Taiwan Undergraduate Students' E-learning with Application for Mobile Devices

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Abstract—**E-learning provides teachers and students one-on-one learning access to PCs, Internet connectivity, and integration to the education environment. E-learning is not confined to geographical barriers, but has flexible learning materials and information, and students can participate in self-directed learning without space limitation.**

Application(APP) specific content could apply for geography, math, world languages, literacy development of reading and writing, e-readers and audiobooks, word processing and handwriting, note taking, reference materials, and so on.

This research uses a quantitative study to discuss student and non-student teacher e-learning with APP on background demographic characteristics with (gender, school, educational status, school department, app learning, and technology contact), learning styles and how e-learning factors affect undergraduate students' attitude toward APP.

The accessible population included 290 participants, resulting in a response rate of 91%. Research Hypothesis 1 was not supported for student learning styles, e-learning, and attitude toward APP with student teachers. Research Hypothesis 2 showed no statistical significance for student learning styles, e-learning, and attitude toward APP with non-student teachers. Research Hypothesis 3 was not supported for the *R* Square value in student learning styles, e-learning, and attitude toward APP with student teachers than with non-student teachers'. Research Hypothesis 4 showed no statistical significance for learning styles, e-learning, and student attitude. Research Hypothesis 5 was supported for significance value in background demographic characteristics, learning styles, e-learning, and attitude.

Keywords: E-learning, APP, student teacher, learning styles, attitude

I. INTRODUCTION

Internet network technologies are a learning revolution. Unlike the traditional educational system, students may spend years learning a project [1]. The number of people connected to the network in the twenty-first century has increased, and technology has changed students' learning environment dramatically. E-learning has changed the educational materials designed, developed, and delivered to students [2] [3].
E-learning provides teachers and students with one-on-one learning opportunities to access PCs, Internet connectivity, and integration to the education environment, such as at school, in different locations, or even at home. E-learning is not confined to geographical barriers, but possesses flexible learning materials and information, and students can participate in self-directed learning without space limitations [4] [3].

Application refers to the abbreviation of APP. The term has been used in the community for a long time and recently becomes popular mobile application in smart phones and tablets. Especially, due to the advent of apple's iTune App store in 2008. Since APP was launched in July 2008, more than 200,000 items in the APP store have been downloaded more than 4 billion times [5] [6]. Mobile touch screen devices such as the iPhone and iPad with APP are an attractive e-learning platform for learning. Learning activities can create gaming, inspire and customize magazine formats, which increase learning convenience [7] [6].

The current college students have the trend to learn App from mobile devices. However, seldom Taiwan colleges provide the learning courses with APP for mobile devices. Therefore, the current study discusses student and non-student teacher e-learning with APP on background demographic characteristics with (gender, school, educational status, school department, student living expenses or wage, studying places, app learning, technology contact) learning styles, and how e-learning factors affect undergraduate students' attitude toward APP.

II. LITERATURE REVIEW

A. Learning Styles

Keefe [8] defined learning styles as the "composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (p.2). Kolb [9] developed Learning Styles Inventory (LSI) theory to assess the different patterns of individual learning styles and identified four basic learning styles: diverging - emphasizes the innovative and imaginative approach, assimilating-using different observations to integrate the whole, converging - emphasizes the practical implication of ideas and solving problems, and accommodating - trial and error usage [9] [10]. Kolb's [9] model is organized by four main stage cycles that are defined clearly: concrete experiences (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE) [9].
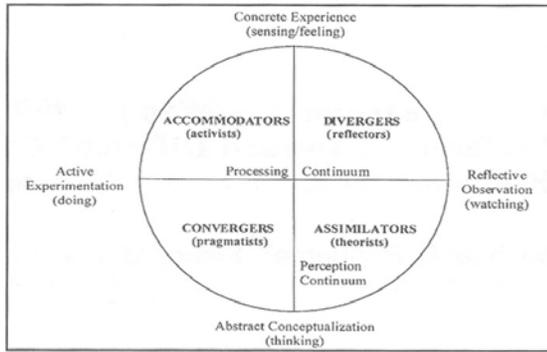
. Fig. 1: Kolb's Learning Styles inventory (adapted from [9])

Honey and Mumford [11] [12] adapted Kolb's model in *The Manual of Learning Styles* and *Using Your Learning Styles*. McCarthy [13]developed the 4Mat system based on Kolb's learning types on teaching in a cyclical process. Sun, Joy, and Griffiths [14] combined a new method to learning styles theory and adaptive e-learning system to improve education systems.

