Information Technology Integrated Into Classroom Teaching and Its Effects[*]

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IT (information technology) has grown in popularity from increased use in different areas in the world. However, school teaching has usually been found to be a little late in following this step. The purpose of this study was to explore the effects of IT when integrated into classroom teaching at primary and secondary schools in Taiwan. The data were collected by the RDEC (Research, Development and Evaluation Commission) under the Executive Yuan. The survey was called "The student digital learning and digital opportunity survey in Taiwan 2009". In this study, we selected primary and secondary school teachers as the target groups. The total samples are 1,724, comprising 906 primary and 818 secondary school teachers. The results reveal that personal factors related to using IT in teaching include the teacher's age, seniority and education. School factors related to using IT are school level and location. The most popular subjects using IT in primary schools are Chinese courses, social studies and integrated activities. The picture in secondary schools revealed a slight difference. Subjects using IT-integrated activities in secondary schools are nature, Chinese and social studies. For both primary and secondary school teachers, the primary place for implementing IT is in their general classrooms and the typical methods used involve playing movies or using course related CD-ROMs (compact disc read-only memory). The difficulties for teachers using IT include related facility shortage, the lack of time to prepare teaching materials and the incompatibility of subjects with IT-integrated teaching. In this study, we found that when teachers use IT in classrooms, they also report experiencing higher teaching effectiveness, including communicating course contents more effectively, assisting students engaged in learning and improving students achievement.

Keywords: IT (information technology), classroom teaching, teacher perception, learning outcomes

Introduction

In the information age, increasingly more knowledge and teaching depends on new technology to deliver and construct. Related information skills have undoubtedly become the key competencies for students facing global competition. Teachers have been asked to perform the novel and vital task of integrating technology into

instruction (Liu, 2004). The study found that infusing IT (information technology) into classroom teaching is more effective than using traditional teaching methods and can promote students' learning attitudes and achievements (Lin, 2005; Mehra & Mital, 2007). Some scholars have illustrated that integrating technology into the teaching-learning process transforms the teacher's role from being the traditional "sage on the stage" to being a "guide on the side" (Alley, 1996; Mehra & Mital, 2007). In this movement, students' roles have changed from passive contents knowledge receivers to more active participants in the process. Students have been expected to respond positively to the process of infusing technology into teaching (Alley, 1996; Lin, 2005; Mehra & Mital, 2007).

The years since 1999 have been viewed in Taiwan as a vigorous development period for integrating IT into teaching. The reasons for supporting this development are as follows. First, due to implementing the "Program of Expanding Domestic Demand" initiated by the Ministry of Education, the demands of primary and secondary schools for new "hardware facilities" have been reviewed. The program provides an excellent chance to build new information equipment in schools. Second, the government policy for implementing "the Nine-year National Curriculum Program" has formally asked schools to integrate IT into classroom teaching, providing the legal basis for implementing IT therein. Third, implementing the "General Information Education Blueprint" also supports IT education at the school level.

Although enhancing hardware, curriculum planning and scope is a crucial goal, we missed an essential part—"teachers". The requirement of information interaction is not only involved in the integration of IT, but also in systems supporting the teaching objectives and strategies. When implementing IT into the classroom as a part of teaching activities, we need teachers' engagements. The purposes of this study are to understand IT use among elementary and secondary school teachers, their integrated activities, the factors that affect the integration of IT into teaching and their effects. The results can be used to improve related teaching practices or further policy formulation for resource allocation.

Related Literature Review

Many IT tools are available for teachers to provide students with simple practice and provide even more media for cultivating students' critical thinking and complex thoughts (Jonassen, 2000). Implementing and practicing IT in classrooms help students improve their performance. Some teaching-related programs and Web designs have shown the ability to provide students with completely new learning contents. Its focus is to provide students technology devices to perform one-to-one learning operations, sometimes more often than receiving instruction from their teachers (Geisert & Futrell, 1995). Teaching under the rules of the game provides students with higher quality learning. Challenging students' efforts when aiming for certain targets increases their motivations and drive (Newby, Stepich, Lehman, & Russell, 2000). Students learning from the images of science and technology not only receive knowledge, but also learn about the process of thinking, as well as thinking what they can do well think about any others you can do (Jonassen, Peck, & Wilson, 2000).

