The Development of Indicators for Utilising Portable Electronic Devices of the Undergraduates

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Abstract: There are 3 objectives in this research. To study students' behaviours for utilising portable electronic devices. To integrate the indicators and factors of the use of portable electronic devices and to validate the measurement structure of the use of portable electronic devices. The sample groups were 282 students in the Faculty of Education, Chiang Mai University. The research Instruments were the questionnaires with 25 questions. The discrimination values were between 0.182-0.661. The reliability value was equal to (α) 0.862. The data analysis used the descriptive statistics and factors analysis. The findings revealed that there were 25 indicators of utilisation and could be divided into 2 dimensions including daily life total 11 indicators and learning total 14 indicators. The most popular device was a Smart Phone (93.15%), there were 4 factors of the daily life aspect which were online payment, picture and sound, relax and remind and movies and social. The learning also had 4 factors consisting of homework and notice, remind and storage, technical supports and telecommunication and the measurement structure of utilisation showed the validity value at the good level.

INTRODUCTION

Modern technologies rapidly influence the learning of individuals in today society. With the advancement of the unceasing development of hardware and software, everyone in society can access to the use of technological products by means of the electronic devices which tend to have developed to ease the users for carrying. Besides, the competitive pricing will gradually lower the price of those devices. And young people can access to them dramatically. These Portable Electronic Devices (PED) or mobile devices (Fojtik, 2015) help with information learning anywhere and anytime. The results from the use of mobile devices of young people cause the idea of educational reform so that learners are able to keep pace with the changing world, especially the concept of learning by preparing citizens in the 21st century. One method that educators try to modify the format of the learning experience is to apply the PED with the description of contents in the classroom which is different concept from using Computer Assisted Instruction (CAI) with e-Learning process as in the past. This became a guideline of new education which was called M-learning as obviously seen in 2004 and increased dramatically around the year 2009-2013 (Fojtik, 2015; Sung *et al.*, 2015). Learners could use the mobile devices to access learning more than ever as well as the instructors could teach more

effectively. The educational leading countries actively responded to the changes and developed the learning system through PED.

The findings of previous researches indicated that the application of PED caused the positive learning results to the learners if there was the analysis on the learners and the system was developed in accordance with life style of individuals (Decman, 2015; Sung *et al.*, 2015), for instance, the interaction between students and teachers, e-Books are more convenient to carry than the regular books, the engaged learning amongst students, self-access learning, applications to the disabled and elderly, the increase of durability of learning, the reduction of the cost of learning materials, etc. (Rockinson *et al.*, 2013; Lee *et al.*, 2016; Sung, *et al.*, 2016). These made the academicians consider the definition of the formal learning system that the education had not formed by the interaction between students and teachers and not existed only in the classroom that the teachers completely provided the learning situations (Nordin *et al.*, 2010). The new learning system with M-learning method had broadened the learning boundary at anytime, any situations and any ages. It helped support the learning throughout the life (Goksu and Atici, 2013; Slavkovic and Savic, 2015; Sung *et al.*, 2015). Amidst the situation that the elder citizen had increased more than the work-force ages, it led to the worthy use of electronic

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devices amongst people with balance of profit in both everyday life and additional knowledge unceasingly.

Thailand is one of many countries that the youth easily accepts the PED. Students initially owned electronic devices since they were in primary school so that the parents could contact them directly. They were closed to and familiar with the equipments as if they were parts of their 24 h life. Nevertheless the trend of electronic media application for education was still not increasing as the way it should be. There was a lack of a survey on behaviours for utilising electronic devices by young people seriously so that the information could be used to develop the proper ways to use the equipments in everyday life. It was likely that the use of electronic devices by young people could benefit their everyday life more than educational purpose. This could be considered that the use of electronic media was not worthy and adversely effected learning in students who could not distinguish their duties. Children's behaviours were different from the past; they spoke less but communicated more through the text (Slavkovic and Savic, 2015). Therefore, these behaviors should be seriously studied again for the development of teaching at the present and for the future citizen, especially the undergraduates who stayed away from their family and could easily procure the electronic devices without any controls and useful instructions including the influence of using pattern perceived from their friends.

