Examining the Digital Divide between Rural and Urban Schools: Technology Availability, Teachers' Integration Level and Students' Perception

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Abstract

This study aimed to explore the gap regarding technology integration between urban and rural schools based on the Will Skill Tool model. This study was guided by three main questions: 1) Is there any significant difference in terms of technology availability between rural and urban elementary schools?; 2) Is there any significant difference in terms of teachers' attitudes, competence, levels and experiences in technology integration between rural and urban elementary schools?; 3) Is there any significant difference in terms of students' attitudes, competence and experiences in technology integration between rural and urban elementary schools? This was a survey study with 275 teachers and 293 students as participants in southern Taiwan. Half of the participants came from regular urban schools and the other half were from disadvantaged rural schools. T-tests and Chi-Square tests were done to examine differences. The results showed that there was a significant difference in technology availability between rural and urban schools, including the number of interactive whiteboards, desktops in labs, notebooks, netbooks, and tablet computers. There was also a difference in teacher overall high-tech integration level between rural and urban schools. Urban teachers reached the level of "familiarity and confidence" but rural teachers only stayed at the level of "understanding and application of the process." Teachers' experience, purpose and difficulty in technology integration between rural and urban schools were also slightly different. In addition, there was a difference in students' experience and preference in using technology to learn, especially using interactive whiteboards in learning.

Keywords: *digital divide; will skill tool model; technology intgration*

1. Introduction

Introducing information and communication technology into educational reform is a major priority of governments worldwide. Instructional tools have recently evolved from basic computers labs to high-tech facilities such as laptops, netbooks, interactive whiteboards, or even tablet computers. Among U.S. public schools, 58% of public schools have laptops on carts, 73% have interactive whiteboards, and 4% provide handheld computing devices (e.g., Palm OS, Windows CE, Pocket PC, BlackBerry) (Gray, Thomas, & Lewis, 2010). Reports reveal increasing availability of high-tech facilities in U.S. public schools. However, the actual distribution of these facilities and passion for their use in the schools differed by districts. Rural schools with high poverty concentrations usually do not possess adequate technological facilities, ICT skills or knowledge about how to integrate technology into instruction. A larger percentage of public schools with lower poverty concentrations agreed that teachers are insufficiently trained in technology use and integration (Gray, Thomas, & Lewis, 2010). The inconsistent quality of public school technology integration is one of the emergent issues in the digital divide and relevant political actions have been taken to address it.

Political action to shrink the digital divide among schools is not increasing only in the United States. In East Asia, Japan has developed the U-Japan Promotion Program 2006. One important goal of this policy was to reduce the regional divide in advanced services, including mobile phones, and digital television (http://www.soumu.go.jp/menu_seisaku/ict/u-japan_en/). The same year, Singapore launched a ten-year national plan, Intelligent Nation 2015, and digital inclusiveness was one main goal of the plan. In 2008, the South Korean government set up and provided resources to a semi-government organization, the Korean Agency for Digital Opportunity and Promotion, to promote knowledge and usage. In Hong Kong, projects such as the Digital Bridge Project, Computer Recycling Projects, Digital Solidarity Fund, and ICT plans for persons with disabilities have been introduced to balance the digital divide since 2001.

Taiwan, one of the most developed countries in east Asia, launched the U-Taiwan Programme to cause the benefits of new technologies to be shared equally by society in 2007. In 2009, Taiwan launched the project to expand investment in public works, and one of the main purposes was to establish high-quality digital specialized classrooms and multi-function digital classrooms in all elementary and secondary schools. Though new policies shed light on these rural schools for upgrading high-tech facilities, there is no concrete evidence showing that these schools were improved by these changes. Some questions emerge: Are the urban schools different in teachers' attitudes, skills, high-tech facilities integration, and high-tech facilities access from rural schools? If so, how are they different? Besides, most studies on the digital divide only present descriptive data to show the difference between rural and urban schools; seldom do we see a study examining digital divide problems with a theoretical and systematic model considering both teachers and students' will and skill of technology integration. With respect to the aim of the study, three main research questions were proposed:

1) Is there any significant difference in terms of technology availability between rural and urban elementary schools?

2) Is there any significant difference in terms of teachers' attitudes, competence, levels and experiences in technology integration between rural and urban elementary schools?

3) Is there any significant difference in terms of students' attitudes, competence and experiences in technology integration between rural and urban elementary schools?

Toward this end, we first need a fine-grained understanding of the digital divide, high-tech facilities, and factors for technology integration.

