A Meta-Analysis on the Information Technology Application in Patients' Knowledge and Anxiety in Taiwan

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ABSTRACT—*The application of information technology in health education plan in Taiwan had gone for a long time. This study was performed to synthesize existing research comparing the effects of information technology application versus traditional instruction in health education plan on patients' knowledge and anxiety in Taiwan. In spite of claims regarding the potential benefits of using information technology in health education plan, research results comparing the effects of information technology application and traditional instruction in Taiwan were conflicting. Some studies all reported significant gains for information technology application over traditional instruction. However, some studies had found no significant differences between information technology application and traditional instruction. Meta-analysis was a statistical process whereby the findings of several studies, focusing on a common problem or topic, are pooled in an effort to draw inferences as to the meaning of a collective body of research. In an effort to lend data to this debate, this study provides the meta-analysis of information technology application verse traditional instruction in Taiwanese hospital. The results from this study suggest information technology application with health education is positive with patients' knowledge, and information technology application with health education is negative with patients' anxiety.*

Keywords—Health Education Plan, Patients' Knowledge, Patients' Anxiety, Meta-analysis

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1. INTRODUCTION

The application of information technology in healthcare in Taiwan had gone for a long time. The need to improve the health care system has led to the launch of a national initiative that stresses the use of health information technologies to enhance quality of care, support health care safety, and provide cost-effective health services for consumers, such as patients or individuals who receive medical care. While much of the discussion has focused on how health care organizations such as hospitals need to adopt health information technologies for patient safety, there is a growing recognition that such technologies can be used directly by consumers to acquire new forms of health care, such as telehomecare or eHealth. When used by patients, these technologies are referred to as consumer health information technologies [1]. Several definitions describing health information technologies can be found. Consumer health information technologies are defined as computer-based systems that are designed to facilitate information access and exchange, enhance decision making, provide social and emotional support, and help behavior changes that promote health and well-being [2].

While the potential for using information technology application to improve health care has been acknowledged, these technologies are still not always accepted by patients for variety of reasons, including poor device usability, insufficient training on how to use the technology, lack of computer skills, and low self-efficacy [3, 4, 5]. This is a significant concern for patients and health care organizations; patients who reject information technology application would not benefit from them, and rejection means a loss of return on investment for health care organizations. This concern has been realized. Evidence shows that substantial numbers of potential users do not accept information technology application and this has led to technology implementation failure in several projects [5]. Therefore, studies that examine variables predicting patient information technology application acceptance are needed.

It was important to define these approaches to ensure proper selection of appropriate studies. Information technology application, depending on their purposes, may be used by healthy individuals seeking out health information or by ill/injured individuals for treatment and/or self-management. This latter group is our current population of interest because information technology application acceptance may directly affect their health and well-being. It could be referred to this group actively receiving medical care for an injury or illness as patients. Acceptance of technology has been defined in four primary ways: satisfaction with the technology, use or adoption of the technology, efficient or

effective use of the technology, and intention or willingness to use the technology [6, 7, 8]. Therefore, our definition of information technology application acceptance is limited to those four conceptualizations. As described earlier, consumer health information technologies on which this article focuses are patient-oriented computer-based systems used to promote health, well-being, and safety, including telemedicine, e-health, and Web-based health technologies.

In spite of claims regarding the potential benefits of information technology application in health education, research results comparing the effects of information technology application and traditional instruction in health education in Taiwan are conflicting. Chao [9], Chiang [10], Chung [11], Li [12], and Liu [13] all reported significant gains for information technology application over traditional instruction in health education in patients' knowledge. However, Chiu [14] and Hsu [15] had found no significant differences between information technology application and traditional instruction in health education in patients' knowledge. Chao [9], Chung [11], Li. [12], Lin [16], Yung [17], and Liu [13] all reported significant gains for information technology application over traditional instruction in health education in patients' anxiety. However, Chang [18] had found no significant differences between information technology application and traditional instruction in health education in patients' anxiety. Meta-analysis was a statistical process whereby the findings of several studies, focusing on a common problem or topic, are pooled in an effort to draw inferences as to the meaning of a collective body of research [19]. Early meta-analysis studies were published prior to the microcomputer revolution, since 1970. In an effort to lend data to this debate, this study provides the meta-analysis verse traditional instruction in health education in patients' knowledge and anxiety.

