

A Study on the Effects of Teachers' Information Literacy on Information Technology Integrated Instruction and Teaching Effectiveness

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The approach of information digitalization era has largely changed the teaching environment on campus. The application of information technology to education has become a concern in modern education. Traditional basic literacy of reading, writing, and algorithm could no longer cope with the demands in information societies that the information technology ability has become the fourth basic literacy for modern citizens. In face of changes, first-line teachers are in education required for adequate information literacy to integrate information technology equipment into instruction and to be competent for the role of teachers. Nonetheless, successful information technology teaching environments simply with adequate computer hardware and software equipment could not guarantee excellent teaching performance. Instead, it is necessary for teachers presenting adequate information literacy to integrate information technology into instructional processes, having students perceive the convenience and use security of information technology equipment, enhancing students' learning interests, and promoting teachers' professional growth and teachers' teaching efficacy. Aiming at university teachers in central Taiwan and Fujian Province, 450 copies of questionnaires are distributed in this study. Total 288 valid copies are collected, with the retrieval rate 64%. The research results are summarized as below. 1. Information literacy reveals significantly positive effects on information technology integrated instruction. 2. Information technology integrated instruction shows notably positive effects on teaching effectiveness. 3. Information literacy presents remarkably positive effects on teaching effectiveness. Aiming at the research results, some suggestions are proposed, expecting to help teachers promote the teaching effectiveness by applying information technology equipment to teaching activities or processes with sufficient information literacy.

Keywords: information literacy, information technology integrated instruction

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INTRODUCTION

Human life is getting in the information digitalization society, and the combination of computers and network has changed people's living habits. To cope with technological development and rapid changes of societies, Ministry of Education has promoted information education infrastructure plan, information education blueprint, and national key development plan of e-generation talent cultivation plan and stressed on applying information technology as the learning tool to assist in various learning areas and enhance students' problem-solving abilities.

In the informatization society, it becomes a common trend of education development in many countries in the world to cultivate the citizens presenting the basic knowledge and skills for the application of information technology. Traditional basic literacy of reading, writing, and algorithm could no longer cope with the demands in information societies that information technology abilities have become the fourth basic literacy for modern citizens. The application of information technology allows rapidly and broadly acquiring information, promoting personal learning efficacy and work efficiency, enhancing cooperation and communication with others, and cultivating personal habits of active learning and lifelong learning. The application of information technology tools also brings new issues into human societies, e.g. improper use causing individual physical and mental injuries, the belongingness and violation of intellectual property rights, and committing crimes with information technology. In this case, it is the core subject of information education in schools to cultivate students effectively using information technology tools and understanding issues related to information technology and human societies (Donnelly et al, 2011). Chen (2011) regarded information literacy education as the cross-century new content for the development of Grade 1-9 Curriculum.

The wave of globalized knowledge and the power of the Internet allow people rapidly receiving distinct information anywhere to learn problem solving. It is the information society in the 21st century, when information education determines the future competitiveness of a country that everyone should present basic information literacy to cope with changing environments. Nevertheless, a successful information technology teaching environment simply with adequate computer hardware and software equipment could not guarantee excellent teaching performance.

It is necessary for teachers presenting adequate information literacy to actually practice the integration of information technology into instruction and enhance the teaching effectiveness. To cope with the approach of information societies, the government has planned several information talent trainings and actively promotes information education downwards, as teachers with excellent information abilities could be competent for information instruction and promote information education. In face of future information era, the first-line teachers in education are required adequate literacy for integrating information technology into instruction so as to cope with the demands for globalization and knowledge economy and be competent for the role of modern teachers. After the government enriches information

State of the literature

- Successful information technology teaching environments simply with adequate computer hardware and software equipment could not guarantee excellent teaching performance.
- To discuss the effects of teachers' information literacy on information technology integrated instruction and teaching effectiveness.

Contribution of this paper to the literature

- Real operation and experience sharing better than paper-based lecture.
- Enhancing professional growth and promoting information literacy: Education units are suggested to broaden the study channels, rather than being restricted to information study; any studies which could enhance teachers' professional growth could be held
- Updating information technology equipment: Information technology equipment is sufficient in classrooms.

technology equipment for teachers, this study therefore intends to understand teachers' information literacy to apply information technology equipment to teaching activities or processes so as to promote teachers' teaching effectiveness.