2. Literature Review

2.1 Digital Divide and High-Tech Facilities

The term "digital divide" refers to the inequities among individuals who have access to technology and opportunities to learn ICT skills (International ICT Literacy Panel, 2002). Researchers have explored socio-economic factors to explain the phenomenon, and public schools are often perceived to serve as the bridges to connect the haves and have-nots and ultimately to correct the social inequity (Alexander, Entwisle, & Olson, 2001; Warschauer, Knobel, & Stone, 2004) Nevertheless, even when schools have the mission to provide this bridge for their have-not students, schools may not possess the facilities and ICT skills and knowledge necessary to integrate technology into classes (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). Researchers have presented a framework of the digital divide for examining the levels of digital divide within schools (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). The first level of digital divide supports the equitable access to hardware, software, the Internet and technology support within schools. The second level of digital divide addresses how frequently students and teachers use technology within the classroom and the purposes for which the technology is being used. The third level expands the focus of digital divide to include how technologies are used to empower the individual within the context of a school (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). This framework is imilar to Zhao and Frank's technology integration model presented in 2003. In their model, the first level is to provide school computer hardware and establish the presence of technology. The second level is to create interaction between a focal teacher and the new technology. The third level is that teachers develop the capacity to modify technology to suit their pedagogical needs.

Most studies that have been done have focused on the first level, not only because it is the basis of the other two levels, but also because the data for the first level can be most easily obtained. It is apparent that access to desktops and Internet in schools has drastically improved internationally. However, these studies do not describe the realities of all schools and all students. Although schools may provide an adequate number of desktops for students, some schools may not have updated facilities and software located in places that students can access regularly, especially those high-tech tools or mobile facilities. The evolution of instructional tools may increase the digital gap.

The "high-tech environment" was defined as an educational setting where students and teachers have constant access to interactive technologies (Sandholtz, Ringstaff, & Dwyer, 1992), and the focus is on the use of advanced technologies to support teaching and learning interactivity. Based on this definition, the addressed high-tech facilities in this study were limited to those advanced tools capable of supporting interactive or mobile learning activities, including interactive whiteboards (IWB), netbooks, and tablet computers. The interactive whiteboard, described as "a touch-sensitive screen that works in conjunction with a computer and a projector," was first used in education in the late 1990's (SMART, 2006; Beeland, 2002). It has also been given several names including "smart board" or "electronic whiteboard". It is a helpful technology which enhances classroom interactivity. A recent report revealed that countries such as the UK (73%), Denmark (50%), the Netherlands (47%), Australia (45%), and the USA (35%) have dramatically increased IWB penetration rates in classrooms (Lee, 2010; Mclntyre-Brown, 2011). An IWB plays an important role in making whole-class teaching more effective, productive, and creative (SMART, 2006). As a whole-class presentation medium, IWB has strong multimedia and multi-sensory presentation capabilities. It can appeal to the three major senses of students: seeing, hearing, and touch (Smith, Higgins, Wall, & Miller, & 2005). The use of IWB is also popular in East Asia. Japan now has ten future schools; all the students are provided with one tablet computer each and an IWB is provided for each classroom so that collaborative learning activities can be created (Mineshima, 2012). In addition to the interactive whiteboard, netbooks are tools to create interactive learning. "Netbook" was coined by Psion in 1999 but penetrated educational use in the late 2000's, with 2009 being claimed "the year of the netbook." Netbooks are mini-laptop computers designed for mobility, online access, and general office applications. Netbooks were originally designed as the second home personal computer for consumers in developed countries. Netbooks can be defined as lightweight laptops with lower price and capability. They typically retail for less than USD 300, have a screen size of less than 10 inches, and weigh under 3 pounds. They are designed as an inexpensive computer for distribution to children in developing countries around the world (Chan, Movafaghi, Collins, & Pournaghsband, 2010). The One Laptop Per Child Project (OLPC) was an initiative aimed at providing inexpensive laptop computers to children in the developing world as a means of bridging the digital divide (Chan, Movafaghi, Collins, & Pournaghsband, 2010). A tablet computer is also one of the modern instructional tools this study considered. A tablet computer is a laptop computer that is manipulated with a stylus pen using natural handwriting by touching the display screen directly rather than using an external keyboard. With appropriate software, the tablet computer appears to support all three pedagogical functions. First, as with blackboards and overhead transparencies, it allows an instructor to demonstrate a problem solving process in real time using free-hand writing. Second, it provides effective visual aids by supporting display formats such as PowerPoint slides and digital video. Finally, it allows the instructor to save all lecture materials in digital files for future use.

It is more complicated to integrate these high-tech tools in classrooms than traditional desktop computers. Rogers (1986) proposed in his Diffusions of Innovation Theory that the adoption curve for ICT would be S-shaped as new communication technologies initially are adopted by the very few who can afford them, followed by high rates of adoption by many people as the price drops, and finally, technologies are reluctantly accepted and used by the remaining few. This differentiated rate of adoption may be extreme while especially focusing on high-tech tool integration, which would result in a larger learning or content divide between early adopters and late accepters. This study aims to explore the digital divide from this viewpoint, to provide empirical evidence of the impact of high-tech tools on the digital divide.

