# A Meta-Analytic Path Analysis of e-Learning Acceptance Model

David W.S. Tai, Ren-Cheng Zhang, Sheng-Hung Chang, Chin-Pin Chen, Jia-Ling Chen

*Abstract*—This study reports results of a meta-analytic path analysis e-learning Acceptance Model with k = 27 studies, Databases searched included Information Sciences Institute (ISI) website. Variables recorded included perceived usefulness, perceived ease of use, attitude toward behavior, and behavioral intention to use e-learning. A correlation matrix of these variables was derived from meta-analytic data and then analyzed by using structural path analysis to test the fitness of the e-learning acceptance model to the observed aggregated data. Results showed the revised hypothesized model to be a reasonable, good fit to aggregated data. Furthermore, discussions and implications are given in this article.

*Keywords*—E-learning, Meta Analytic Path Analysis, Technology Acceptance Model

## I. INTRODUCTION

WITH the maturity of the e-learning market, the increasing sophistication of its customer or user base, and the growing intensity of competition, e-learning has now become a pressing issue [1]. Previous researches have employed information technology adoption theories, such as the technology adoption model (TAM), innovation diffusion theory (IDT), task technology fit (TTF), and the unified theory of acceptance and usage of technology (UTAUT), to examine the factors affecting users' adoption [2]. The technology acceptance model (TAM) is developed by Davis [3], from this stream of social psychology research, the technology acceptance model, has emerged as a powerful and parsimonious way to represent the antecedents of technology use [4]. TAM was an adaptation of theory of reasoned action (TRA) and described that users' attitude toward an information system/information technology was determined by two particular beliefs, perceived usefulness and perceived ease of use. Attitude leads the behavioral intention on using technology, and then generates the actual usage behavior [5]. The model is the effective use to explain the determinants of user acceptance of a wide range of user computing technologies. Technology acceptance research carried out originally to predict technology user acceptance and extended to e-learning [6,7,8].some scholars have called it "E-Learning Acceptance Model [9]." Nowadays, there have been many studies trying to investigate how to improve learning performance efficiently in e-learning, however, it would be meaningless if students cannot accept e-learning [10].

David W. S. Tai is with the Hungkuang University, Taichung, 43302, Taiwan (e-mail: david60123@gmail.com).
Ren-Cheng Zhang is with the National Changhua University of Education, Changhua, 500, Taiwan (e-mail: clayclctw@hotmail.com).
Sheng-Hung Chang is with the National Changhua University of Education, Changhua, 500, Taiwan (e-mail: evans130@gmail.com).
Chin-Pin Chen is with the National Changhua University of Education, Changhua, 500, Taiwan (e-mail:iechencp@mail.ncue.edu.tw) * Corresponding author.
Jia-Ling Chen is with the National Changhua University of Education, Changhua, 500, Taiwan (e-mail: d97311003@gmail.com).

The introduction of e-learning technologies in teaching institutions is often complex and learners and educators do not always use it as expected [11]. However, the methods of applying technology in learning from teachers and students are really affect the results of e-learning. To find out students' intention, ease of use and belief in e-learning can create a kind of learning mechanism to attract more students use it [12]. Furthermore, as with any other information system or service, the success of an e-learning service depends on both its initial adoption (acceptance) and its continued usage [13]. In order to construct well-designed e-learning systems, it is necessary to understand what factors will influence users' intention to use e-learning systems.

The lack of E-Learning Acceptance Model meta-analysis is actually existed in this field, even though, in the study of Šumak, B., Heričko, M., & Pušnik, M. just analyzed the correlation between pairwise variables without considering the interpretation of the highly correlation between variables[14].

However, in the ordinary meta-analysis, the correlation value should be calculated by two variables independently, but it would overestimate the correlation value. But in fact, this problem can be solved by meta-analytic path analysis. [15]. The goal of this study was to use meta-analytic path analysis to evaluate a theoretical model of E-Learning Acceptance Model.

