is gained by two experts who major in information management. Figure 4 shows descriptive statistics were used to summarize all variables (questions) for learning interests.

Figure 5(a)-(d) illustrate the editing for the contents for four kinds of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively. Figure 4(a) displays APPs in smart mobile device offers login function to identify legal users. Figure 5(b) displays in getting students' locations via smart mobile devices. Once iBeacon devices are read, APPs display signal status for location information on screen of students' mobile devices. Figure6 (c) shows log data for student's position information exhibited in Figure 6(b), which are kept in the cloud server. Figure 6 illustrate that student's APPs display three kinds of responses for four sorts of pushing information. Figure 7 (a)-(d) exhibit four operating screens for four sorts of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively. Figure 8 (a)-(d) show detailed results of students' responses for four sorts of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively. Figure 9 presents summary results of three choices each student chooses for four kinds of pushing information.

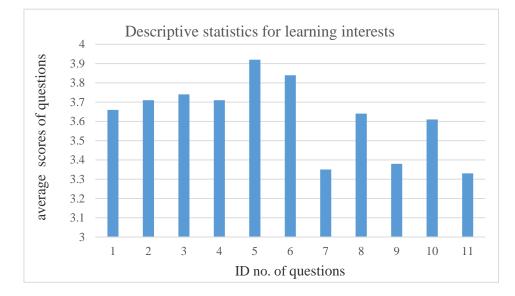


Figure 8. Results in terms of descriptive statistics to summarize all questions for learning interests.

挂播資料表列			Resa	推播資料表列			RUSH
	14		EF BB		54		####
Bulletins				Course key	points		
			8369552		1		******
般公告	Title	Content		授課重點			
8		f 8		BN	📲 Title	M Content	
876/314/0/25	201746-03年日蘇聯十七團一一級公司一	BRANDAR - 1. BIZ-KANDO-CO 2.2 MAIN-2002/07 M		2017/6/13 114 11/08 40	20140-13-9588-428-88888-14	151 DV5 152 DH2P 152 DW2P 161 OS使生研究 161 度 反生性邪感性 163 國際常政的安全成會 164 反思定式解放 風之間 165 常見的登出情報主 164 立图的原语用重用 16	第四[出版]学生四篇
n1673 £9 1011 04	2017-06-139日是第十七週一一般公治一	子園町上湖日総・時間・新建地版・単位総米原題	NH HR PER			ALM NO KANETARYA NA LENNIKAN N 18152	
1155 14 (2215)	2017-05-08年日夏夏十六唐一一般公帝一	請於唐培堂電腦。使AuGontous,看公徑。但A目的氣像。		2017年13上午10:07日	2017-06-15 9日星第十七個一個調算是一切)	12-1 TORPHER 12-2 LOPHIESE 12-0 TOPHIESE	
H7518 74 (E2018	2017-05-18年日北京十三省一一級公省一	講師は予範世版APK 備名 iBencon - 2017-05-15.apk mm 1. 名かけつの子様可想 - 語会は予範学組APPK - 2.5.8年 Divetoxeの文明APK - 世後 - 世後APF	EN EN PISE			12-561127音史和三角文音 (5-way handmaking)。Time- way handmaking	
11516740364	2017-05-149日是第1日第一一般公告**	ROATENSAM HELFERERAD SE Gudger-	HID (#10) (#11) (#11)	39(7/5*15 노부 16:14.38	101746-13 今日長常十七倍一倍常意知一切		BULLER WELLE
		2017-05-15.apt		2017/6/6 7 = 022617	2017-08-08 今日後第十八級一般第五版一つう		ANIAN AFTE
(1516 平平 45:4位)	2017-04-11 今日意識人選一一級企告	下居為來九過一曲日經中年以	AH 80 9158	20/709/74 022419	2017-09-08 今日是第十六团一根菜菜是一粥		NULLER PERM
1152 74 014127	2017-05-02 9日建第十一进一一册公告	目各住安装用SAPKEEdarcood aci ・ 開放は7載・	編輯 根則 学生回答	20/769 74 022308	2017-06-05 今日長期十六日 一田田田知一5日		第81年期, 举生日期
11328 79 041823	1006-05-211-05-25 (注意的下面形象49%	1.Randod手值同意·最后的了更新能从IPK+ 2.先居自 Duetoch2.SRAPK- 作用·意思APP	編輯 新政 学生发展	2017月57日下午4037757		のの後の生活の (ACE) (A	编制[图制] 带生彩雕
11321 74 6457.47	2017-03-01 第三週一週刊公告は	T##1011.000 BRESEALBY		2017518 F¥ 003401	2017-06-189日建築十三番—	금융 PTY 1001 금환 0001 금환호基 0102 등학급환 1000 将说 금융 0004 - 학-금환	國町1形町 伊生日第
出於會留設式品質約名法	(a)			業成長に支全導行三於項に	11.54 · 11.11	(b)	
城建學習活動歷程系統	~ /		安徽 韓語 動	服装式收益争取运动要求	15.8 200	(b)	·宋·朝:唐朝 章章
	~ /			^{展現成的主要型注意要} 推播資料表列		(b)	11211郡:長部 1121 11211日 11211日
^{出我里早留已到那匹系统} 資料表列	~ /		92188-1428 193 10388		19.54 X X X X X X X X X X X X X X X X X X X	(b)	
	~ /		開始日期	推播資料表列	н		REER
資料表列	ani			推播資料表列			REER
資料表列	ani		No.29 gazu	推播資料表列 Supplemen	н		RIEER ERER
資料表列	ani		開始日期	推播資料表列	н	g material	RIEER ERER
資料表列	ani		No.29 gazu	推播資料表列 Supplemen	н		RIEER ERER
資料表列 tudent's q 翻	en Id Juestion		No.29 gazu	推播資料表列 Supplemer 補充数数	H atary teaching	g material	RUCH EE28 EXPREM NSNONSUSSEN
資料表列 tudent's q 翻	eril In puestion	Content	No.29 gazu	推播資料表列 Supplemen 補充数材 BM 271516 7746:038	ntary teaching	g material	RUCH EE28 EXPREM NSNONSUSSEN
資料表列 tudent's q 調	In the Title	A章 Content +能E5联1	No.29 gazu	推播資料表列 Supplemen <u>補充教材</u> ™	ntary teaching	g material	REFR ERER Exercise Newonactive ter ter ter ter ter ter ter ter ter te
資料表列 tudent's q 閱 物开始如文	Title	相	RESQ RREQ Internation	推播資料表列 Supplemen 補充数材 BM 271516 7746:038	Itary teaching	g material	