Student learning typically means learning that results in a satisfactory way. Learners generally agree with that they are interested in the learning process and learning means being satisfied with the results. Irons, Jung, and Keel (2002) reported that distance learning courses conducted only in remote Web pages without interaction result in less satisfaction for students, because it is difficult to receive attention from teachers. Bannert (2000) found that learners are satisfied with using technology for learning in general. However,

learners tend to choose their own learning activities in the learning process and want to receive opportunities to interact with others. We can see that information integrated into teaching practice not only uses science and technology, but also teachers' incentives and students' interaction.

The other side of learning achievement contains the findings of formative assessment and the results of summative reports. Many studies have shown that information integrated into teaching contributes to the promotion of learning achievement (Bennett & Kottasz, 2001; Gilliver, Randall, & Pok, 1998; Shiratuddin, 2001). Particularly, teaching math and science through visual simulation or actual screen rendering technology helps students recognize mistakes and idea raised for content understanding (Jonassen, 2000). Teachers using technology in the teaching process encourage students' learning, which is positively related to students' achievement with students' learning attitudes improving significantly (Bennett & Kottasz, 2001).

Method

Data Collection

The data were collected by the RDEC (Research, Development and Evaluation Commission) under the Executive Yuan of Taiwan. The survey was conducted from August to September 2009. In this study, we selected teachers of Grade four and Grade six from primary schools and Grade two from secondary schools as the target groups (comprising teachers from the two municipalities and 23 counties or cities). Using stratified sampling, we selected teachers from schools in different areas. According to location, we classified these schools into three stratified layers: First, metropolitan area schools (Taipei City, Kaohsiung City, the provincial cities and industrial and commercial towns); Second, industrial and commercial town schools (new town and integrated town); Third, remote township schools (include remote villages and towns, mountain area towns and islands).

Participants

In this study, 34.7% of participants were male ($n = 582$) and 65.3% were female ($n = 1,094$). Forty-two point nine percent of participants were main classroom teachers ($n = 716$) and 57.1% were academic teachers ($n = 952$). Forty-five point six percent of teachers were between 31 to 40 years old, and their various levels of teaching experience were between six to 15 years. Thirty-six point three percent of teachers graduated from teacher universities or colleges, 29.6% graduated from universities and 34.1% graduated from graduate institutes.

Fifty-two point six percent of participants ($n = 906$) taught in primary schools and 47.4% were secondary school teachers ($n = 818$), and 37.4% of teachers ($n = 644$) worked in metropolitan areas, 30.6% of teachers ($n = 528$) taught in industrial and commercial towns and 32.0% of teachers ($n = 522$) taught in remote townships (see Table 1).

Results

Current Status of IT Integrated Into Classroom Teaching

Research results have shown that the most popular courses for teachers using IT are Chinese language (32.8%, $n = 297$), social studies (30.1%, $n = 273$) and integrated activities (14.0%, $n = 127$) in primary schools. The picture was different in secondary schools. Popular IT-integrated activities in secondary schools were science (9.4%, $n = 77$), Chinese language (8.3%, $n = 68$) and social studies (7.0%, $n = 57$). However, the

number and proportion of elementary school teachers using IT in all subjects was higher than that of secondary school teachers (see Table 2).

Table 1

Teacher Demographics

Personal variables			School variables		
	n	Percentage (%)		*n*	Percentage (%)
Gender			School level		
Male	582	34.7	Primary school	906	52.6
Female	1,094	65.3	Secondary school	818	47.4
Age			Location		
Under 30 years	362	21.8	Metropolitan area	644	37.4
Between 31and 40 years	759	45.6	Industrial and commercial town	528	30.6
Over 41 years	542	32.6	Remote township	552	32.0
Seniority					
Under 5 years	386	23.2			
Between 6 and 15 years	780	46.8			
Over 16 years	500	30.0			
Education					
Teacher university or college	620	36.3			
General university	505	29.6			
Institute	582	34.1			
Position					
Main classroom teacher	716	42.9			
Academic teacher	952	57.1			

Table 2

The Most Popular Courses Using IT

Programs	Primary school (*n* = 906)		Secondary school (*n* = 818)	
	n	Percentage (%)	*n*	Percentage (%)
Chinese	297	32.8	68	8.3
English	42	4.6	51	6.2
Social study [a]	273	30.1	57	7.0
Science [b]	112	12.4	77	9.4
Integrated activity [c]	127	14.0	49	6.0
Arts & Humanities [d]	109	12.0	49	6.0
Health and Physical Education	91	10.0	35	4.3
Computer	31	3.4	24	2.9
Other	169	18.7	52	6.4

Notes. [a] Social study includes history, geography and citizens; [b] Science includes physics and chemistry, biology and earth science; [c] Integrated activity includes guidance, and boy scouts; [d] Arts and humanities include fine art and music.