LITERATURE AND HYPOTHESIS

Information literacy

Information Literacy was first proposed by Paul Zurkouski, the chairman of American Library Association and American Society for Information Science, in 1974, when information literacy was defined as people's abilities to apply information resources to work and learn relevant skills to solve problems (Alloway et al., 2010). Casciato (2010) pointed out people with information literacy as those being capable of acquiring and judging information to satisfy the information demands. La (2010) covered library skills and computer literacy in the core concept of Information Literacy. Information literacy was closely related to functional literacy, including the ability of daily reading and using information, the perception of personal information demands, and the abilities to actively search information for making decisions and learn new technology and knowledge. The idea of information literacy indicated to efficiently look for required information through libraries or computers (Aydinli & Elaziz, 2010). Accordingly, Teachers' Information Literacy in this study refers to teachers applying the information integration ability to integrate various information facilities into teaching activities and help students' learning with the information literacy and equipment.

Referring to Chen's (2011) information literacy meaning and basic information literacy indices for teachers, information equipment such as network and computers are utilized for assisting students' learning abilities and knowledge, according to the actual teaching processes, and promoting teachers' teaching effectiveness. The information literacy therefore is classified into information cognition, information skills, and information affection.

1. Information cognition: To know the software and hardware of information equipment and the operation, to understand the function and application of information equipment, to realize the basic courtesy of using network information, to be acquainted with basic information security, and to respect intellectual property rights.
2. Information skills: To be familiar with the operation of package application software, to apply computer technology to collect relative teaching materials, to deal with teaching and learning affairs, to utilize network and information equipment, to exchange teaching resources and teaching thoughts with others, and to guide students to engage in analyses and application to learning for communication, cooperation, research, and problem solving.
3. Information affection: To establish the concepts of morality, equality, and intellectual property rights for using software and hardware and to regularly enrich new knowledge to establish the idea of lifelong learning.

Information technology integrated instruction

Information technology integrated instruction refers to computer multimedia or network technology with the functions of digitalization, video and audio stimuli, accessibility, fast handling, and convenient communication, i.e. regarding information technology as the teaching tool to apply the characteristics of computer multimedia network to teaching contents and teaching strategies. Consequently, information technology integrated instruction does not simply indicate that teachers could use computers, but should be teachers being able to use computers for

effectively achieving the teaching objectives (Batton, 2010). Information technology integrated instruction integrates information technology into curricula, teaching materials, and instruction so that technology becomes a necessary teaching and learning tool. That is, the use of technology becomes a part of daily life in classrooms and information technology could be regarded as an approach or a process to look for problem solutions anytime and anywhere (Donnelly et al., 2011). In this case, information technology integrated instruction is expected to enhance students' learning effectiveness through the integration of information technology and learning areas as well as promote students' information abilities. As a result, information technology integrated instruction covers teachers' teaching activities, student s' learning activities, teaching preparation, and classroom management (Lopez, 2010). Anonymous (2011) mentioned that integrating information technology equipment into education and instruction could help students' learning and provide students with learning assistance.

1. Supporting knowledge construction: In the information technology integrated instruction, students could reorganize, analyze, and express the learned knowledge to achieve meaningful learning. Students could re-combine knowledge and construct personal knowledge through information technology in order to generate meaningful learning.
2. Supporting knowledge exploration: Information technology provides rich information, allowing students to find out data, select and analyze useful knowledge, and apply data to present complete learning outcomes through information technology in the exploration processes. The exploration processes allow students learning knowledge and further solving problems. Such processes could accomplish students' abilities of knowledge exploration.
3. Supporting learning by doing: Information technology offers opportunities for learning by doing, expecting that students acquire practice opportunities and accumulate experiences in constant practice.
4. Supporting cooperative learning: Students could cooperate and discuss with others to construct shared knowledge with synchronous or asynchronous cooperative learning through information technology.
5. Supporting reflective learning: Information technology, as students' intelligent learning partner, not only could help students clearly express the learned knowledge and construct new knowledge, but could also have students reflect and rethink the learned knowledge.