2.2 Technology Availability, Teacher/Student Will and Skill toward Technology Integration between Rural and Urban Schools

This study used the *Will Skill Tool* model as its framework to examine digital divide. The Will Skill Tool model is a well-established theoretical framework that elucidates the conditions under which teachers are most likely to employ information and communication technologies in the classroom (Knezek, Christensen, Hancock & Shoho, 2000). Previous studies have shown that these three factors (will, skill, and tool) explain a very high degree of variance in the frequency of classroom ICT use (Petko, 2012). *Will* refers to teachers' or students' attitudes about technology integration. Huang and Liaw (2005) stated that among all factors considered to influence the successful integration of computers in the classroom, the attitude towards computers is a key factor. *Skill* (Competence) is usually defined as having the ability to perform a specific task. It is also indicated with the terms computer performance, computer ability, or computer achievement (Agyei & Voogt, 2011). *Tools* refer to computer access level, usage frequency, computer ownership and amount and breadth of time in the use of computers as indicators of an individual's level of technology use (Gurcan-Namlu, 2003).

While examining the digital divide problem using the Will Skill Tool model, rural and urban schools have shown different levels in almost every aspect. In terms of technology access, rural schools do not always have access to the same level of funding for educational technology as urban schools, which can limit the opportunity students have for learning. The rural-urban infrastructure disparities indicate that urban areas can boast electricity and telecommunications capabilities, but rural areas remain unconnected and hence disadvantaged (Gulati, 2008). For example, in developing countries such as South Africa, research indicates that rural schools lack school telephone facilities, computer hardware and software (Herselman, 2003). The lack of ready access to technology is a key barrier to technology integration for developing areas. Recent studies have shown that the access to hardware in schools has drastically improved internationally, but it needs more empirical evidence to understand if infrastructure is still a key factor causing the digital divide (Grime, 2000). With regard to teachers, Clark's study (2000) shows that urban teachers in the U.S. have positive reactions towards technology integration. The findings include three points: 1) urban teachers feel confident about their ability to use technology; 2) urban teachers believe that technology is an integral part of their classroom; and 3) urban teachers want more software and equipment in their classrooms. However, research indicates that rural schools do not have teachers with the same qualifications and confidence levels in technology integration as urban schools do. Lacking experienced and skilled teachers and technical training have been an ongoing problem for rural schools (Herselman, 2003). With regard to students, research show that students from rural or migrant schools score lower on all the Internet inequality indicators (digital access, autonomy of use, social support, Internet use and self-efficacy) and are therefore more disadvantaged in Internet usage status than their urban peers. Taking China as an example, there are 70,000 schools with computers and more than 10 million students who have mastered basic computer skills, but most of these schools and students are in cities, not in rural areas (Zhang, 2005). Researchers have also argued that students in low-income areas often use computers for repetitive activities, whereas students in high-income areas often use technology for higher-order thinking, problem solving, and other intellectually challenging activities (Songer, Lee, & Kam, 2002).

Most studies examine the digital divide problem on single dimensions (teacher or student or technology only) instead of systematically and simultaneously considering teachers, students, and tools. For comprehensively examining digital divide problems, this study adopted the WST model and investigated both teachers and students' practices and viewpoints. Hopefully this study can broaden the knowledge on digital divide.

3. Method

3.1 Participants

This study sampled a total of 322 teachers and 322 students from 46 public elementary schools in southern Taiwan with the permission of school principals and administrators. Half of them were disadvantaged rural schools and half were regular urban schools. All participants were sent a paper-based questionnaire. In terms of teachers, this study received 275 valid questionnaires back and the response rate was 85.40%. For the valid respondents, 47.6% were from regular urban schools, 52.4% were from rural disadvantaged schools. For gender distribution, 42.7% were male and 57.3% were female. The average teaching experience of teachers was 13 years ranging from as low as 1 year to as many as 30 years. In terms of students, this study received 293 valid questionnaires back and the response rate was 90.99%. For the valid respondents, 46.4% were from regular urban schools, 53.6% were from rural disadvantaged schools. For gender distribution, 38% were male and 62% were female; for grade distribution, 3.8% were third grade students, 21.8% were fourth grade students, 38.6% were fifth grade students, and 35.8% were sixth grade students.