B.   E-Learning

E-learning defines "the use of technology to support and enhance learning practice" [15] and "the use of various technological tools that are either Web-based, Web-distributed, or Web-capable for the purposes of education" [16]. E-learning incorporates communication, self-motivation, technology, and efficiency [17]. The e-learning framework of Fowler and Mayes [18] is organized by three main stages: conceptualization refers to users' initial contact with other people, construction refers to the process of building and combing concepts to users' performance tasks, and application means the testing and tuning of conceptualizations to applied contexts. The conceptual e-learning framework includes transformative learning by integrating dilemmas, threshold concepts, concept mapping, social learning, variability, inquiry, and conflict [19] [20].

In the *P3 Model*, people involved in e-learning can be referred to the whole comprehensive picture: e-learning team, development, and materials.

Fig. 1: E-Learning P3 Model (adapted from [21])
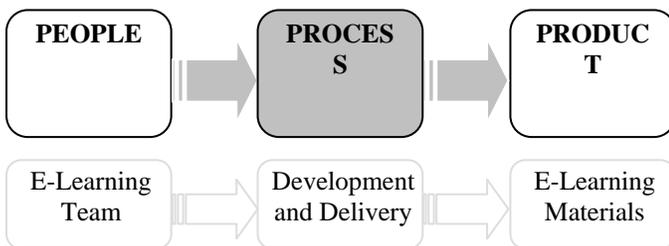
C.   APP

APP specific content could apply to geography, math, world languages, literacy development of reading and writing, e-readers and audiobooks, word processing and handwriting,

note taking, reference materials, and so on [22]. The iPod touch, iPad, and iPhone could be an educational tool such as an e-reader for students with disabilities, handheld script, visual learning of logistic structures, language coach for studying abroad, and for interface design and usability of digital textbooks [7]. The APP becomes worthless if students cannot use it. Therefore, Apple could build some features for the iOS (operating system for mobile devices), such as voiceover for users who are blind; zoom and large font for users with low vision; white on black display; closed captioning and mono audio, and voice control [21]. More than 300,000 are filled in the iTunes APP stores, and 100,000 to download to the Android market. Some APPs require payment, for example, angry birds, doodle jump, and skee ball, and some APPs are free, such as Facebook, words with friends free, and Skype [23].

D.   Attitude

Gandner [24]defined attitude as an evaluative reaction to attitude toward the object and the basis of individual belief or opinion. Doob [25] and Ajzen [26] referred to attitude as a learned, implicit anticipatory response and extensively explored and explained human behavior. Fishbein and Ajzen's [27] attitude theories provided a foundation to understand attitude and predict behavior. Fishbein and Ajzen's [27]views on attitude can be categorizedes into three theories: a) information and integration theory - accumulating and organizing information; b) expectancy value theory - believe in something; c) theory of reasoned action - the effect of behavior on people's attitude and the effect of belief on people's actions. Fishbein [28] developed the attitude model as follows:

$$\sum_{i=1}^{n} \quad Ao = \quad b_i e_i$$

where,
Ao = Attitude toward the object (brand)
b_i = belief on the brand's possession of the attribute
e_i = evaluation of the attribute as good or bad
n = a limited number (n) of attributes a person considers