Referring to three dimensions proposed by Mercer et al. (2010), external environment, instruction design, and teacher are used for measuring information technology integrated instruction in this study.

1. External environment: Governmental policies, administrative support of funds, hardware equipment, and professional technology, and technological development are resulted from the effects of external environment on teachers practicing information technology integrated instruction.
2. Instruction design: The acquisition of teaching materials, teaching time, and students' abilities are the factors in teachers designing information technology integrated instruction.
3. Teacher: Mercer et al. (2010) indicated that teachers who intended to use information technology for instruction had to believe in technology being able to effectively achieve higher level of learning objectives, the use of technology not being inconvenient, and teachers themselves presenting adequate use abilities.

Teaching effectiveness

Teachers are the body of instruction that teachers' teaching effectiveness would affect students' learning behaviors and performance (Jones et al., 2011). Promoting teacher quality is currently the critical education reform domestically, and teaching effectiveness is the key factor in students' learning effectiveness and teacher quality

(Lorena & Yvette, 2010). The idea of teaching effectiveness originated from self-efficacy, which Ash (2011) defined as individual judgment of organization and planning before actions in order to achieve specific objectives. Self-efficacy was the theory of behavior change and the media of behavior cognition and contained outcome expectancy and efficacy expectancy. Bonnington (2011) included personal teaching effectiveness, general teaching effectiveness, and classroom management efficacy in teaching effectiveness. Mathews-Aydinlia & Elazizb (2010) regarded it as teachers being familiar with the contents and knowledge of teaching materials before instruction and paradigm shift, presenting enthusiasm and concentration on teaching subjects, and being able to connect with students' cognition development. Mercer (2010) defined teaching effectiveness as teachers' self-teaching beliefs in school education, students' learning success, learning function, and effects on students to systematically present teaching materials, apply multiple instruction, avoid ambiguity, check on students' understanding, provide exercises and feedback, create favorable classroom climate, and enhance effective teaching and learning to achieve educational objectives and promote education quality. Mikalajunaite (2011) pointed out the decisive effect of teachers' teaching effectiveness on school effectiveness that teachers' teaching effectiveness was a critical forecast indicator for school effectiveness. Teachers' instruction and students' learning were equally important for teachers' teaching effectiveness. Parker (2010) considered teaching effectiveness as a belief with which teachers could affirm self-teaching abilities, well do teaching preparation, organize and present systematic and proper teaching materials, and apply effective teaching strategies and skills, favorable classroom management, and multiple assessment through lesson plans to guide students' effective learning and present students' learning outcome and teachers' teaching performance in the teaching process to achieve the education objective.

Referring to Tataroglua & Erdurana (2010), teaching efficacy in this study covers the following dimensions.

1. Instructional plan: A teacher is clear about teaching objectives before instruction, could use information technology media, and is familiar with teaching material contents so that the teaching processes and activities are smoothly preceded as arranged and the teaching activities could be flexibly adjusted depending on students' characters and differences.
2. Teaching strategies: Before the instruction, a teacher could apply strategies and use information technology media to enhance students' learning motivation and guide students understanding the importance of learning objectives. In the instruction, a teacher could effectively apply time, clearly and systematically present new teaching materials, flexibly change teaching skills, and properly select information technology media to maintain students' concentration and enhance the learning effectiveness.
3. Teaching climate: A teacher could keep favorable communication and interaction with students and effectively practice reward and punishment principles, reduce students' deviation behaviors, encourage positive behaviors, and create harmonious and positive learning environments through the use of information technology media.
4. Teaching assessment: A teacher could appropriately use multiple assessment methods with information technology media for evaluating students' learning effectiveness and give students reasonable expectation and proper feedback in order to enhance the sense of learning achievement.
5. Instructional research: According to teaching objectives and lesson plans, a teacher could actively explore and research, study for professional growth, apply resources to innovate teaching methods, and use information technology media to deeply study relevant teaching materials.