3.2 Data Collection

Quantitative data collection was conducted by paper-based questionnaires. Teachers' and students' questionnaires were designed and collected separately. The teachers' questionnaire included the following factors: technology facility access, teacher attitudes, teacher competence, overall level of high-tech integration, and technology integration experience. All questions were revised from existing instruments which had proven reliability and validity except questions on technology facility availability and technology integration experience. For the teacher attitudes dimension, we used four sub-scales from the Teachers' Attitudes towards Computers (TAC) questionnaire (5-point scale): anxiety, productivity, enjoyment, and helpfulness. For teacher competence, we used the Technology in Education Competency Survey (5-point scale). For teachers' level of technology integration, we revised the Stage of Adoption (SoA) survey as the main measurement. The original SoA survey serves as a measure of the teachers' stage of adoption of technology use in educational practice. This instrument is a quick and reliable self-report single-item survey for use in assessing technology integration. The test-retest reliability was .91-.96. There are six technology stages in this SoA survey. The six stages were revised to match the purpose of this study as follows: 1) Awareness: The teacher is aware that high-tech tools exist but has not used it, perhaps even avoiding it; 2) Learning the process: The teacher is currently trying to learn the basics and is often frustrated using high-tech technologies and lacks confidence when using them; 3) Understanding and application of the process: The teacher is beginning to understand the process of using high-tech facilities and can think of specific tasks in which it might be useful; 4) Familiarity and confidence: The teacher is gaining a sense of confidence in using the high-tech facilities for specific tasks and is starting to feel comfortable using the tools; 5) Adaption to other contexts: The teacher thinks about high-tech facility as a tool to help him or her, is no longer concerned about it as technology and can use it in many applications and as an instructional aid; 6) Creative application to new contexts: The teacher can apply what he or she knows about high-tech facilities in the classroom and is able to use it as an instructional tool and integrate it into the curriculum. Teachers were asked to read the descriptions of each of the six stages related to adoption of high-tech facilities and chose one stage that best described where he or she was in the adoption of high-tech facilities. The six stages were viewed as a continuum variable while doing data analysis.

The students' questionnaire included the following factors: student attitudes, computer competence, technology integration experience, and expectation and preference. For the student attitude dimension, we used four sub-scales from the Student Attitudes towards Computers questionnaire (Chen, 2004) (5-point scale): anxiety, productivity, enjoyment, and helpfulness. For student competence, this study designed 12 multiple-choice questions. For technology experience, this study designed 3 multiple-choice questions. For technology preference and expectation, this study designed 6 5-point scale questions. Table 1 shows the instrument of the study in detail.

For technology availability, we surveyed the numbers of interactive whiteboards (IWBs), mobile facilities (notebooks, netbooks, and tablet computers), and the numbers of desktop computers. For teachers' experience for technology integration, this study designed 39 questions including multiple-choice, multiple-answer and fill-in-the-blank questions.

Qualitative data collection was conducted through interviews with four participants after the quantitative data analysis. The four participants were selected randomly; two were from rural schools and two were from urban schools. The aim of the interviews was to clarify the quantitative data analysis results. Interview questions included teachers' thoughts as to the causes and solutions for the digital divide problem.

Table 1: Instruments Used in the Study

	Dimension	Variables	Instrument
Teachers' survey	Geographic data	Gender, experience, educational background, subject, etc.	7 multiple-choice questions designed by the researcher
	Technology availability	# of Desktop PCs, IWBs and mobile facilities	7 fill-in-blank questions designed by the researcher
	Attitudes	Anxiety, productivity, enjoyment, helpfulness	Teachers' Attitudes towards Computers (TAC) questionnaire (5-point scale)
	Competence	Competency in instructional technology	Technology in Education Competency Survey (5-point scale)
	High-tech integration level	Level of high-tech integration	Stage of Adoption (SoA) survey (revised)
	Technology experience	Frequency, purpose, approach, and difficulty of technology integration	39 questions including multiple-choice, multiple-answer and fill-in-blank questions designed by the researcher
Students' survey	Geographic data	Gender, grade, achievement performance, etc.	5 questions including multiple-choice, multiple-answer and fill-in-blank questions designed by the researcher
	Attitudes	Anxiety, enjoyment, and self-efficacy	Student computer attitude scale (5-point scale)
	Competence	Computer competency	10 multiple-choice questions designed by the researcher
	Technology experience	Frequency of using technology in learning	3 multiple-choice questions designed by the researcher
	Technology preference and expectation	Preference and expectation of using IWB, netbooks/notebooks, and tablet PC	6 questions designed by the researcher (5-point scale)

3.3 Data Analysis

The questionnaires were distributed to the participant teachers in the 2012 spring semester. All questionnaires were sent to the elementary schools in southern Taiwan with the help of the school principals and technology coordinators. Descriptive statistics, t-tests and Chi-Square tests were used as data analysis methods. Interview data were transcribed and categorized for supporting and clarifying the statistical analysis results.