Objectives and hypothesis: Based on the relevant knowledge revision, the researchers set up the objectives into 3 aspects which included, to study the students' behaviours for utilising PED because there was a doubt about a scope of use of the devices at present. Although, a knowledge gained from studying the documents would make us believe that there were various behaviours of using the devices but the researchers were not sure about the scope of use of the devices amongst the target groups. To integrate the indicators and factors for utilising PED of students. And to improve and examine the validity of the measurement model of the use of PED of students. Regarding to the abovementioned objectives, the researchers believed that the indicators for utilising the devices could be divided into 2 main factors which included the utilisation in daily life (life) and learning (learn). When we brought these two factors to test the data accuracy, we found that the model for measuring the use of PED was statistically consistent with empirical data.

MATERIALS AND METHODS

Electronic devices and mobile learning: Electronic Devices are not new words. They are designed to control the flow of electrical current through the internal controlling device. Previously they were big in size but at present each component is developed to be smaller with higher quality which allows them to be small and portable and more popular. When the equipments have been developed for use with wireless technology, it results in the development of a variety of devices rapidly (Park, 2011). Many academicians gave a definition of the PED for learning as mobile learning or M-learning. It refers to a device that one can carry with at anyplace and anytime. It doesn't need any programmes to be installed when operating on the screen. It is rechargeable and light in weight (Lan and Sie, 2010).

The research findings on the PED showed that a variety of the devices in each country was both similar and different. For instance, the findings of the device usage by Oz *et al.* (2015) surveyed with 123 student teachers majoring in English in Turkey found that there were various types of the electronic devices including the Smart Phone, Laptop, Tablet and Ipod owned by most students at between 63-78% while the findings of Slavkovic and Savic (2015) in Serbia with 347 old aged students revealed that a variety also covered those 4 devices but the usage rate was at around 18-28% only or the findings of Fojtik (2015) with 113 undergraduate students majoring in Accounting in Czech Republic found that a variety occurred in 3 devices which were the Smart Phone, Laptop and Tablet with the usage level between 31-78% while the findings of Teodorescu (2015) with 100 undergraduates majoring in English showed that the variety also covered the 3 devices but usage level was lesser at between 9-46%.

The findings showed that the use of the devices and usage levels in each area differed according to the taste, attitude, economic status, trading policy and Information Technology system of each country. However, the data synthesis of the researches in the past could be used to summarise the variety of the devices and be the framework of the preliminary research. It can be divided into 4 groups as follows (Oz *et al.*, 2015; Sung *et al.*, 2015); group 1: a laptop known as a Notebook. It functions as a PC. Group 2: a tablet PC; it is similar to a portable PC, smaller than the notebook but bigger than a Smart Phone. With the screen of 7-10.1 inches, it is convenient for carrying. The devices of this group include IPad, Tablet, Kindle and Nook. Group 3: Personal Digital Assistants (PDA) known as a Palmtop computer. It helps manage a personal data. It later was improved its

performance to support the internet and computer. The devices of this group included Digital Camera/VDO, Video, GPS, IPod, MP3, Digital Pen, Pocket Dictionary, Tape Recorder and Radio. At present those functions can be found in Smart Phones. Group 4: A Smart Phone or Cell Phone. It is used as a means for communication. Then, it was improved to have a quality of the PDA so that it was known as a multi-functioned device as it contained many functions in itself. Amongst the abovementioned, there was an observation from the research findings that the Smart Phone and Laptop gained popularity in priority rank in most reports. Sung *et al.* (2016) conducted a meta-analysis of 925 research studies on PED resulting the learning results during the years 1993-2013. The calculation on the effect size based on Cohen's theory revealed that the research studies of Handhelds, Smart Phones and Tablets had the highest values of positive effect size at 0.743, 0.676 and 0.615, respectively while the use of E-book reader and Pocket Dictionary unbelievably showed the negative effect size at -0.693 and 0.160 consecutively with conflicts with the findings of Rockinson *et al.* (2013) showing that the use of e-Book gave the better positive effect to the study of the university students than the Textbook at statistical significance of 0.01. The findings also found that if it applied with the study of the adults and young children with the inquiry-oriented learning and self-directed learning patterns in science, languages, arts or professional subjects, it would give the high values of positive effect size too.