<u>Figure 5</u>. (a) - (d) illustrate the editing for the contents for four kinds of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively.

回业 ≛ ●	D → ● 本O 合助計 29% (PI ±+1:26 ble	100 %		5 11.8	Collec	ted iBeacon attr	ubu	tes	1	
Email	Signal strength		4	ante	wat	~ ~	-	DARK .	NAME OF	tiles
studentestre@gmail.com	[講台]; [訊號強度(rssi) -46]	1	105	TEBencould 6	A485011	B-134B-452C-B3C4-50A183EDD13	9 63	33	6	glipbobe
密碼		2	105	UIDencall 6	A485011	B-134B-450C-B3C4-50A183EDD17	9 -51	33	6	pitplode
	[教室後方];[訊號強度(rssi):-64]	3	107	IllBewon316	A485011	B-134B-459C-B3C4-StateJEDD17	9 -61	33	6	glitplode
		4	100	UIBeatoal35	A485011	B-134B-459C-B3C4-StatistedD1A	0 64	33	6	glipbobe
▲	[教室門口];[訊號強度(rssi):-56]	5	109	ITBescould 5	A485011	B-134B-452C-B3C4-50&183EDD1J	9 -62	33	6	gliphohe
AutoLogin(Test)	(致重门口],[[[]]],[[]]]).50]	6	110	UIBeaco.33.6	1485011	B-134B-452C-B3C4-50A183EDD1A	0 -57	33	6	gliphobe
Priocogni (rest)	The state of the second st	7	111	UIBeeco.336	00112233	-4455-6677-8899-AABBCCEDEER	F72	22591	39682	gliptobe
	│ │ └─→ Front door	8	112	UlBenoal76	A485011	B-134B-452C-B3C4-SUA183EDD17	9 -64	33	6	gliphobe
	$\square \longrightarrow Back door$	9	113	UlBrecoul3.6	A485011	B-134B-450C-B3C4-50A18380017	9 -66	33	6	glilplode
		10	114	UIBescal3.6	A485011	B-134B-450C-B3C4-50A183ED017	9 -59	33	6	gilplode
		11	115	IIIBeacou33.6	A485011	B-134B-452C-B3C4-50A183ED01/	9 -61	33	6	gälplode
	└ Lectern	12	116	ITIBenos33.6	A485011	B-134B-450C-B3C4-SOA183EDD1/	9 -75	33	6	gliphohe
		13	117	UIBeecoul) 6	A485011	B-134B-452C-B3C4-50A183EDD1A	9 -62	33	6	gitplote
		14	1	IIIBeacoal16	A485011	B-134B-450C-BIC4-50A183EDD()	g -3	. 33	6	gliplobe
login		15	1_	IllBeacos2.4	EDCS6DE	5-DIFFE-4102-B060-D0P5A710968	0 -68	2	4	gifplote
`Log in		16	1_	ISBeecou55.	00112233	4455-6677-8899-AABBCCDDEER	F -55	22613	1568	gliphohe
		17	1_	IIIBencoal5	A485011	B-134B-452C-B3C4-50A183EDD17	9 -35	55	33	gléphohe
		18	1_	ITBentos2.4	EDCSIDE	5-DFFB-4802-B060-D0F5A71096B	0 -62	2	4	glipbole
5 0 0	5 6 6	19	t.,	00Bewood5	00112233	4455-6677-9899-AABBCCDDEER	-51	22613	1568	gifplote
(a)	(b)					(c)				