4. Results

All scales showed minimum acceptable reliability values using Cronbach's alpha larger than .60. In terms of the teacher questionnaire, the reliability for the anxiety scale was .91; for productivity, it was .87; for enjoyment, it was .93; for helpfulness, it was .92; for competence, it was .79. In terms of the student questionnaire, the reliability for the anxiety scale was .79; for enjoyment, it was .89; for self-efficacy, it was .93, and for competence, it was .61.

4.1 Analysis of Technology Availability between Rural and Urban Elementary Schools

T-test comparisons between the urban and rural schools were conducted to examine the difference in school facility availability, including the number of interactive whiteboards (IWBs), lab desktops, notebooks, netbooks, and tablet computers. On average, urban schools have 2.24 IWBs, and rural schools have 1.02 IWBs; urban schools have 34.13 lab desktops, and rural schools have 21.27 lab desktops; urban schools have 4.98 notebooks, and rural schools have 3.89 notebooks; urban schools have 5.78 netbooks, and rural schools have 2.49 netbooks; urban schools have 2.38 tablet computers, and rural schools have .24 tablet computers. Technology availability in urban schools was significantly better than that in rural schools in every aspect (Table 2).

Table 2: Technology Availability Comparison between the Urban and Rural Schools

		N	*Mean*	*SD*	*t*	*p*
# of IWB	Urban schools	131	2.24	1.75	7.37	.00*
	Rural schools	144	1.02	.73		
# of desktops in labs	Urban schools	131	34.13	10.77	11.49	.00*
	Rural schools	144	21.27	7.65		
# of notebooks	Urban schools	131	4.98	3.86	2.53	.01*
	Rural schools	144	3.89	3.32		
# of netbooks	Urban schools	131	5.78	6.24	5.09	.00*
(e.g. Eee PC)	Rural schools	144	2.49	4.17		
# of tablet PCs	Urban schools	131	2.38	4.68	5.13	.00*
	Rural schools	144	.24	1.01		

*p<.05

4.2 Analysis of Rural and Urban Elementary School Teachers' Attitudes, Competence, and Levels in Terms of Technology Integration

T-test comparisons between the urban and rural schools were conducted to examine the difference in teacher attitudes (including technology anxiety, productivity, enjoyment, and helpfulness), competence, and overall technology integration level. The results show that there was no significant difference between rural and urban teachers in terms of all attitudinal items and competence. However, the teachers' self-reported overall technology integration level in urban schools was significantly better than in rural schools (Table 3).

Table 3: Teacher Attitudes Comparison between the Urban and Rural Schools

		N	*Mean*	*SD*	*t*	*p*
Anxiety	Urban schools	128	2.14	.69	-.75	.46
	Rural schools	140	2.21	.73		
Productivity	Urban schools	128	3.74	.52	.72	.47
	Rural schools	140	3.69	.50		
Enjoyment	Urban schools	128	3.57	.56	.08	.93
	Rural schools	141	3.56	.66		
Helpfulness	Urban schools	128	3.69	.59	.53	.59
	Rural schools	140	3.65	.61		
Competence	Urban schools	127	3.68	.62	.36	.72
	Rural schools	141	3.65	.73		
High-tech integration level	Urban schools	125	4.23	1.15	2.12	.04*
	Rural schools	142	3.93	1.17		

$^{*}p<.05$

4.3 Analysis of Rural and Urban Elementary School Teachers' Experience of Technology Use

A comparison between the urban and rural schools was conducted to examine the difference in teacher experience, including 1) frequency of use of IWBs, netbooks/notebooks, and tablet computers, 2) purpose, 3) approach, and 4) difficulties with using technologies. Table 4 shows only part of the test results, which are all key findings in the study.

The study found that the use of high-tech facilities was not very popular in both urban and rural areas. More than 40% of teachers did not have experience teaching with the IWBs, notebooks and netbooks. Only 8%-12% of teachers had experience teaching with tablet computers. Interestingly, the percentage of rural teachers who had experience with netbook/notebook integration in class was higher than that of urban teachers.

In terms of IWB experience, the percentage of rural and urban teachers using IWBs with video, animation, or to promote students activities was similar. However, teacher integration of IWBs with Internet and PowerPoint slides in the urban schools was significantly more popular than in the rural schools. In addition, 37.4% of urban teachers used the IWB for simplifying instructional content, and this percentage was higher than that for rural teachers.

In terms of netbook/notebook experience, the percentage of rural and urban teachers using netbooks/notebooks with Internet and promoting students activities were similar. However, teacher integration of netbooks/notebooks with PowerPoint slides, video and animation in the rural schools was significantly more than that in the urban schools. In addition, 42.0 % of rural teachers use netbooks/notebooks for motivating students, and 43.4% of rural teachers use netbooks/notebooks for interaction; both percentages were higher than those for urban teachers.