When we explored the ways teachers integrate IT into classroom teaching, it revealed that nearly half of the teachers play movies (46.9%, *n* = 809) or use course-related CD-ROMs in their classes (45.0%, *n* = 775). However, teachers using their own teaching materials were 25.2% (*n* = 435) and teachers linking with auxiliary information Web sites (such as maps) totaled only 28.8% (*n* = 497). This finding revealed that ready-made movies and CD-ROMs (compact disc read-only memory) are usually used in classes, but the reasons that teachers tend not to use related IT are the time required to design and collect materials, as well as search Web

pages (see Table 3).

Table 3

The Ways Teachers Integrate IT Into Classroom Teaching

Purposes for using IT	n	Percentage (%)
Playing movies	809	46.9
Using course related CD-ROMs demo	775	45.0
Playing their own teaching materials	435	25.2
Linking with auxiliary information Website (such as maps)	497	28.8
Other	20	1.2

A general classroom usually includes a PC (personal computer) or laptop, and a project device or TV. This study found that students engaged in IT-related exercises in classrooms are the main effects caused by the teachers. In computer classrooms, each student has a computer, the teacher can control the equipment and students are allowed to engage in their own activities. In multimedia audio-visual classrooms, the sound and light effects are of higher quality and a movie screen is usually available. The multi-function e-classroom is designed for students to participate in group discussions or to practice their exercises. This study found that the primary place to implement IT is in general classrooms, as reported by both primary and secondary school teachers (41.2%, $n = 710$). Computer classroom and multimedia audio-visual classrooms similarly implement IT (14%-14.8%), compared to that of the multi-function e-classroom totaling only 3.6% ($n = 62$) (see Table 4). It can be explained that teachers usually use IT in general classrooms. However, IT is not yet extended to the multi-function and e-classroom.

Table 4

The Main Places Teachers Integrate IT Into Classroom Teaching

Places for using IT	n	Percentage (%)
General classroom	710	41.2
Computer classroom	242	14.0
Multimedia audio-visual classroom	255	14.8
Multi-function e-classroom	62	3.6
Other	56	3.2

The difficulties involved in teachers integrating IT into classroom teaching include related facility shortage (62.7%, $n = 1,059$), lack of time to prepare teaching materials (57.6%, $n = 973$) and incompatibility of subjects with IT (36.7%, $n = 620$). Only a few teachers agreed that the problem in integrating IT into classroom teaching was caused by parents (8.0%, $n = 135$), students lacking interest (3.1%, $n = 53$) and school policy ignoring these specific concerns (5.0%, $n = 85$) (see Table 5).

Factors Influencing Teachers Integrating IT Into Teaching

We used a chi-square test (x^2 test) to analyze the factors that influence teachers integrating IT into teaching. Because it reached the significant difference level ($á = 0.05$), we further used post hoc to compare the differences. The results revealed that personal factors related to using IT in teaching included a teacher's age (Phi = 0.079, $p < 0.01$), seniority (Phi = 0.098, $p < 0.001$) and education (Phi = 0.089, $p < 0.01$). School factors related to using IT are different levels of schools (Phi = 0.249, $p < 0.001$) and locations (Phi = 0.104, $p < 0.001$) (see Table 6).

Table 5

The Difficulties of Teachers Implementing IT Into Classroom Teaching

Difficulties	n	Percentage (%)
Related facility shortage	1,059	62.7
Lack of time to prepare teaching materials	973	57.6
Incompatibility of subject with IT integrated in teaching	620	36.7
Teachers lack of information capacity	462	27.4
Student information gap	378	22.4
Parents neglect	135	8.0
School's policy ignored	85	5.0
Students are not interested	53	3.1