Electronic device utilisation behavior: The findings of previous researches showed that students applied the electronic devices as a part of their lives. The users in Northern America and industrialised countries in Asia about 30% used the electronic devices in their daily life at the indispensable level (Henrie *et al.*, 2015). The trend of using technology at fast and intensive level like this can be described by the Technology Acceptance Model (TAM) theory which is developed from 2 concepts (Liu *et al.*, 2010; Mohammadi, 2015) as follow. Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980) which describes causal relationships of beliefs, attitudes, intentions and leads to behavior or action and) The concept of the User's IT Acceptance (Davis, 1989) which describes the two key factors that are a perception of the ease of use as using a particular service would be free of effort and the perception of usefulness to enhance job performance. The important devices mentioned above resulted the use of PED both in the short and long term. The study of the previous research findings revealed that students' behaviours in using the electronic devices more

or less were different. Oz (2014) found that the behaviours were consistent. Those included SMS, calling, taking photos, Using MP3, listening to music, surfing the internet, recording, loading applications and sending e-mail. It was a pity that identifying such behaviours only showed a typical behaviour but did not identify a circumstance of usage while Teodorescu (2015) proposed the more contextual and behavioral survey findings covering both academic and everyday use in 8 areas which included socializing, communication, learning, games, homework, at work, personal development and e-Commerce. But it was a pity that such behaviours were a broad approach. There was not specific in the form of indicators as in a study of Oz and Slavkovic. Although, the results of the study were different, the interesting thing about the study of Oz was that the sample groups tended to send text messages rather than voice calls and used a Social Network mostly. Therefore, if there will be a behavioural review on the use of PED in term of indicators and new factors, it will obviously clarify the behavioural study in a more concrete level. The concerned people can see the observable behaviours including all possible behaviours before designing a policy to promote the use of electronic devices in the new teaching concept with success henceforth.

Participants: The informer groups were the undergraduates from Faculty of Education, Chiang Mai University total 282 people divided into, the third year students total 63 people, randomly chosen, surveyed by using the utilisation indicator in the first round. The results were used to develop the completed questionnaires and 219 students from 5 different classes (not the same group as the first one; analysed the indicators and affirmed the structural validity of the measurement of the use of PED based on the research objectives. The random sampling was stratified by classes and fields of study to get the Strata. We found that the sampling groups were mostly female (64.68%) with the average age of 22.19 years. The majority were the second year students (42.1%) from 10 fields of study including the top 3 fields with most informers from Social Science (23.29%), Science (21.46%) and Liberal Arts (17.81%).

Instruments: The research instruments consist of 2 sets of questionnaires which were, the questionnaires on the primary use of PED. They were the ranking type open-ended questionnaires used for asking 2 questions which included the electronic devices that the students owned and made use of them and the advantages in their life and in learn with 5 ranks for each. We found that the variety of the electronic devices included the following 7

equipments; Smart Phone, Laptop, Camera, Tablet, Ipod, MP3 and Video Recorder. We also found that there were 11 advantages for using the devices in LIFE and 14 benefits for learning and the completed questionnaires on the use of electronic devices consisting of 2 parts included the primary data of the students and the advantages of the PED based on the 25 indicators as surveyed in ahead of time. The question pattern was the four-level scales (1 = seldom use or never; less than 25% of usage, 2 = sometimes use; at around 25-50%, 3 = often use; at around 51-75%, 4 = very often or usually; >76%). They were divided into 11 questions for the advantages in LIFE with the discrimination value between 0.182-0.661 and the reliability value of 0.702 and the advantage for learn total 14 questions with the discrimination value between 0.289-0.530 and the reliability value of 0.810 and the reliability value of 0.862 of total 25 questions. And part 3 consisted of the promotion pattern on the use of PED. It was the open-ended question type.