Research on information literacy and information technology integrated instruction

Phillips (2010) proposed that teachers' teaching beliefs and external environment were the key factors in teachers applying computer technology. Merritt (2011) pointed out the factors in teachers using information technology integrated instruction as environment, external stimuli, internal beliefs, and skills. Wuzhimin (2010) divided the factors in information technology integrated instruction into external factors of those beyond the teachers, e.g. adequate information technology equipment, abundant time for instructional plans, favorable computer technology training, and complete administrative support, and internal factors of teachers' information literacy, i.e. the ability, attitudes, and beliefs in using information technology. Thomas & Jones (2010) also regarded teachers' personal information technology ability as the key factor. La (2010) pointed out the factors in information technology integrated instruction as the management of technology resources and the knowledge and skills of information technology integrated instruction. In sum, the following hypothesis is proposed in this study.

H1: Information literacy presents notably positive effects on information technology integrated instruction.

Research on information technology integrated instruction and teaching effectiveness

Information Technology Integrated Instruction refers to integrating information technology into curricula, teaching materials, and instruction. The integration of information technology and learning areas and the application allow information technology being necessary teaching tool and learning tool. The use of information technology not only could enhance teachers' teaching effectiveness in the areas, but could also promote students' information abilities (Odom, 2010). Xin & Sutman (2011) mentioned that information technology integrated instruction could enhance teaching effectiveness and deepen students' application and understanding of information technology. Anonymous (2011) indicated that information technology integrated instruction could enhance students' learning motivation and learning autonomy to solve problems with visualized learning tools and support different teaching styles to enhance the interaction between teachers and students to promote teachers' teaching effectiveness. Accordingly, the following hypothesis is proposed in this study.

H2: Information technology integrated instruction shows significantly positive effects on teaching effectiveness.

Research on information literacy and teaching effectiveness

The boom of network equipment closely connects with human life in past years that information literacy no longer stresses on the use of computer, but the mastering of information communication processes, including the analyses of information demands and the evaluation and application of information retrieval. The cultivation of information literacy was inseparable from the idea of computers, the acquisition of network information and electronic media, and assessment and utilization (Torff & Tirotta, 2010). Yoshida (2011) found out the significant effect of teachers' information literacy on teaching effectiveness. Jones et al. (2011) pointed out the remarkably positive correlation between teachers' information literacy and teaching effectiveness. Bonnington (2011) indicated the notably positive effect of teachers' information literacy on teaching effectiveness. Mikalajunaite (2011) found out the significantly positive correlation between teachers' information literacy and teaching effectiveness that the higher information literacy, the higher efficacy. The following hypothesis is therefore proposed in this study.

H3: Information literacy reveals remarkably positive effects on teaching effectiveness.

SAMPLING AND MEASURING INDEX

Research sample and subject

Aiming at university teachers in central Taiwan and Fujian Province, total 450 copies of questionnaires are distributed and 288 valid copies are retrieved, with the retrieval rate 64%. Total 12 universities in central Taiwan and Fujian Province are sampled, including National Chung Hsing University, Tunghai University, Feng Chia University, Asia University, National Central University, National Tsing Hua University, National Chiao Tung University, Xiamen University, Fujian Normal University, Huaqiao University, Fujian University of Technology, and Xiamen University of Technology.

Test of reliability and validity

Validity refers to a measuring tool being able to really measure the questions as the researcher desires. Validity is generally divided into content validity, criterion-related validity, and construct validity. The questions in this study are revised from domestic and international researchers' questionnaires, and a pretest is preceded after discussing with professors that the questionnaire presents certain content validity. The casual relationship among information literacy, information technology integrated instruction, and teaching effectiveness is tested with Linear Structural Relation Model in this study, and the data input is based on the correlation coefficient matrix of above observed variables. The analysis result of Linear Structural Relation Model shows the overall model fit reaching the reasonable range that it reveals favorable convergent validity and predictive validity. Kerlinger (1986) suggested that the construct validity of questionnaire could be tested with item-to-total correlation coefficients, i.e. reliability analysis, and the obtained item-to-total correlation coefficient could be used for judging the questionnaire content. The item-to-total correlation coefficients of the dimensions in this study are larger than 0.7, showing the certain degree of construct validity.

