How incorporation of information technology in teaching affects learning satisfaction: a case study

Pao-Ching Lin†, Yuan-Chau Liour‡ & Hai-Ming Chen†

Tamkang University, New Taipei City, Taiwan†
Takming University of Science and Technology, Taipei City, Taiwan‡

ABSTRACT: Nowadays, information technology innovation progresses very quickly. Teachers are able to apply information technology as a teaching medium in daily life and instruct students on how to learn and to meet their needs, perhaps enhancing students' learning satisfaction. This case study aims to apply meta-analysis in order to verify the impact of the integration of information technology into teaching at a certain vocational and technological university in Taiwan. This research used convenience sampling to target teachers (full-time lecturers or above) and students to conduct a questionnaire survey, and data for meta-analysis were collected on the basis of literature in Taiwan and abroad. In addition, meta-analysis was conducted with random effect. The research shows that the integration of information technology into teaching has a positive and significant impact on learning satisfaction. The results have strong practical implications and can serve as a reference to teachers and policy makers in education, based on the teaching at a certain vocational and technological university in Taiwan.

INTRODUCTION

All the world's governments have been promoting the integration of information technology into teaching, as the technology continues to evolve. The Grade 1-9 Curriculum driven by the Ministry of Education in Taiwan emphasises the application of information technology in the teaching of different subjects, so as to foster a diversity of teaching methods and to nurture the information technology competence of students [1].

The 21st Century is a new era of social diversity, information technology and knowledge economy. In order to keep up with the times, constant learning is required from everyone. Students have ready access to information, from smartphones and tablets via the Internet, anytime and anywhere. Teachers are expected to guide students to sift through information by leveraging information technology, meet their learning needs and accumulate knowledge with clarity. This will help students to develop a good learning attitude and achieve learning effectiveness [2].

All industries have taken measures to respond to the rapid development of information technology. New ideas and perspectives have emerged in education, as the integration of information technology to education has brought about innovative teaching methods. The information technology literature of teachers is increasingly important. An educator has to be active in acquiring new knowledge and competence in order to stay competitive [3].

Schools are required to meet with the changing needs of society by modernising teaching techniques. Information technology enables interactivity and personalisation in the content of teaching. This breaks away from the old-fashion inflexible teaching style and inspires innovation, judgment, independent thinking and problem-solving capabilities in students [4].

In Taiwan, some vocational colleges and universities are the cradle of professional talent. Aiming to prepare fresh graduates for workplaces, teachers are encouraged to integrate information technology into teaching. It is, hence, worth verifying whether this approach enhances learning satisfaction of students.

Research methods, such as meta-analysis are able to be used in confirmatory factor analysis (CFA) instead of functions of structural equation modelling (SEM), so this research attempts to apply a novel research approach to verify the view-point of the former related literature and processes the sampling population data by using Stata software. In a word, this case study aims to conduct a meta-analysis in order to verify the impact of the integration of information technology into teaching at a certain vocational and technological university in Taiwan.

LITERATURE REVIEW

Below is a review of the literature on the topics relevant to this article.

Integration of Information Technology into Teaching

This article defines the integration of information technology as the application of the Internet, digital materials (e.g. interactive whiteboards and slides), teaching materials and information technology literacy into teaching activities. This definition has been derived and summarised from the following literature:

Chen believed that the sufficiency of computer hardware and software, the planning of the teaching environment, the penetration of computers in classroom, the information technology literacy of teachers and students, and the availability of teaching materials are the most critical factors [5].

Li thought that it is important to represent lively, innovative and meaningful teaching methods by leveraging the characteristics of information technology and the Internet. This will benefit teaching material design, teaching activities and curriculum reviews [6].

Chen indicated that the integration of information technology into teaching, materials and curriculum is essential part of daily work for teachers. In other words, the application of information technology to teaching is about using it as a teaching tool in teaching applications [7].

Chen suggested that information technology should be applied to curriculum, according to the understanding and needs of teachers about the curriculum. The application of information technology in teaching materials helps learning [2].