Rosenberg and Hovland [29]_proposed three component views of the attitude model: a) the affective component consists of positive or negative emotions, b) the cognitive component consists of individual thoughts or beliefs toward attitude objects, and c) the behavioral component comprises individual actions or intentions.
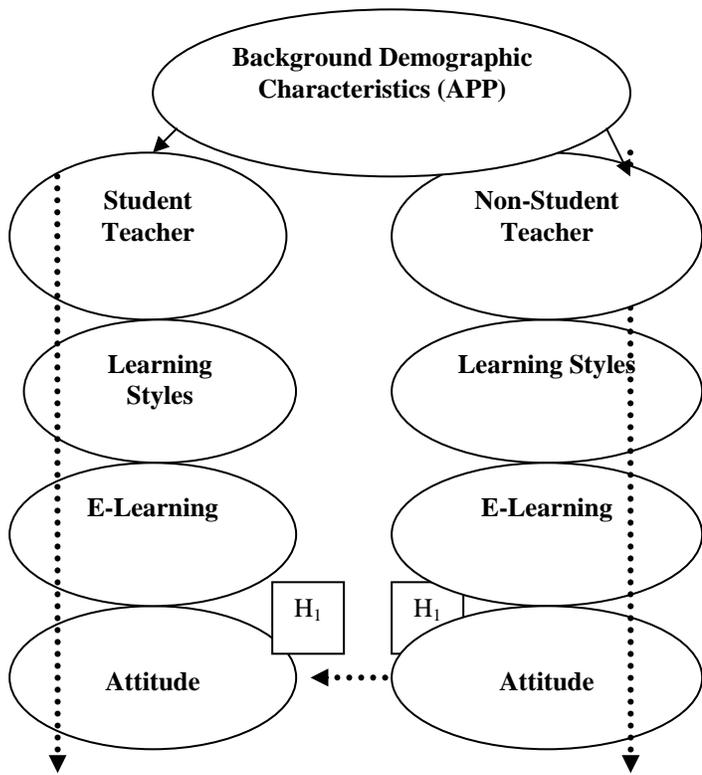
III.

IV.   HYPOTHESIS DEVELOPMENT AND METHOLOGY

Fig. 3: Hypothesized model of student and non-student teacher, background characteristics, learning styles, e-learning, and attitude

A. Research questions and hypothesis

Are there any differences in undergraduate student background demographic characteristics, learning styles, e-learning, and attitude toward APP between the student teacher and the non-student teacher?

H1: Taiwan undergraduate student teachers are significant explanatory variables of student learning styles, e-learning, and attitude toward APP with student teachers.

H2: Taiwan undergraduate student teachers are significant explanatory variables of student learning styles, e-learning, and attitude toward APP with non-student teachers.

H3: Taiwan undergraduate student teachers have a greater explanation of the relationship of student learning styles, e-learning, and attitude toward APP than non-student teachers (Compare adjusted R-Squares in H_{1a} versus H_{1b}).

H4: Learning styles (auditory, visual, tactile) and e-learning (audio-visuals, computer program, internet) are significant explanatory variables of perceived attitude (integrativeness, motivation, instrumental, orientation) for Taiwan undergraduate students.

H5: Background demographics characteristics, learning styles, and e-learning are significant explanatory variables of attitude for Taiwan undergraduate students.

B. Research design

A non-experimental, quantitative, SPSS 17.0, research design explored the relationship of background demographic characteristics, learning styles, e-learning, and attitude.

C. Population and sampling plan

Target population

According to the Taiwan Ministry of Education Department of Statistics, over 100,000 students have taken the national university entrance exam, which is roughly 66.6%. Since the 1990s, many junior colleges and trade schools have been promoted to universities. Target populations were 177 college students in Taiwan. The convenience sample included students enrolled in the National Taichung University of Education, Ling Tung University, and Toko University in Taiwan.

Sampling plan

The entire accessible population included 390 people, who were invited to participate in the study. However, the final data-producing sample was self-selected, depending on those who agreed to participate in the study.

D. Instrumentation

The instrument used in this study includes four parts: For the surveys, (1) *Background Demographic Characteristics* were developed by the researchers, (2) learning styles were measured by items from the *Learning Styles Inventory (LSI)* developed by Kolb David [9], (3) e-learning was measured by *Informational and Communication Technologies (ICTs)*, developed by Dennis Stevenson [30], and (4) attitude toward APP was measured by the *Attitude Motivation Test Battery (AMTB)* by Gardner [24].