Data collection and data analysis: The researchers started collecting data with 63 students using the open-ended questionnaires. The students could freely answer the questions and rated the use of PED according to their lifestyle. They had around 20 min to complete the questionnaires before handing in. Then, the content analysis was taken place to develop the information for the second group. After that we liaised with the instructors in each department asking for distributing 260 copies of questionnaires but we got 219 copies in return which could be calculated at 84.23% of returning rate. We spent 3 weeks to have things done. After that the questionnaires were taken to check the completeness and accuracy before recording and analysing the data. Data analysis was conducted to study the use of PED by using descriptive statistics method. The researchers studied the indicators and factors for utilising the electronic devices of the students by doing the Exploratory Factor Analysis (EFA) for 2 times, each time per one dimension, using the Principal Component Analysis (PCA) process and Varimax Rotation to consider the factor loading from 0.3 or more and the eigen value of >1 onwards (Hair *et al.*, 1998). After that the measurement model development and validation for the utilisation of the two factors was done by the Third-order Confirmatory Factor Analysis (CFA) using Mplus 7.4 Programme to examine the model validation with the empirical data. The relative Chi-square (χ^2) revealed not <2 p-value and had no statistic significance. If the CFI and TLI values were >0.95 but the RMSEA and SRMR found <0.05 (Goffin, 2007; Steiger, 2007; Hox, 2010), the measurement model of indicators and factors with structural measurement association could be used to describe the students' behaviour for using PED. The research findings can be concluded as.

RESULTS AND DISCUSSION

The results from the study of the students' behaviours for utilising PED revealed that the use of electronic devices in LIFE showed the maximum average with top five included X9: following friends (X = 3.781), X7: alarming (X = 3.708), X11: chatting (X = 3.612), X4: taking photos (X = 3.534) and X8 calling (X = 3.498). And the top five for Learn were X20: storing data (X = 3.539), X23: translation (X = 3.479), X18: reminder (X = 3.447), X16: educational purpose (X = 3.384) and X12: homework (X = 3.306), respectively (Fig. 1). The electronic devices owned by students included 7 devices as follow; Smart Phone (93.151%), Notebook (61.187%), Camera (12.785%), Tablet (10.502%), Ipod (3.653%), MP3 (2.283%) and Video Recorder (0.913%). The findings also revealed that on the average each student generally owned 2 devices. Mostly, those were the Smart Phone and Laptop at 40.60% of the total (Fig. 2).