To further understand the reliability and validity of this questionnaire, both reliability and validity are analyzed. According to Cuieford (1965), the higher Cronbach's α presents the better reliability. The formal questionnaire in this study is developed based on such a standard, and the measured Cronbach's α reliability coefficient appears in 0.78~0.89, in the reliability range.

ANALYSIS OF EMPIRICAL RESULT

Evaluation index of LISREL model

LISREL (linear structural relation) model, combining traditional factor analysis and path analysis in statistics and added simultaneous equations in econometrics, could simultaneously calculate multiple factors and multiple casual paths. Regarding the assessment of goodness-of-fit, Bagozzi et al. (1998) considered to evaluate preliminary fit criteria, overall model fit, and fit of internal structure of the model.

The data results are organized in Table 1. Preliminary fit criteria, fit of internal structure of model, and overall model fit in this study are explained as below.

Regarding preliminary fit criteria, three dimensions (information cognition, information skills, and information affection) for information literacy achieve the remarkable explanation ($t > 1.96$, $p < 0.05$); three dimensions (external environment, instruction design, and teacher) for information technology integrated instruction reach the significant explanation ($t > 1.96$, $p < 0.05$); and, five dimensions (instructional plan, teaching strategies, teaching climate, teaching assessment, and instructional research) for teaching effectiveness achieve notable explanation ($t > 1.96$, $p < 0.05$). Apparently, the overall model shows favorable preliminary fit criteria, Table 1.

In regard to fit of internal structure of model, information literacy appears positively remarkable correlations with information technology integrated instruction (0.846, $p < 0.01$), information technology integrated instruction presents positively significant correlations with teaching effectiveness (0.859, $p < 0.01$), and information literacy reveals positively notable effects on teaching effectiveness (0.827, $p < 0.01$), showing that H1, H2, and H3 are supported.

In terms of overall model fit, the overall model fit $\chi^2/Df = 1.698$, smaller than the standard 3, and $RMR = 0.007$, revealing the appropriateness of χ^2/DF and RMR . Furthermore, the chi square value is extremely sensitive to the sample size that it is not suitable for directly judging the fit. However, the overall model fit presents $GFI = 0.952$ and $AGFI = 0.938$, larger than the standard 0.9 (the closer GFI and $AGFI$ to 1 showing the better model fit) that this model appears favorable goodness-of-fit index.

Hypothesis test of overall LISREL model

From Figure 1, Diagram of relationship path, the estimates between dimensions and variables are significant. The test results of research hypotheses are show in Table 2.

Table 1. Analysis of overall linear structural relation model

Item	Parameter/evaluation standard	Result	t value	
Preliminary fit criteria	Information literacy	Information cognition α_1	0.788	9.46**
		Information skills α_2	0.763	8.73**
		Information affection α_3	0.811	11.25**
	Information technology integrated instruction	External environment β_1	0.823	13.16**
		Instruction design β_2	0.806	10.37**
		Teacher β_3	0.791	9.75**
	Teaching effectiveness	Instructional plan σ_1	0.735	7.69**
		teaching strategies σ_2	0.772	9.11**
		Teaching climate σ_3	0.831	16.82**
		Teaching assessment σ_4	0.817	12.04**
		Instructional research σ_5	0.746	8.47**
Fit of internal structure of model	Information literacy \rightarrow information technology integrated instruction	0.846	27.36**	
	Information technology integrated instruction \rightarrow teaching effectiveness	0.859	32.44**	
	Information literacy \rightarrow teaching effectiveness	0.827	22.53**	
Overall model fit	χ^2/Df	1.698		
	GFI	0.952		
	AGFI	0.938		
	RMR	0.007		

Note: * stands for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$.