2. MATERIALS AND METHODOLOGY

The research methodology implicated in this study was the meta-analytic approach which was similar to that suggested by Higgins, Thompson, Deeks, and Altman [20]. Their approach requires a reviewer to locate studies through objective and replicable searches, code the studies for salient features, describe outcomes on a common scale, and use statistical methods to relate study features to outcomes. This approach requires the reviewer to use objective procedures for locating studies, use quantitative techniques to describe study features and outcomes, and use statistical methods to summarize overall findings and explore relationships between study features and outcomes. The research framework of this study was as Figure 1. H1 is information technology application with health education is positive with patients' knowledge. H2 is information technology application with health education is negative with patients' anxiety.
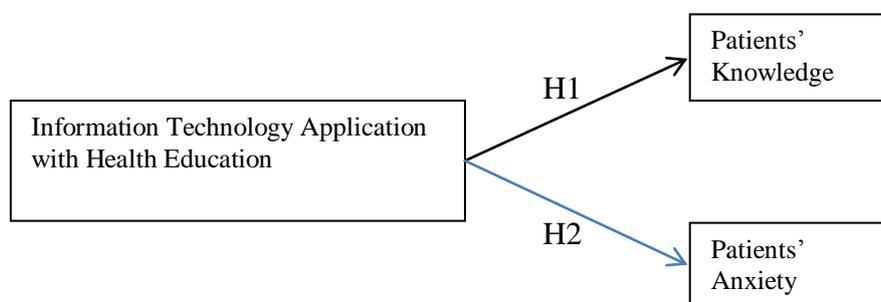

Figure 1: Research Framework of This Study

2.1 Research Data

These studies considered for use in this meta-analysis came from Taiwan Theses and Dissertations Knowledge Value-Added System. 12 theses were located through this search procedure. They include 7 studies for patients' knowledge, and 7 studies for patients' anxiety.

Several criteria were established for inclusion of studies in the present analysis as:

1. The study had to compare the effects of information technology application and traditional instruction in health education plan on patients' knowledge and anxiety.

2. The study had to provide quantitative results from both information technology application and traditional instruction in health education plan classes.

3. The study had to use Taiwan patients as subjects.

4. The study could be obtained with full-text.

Taiwan Theses and Dissertations Knowledge Value-Added System was the project entrusted to Taiwanese National Central Library (NCL) by the Department of Higher Education of The Ministry of Education in Taiwan. As recalling to the past efforts of theses and dissertations related information gathering, NCL started editing and printing of Catalog of

Theses and Dissertations in Taiwan in 1970. Taiwanese NCL has implemented the specific plan of theses and dissertations abstracts nationwide since 1994 by establishing abstracts files of theses and dissertations and launched web version of on-line search system which got very good feedback about positive value by various fields in 1987. In 1998, it also established theses and dissertations abstracts online system with the financial support by The Ministry of Education in Taiwan. Taiwanese NCL held the opening ceremony of National Theses and Dissertations Abstract File Building Plan which set up another new milestone on formal internet service of theses and dissertations. After 2000, Taiwanese NCL added functions of uploading of full text electronic theses and dissertations and online printing of authorization papers in addition to above mentioned National Theses and Dissertations Abstract File Building Plan. Thus Taiwanese NCL integrated the existing collaborative production and sharing of on-line database of National Theses and Dissertations information network [22].

2.2 Data Analysis

Meta-analysis was originally created by Glass, McGaw, and Smith [21]. In relating it to existing analyses, it could be classified research analysis into primary analysis, secondary analysis, and meta-analysis. Primary analysis is the original analysis of raw data. Secondary analysis uses alternative analytical techniques to analyze the same data to answer the same research questions, or uses the same techniques to answer different questions from the same data. A meta-analysis encompasses results of studies that are already conducted. It did not use the term to refer to the analysis of a planned series of investigations. Purpose of a meta-analysis was not simply to summarize a whole body of literature with a single effect size or overall significance level. It also tried to determine how study features influence effect sizes.

The effectiveness of information technology application in health education and training was determined by the overall effect of the treatment. Meta-analytic procedures were applied to calculate the size of this effect. As the meta-analysis progressed, and results unfolded, studies were grouped according to their common study features, and the various categories within the features were identified. Since a meta-analysis synthesizes the statistical results from many different studies, it is not necessary to define the independent variable in very specific terms. For this meta-analysis, it was sufficient to state the independent variable as the teaching method in technical education and training, which could be either computer-assisted instruction or traditional instruction. For the same reason, it was adequate to begin the meta-analysis by defining the dependent variable as student learning or achievement in learning resulting from technical education and training, as measured by some test or tests. The meta-analysis would be applied with Stata 13 computer software in this study.