V. RESULT

A. Research question and Independent t-test

Levene's test for Equality of Variances in Table 1 indicates that the variances of students who learned with a student teacher and a non-student teacher according to gender ($p = .001$) and type of school (public and private) ($p = .005$) differed significantly between the student teacher and the non-student teacher. Other variables did not differ significantly between the student teacher and the non-student teacher.

Table 1 *Independent Sample* t *test for all Variables with Student Teacher and Non-Student Teacher.*

	Levene's Test for Equality of Variances		*t* test for equality of means	
	F	Sig.	t	Sig. (two-tailed)
Gender	10.552	.001	2.036	.043
			2.009	.046
School	7.920	.005	-1.423	.156

			-1.432	.154
Educational Status	.054	.816	.020	.984
			.020	.984
School Department	2.698	.102	-.261	.794
			-.213	.832
Student Living Expenses	2.074	.151	.371	.711
			.387	.699
Learning Style Average	.000	.986	1.238	.217
			1.223	.223
E-Learning Average	.440	.507	.817	.415
			.809	.419
Attitude Average	.796	.373	3.478	.001
			3.364	.001

Residual	102.702	206	.499
Total	114.344	208	

a. Predictors: (Constant), E-Learning Average, Learning Styles Average

b. Dependent Variable: Attitude Average

Table 4 shows that the *R* Square value of the model accounted for 6.7% of the variation in student learning styles, e-learning, and attitude toward APP with the student teacher and 10.2% with the non-student teacher. Research Hypothesis 3 was not supported.

Table 4 *Multiple Regression R Square Analyses of Student Learning Styles, E-Learning, and Attitude with Student Teacher and Non-Student Teacher*

Model		*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
Student Teacher	1	.259(a)	.067	.038	.726
Non-Student Teacher	2	.319(a)	.102	.093	.706

B. Hypothesis 1, 2 Multiple regression analyses and Hypothesis 3: R-Square

The value of significance ($p = .105$) in Table 2 indicates no statistical significance. Therefore, Research Hypothesis 1 was not supported.

Table 2 *ANOVA for Multiple Regression Analyses of Student Learning Styles, E-Learning, and Attitude toward APP with Student Teacher*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.460	2	1.230	2.331	.105[a]
	Residual	34.304	65	.528		
	Total	36.765	67			

a. Predictors: (Constant), E-Learning Average, Learning Styles Average

b. Dependent Variable: Attitude Average

The value of significance ($p = .000$) in Table 3 indicates statistical significance. Therefore, Research Hypothesis 2 was supported.

Table 3 *ANOVA for Multiple Regression Analyses of Student Learning Styles, E-Learning, and Attitude toward APP with Non- Student Teacher*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.642	2	5.821	11.676	.000[a]

C. Two-Way ANOVA Analysis

There was no significant ($p = .205$) main effect for learning styles, e-learning, and student attitude. Research Hypothesis 4 was not supported.

Table 5 *Two-way ANOVA for learning styles, e-learning toward student attitude.*

F	df1	df2	Sig.
1.334	11	267	.205

D. Multiple regression analysis

The value of significance ($p = .000$) in Table 6 indicates statistical significance. Therefore, Research Hypothesis 5 was supported.

Table 6 *Multiple Regression Analyses of Student Background Demographics Characteristics, Learning Styles, E-Learning, and Attitude*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.154	2	7.577	15.175	.000[a]
	Residual	137.813	276	.499		
	Total	152.968	278			

a. Predictors: (Constant), E-Learning Average, Learning Styles Average

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.154	2	7.577	15.175	.000[a]
	Residual	137.813	276	.499		
	Total	152.968	278			

a. Predictors: (Constant), E-Learning Average, Learning Styles Average

b. Dependent Variable: Attitude Average

E. Reliability analysis

Table 7 indicates that Cronbach's Alphas for internal consistency on attitudinal characteristics $a=0.745$ were an acceptable value of reliability. All of them were more than 0.70; therefore, internal consistency was satisfactory.