<u>Figure 9</u>. (a) Mobile device APPs login interface; (b) iBeacon devices are first read and then APPs display signal status for location information on screen of students' mobile devices; (c) log data for student's position information exhibited in (b), which are kept in the cloud server.



<u>Figure 10</u>. Student's APPs display three kinds of responses for four sorts of pushing information. (a) - (d) are four operating screens for four sorts of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively.

回應列表	Student's	response for bulletins		回應列表	Student's i	responses for cours	e key points
一般公告				授課重點			
e Wi	使用者名稱	AB		日期	使用者名稱	内容	
2017/5/16 下午 03:26:32	I	 避和	8 19	2017/5/16 下午 03:26:42	I	證解	#1 53
2017/5/16 下午 23:26:46	N.	知道	間 38	2017/5/16 下午 03:27:32	-	知道	#1 38
2017/5/16 下午 03:26:49	88 	知道	8 8	2017/5/16 下午 03:28:58	E	知道	10 13
2017/5/16 下午 33:27:54	R .	證解	81 19	2017/5/16 下午 03:29:07	5	股 稱	11 12
2017/5/16 下午	5.000	知道		2017/5/16 下午	T.	股 和6	
33-28-00		(a)	8	03:29:12 無線威知教室學習	育活動歷程系統	(b)	
144 展知教室学習 回應列表	活動歷程系統		*	03:29:12		(b) esponses for supple	Ξ
33-28-00 計線感知教室學習	活動歷程系統	(a) esponses for student's que	*	03:29:12 無線威知教室學習			Ξ
2322800 1線展知数室季音 回應列表	活動歷程系統		*	03:29:12 無線威知教室學習 回應列表			Ξ
23228:00 21 21 21 20 20 20 20 20 20 20 20 20 20 20 20 20	活動歷程系統 Student's r	esponses for student's que	*	0329:12 <u>無線裏切数室等</u> 回應列表 補充教材	Student's re	esponses for supple	Ξ
3322800 1線夏知教室季音 回應列表 聚生提問	活動應程系統 Student's r 使用者名属	esponses for student's que	estions	0329-12 無線販知執致事事 回應列表 補充教材 ^{日期} 2017/52 下午	Student's re	esponses for supple	ementary mater
	活動應程系統 Student's r 使用者名稱 近	esponses for student's que	sestions	03.29.12 無線展如数容學計 回應列表 補充教材 日期 2017/52 下年 02.3014 2017/5/16 下年	Student's re 使用者名稱 风	esponses for supple	ementary mater
加速を00 加速の加速にする 可應列表 単生提問 1期 17月 17月 17月 17月 17月 17月 17月 17月	活動應程系統 Student's r 使用著名編 近 二	esponses for student's que	estions	0329:12 無線更初熟證事育 回應列表 補充教材 日期 2017/5/16下年 2017/5/16下年	Student's re 使用者名稱 與 王	Area Transmission Statements for Supple	ementary mater

<u>Figure 8</u>. (a) - (d) show detailed results of students' responses for four sorts of pushing information, bulletins, course key points, students' questions, and supplementary teaching materials, respectively.