In terms of difficulty of technology use, 19.6% of rural teachers felt preparing notebook/netbooks was time-consuming, and 16.8% felt hardware and software problems interrupt the class; both percentages were significantly higher than those for urban teachers.

Table 4: Teacher Experience Comparison between the Urban and Rural Schools

Variables	Levels	Urban		Rural				
		Count	% of Total Count	Count	% of Total Count	X^2	*df*	*p*
IWB experience in teaching	Yes	74	56.5%	71	50.7%	.91	1	.34
	No	57	43.5%	69	49.3%			
Netbook/notebook experience in teaching	Yes	58	45.0%	83	57.6%	4.38	1	.04*
	No	71	55.0%	61	42.4%			
Tablet PC experience in teaching	Yes	16	12.3%	12	8.5%	1.09	1	.27
	No	114	87.7%	130	91.5%			
Use IWB with Internet	Yes	33	25.2%	19	13.6%	5.89	1	.02*
	No	98	74.8%	121	86.4%			
Use IWB with PowerPoint slides	Yes	58	44.3%	42	30.0%	5.92	1	.02*
	No	73	55.7%	98	70.0%			
Use IWB for simplifying content	Yes	49	37.4%	33	23.4%	6.32	1	.01*
	No	82	62.6%	108	76.6%			
Use Netbook/notebook with PowerPoint slides	Yes	37	28.7%	60	41.7%	5.01	1	.03*
	No	92	71.3%	84	58.3%			
Use Netbook/notebook with animation	Yes	38	29.5%	64	44.4%	6.53	1	.01*
	No	91	70.5%	80	55.6%			
Use Netbook/notebook for motivation	Yes	37	28.7%	60	42.0%	10.31	1	.00*
	No	92	71.3%	83	58.0%			
Use Netbook/notebook for interaction	Yes	32	24.8%	62	43.4%	5.21	1	.02*
	No	97	75.2%	81	56.6%			
Why not use Netbook/notebook : Preparing costs time	Yes	12	9.3%	28	19.6%	5.71	1	.02*
	No	117	90.7%	115	80.4%			
Why not use Netbook/notebook : Hardware and software problem interrupts class	Yes	11	8.5%	24	16.8%	4.12	1	.04*
	No	118	91.5%	119	83.2%			

*p<.05

4.4 Analysis of Rural and Urban Elementary School Students' Attitudes, Competence and Experience in Terms of Technology Integration

T-test comparisons between the urban and rural schools were conducted to examine the difference in the student attitudes, including anxiety, enjoyment, and self-efficacy. No significant difference was found in terms of these items between rural and urban students (Table 5).

Table 5: Student Attitude Comparison between the Urban and Rural Schools

		N	*Mean*	*SD*	*t*	*p*
Anxiety	Urban schools	134	2.37	.90	-.63	.53
	Rural schools	156	2.43	.81		
Enjoyment	Urban schools	132	3.94	.90	1.18	.24
	Rural schools	149	3.81	.95		
Self-efficacy	Urban schools	133	3.69	.87	-.55	.58
	Rural schools	153	3.75	.87		

*p<.05

T-test comparisons between the urban and rural schools were conducted to examine the difference in student technology experience, including IWB experience in learning, notebook/netbook experience in learning, and technology expectation and preference. Student frequency of using IWBs in learning in urban schools was significantly better than in rural schools. On average, urban students had used IWBs in learning 15.87 times per semester, while rural students had used them only 8.40 times (Table 6). Interestingly, student preference and expectation to technology integration did not differ between rural and urban schools, except for the preference of using IWBs.

Table 6: Student Experience, Expectation, and Preference Comparison between the Urban and Rural Schools

		N	*Mean*	*SD*	*t*	*p*
# of IWB experience in learning (one semester)	Urban schools	120	15.87	33.74	2.17	.03*
	Rural schools	149	8.40	18.75		
# of notebook/netbook experience in learning (one semester)	Urban schools	128	2.09	12.57	-.38	.71
	Rural schools	144	2.56	8.09		
# of tablet PC experience in learning (one semester)	Urban schools	132	1.67	9.12	1.94	.06
	Rural schools	154	.12	.95		
Preference of IWB in learning	Urban schools	129	3.82	1.05	3.26	.00*
	Rural schools	140	3.41	1.00		
Expectation of IWB in learning	Urban schools	129	3.55	1.02	1.24	.22
	Rural schools	142	3.41	.86		
Preference of notebook/netbook in learning	Urban schools	129	3.61	1.08	1.01	.31
	Rural schools	144	3.49	.97		
Expectation of notebook/netbook in learning	Urban schools	129	3.48	1.10	.07	.95
	Rural schools	144	3.47	.95		
Preference of tablet PC in learning	Urban schools	130	3.81	1.19	1.92	.06
	Rural schools	138	3.54	1.06		
Expectation of tablet PC in learning	Urban schools	129	3.62	1.10	1.18	.24
	Rural schools	139	3.47	1.02		
Overall computer competency	Urban schools	131	6.23	2.26	-.70	.49
	Rural schools	154	6.40	1.94		