Learning Satisfaction

This article defines learning satisfaction as satisfaction with curriculum design, content, teaching, learning environment and interpersonal relationships in the setting. To put it differently, students are pleased with the learning process as the learning activities meet with their psychological needs.

The above definition has been derived and summarised from the following literature:

Tough contended that learning satisfaction is a learning attitude accompanied with feelings. A good and positive attitude indicates satisfaction, whilst a bad and negative attitude indicates dissatisfaction [8].

Daley Thompson pointed out that learning satisfaction is the level of satisfaction with curriculum design, teaching materials, teaching processes, learning environment and interpersonal relationships in the learning setting [9].

Lee said that learning satisfaction is measured with the gap between the expectation (what is supposed) and the actual results (what is received) in the learning process. The smaller the gap, the greater the satisfaction is. The larger the gap, the lower the satisfaction is [10].

Cheng defined learning satisfaction as the feelings or attitudes developed by students about learning activities. Such feelings or attitudes are formed on the basis of the enjoyment of the learning activities or the satisfaction of their wishes and needs during the learning process [11].

Chen held that learning satisfaction is the involvement, attitude and the perceived level of goal achievements (by comparing to their expectations) from the learning activities and the learning process [12].

Yang regarded learning satisfaction as the feelings or attitudes students have towards learning activities. Happy feelings or a positive attitude indicate satisfaction. Upset feelings or a negative attitude suggest dissatisfaction [13].

Liao believed that learning satisfaction is the feelings derived from the learning process based on the first-hand experience of students in learning activities. Students determine how much they enjoy the learning activities and how much their needs and expectations are met. Learning satisfaction affects learning motivation and continued involvement going forward [14].

Huang considered learning satisfaction the reason for involvement in learning activities and learning results of students [15].

Yang posited that learning satisfaction is the satisfaction of psychological needs of students with learning activities in the learning process. It creates a pleasure and positive attitude [16].

Lin indicated that happy feelings or an active attitude towards electronic textbooks means satisfaction among students. In contrast, unhappy feelings or a passive attitude suggest dissatisfaction [17].

Learning Effective Associated with Integration of Information Technology into Teaching

Wu highlighted a positive and significant correlation between learning interest and satisfaction and the integration of information technology in teaching in vocational colleges in Chiayi city/province [18].

Lai supported a positive influence of the integration of information technology into teaching on the learning motivation and satisfaction of students from the third to the sixth grades in elementary schools. There is a strong positive correlation between the application of information technology in teaching and learning motivation and satisfaction [19].

Chiang argued for a positive and significant correlation between the integration of information technology in mathematics teaching and learning interest and satisfaction [20].

Tseng et al indicated that students had significant positive attitudes towards the courseware design; the instructor's teaching method; and the impact of concept mapping instruction and the quality of courseware design was found to be the mediator between the instructors' teaching methods and students' learning performance [21].

Chen and Hsiao showed that there was a significant difference between the two common factors of team integration and independent thinking. This proves that Web-Quest can be used in music appreciation as a creative educational tool. It can promote learning effectiveness in music appreciation courses, and it can improve creative higher order thinking ability [22].

Wang showed that blog teaching is an improvement on traditional teaching and it specifically boosts students' academic performance. Hence, blog teaching as a method deserves to be promoted [23].

According to Chen, the greater the integration of information technology into teaching, the higher the learning satisfaction and the better the learning attitude become [2].

Based on the above, this research develops the following hypothesis:

H_1: The integration of information technology into teaching by full-time lecturers and above in a vocational college in Taiwan creates a positive and significant influence on learning satisfaction.

RESEARCH METHODOLOGY

Based on the above research motivations, objectives and literature review, this case study establishes the following research model and structure to validate the research hypothesis (Figure 1).

Research Structure

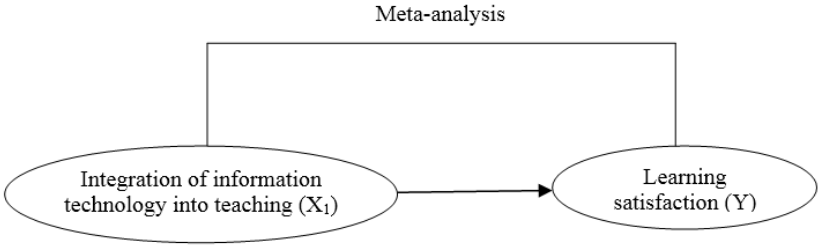


Figure 1: Research structure.