2.3 Outcome Measures

The outcomes of health education measured in these 11 theses were patients' knowledge and anxiety, as indicated on researcher-developed achievement tests at the end of the program. A meta-analysis was performed to synthesize existing research comparing the effects of information technology application and traditional instruction on students' learning achievement in Taiwan. For statistical analysis, outcomes from a variety of different studies with a variety of different instruments had to be expressed on a common scale. The transformation used for this purpose was the one recommended by Higgins, Thompson, Deeks, and Altman [20]. For reduce measurements to a common scale, each outcome was coded as a standardized mean difference (SMD) that was information technology application group's learning outcome (treatment group) minus traditional instruction group's the learning outcome (control group).

2.4 Coder Reliability

For get more reliable outcomes from coding, three research assistants coded these studies (theses). Each of the three research assistants coded one third of the studies on each of the independent variables. To check for accuracy, the researcher coded each of the studies independently. In addition, the different codes on each of the studies between research assistants were discussed. The final agreement had to be met after discussion.

3. RESULTS

These studies considered for application in meta-analysis got from Taiwan Theses and Dissertations Knowledge Value-Added System, and 11 theses were obtained through this search method. The summarize of these 11 theses in this study was as Table 1. They all were published after 2003. Most of them (81.82%) with the sample size between 51 and 100.

Table 1: Summarize of these 11 Theses in this study

| Variables		N	%
Year of publication	2003	1	9.09
	2004	1	9.09
	2006	4	36.36
	2008	2	18.18
	2011	1	9.09
	2012	1	9.09
	2013	1	9.09
Sample size	1-50	1	9.09
	51-100	9	81.82
	101-500	1	9.09
Total		11	100.00

3.1 The Effects of Information Technology Application with Health Education on Patients' Knowledge

7 theses with the effect of information technology application versus traditional instruction on patients' knowledge in Taiwan were in this study. They include Chao (2003), Chiang (2004), Chiu (2006), Hsu (2006), Chung (2006), Li (2008), and Liu (2013).
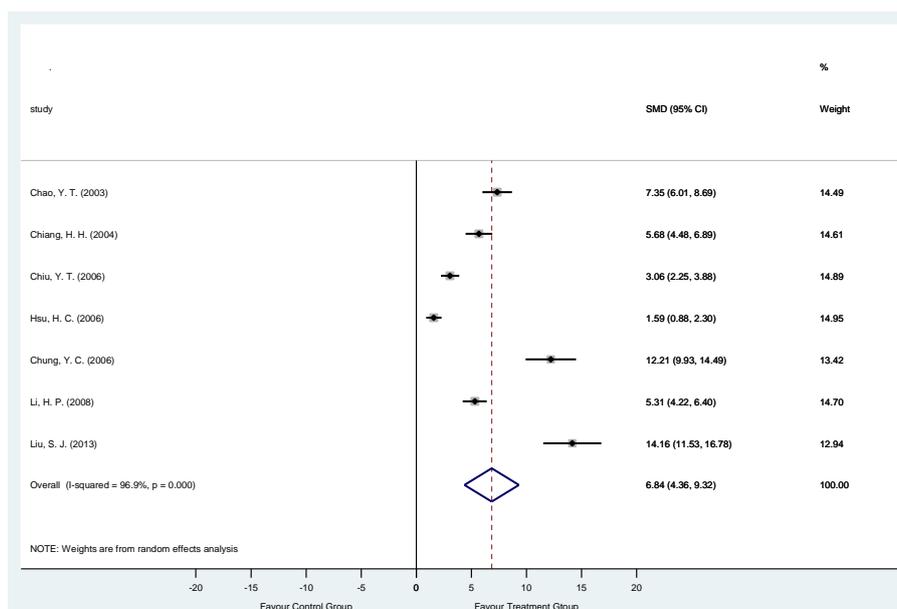
The number of comparisons and the study-weighted SMD with fixed effects analysis were reported and the SMDs for the 7 theses were presented as a forest plot in Figure 2. In these 7 theses included in this study, the study-weighted SMD of all of them were positive and favored the information technology application group. The range of the study-weighted SMD was from 1.59 to 14.16. The overall grand mean for all 7 study-weighted SMD was 4.16 (p < 0.001), suggesting that the patients' knowledge of information technology application group was better than traditional instruction group. I-squared of 0.97 reflects the great heterogeneity across studies.