In the relative researches of e-learning field, there have been many scholars investigating the intention to use e-learning by TAM, the two key factors in determining intention, which predict the development of an innovation and are present in all studies of TAM model development, are: perceived usefulness (PU) and perceived ease of use (PEOU)[3]. These two beliefs both influence users' attitude towards using. Attitude sequentially has the influence on which behavioral intention to use, which is the key factor in determining to use [16]. This relationship between PU and PEOU variables has been questioned in other studies that find no empirical evidence to support it, although they verify their direct relationship to attitude and the user's final intention [17].

Most TAM researchers have focused on its extrinsic perspective [18], they came out with different point of view in external variables. Usually, there are 3 kinds of external variables have been used, for example, the characteristics of system, teaching material and learners. Thus, there is no clearly definition toward the external variables so far, and that is the reason why this study just used based TAM and e-learning meta-analysis to address this issue. The model is shown as followed:
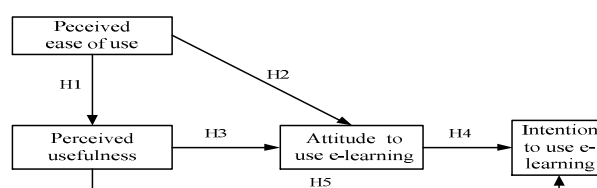


Fig. 1 E-Learning Acceptance Model

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## II. METHODS

### A. Literature search

The literatures in this study were searched from ISI Web of Knowledge database. After selecting and preparing, the data were coded in the coding book. A meta-analysis was used to analyze the correlation between the variables. There were 6 correlation coefficients among 4 variables forming the matrix. After coded by the researcher, the data were rechecked again by the assistant to confirm the accuracy. Through the Kappa coefficient to test the consistency between different scholars.

### B. Rules for inclusion

The data of this study is the literatures about application of technology acceptance model in e-Learning and selected from the international research journals (search from ISI Web of Knowledge). The subjects are students (from elementary school to university, excluding in-service training) in quantitative researches, and Correlation coefficient values are provided in the literatures. The target literatures were published within one decade (2000 ~ 2010). The data which had no correlation coefficient were eliminated, such as qualitative researches, action researches and so on.

## III. RESULTS

Meta-analytic path analysis was used to test the hypothesized model. We used meta-analyzing the correlations at first and then converting the results to structural path relationships.

### A. Result of meta-analysis

Meta-analysis is a technique that allows individual study results to be aggregated while correcting for various artifacts that can bias relationship estimates. For a construct to be included in such analyses, there must be multiple study effects that relate it to every other construct in the model [19]. Our meta-analyses were conducted using Hunter and Schmidt's procedures [20]. The corrected correlations shown in Table I were all significantly different from zero according to Fisher's z-test of significance. Results showed that an expected pattern of relationships consistent with study hypotheses and previous research trends observed in individual studies.

TABLE I
SUMMARY OF EFFECT SIZES

| Path | r | 95%CL | Z | k | N |
|------|------|----------|-----------------|----|-------|
| H1 | .362 | .288/.436 | 9.614(P=.000) | 21 | 6897 |
| H2 | .355 | .270/.439 | 8.192(P=.000) | 6 | 2775 |
| H3 | .651 | .579/.723 | 17.698(P=.000) | 7 | 3128 |
| H4 | .278 | .126/.431 | 3.574(P=.000) | 10 | 3469 |
| H5 | .420 | .354/.486 | 12.484(P=.000) | 27 | 17914 |

r:correlation coefficient representing the mean effect size; 95% CL: the 95% confidence limits of r; Z:z test for the mean effect sizes; p:probability of z test; k : number of studies; N:total number of participants.

Table II shows the correlation matrix needed to analyze the models shown in Figures 2. Meta-analysis requires that each observed correlation from a given study be weighted by that study's sample size to provide a weighted mean estimate of the correlation.

The TAM core model (shown in Table II,III) suggests that Perceived ease of use(PEU), Perceived usefulness (PU) and Attitude to use e-learning (ATUE) are the important predictors of an individual's behavioral Intention to use e-learning (ITUE).

TABLE II
META-ANALYTIC CORRELATION VALUES

| Variables | PEU | PU | ATUE | ITUE |
|-----------|-------|-------|-------|-------|
| PEU | 1.000 | | | |
| PU | .362 | 1.000 | | |
| ATUE | .355 | .651 | 1.000 | |
| ITUE | .323 | .420 | .278 | 1.000 |

All the correlation coefficients were significant among 4 observed variables in 27 studies. Base on this, a 4*4 correlation matrix was proposed and then serve as data entry in next phase to testify the theory of E-Learning Acceptance Model.