推播資料紛	5±4-				
山田與小小の	LOI		與魯答回	犎:17 %	
學生姓名	80%	知道	忽略	Email	
-	33 %	0.%	0.%	402 @gm.nfu.edu.tw	
# #	4 %	0 %	0 %	402 @gm.nfu.edu.tw	
# 60	4 %	15 %	0 %	405 @gm.nfu.edu.tw	
-	15 %	4.%	0 %	405 @gm.nfu.edu.tw	
1	26 %	26 %	4 %	40: @gm.nfu.edu.tw	
2	7 %	11 %	0 %	405 @gm.nfu.edu.tw	
	11 %	26 %	0 %	405 ggm.nfu.edu.tw	
-	26 %	15 %	7 %	408 @gm.nfu.edu.tw	
3 6	7 %	30 %	0 %	405 @gm.nfu.edu.tw	
3	7 %	11 %	7 %	408 @gm.nfu.edu.tw	
-	11 %	26 %	4 %	405 @gm.nfu.edu.tw	

Figure 9. Summary results of three choices students' send for four kinds of pushing information.

5. Conclusions

The paper has proposed a cloud service system, the CLAP system, for students' awareness classroom activity portfolio. The paper also builds a LAE using iBeacon devices in the design of wireless awareness functions. In the LAE, the CLAP system develops APPs for smart mobile devices for collecting data to construct students' classroom activity portfolios. There are several types of students' classroom activity portfolio, including records that students enter/leave classroom, responses to pushing information once students entered classroom, and distances from students' seat to teacher' presentation location (for example, the front desk of the classroom). It also offers analysis results of the classroom activity portfolio. Hence, it can benefit students who can readily send their records or responses on class in classroom learning. Moreover, they do not require to type many data (for example, long URL) for interacting with the portfolio collection system. Furthermore, the system can assist teacher in collecting students' classroom activity portfolio, and then to have analysis results of the portfolio. For instance, teachers can get the result that students entered classroom but they send less or no feedback in classroom to the system. Descriptive statistics were used to summarize all variables for learning interests. Evaluation results show that the CLAP system benefits students for learning interests.

Acknowledgements

The authors would like to acknowledge the Ministry of Science and Technology of Taiwan, R.O.C., for financially supporting this research under Contract Number MOST 105-2511-S-150-003.

References

Bergmann, J., & Sams, A. (2012). Before you flip, consider this. Phi Delta Kappan, 94(2), 25-25.

- Chen, Z., Zhu, Q., Jiang, H., & Soh, Y. C. (2015, June). Indoor localization using smartphone sensors and iBeacons. In Industrial Electronics and Applications (ICIEA), 2015 IEEE 10th Conference on (pp. 1723-1728).
- Diller, D. (2015). TF6 Implementation of the Flipped Classroom Model Using VirtualACEP to Teach a Cardiology Curriculum to Emergency Medicine Residents. Annals of Emergency Medicine, 66(4), S157-S158.
- Evseeva, A., & Solozhenko, A. (2015). Use of flipped classroom technology in language learning. Procedia-Social and Behavioral Sciences, 206, 205-209.
- Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. Journal of nutrition education and behavior, 47(1), 109-114.

- Hwang, G. J., & Chang, H. F. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. Computers & Education, 56(4), 1023-1031.
- Obradovich, A., Canuel, R., & Duffy, E. P. (2015). A survey of online library tutorials: guiding instructional video creation to use in flipped classrooms. The Journal of Academic Librarianship, 41(6), 751-757.
- Radhakrishnan, M., Misra, A., Balan, R. K., & Lee, Y. (2015, October). Smartphones and ble services: Empirical insights. In Mobile Ad Hoc and Sensor Systems (MASS), 2015 IEEE 12th International Conference on (pp. 226-234).
- Domingo, M. G., & Gargante, A. B. (2016). Exploring the use of educational technology in primary education: Teachers' perception of mobile technology learning impacts and applications' use in the classroom. Computers in Human Behavior, 56, 21-28.
- Volk, M., Cotič, M., Zajc, M., & Starčič, A. I. (2017). Tablet-based cross-curricular maths vs. traditional maths classroom practice for higher-order learning outcomes. Computers & Education, 114, 1-23.
- López, O. S. (2010). The digital learning classroom: Improving English language learners' academic success in mathematics and reading using interactive whiteboard technology. Computers & Education, 54(4), 901-915.
- Moreira, F., Ferreira, M. J., Santos, C. P., & Durão, N. (2016). Evolution and use of mobile devices in higher education: A case study in Portuguese Higher Education Institutions between 2009/2010 and 2014/2015. Telematics and Informatics, 34(6), 838-852.