The number of comparisons and the study-weighted SMD with random effects analysis were reported and the SMDs for the 7 theses were presented as a forest plot in Figure 3. In these 7 theses included in this study, the study-weighted SMD of all of them were positive and favored the information technology application group. The range of the study-weighted SMD was from 1.59 to 14.16. The overall grand mean for all 7 study-weighted SMD was 6.84 (p < 0.001), suggesting that the patients' knowledge of information technology application group was better than traditional instruction group. I-squared of 0.97 reflects the great heterogeneity across studies.

Based on the result, information technology application with health education is positive with patients' knowledge.
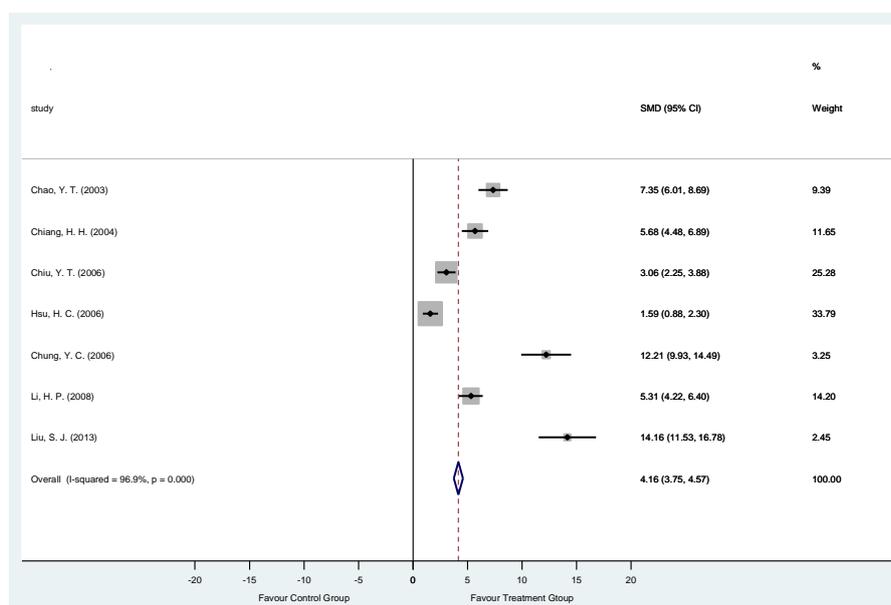
Figure 2: The Forest Plot of These 7 Theses in This Study of Patients' Knowledge with the Weights from Fixed Effects Analysis

Figure 3: The Forest Plot of These 7 Theses in This Study of Patients' Knowledge with the Weights from Random Effects Analysis
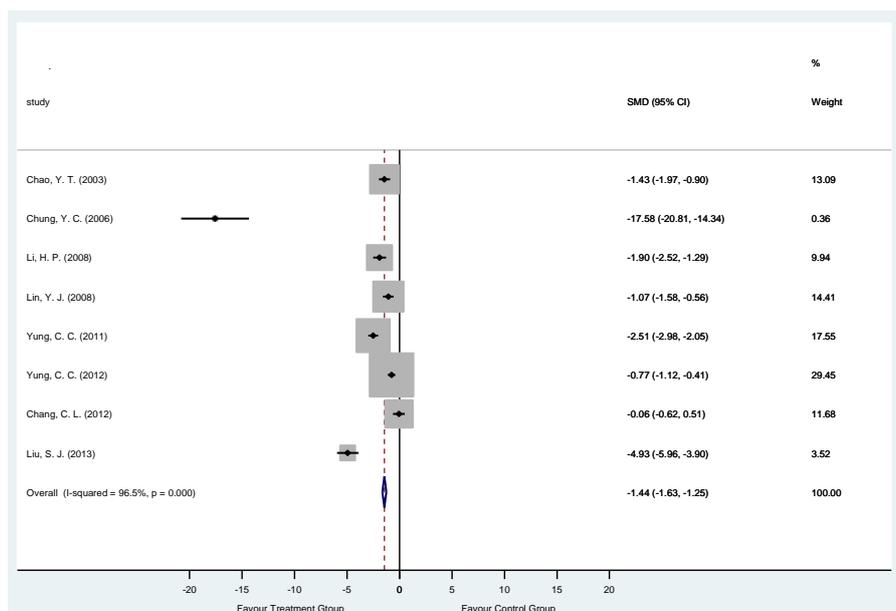
3.2 The Effects of Information Technology Application with Health Education on Patients' Anxiety