Data Collection and Research Techniques

This case study used convenience sampling to target teachers (full-time lecturers or above) and students at a certain vocational and technological university in Taiwan to conduct the questionnaire survey. In addition, this research disseminated 20 sets of an expert questionnaire as a pilot test. Revisions were made according to the improvements suggested by the experts. Post tests were then conducted. Four hundred questionnaires were formally disseminated, 322 valid samples were returned, indicating a sample recovery rate of 80.5 %.

In brief, this case study conducted a survey of full-time lecturers and above at a certain vocational and technological university in Taiwan regarding the effects of the integration of information technology into teaching. All the students in this institution were surveyed to gauge their learning satisfaction. A meta-analysis was conducted with the Stata statistical software program, by assuming a normal distribution for estimates. In the case of greater heterogeneity (i.e. standard errors), random effects are more accurate than fixed effects. Therefore, this study refers to random effects to compare multiple effects [24].

Theoretic Basis of Meta-analysis [25]

1) Highlights of DerSimonian and Laird method (random effect method):

   a) For binary or continuous outcomes.
   b) Effect size q_i for study *i* could be In(OR), In(RR), RD, difference in means or standardised mean difference.
   c) Note that the effect sizes for OR and RR are logged.

d) Assume that there is a single true answer that all studies are trying to estimate is relaxed.
e) Now assume that each study has a different true answer that they are trying to estimate.
f) Assume true effect sizes θ_i have normal distribution with mean θ and variance τ^2.
g) τ^2 is the between-study variance.
h) Between study variance:

$$\tau^2 = \frac{Q - (k-1)}{\sum_i w_i - \left[\frac{\sum_i w_i^2}{\sum_i w_i}\right]} \quad [1]$$

Where:

w_i are weights from the fixed effect inverse-variance method;

Q is the heterogeneity test statistic form before (either form inverse-variance method or Mantel-Haenszel method);
K is the number of studies;
τ^2 is set to zero if Q < k-1.

i) Random effect pooled estimate is weighted average:

$$\theta_{DL} = \frac{\sum_i w'_i \theta_i}{\sum_i w'_i} \quad [2]$$

j) Weights used for the pooled estimate are similar to the inverse-variance, but now incorporate a component for between-study variation:

$$w'_i = \frac{1}{SE(\theta_i)^2 + \tau^2} \quad [3]$$

k) When there is little heterogeneity, so Q is smaller than k-1, $\tau^2 = 0$ and the weights are the same as the inverse-variance method.
l) When $\tau^2 > 0$ the weights are smaller and more similar to each other than in a fixed effect model.
m) Because the weights are smaller, the sum of weights will be smaller, and so the SE will be bigger, CIs wider and *p*-values less significant.
n) Small studies will have relatively greater influence.
o) Advantages:

- As widely applicable as the inverse-variance fixed effect model;
- Incorporates heterogeneity into the model.

2) Confidence interval for pooled estimate:

A 95% CI for the pooled estimate θ is:

$$\theta - (1.96 * SE(\theta)) \text{ to } \theta + (1.96 * SE(\theta)) \quad [4]$$

For ratios, θ is the log-transformed estimate.

3) Test for overall effect:

Overall significance test for whether the pooled estimate is significantly different from zero (no effect):

$$z = \frac{\theta}{SE(\theta)} \quad [5]$$

Look up for z in tables of the normal distribution to get the *p*-value.
For ratios, θ is the log-transformed estimate.

4) Test for heterogeneity:

   a) Look up for Q in tables of the *chi*-squared distribution on k-1 degrees of freedom. The null hypothesis is that the true effect size is the same for all studies.
   b) A statistically significant result means that there is strong evidence against there being one common effect size, so one can take it that there is heterogeneity.