Table 6

Factors Influencing Teachers Integrating IT Into Teaching

Factors	Using IT to integrate into teaching Yes (percentage)	No (percentage)	Phi	Post-hoc comparisons
Gender				
Male	362 (62.2%)	220 (37.8%)	0.023	
Female	706 (64.5%)	388 (35.5%)		
Age				
Under 30	240 (66.3%)	122 (33.7%)	0.079**	Under 30 > Over 41
Between 31 and 40	502 (66.1%)	257 (33.9%)		Between 31 and 40 > Over 41
Over 41	315 (58.1%)	227 (41.9%)		
Seniority				
Under 5	242 (62.7%)	144 (37.3%)	0.098***	Between 6 and 15 > Over 16
Between 6 and 15	532 (68.2%)	248 (31.8%)		
Over 16	286 (57.2%)	214 (42.8%)		
Education				
Teacher university or college	398 (64.2%)	222 (35.80%)	0.089**	Teacher university > General university
General university	288 (57.0%)	217 (43.00%)		
Institute	394 (67.7%)	188 (32.30%)		
Position				
Main classroom teacher	262 (36.6%)	454 (63.4%)	0.007	
Academic teacher	342(35.9%)	610 (64.1%)		
School level				
Primary school	676 (74.6%)	230 (25.4%)	0.249***	Primary > Secondary
Secondary school	414 (50.6%)	404 (49.4%)		
Location				
Metropolitan area	449 (69.7%)	195 (30.3%)	0.104***	Metropolitan area > Industrial and commercial town
Industrial and commercial town	311 (58.9%)	217 (41.1%)		Metropolitan area > Remote township
Remote township	330 (59.8%)	222 (40.2%)		

Notes. **$p < 0.01$; ***$p < 0.001$.

IT Integrated in Classroom Teaching and Its Effects

In this study, we used a *t*-test to analyze when teachers integrated IT into their classroom teaching and whether the teaching effect is significantly different or not. We found that when teachers use IT in classrooms, they also report having significantly higher teaching effectiveness, including communicating course content

more effectively (t = 7.68, p < 0.001), assisting students engaged in learning (t = 7.48, p < 0.001) and improving students' achievement (t = 8.773, p < 0.001) (see Table 7).

Table 7

IT Integrated in Classroom Teaching and Its Effects

	IT integrated into teaching	n	Mean	Standard deviation	t
Communicating course content	Yes	1,075	4.24	0.514	7.968[***]
	No	621	4.00	0.653	Yes > No
Enhancing student engaged in learning	Yes	1,080	4.30	0.542	7.148[***]
	No	625	4.09	0.613	Yes > No
Improving student achievement	Yes	1,079	4.15	0.516	8.773[***]
	No	622	3.90	0.618	Yes > No

Note. [***]p < 0.001.

Conclusions

According to the "World Information Society Report 2007", Taiwan was ranked 7th of 181 countries in the DOI (Digital Opportunity Index), the index comprising three sub-indexes including infrastructure, opportunity and application (International Telecommunication Union, 2007). Although the country/economy ranking of Taiwan was listed 12th in the "Global Competitiveness Report 2009-2010" (published by The World Economic Forum), Taiwan also enjoyed the ranking of 16th in infrastructure and 18th in technological readiness. However, compared to the rankings, school teachers integrating IT in classroom teaching still exhibited a gap requiring elimination.

Current Status of IT Integrated Into Classroom Teaching

In this article, the results revealed that personal factors related to using IT in teaching included a teacher's age, seniority and education. School factors related to using IT are different school levels and locations. The most popular courses using IT in primary schools are Chinese, social studies and integrated activities. The activities in secondary schools have revealed a picture similar to primary schools. The IT integrated activities in secondary schools are in science, Chinese and social studies courses. The research also showed that older teachers with higher seniority, teachers who graduated from general universities, teachers in remote regions and secondary teachers in general required assistance that is more systematic.

The Difficulties That the Teachers Confront

Most of the teachers who integrated IT into classroom teaching were found to use ready-made materials and felt lacking in IT equipment. The research showed that, for both primary and secondary school teachers, the primary place to implement IT is in general classrooms, and the typical methods used involve playing movies or using course-related CD-ROMs. The difficulties for teachers using IT included related facility shortage, lack of time to prepare teaching materials and the incompatibility of subjects with IT. Schools are not only the places to buy computers and hardware, but also to increase teachers' abilities to use information and create new teaching materials to attract students.

Encourage Teachers Using IT to Increase Teaching Effectiveness

In this study, we found that when teachers use IT in classrooms, they also report having higher teaching effectiveness, including communicating course contents more effectively, assisting students engaged in

learning, and improving student achievement. Integrating IT into teaching provides richer and more interesting teaching methods to attract students, assisting teachers to teach in ways that are more effective. Why do we not encourage teachers to try?

Suggestions for School and Government Policy Makers

Although the national boundary factor has gradually reduced from the point of digital technology development, "digital intelligence" has become a new concern of competitive factors. Increasingly, more knowledge and teaching content are through new IT to deliver. Facing this trend, how to establish a fair IT learning environment has become the responsibility for school and government policy makers facing global competition.

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