7 theses with the effect of information technology application versus traditional instruction in patients' anxiety in Taiwan were in this study. They were Chao (2003), Chung (2006), Li (2008), Lin (2008), Yung (2011), Chang (2012), and Liu (2013).

The number of comparisons and the study-weighted SMD with fixed effects analysis were reported and the SMD for these 7 theses were presented as a forest plot in Figure 4. In these 7 theses included in this study, the study-weighted SMD of all of them were positive and favored the information technology application group. The range of the study-weighted SMD was from -17.58 to -.06. The overall grand mean for all 7 study-weighted SMDs was -1.44 (p < 0.001), suggesting that the learning achievement of information technology application group was better than traditional instruction group. I-squared of 0.97 reflects the great heterogeneity across studies.

The number of comparisons and the study-weighted SMD with random effects analysis were reported and the SMD for these 7 theses were presented as a forest plot in Figure 5. In these 7 theses included in this study, the study-weighted SMD of all of them were positive and favored the information technology application group. The range of the study-weighted SMD was from -17.58 to -.06. The overall grand mean for all 7 study-weighted SMDs was -2.78 (p < 0.001), suggesting that the learning achievement of information technology application group was better than traditional instruction group. I-squared of 0.97 reflects the great heterogeneity across studies.

Based on the result, information technology application with health education is negative with patients' anxiety.

Figure 4: The Forest Plot of These 7 Theses in This Study of Patients' Anxiety with the Weights from Fixed Effects Analysis
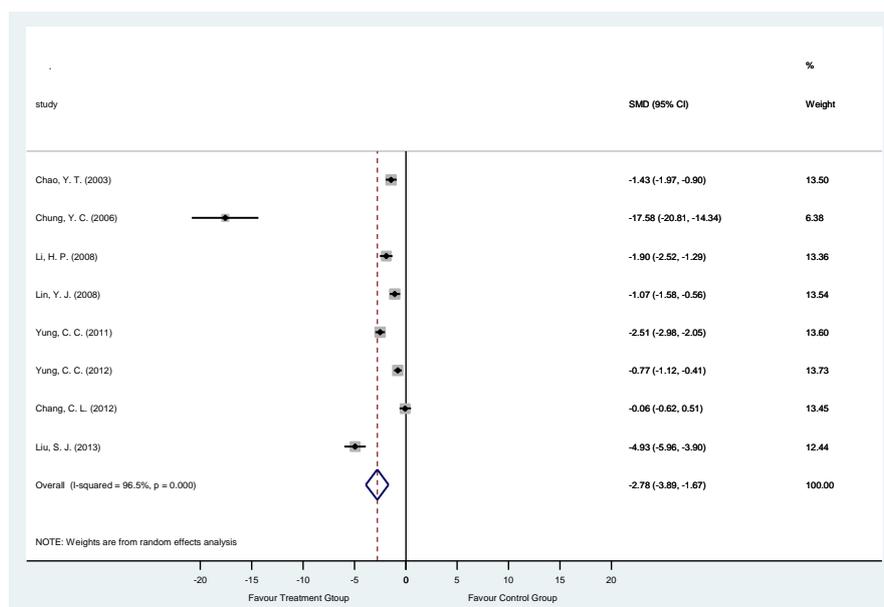
Figure 5: The Forest Plot of These 7 Theses in This Study of Patients' Anxiety with the Weights from Random Effects Analysis

4. DISCUSSION AND CONCLUSION

The results of this meta-analysis indicate that information technology application in health education plan had moderately effects on patients' knowledge and anxiety over traditional health education plan in Taiwan. The results from this study suggest information technology application with health education is positive with patients' knowledge, and information technology application with health education is negative with patients' anxiety. Although traditional health education plan that provided by nurse make some patients feel not comfortable than information technology health education plan that provided by computer. But information technology was a good tool for improve patients' knowledge and reduce patients' anxiety.

5. ACKNOWLEDGEMENT

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