5) Getting data into Stata:

   a) Easier to enter into Excel then cut and paste into Stata's data editor.
   b) Ensure each numeric column contains only numbers.
   c) Leave cells empty if data missing.
   d) Use one row per study.

RESULTS AND ANALYSIS

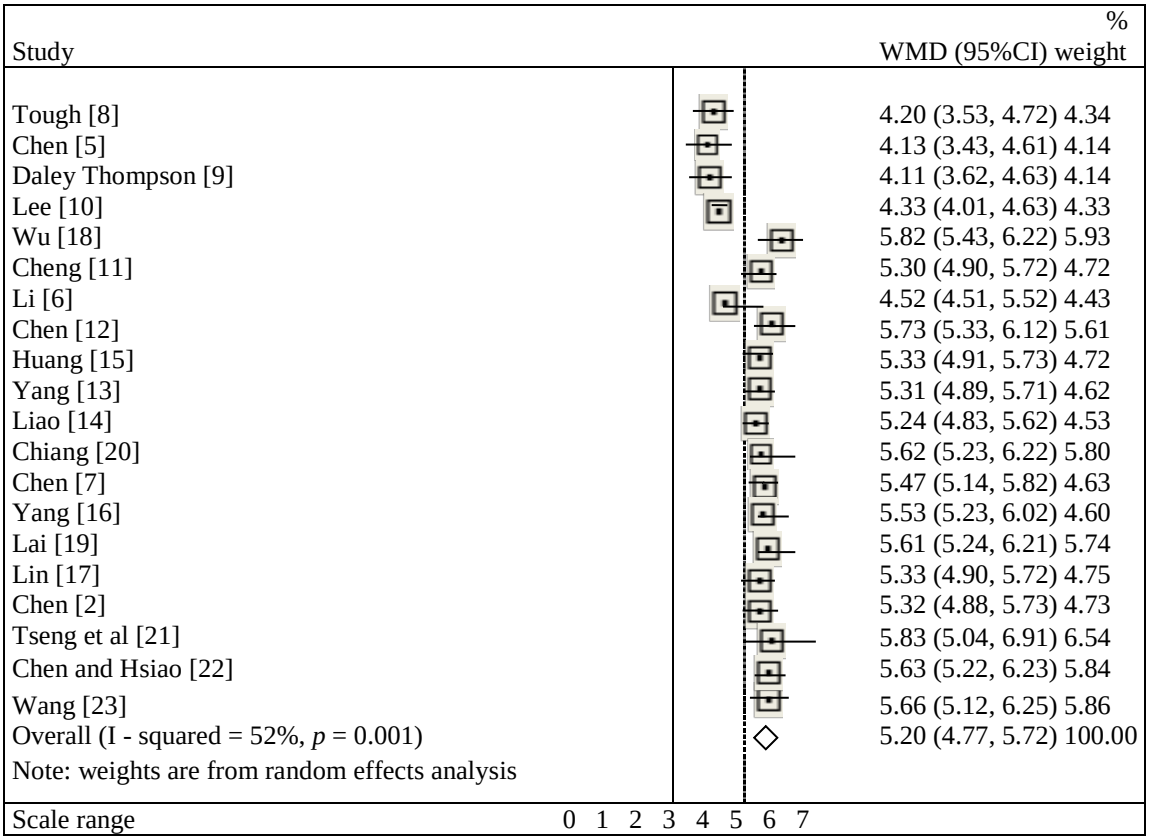
As mentioned above, this case study applied a novel research approach to verify the viewpoint of the former related literature and process the sampling population data by using Stata software (see Table 2). The statistical values of WMD, 95% CI, weight, overall *I* and *p*-value in Table 1 were summarised and transferred into Word format, but in order to help readers to understand the table's meanings more easily, this study excluded the scaling mapping as shown in Table 2.

In Table 1 and Table 2, if the values of WMD range of scale-mapping are from 0 to 10 and the values are positive, especially, if the overall I-squared is larger than 50% and the *p*-value is smaller than 0.05, it indicates that the independent variable has a positive and significant influence on the dependent variable in the research model.