The results of indicators and factors synthesis for utilising electronic devices in life and learn dimensions showed that each indicator was related to each other. The factors could be arranged in each element (KMO >0.50). There were 11 indicators for life and could be arranged in 4 factors included the first factor named as "Online Payment" consisted of 2 indicators (X1 and X2) describing the variance at 16.525%. The second factor, "Picture and Sound", consisted of 3 indicators (X3-X5) describing the variance at 14.766%. The third factor, "Relax and Remind", consisted of 2 indicators (X6-X7) describing the variance at 14.161%. And the fourth factor, "Social and Movies", consisted of 4 indicators (X8 -X11) describing the variance at 13.362% accordingly. For the Learn factor, there were totally 14 indicators and could also be arranged in 4 factors included the first factor named as "Homework and Notice" consisted of 6 indicators (X11-X17) describing the variance at 15.300%. The second factor, "Remind and Storage", consisted of 3 indicators (X18-X20) describing the variance at 13.646%. The third factor, "Technical Supports", consisted of 3 indicators (X21-X23) describing the variance at 12.812%. And the fourth factor, "Telecommunication", consisted of 2 indicators (X24-X25) describing the variance at 12.799%, respectively. Details for the exploratory factor analysis were shown in Table 1. The Measurement Model Development and Validation for the use of PED found that the measurement model showed the validity in a good level. When considering the consistency of the model with empirical data, we found that the Relative Chi-square was 1.017, p-value was 0.410, CFI was 0.996, TLI was 0.996, RMSEA was 0.009 and SRMR was 0.057. All the index values followed the criteria for determining the validity of the measurement model in all respects.
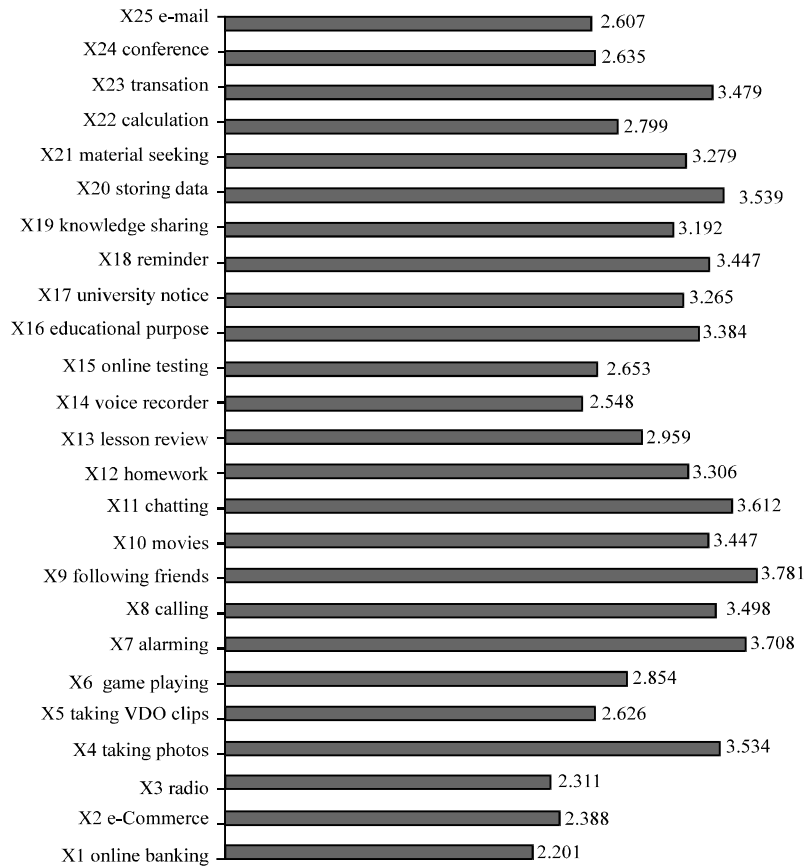
Fig. 1: The average of the use of PED of students life shows in X1-X11, learn shows in X12-X25
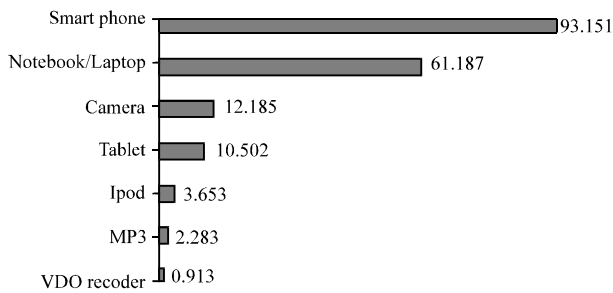

Fig. 2: Percentage of the PED owned by students

When considering the factor loading of the measurement model in the first order loading with the standardized coefficient, it showed the values between 0.295 (X23) and 0.913 (X1) at statistical significant level of 0.01 in all 25 indicators. Each indicator revealed the reliability (R^2) between 0.086-0.834 which meant the indicator could be used for the measurement of the factors in the first order, especially the X23 which seemed to have the low value but had its value differently from 0 at the reliability of 99%.

When considering the factor loading of the measurement model in the second order loading with the standardized coefficient total 8 indicators, we found the values in between 0.491 (LI1) and 0.902 (LI4) at statistical significant level of .01 in all 8 indicators similar to those in the first order. Each indicator showed the reliability (R^2) between 0.241-0.857. When considering the factor loading of the measurement model in the third order loading with the standardized coefficient total 2 indicators, we found that the values for the advantages in life was 0.968 and learn at 0.969 at statistical significant level of 0.01 in both indicators and the Reliability (R^2) of 0.936 and 0.938, respectively. Details of the analysis and structure of the indicators and factors mentioned above were shown in Table 2 and Fig. 3.