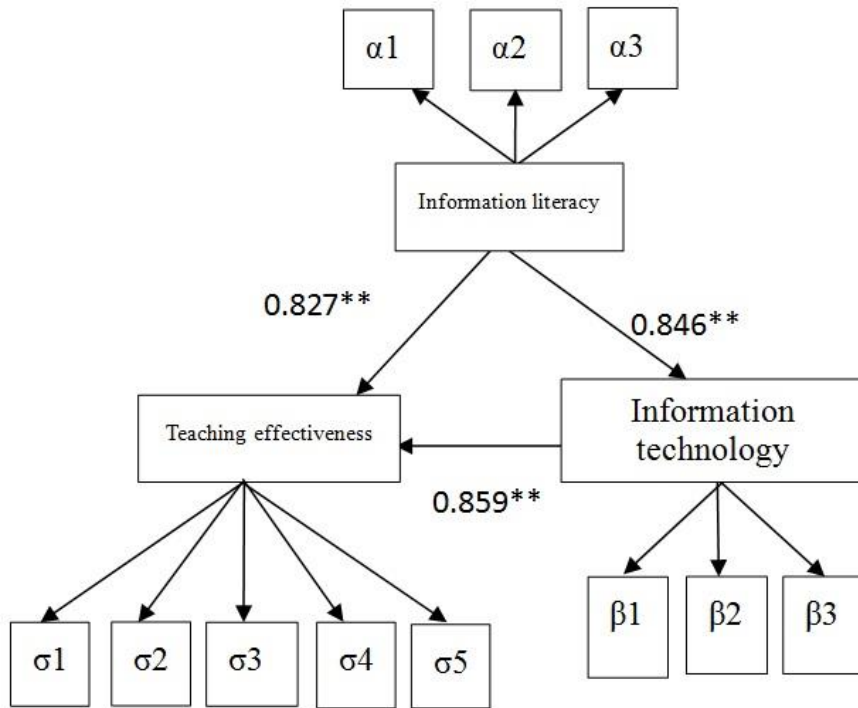


Figure 1. Diagram of relationship path

Table 2. Hypothesis test

Hypothesis	Correlation	Empirical result	P value	Result
H1	+	0.846	P<0.01	Supported
H2	+	0.859	P<0.01	Supported
H3	+	0.827	P<0.01	Supported

CONCLUSION

The research results reveal that the better teachers' information literacy, the higher intention and ability of information technology integrated instruction to enhance teachers' teaching effectiveness. Teachers present relevant knowledge to integrate information technology equipment and concept into instruction and realize how to enhance the teaching effectiveness. The abilities of teacher information literacy and information technology integrated instruction have become the focus in education in past years. The effectiveness of Ministry of Education regulating the hours for teachers' annual information study has shown the outcome. In the trend of information digitalization society, information technology abilities are regarded as the basic literacy for modern citizens. Being the first-line educators, teachers are the primary indicator as well as the focus in modern education. Teachers should enhance the information literacy and integrate information technology equipment into teaching principles to become a powerful teaching aid (Chen, 2011). Teachers with information literacy and information technology integrated instruction abilities would be able to promote the professional growth and teaching efficacy. In sum, there are close

relations among information literacy, information technology integrated instruction, professional growth, and teaching efficacy; and, the promotion of teacher literacy could enhance the information technology ability and professional growth to further promote the teaching efficacy.

SUGGESTION

Based on the research results and findings, the following practical suggestions are proposed in this study.

1. Real operation and experience sharing better than paper-based lecture. Teachers' information literacy has been largely promoted in past years. Education units are suggested to offer operation opportunities for teachers in relative information study. Encountering problems in real operation processes could reduce teachers' pressure in face of information technology equipment and further enhance teachers' information skills. When employing lecturers for information study, education units should look for experienced teachers sharing the experiences and conversing with peer teachers so that teachers could understand the application of information technology to instruction and actually integrate it into teaching processes to enhance the teaching efficacy.
2. Enhancing professional growth and promoting information literacy: Education units are suggested to broaden the study channels, rather than being restricted to information study; any studies which could enhance teachers' professional growth could be held. Different types of studies for teachers' professional growth could stimulate teachers' thinking and further improve the teaching efficacy.
3. Updating information technology equipment: Information technology equipment is sufficient in classrooms in past years; each classroom is equipped with computers with the Internet and a projector. Nevertheless, information technology is changing rapidly that the equipment needs to be regularly replaced. The replacement would affect teachers' intention of information technology integrated instruction and promote the teaching effectiveness. It is suggested that education units could provide large-scale schools with more resources for being evenly distributed to each student so as to balance the uneven resources caused by school size.

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