*p<.05

5. Discussion

This study produced several important findings regarding teachers' and students' views of technology integration. Each finding provides insights into the research questions posted for the study: 1) Technology availability difference did exist between urban and rural schools; 2) teacher attitudes and competence did not differ but actual levels and experiences of technology integration were different between urban and rural schools; 3) student attitudes and competence did not differ but actual experiences and preference of technology integration were different between urban and rural schools.

5.1 Technology Availability Exists between Urban and Rural Schools

The first and most important element to describe the digital divide is equitable access to hardware, software, the Internet and technology support within schools (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). Previous studies have shown that the access to hardware in schools has drastically improved internationally, and it may no longer be a key factor causing the digital divide (Grime, 2000). However, in this survey study, we found that the facility access (especially advanced facilities such as IWBs or mobile facilities) is still a critical problem, which might cause different technology integration levels between rural and urban schools. The results support the argument that the digital divide may continuously increase when high-tech facilities such as tablet computers proliferate (Grime, 2000). One rural school teacher gave his opinion on the digital divide problem:

"Rural and urban schools do not get equal resources. We rural schools do not have qualified tachers for computer classes, we don't even have a coordinator to plan and implement technology facility for campus. The problem has been getting worse for years."

The other teacher from the rural school had similar comments. From the interviews, some possible reasons for the ever-growing gap were summarized: 1) political policies were still more geared to facilitate the needs for urban schools than ensuring service provision in remote regions; for example, in Taiwan most satellite schools provided with extra resources for instructional technology were built up in urban instead of rural areas; 2) rural schools still lacked human resources for the plan and implementation of advanced instructional facilities, and 3) government financial support and business sponsorship for rural schools were too limited to help them afford the cost of synchronous connections and the devices. Actions against the digital divide have been taken, however, even with the rapid change and advance of technology, the digital gap problem is not really solved. As researchers mentioned, urban areas are still the locus of innovation and information having a fast update cycle of technical facilities (Grime, 2000). Technology installation has not progressed in an even manner spatially, and many rural areas find themselves still at a disadvantage in terms of access to and the cost of advanced tools and services.

5.2 Teacher Attitudes and Competence Did Not Differ But Actual Levels and Experiences of Technology Integration Were Different Between Urban and Rural Schools

Interestingly, in this study, teacher attitudes and competence did not differ between locations. Teachers' scores in attitudes (productivity, enjoyment, and helpfulness) ranged from 3.57 to 3.74; that is, teachers in both areas hold positive attitudes toward technology integration. In terms of anxiety, teachers' scores ranged from 2.14 to 2.21; that is, teachers in both areas generally agreed that they were not anxious while using technology in class.

There were, nonetheless, differences between these two groups of teachers. In terms of teachers' overall technology integration level, urban teachers had a mean of 4.23, and rural teachers had a mean of 3.93. In the SoA instrument, level 3 means "Understanding and application of the process," level 4 means "familiarity and confidence," and level 5 means 'adaption to other contexts'. The results showed that on average, urban teachers had passed the "familiarity and confidence" level, and looked for adapting technologies in different ways. On average, rural teachers could understand the process of technology integration, but did not reach the "familiarity and confidence level." The difference of technology availability might be one reason for the difference of technology integration between rural and urban schools. In addition, through interviews with participants, we found that school culture might impact teachers' technology integration levels. When discussing this result with participants, one rural teacher mentioned:

"We remote schools have comparatively few peer competiveness and support for the use of instructional technology. We also lacked qualified coordinators or trainers to facilitate technology integration. It is very hard for us to increase the technology integration level."

The other teacher from a ruban school had an interesting argument:

"I feel that teachers' technology integration levels were determined by school administrators or district policy makers, but not directly relative to school locations, teacher attitudes, or teacher competence. If the school

administrators asked us to do technology integration, then we are pushed to do so. Consequently, the technology integration level may be high, but it does not mean we teachers are willing to do this…"

The interview data shows that rural school teachers have limited peer support and school pressure, consequently result in a lower technology integration level. In addition, teacher experience of technology integration between locations was also different. We found that urban teachers had more experience in using IWBs in class activities for going onto the Internet, PowerPoint presentations, and instructional content simplification. However, rural teachers preferred to use notebooks/netbooks in class activities for PowerPoint presentations, animation, motivation and interaction. When participants were asked to explain the phenomena, one rural teacher said that:

"The interactive whiteboard is a more advanced tool than notebooks with projectors. Because of the limited number of interactive whiteboards and training sessions in our rural schools, most teachers were conservative with the use of them. Currently using notebooks with a projector is still the most popular way for us to show instructional materials."