The researchers had the discussion as. The findings of the use of PED of students followed the researchers' prediction that there would be divided into two factors and intended to focus on the use in life rather than in learn. According to the concept of users' IT acceptance (Davis, 1989), it could be described that the PED were developed to be more portable, easier to carry and more advantageous. It led to the frequency of using

Table 1: The exploratory factor analysis for the use of PED

Indicators life/Factor naming	Communalities extraction	Component 1	2	3	4
LI1: Online payment (Life)					
X1: Banking	0.813	0.879	0.141	0.029	0.142
X2: e-Commerce	0.734	0.827	0.211	0.056	0.049
LI2: Picture and sound					
X3: Radio	0.659	0.130	0.787	-0.139	0.060
X4: Taking photos	0.633	-0.009	0.626	0.482	0.091
X5: Taking VDO clips	0.407	0.283	0.566	0.059	0.051
LI3: Relax and remind					
X6: Game playing	0.515	0.331	0.088	0.630	-0.029
X7: Alarming	0.627	-0.075	0.112	0.775	0.090
LI4: Social and movies					
X8: Calling	0.321	0.007	-0.126	0.208	0.512
X9: Following friends	0.743	-0.125	0.169	0.057	0.834
X10: Movies	0.621	0.279	-0.102	0.186	0.706
X11: Chatting	0.397	0.235	0.391	0.043	0.432
Eigenvalue	1.818	1.624	1.558	1.470	
Percentage of trace		16.525	14.766	14.161	13.362
LE1: Homework and notice (Learn)					
X12: Homework	0.588	0.586	0.131	0.053	0.473
X13: Lesson review	0.542	0.580	0.200	0.236	0.333
X14: Voice recorder	0.458	0.576	0.292	-0.029	-0.200
X15: Online testing	0.524	0.605	0.043	0.210	0.335
X16: Educational purpose	0.456	0.525	0.159	0.390	-0.053
X17: University notice	0.403	0.508	0.144	0.223	0.273
LE2: Remind and storage					
X18: Reminder	0.719	0.212	0.810	-0.103	0.086
X19: Knowledge sharing	0.581	0.146	0.637	0.173	0.351
X20: Storing data	0.557	0.049	0.630	0.390	0.077
LE3: Technical supports					
X21: Material seeking	0.705	0.197	-0.112	0.802	0.099
X22: Calculation	0.592	-0.054	0.327	0.642	0.265
X23: Translation	0.372	0.288	0.309	0.418	-0.137
LE4: Telecommunication					
X24: Conference	0.557	-0.011	0.055	-0.038	0.743
X25: e-mail	0.582	0.190	0.208	0.255	0.661
Eigenvalue		2.142	1.910	1.794	1.789
Percentage of trace		15.300	13.646	12.812	12.779

Life: KMO = 0.701, Bartlett's test = 385.101, df = 55, p-value = 0.000; Learn: KMO = 0.839, Bartlett's test = 663.153, df = 91, p-value = 0.000

and users immediately gained aadvantages from it reflecting to the use in a short period of time. But if the behaviors continued, it would inevitably result in beliefs and positive attitudes towards its use. There would cause to the intention or need to use which led to regular habit and long-term usage according to TRA theory (Ajzen and Fishbein, 1980). In the context of education management in the Faculty of Education, Chiang Mai University including the majority of education system of the country, there still lacked the development of the application of the PED in education substantially and variously. Moreover, studying in the university that left students staying far away from home, resulted the trend for utilizing the devices in Life with more average than the use in learn. Besides, we found that there was a variety of the devices used which was similar to the findings of many research studies. The Smart Phones and Laptops were the top ranked devices amongst all the devices which was consistent with findings by Fojitik (2014), Slackovic and