In the structural equation model, only with a number of samples. However, each cell is based on meta-analyses employing different sample sizes. We chose to use the harmonic mean to solve it, because harmonic mean tends to yield the least biased estimates of standard errors of parameter estimates [21]. The formula for the harmonic mean is U(l/Ni + l/N2 + . .. + l/Nk), where k refers to the number of study correlations and N refers to the sample sizes of the studies. Figure 3 shows the harmonic mean of each meta-analysis, and we used these 6 amounts to calculate the total harmonic mean. The harmonic mean of the entire correlation matrix (N = 163.689) was used to test the chi-square's statistical significance.

TABLE III
THE HARMONIC MEAN

| Variables | PEU | PU | ATUE | ITUE |
|-----------|---------|---------|--------|------|
| PEU | -- | | | |
| PU | 164.156 | -- | | |
| ATUE | 249.889 | 268.567 | -- | |
| ITUE | 121.449 | 95.727 | 97.368 | -- |

### B. Result of path analysis

We tested the four models using LISREL 8 [22]. A path analysis of the model (see Fig. 2) shows acceptable fit to the data ($\chi^2 = 9.66$, df = 1, p = 0.002). For the hypothesized model the GFI was 0.98, a value exceeding the standard of 0.8 recommended by Hair, Bush, and Ortinau [23]; the NFI was 0.94, and the CFI was 0.95, exceeding the standard of 0.9 recommended by Brown and Cudeck [24]. These indicators are consistent in indicating an acceptable fit of the hypothesized model to the data. The results showed that all coefficients are statistically different from 0 in this model except the path (H4) was not significant (Attitude to use e-learning -> Intention to use e-learning). The impacts for other paths ranged between 0.14(H2) and 0.71(H5).The total effects on ease of use toward the usefulness was .36, toward the attitude was .35, and toward the intention was .15. These are displayed in Fig. 2.
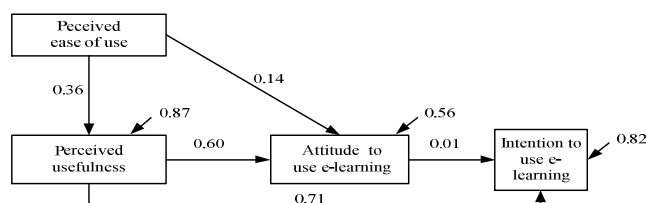


Fig. 2 EAM path analysis

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## IV. DISCUSSION

TAM, by itself, is an excellent model. The findings are similar to other studies. First, this study confirmed that perceived ease of use had significant impact on perceived usefulness as the TAM suggested. Both perceived usefulness and perceived ease of use influence individual attitudes. The influence of perceived usefulness on attitude and behavioral intention to use e-learning is profound. Unexpectedly, the direct path from attitude to intention is near zero. The result is not according to the viewpoints of the Technology Acceptance Model. This is different with other studies because attitude is often an important variable. In order to increase the samples and to research the data widely, all the variables were not considered to be involved simultaneously. Furthermore, the partial correlation would be adjusted by the variables. As the result, compare to other TAM meta-analyses, this study is more qualified for the actual phenomenon. A couple of points deserve attention. According to the research result, the issue of partial correlation should be paid attention to when interpret the data. In another words, when correlation is existing between variables, the value is easier to highly estimated. Therefore, if there is a correlation between 2 variables, especially in meta-analysis, the data interpretation should be more concerned and discreet.

Of course, as in any such analysis, there are possible sources of bias (non-significant results are seldom published and there may be a lack of objective and consistent search criteria)[25]. Additionally, "including all relevant material-good, bad, and indifferent--in meta-analysis admits the subjective judgments that meta-analysis was designed to avoid" [26]. However, the file drawer problem [27] was not avoidable in this study, due to the samples were only chosen from peer-reviewed articles from ISI Web of Knowledge database. Furthermore, the measurement error could be occurred due to the lack of the completeness in reliabilities and distributions.

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