Meanwhile, if the values of WMD range of scale-mapping are from 0 to -10 and the values are negative, especially, if the overall I-squared is also larger than 50% and the *p*-value is also smaller than 0.05, it indicates that the independent variable has a negative and significant influence on the dependent variable.

An analysis of random effects with meta-analysis was gathered, as shown in Tables 1 and 2. The statistical values of WMD, 95% CI and weight show that the overall I-squared is 52% (i.e. larger than 50%) and the *p*-value is 0.001 (which is smaller than 5%). These show that the independent variable has a positive and significant influence on the dependent variable in the research model. So the hypothesis (H_1) is accepted. In a few words, the integration of information technology into teaching has a positive and significant impact on learning satisfaction.

Table 1: Random effects.



It can be seen in Table 1 that the statistical values of WMD, 95% CI, weight, overall I-squared and *p*-value were summarised and calculated by Stata, but all of them are transferred into Word style.

Also, the values of WMD range of scale-mapping is between 0 and 10 and the values are positive, especially, if the overall I-squared is larger than 50% and *p*-value is smaller than 0.05, it indicates that the independent variable has a positive and significant influence on the dependent variable in the research model.

Table 2: Random effects removed scale mapping (derived from Table 1).

Study	WMD	(95%CI)	% Weight
Tough [8]	4.20	(3.53, 4.72)	4.34
Chen [5]	4.13	(3.43, 4.61)	4.14
Daley Thompson [9]	4.11	(3.62, 4.63)	4.14
Lee [10]	4.33	(4.01, 4.63)	4.33
Wu [18]	5.82	(5.43, 6.22)	5.93
Cheng [11]	5.30	(4.90, 5.72)	4.72
Li [6]	4.52	(4.51, 5.52)	4.43
Chen [12]	5.73	(5.33, 6.12)	5.61
Huang [15]	5.33	(4.91, 5.73)	4.72
Yang [13]	5.31	(4.89, 5.71)	4.62
Liao [14]	5.24	(4.83, 5.62)	4.53
Chiang [20]	5.62	(5.23, 6.22)	5.80
Chen [7]	5.47	(5.14, 5.82)	4.63
Yang [16]	5.53	(5.23, 6.02)	4.60
Lai [19]	5.61	(5.24, 6.21)	5.74
Lin [17]	5.33	(4.90, 5.72)	4.75
Chen [2]	5.32	(4.88, 5.73)	4.73
Tseng et al [21]	5.83	(5.04, 6.91)	6.54
Chen and Hsiao [22]	5.63	(5.22, 6.23)	5.84
Wang[23]	5.66	(5.12, 6.25)	5.86
Overall (I-squared=52%, p=0.001)	5.20	(4.77, 5.72)	100.00

Note: Weights are from random effects analysis

CONCLUSIONS AND SUGGESTIONS

Conclusions

The research findings suggest that the integration of information technology into teaching by full-time lecturers and above in a vocational college in Taiwan creates a positive and significant effect on learning satisfaction. This is consistent with Tough [8], Chen [5], Thompson [9], Lee [10], Wu [18], Cheng [11], Li [6], Chen [12], Huang [15], Yang [13], Liao [14], Chiang [20], Chen [7], Yang [16], Lai [19], Lin [17],Tseng et al [21], Chen and Hsiao [22], Wang [23] and Chen [2] , despite differences in weights.

Research Contributions

The research results have strong practical implications and can serve as a reference to teachers and policy makers in education for the teaching in a certain vocational and technological university in Taiwan.

The majority of studies use regression analysis for exploratory research. Few papers use meta-analysis. This article's employment of meta-analysis as the research technique is an innovative approach.

Research Limitations and Suggestions

As stated before, this case study was based on a survey with convenience sampling, which means that the sampling data gathered might not always represent the population. It is suggested that follow-up studies could use other research sampling methods, such as simple random sampling or stratified sampling to gather more representative data or to enlarge the research object range, and compare results with those produced by other research techniques, such as SEM to validate the goodness-of-fit of research models.

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