Savic (2014) and Teodorescu (2015). Surprisingly, nearly 100% of students used the Smart Phones although there was the awareness on the development of Smart Phone devices currently had the trend to combine with the competency of PDA devices which worthily allowed the multi-functions. However, there were a lot of poor students in the Faculty of Education, Chiang Mai University. Those had less opportunity to afford the expensive electronic devices. Thus the researchers had not expected the high percentage of students who owned the electronic devices. And this factor should be brought to study in the future. The EFA revealed that there were 8 factors as found in the study by Teodorescu (2015). The description of behaviours was also incredibly similar. The only difference was that Teodorescu's factors tended to focus on the use in life rather than learn while this research found that the factors in both circumstances were shown in 4 equally. The researchers anticipated that the first survey on the use of electronic devices to
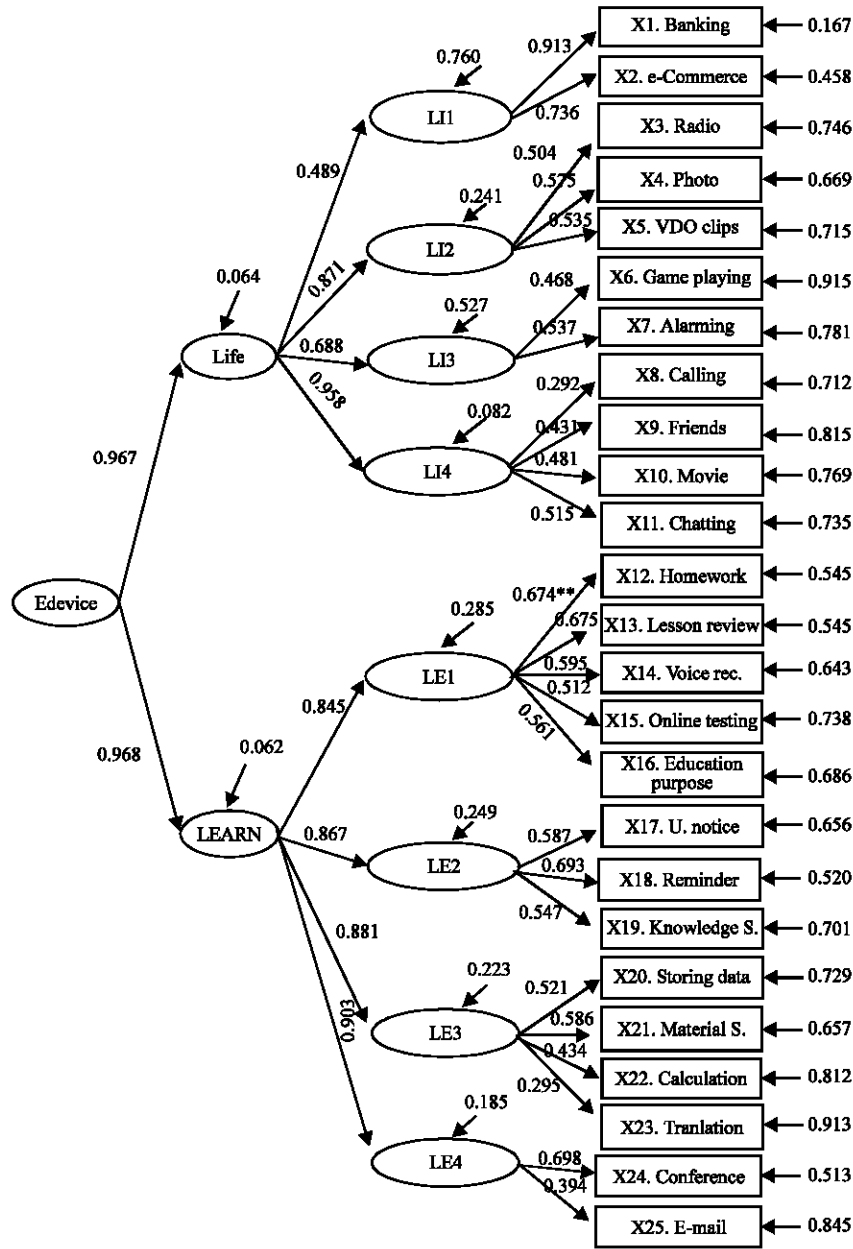
Fig. 3: The measurement model for the use of PED of the undergraduates

Table 2: The analysis of structural validity to measure the use of PED

First-order loading	Estimated	Standardized	SE	Z-values	p-values	R^2
LI1: Online payment						
X1	1.000	0.913	0.009	107.110	0.000	0.833
X2	0.907	0.736	0.035	20.869	0.000	0.542
LI2: Picture and sound						
X3	1.000	0.504	0.045	11.324	0.000	0.254
X4	0.850	0.575	0.059	9.801	0.000	0.331
X5	0.946	0.534	0.060	8.889	0.000	0.285
LI3: Relax and remind						
X6	1.000	0.468	0.082	5.708	0.000	0.219
X7	0.832	0.537	0.093	5.741	0.000	0.288