Table 7 *Reliability Statistics for Learning Styles, E-Learning, and Attitude*

Cronbach's Alpha	N of Items
.745	25

F. Factor analysis for construct validity

Table 8 shows the results of KMO and Bartlett's test of sphericity. The value of KMO for learning styles was 0.668; e-learning was 0.595; and attitude was 0.827.

Table 8 *KMO and Bartlett's Test Results on Learning Styles, E-Learning and Attitude.*

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | .668 |
| | | .595 |
		.827
Bartlett's Test of Sphericity	Approx. Chi-Square	277.905
		161.053
		518.915
	df	36
		36
		21
	Sig.	.000
		.000
		.000

Table 9 shows that three factor values were larger than one after varimax rotation was extracted, which accounted for approximately 54% of the total variance.

Table 9 *Extraction Sums of Squared Loading on Learning Styles*

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	2.266	25.181	25.181
2	1.532	17.023	42.204
3	1.026	11.400	53.604

Table 10 shows that the three factor values were larger than one after varimax rotation was extracted, which accounted for approximately 49% of the total variance.

Table 10 *Extraction Sums of Squared Loading on E-Learning*

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	1.887	20.967	20.967
2	1.297	14.409	35.376
3	1.193	13.253	48.630

Table 11 shows that the three factor values were larger than one after varimax rotation was extracted, which accounted for approximately 45% of the total variance.

Table 11 *Extraction Sums of Squared Loading on Attitude*

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.167	45.241	45.241

VI. CONCLUSION

The accessible population was 290 participants, resulting in a response rate of 91%. The participants are college students in three colleges in Taiwan. The results for research questions show that student teacher and non-student teacher for gender ($p = .001$) and type of school (public and private) ($p = .005$) differed significantly between student teacher and non-student teacher. Other variables did not differ significantly.

The value of significance ($p = .105$) in Hypothesis 1 was not supported for student learning styles, e-learning, and attitude toward APP with the student teacher. Research Hypothesis 2 ($p = .000$) was not supported, indicating no statistical significance for student learning styles, e-learning, and attitude toward APP with the non-student teacher. Research Hypothesis 3 was not supported and the R Square value of the model accounted for 6.7% of the variation in student learning styles, e-learning, and attitude toward APP with the student teacher and 10.2% with the non-student teacher. Research Hypothesis 4 was not supported because of no significant ($p = .205$) main effect for learning styles and e-learning toward student attitude. Research Hypothesis 5 was supported for the value of significance ($p = .000$) in background demographics characteristics, learning styles, e-learning, and attitude.

VII. PRACTICAL IMPLICATION

These results show that Taiwanese college students did not prefer using e-learning with APP for student and non-student teachers. Although APP e-learning is prevalent in Taiwan, students still need to become used to learning e-learning with APP, especially for the student teacher. Most student teachers in Taiwan that learn English still use traditional learning styles.

However, Taiwan is an island of rapid technological growth. E-learning can help many students spontaneously learn English without traveling abroad to study. E-learning with APP can manage time-consuming problems and flexible areas instead of staying in the classrooms at a specific time.

The findings of the study are important to the Taiwanese government, educational institutes, students and employees, and other researchers in Taiwan that may benefit from the results of this study and attempt to change their perspectives of e-learning with APP. For the Taiwan government, the Taiwan Educational Department should support more funding to all Taiwanese colleges to purchase technology equipment and improve their attitude toward e-learning with APP. Students can also learn English with technology to improve their learning motivation, and employees can learn e-learning with APP in flexible time and places. Researchers can apply and conduct research in similar research areas.

VIII. LIMITATION AND FUTURE STUDY

The research design of this study is limited to a non-experimental and quantitative study. All participants were from three colleges in two cities. This research only focuses on undergraduate students in Taiwan, which may not represent Taiwanese students.

Future study might adopt a qualitative research design by interviewing participants and eliciting their opinions about e-learning with APP on iPad, iPhone, and iPad. Future research should enlarge the accessible population to strengthen generalizability of the study and should add diverse occupations of more language learners to compare their motivation and attitude to enhance research quality.

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