Table 2: Continue

First-order loading	Estimated	Standardized	SE	Z-values	p-values	R^2
LI4: Social and movies						
X8	1.000	0.292	0.071	4.112	0.000	0.085
X9	1.232	0.431	0.071	6.077	0.000	0.185
X10	1.956	0.481	0.066	7.265	0.000	0.231
X11	2.038	0.515	0.064	8.057	0.000	0.265
LE1: Homework and notice						
X12	1.000	0.674	0.045	15.008	0.000	0.455
X13	0.930	0.675	0.047	14.218	0.000	0.455
X14	0.932	0.597	0.052	11.458	0.000	0.357
X15	0.771	0.512	0.059	8.730	0.000	0.262
X16	0.860	0.561	0.054	10.377	0.000	0.314
LE2: Remind and storage						
X17	1.000	0.587	0.054	10.800	0.000	0.344
X18	1.399	0.693	0.050	13.940	0.000	0.480
X19	0.800	0.547	0.058	9.349	0.000	0.299
LE3: Technical supports						
X20	1.000	0.521	0.068	7.704	0.000	0.271
X21	1.082	0.586	0.060	9.707	0.000	0.343
X22	0.768	0.434	0.067	6.438	0.000	0.188
X23	0.761	0.294	0.073	4.043	0.000	0.087
LE4: Telecommunication						
X24	1.000	0.698	0.042	16.792	0.000	0.487
X25	0.713	0.394	0.069	5.678	0.000	0.155
Second-order/life						
LI1	1.000	0.489	0.060	8.137	0.000	0.240
LI2	1.007	0.871	0.030	29.269	0.000	0.759
LI3	0.722	0.688	0.111	6.183	0.000	0.473
LI4	0.405	0.958	0.073	13.061	0.000	0.918
Learn						
LE1	1.000	0.845	0.041	20.427	0.000	0.715
LE2	0.888	0.867	0.045	19.254	0.000	0.751
LE3	0.798	0.871	0.068	12.889	0.000	0.777
LE4	1.170	0.903	0.018	51.125	0.000	0.815
Third-order loading ECEVICE						
Life	1.000	0.967	0.009	102.623	0.000	0.936
Learn	1.019	0.968	0.007	139.624	0.000	0.938

improve the second questionnaires reflected the study for identifying all 25 indicators covering the explanation of the use in both circumstances. And the indicators in each circumstance could be used to describe the variance without any difference.

The third-order CFA found that the measurement model conformed to the empirical data in the good level. The important factors might be, the survey on the primary indicators from the students before confirming the measurement structure of the use of the PED) The survey on the internal factors for the hypothesis to define the layout of the relationship of the variables and) The data collected from the sample data sufficient to test the validity of the model. The results showed that the research studies on the indicator development and measurement model had never been conducted before. However, the researchers were interested that under the indicators and factor structure of the use of PED, whether or not this could be a good sample for different sampling group.

CONCLUSION

The development of the electronic devices influenced the life behaviours of young people in many countries around the world including Thailand. The educational theories and concepts needed to be reviewed when the use of technology had developed in order to produce the citizen with internationally competitive competence. Therefore, the study of the change in behaviours resulted from the development of the PED based on the 25 indicators covering the utilisation in life and learn was one means to help understand the behaviours that can be changed yearly in order to support or fulfil the learning according to the lifestyles for the highest benefit (Goksu and Atici, 2013).

SUGGESTIONS

With regards the research findings, the researchers have the suggestions for applying these findings that the factors and indicators found were harmonised with the

previous researches. This is because the development of the technological devices was for commercial purpose. The trend of changes in behaviours was similar. However, the ratio could be more or less depending on the economical status in each area. Thus, the study of behaviours for utilising the devices should be conducted before running the projects or developing the educational inventions for the better chance to worthily use the devices in learning and promote the ultimate lifetime learning habit.

In case of future study, there should be a test on the indicators as a representative of cross-sample groups, for instance, technological group, health group and social science group or students in different year group as well as an in-depth study of conditions for utilising the devices such as a timeframe, period of use, economical status of students and the effects on learning achievement which will help promote in-depth knowledge to students.

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