It is clear that there is still room for the training and promotion of the use of IWBs in rural schools. Besides, the results show that teachers' purpose of technology integration between rural and urban schools was different. Urban teachers tend to use the technology to simplify the delivered content and urban teachers use the technology for enhancing student motivation and class interaction. These results might be caused by the different nature and quality of students in these two areas. In Taiwan most urban schools were exam-oriented and urban students usually had better achievement performance. The difficulty level of instructional content in urban schools might be higher; consequently technology was used to promote student understanding for the abstract content. However, in rural schools, most students had lower expectations and pressure for academic performance, and technology might be used for increasing fun for learning. This result implies different needs of rural and urban teachers. Teachers' different instructional needs should be considered while designing training sessions for technology integration. For example, training sessions for urban teachers may provide more strategies for delivering difficult content via technology while for rural teachers such sessions should provide strategies for using technology in increasing motivation.

Rural teachers showed more difficulties than urban schools in technology integration. 19.6% of rural teachers felt integrating notebooks/netbooks was time-consuming (9.3% for urban teachers), and 16.8% of rural teachers felt hardware and software problems interrupted class (only 8.5% for urban teachers). This shows that rural teachers need qualified technicians, facilitators, resources, or training to overcome these technical difficulties.

5.3 Student Attitudes and Competence Did Not Differ but Actual Experiences of Technology Integration Were Different Between Urban and Rural Schools

Similar to the results in the teachers' survey, student attitudes and competence did not differ between urban and rural schools. Students' scores in attitudes (enjoyment and self-efficacy) ranged from 3.75 to 3.94, positive toward technology integration, no matter if in rural or urban schools. In terms of anxiety, students' scores ranged from 2.37 to 2.43; that is, students in both areas generally agreed that they were not anxious while using technology in class. These results were close to the teachers' survey outcome. In addition, students' overall computer competence was not different between the two groups. This result contradicted our original assumption that urban students have better attitudes about technology integration and computer literacy.

The lack of significancemight be due to the following reasons. First, our student participants were all elementary students whose ages ranged from 9 to 12, and these participants were too young to have sufficient computer experience to reinforce school technology integration. Consequently, the digital divide in student attitudes between areas was not clear. Most previous studies about digital natives focused on college students as participants, which was different from this research. Second, the prevalence of computers and Internet in Taiwan and the centralized curriculum in computer literacy might narrow the gap in student attitudes and competency between areas. In Taiwan, computer and information literacy is an important issue that should be integrated in all subjects, and the government has set up learning goals and sample content for teachers. The existence of the curriculum standards might balance student development in technology attitudes and competency between schools.

However, there was a still difference between these two groups of students, especially in the use of IWBs. Urban students had more IWB experience in learning (15.87 times per semester for urban and 8.40 times per semester for rural), and had a higher preference of using IWBs in learning. It seems that rural students had fewer opportunities to use IWBs in classrooms and their preference of using IWBs was lower. The shortage of technology experience may make rural students mistrust it and feel comfortable with traditional tools. Rural students' low scores in this preference may also be influenced by their teachers who had comparatively lower technology integration levels and less experience. Teachers' technology integration level has been proved to significantly influence students' thoughts of computer importance (Christensen, 2002). To improve rural student preference and expectation of using advanced technology integration, it is necessary to enhance teachers' actual use of these advanced tools.

6. Conclusion

This study aimed to understand teacher and student perceptions about technology use in urban and rural schools. The results showed that there was a significant difference in technology availability between rural and urban schools, including the number of interactive whiteboards, desktops in labs, notebooks, netbooks, and tablet computers; there was a difference in teacher overall high-tech integration level between rural and urban schools. Urban teachers reached the level of "familiarity and confidence," but rural teachers only stayed at the level of "understanding and application of the process." Teachers' experience, purpose, and difficulty in technology integration between rural and urban schools were also different. In addition, there was a difference in students' experience and preference in using technology to learn, especially using IWBs in learning. This study has several suggestions for reacting to digital divide problems: 1) improving the quantity of advanced facility (such as IWBs and mobile tools) in rural schools first and then move to the instructional quality issue, 2) increasing the number of qualified teachers or technology coordinators in urban schools for planning technology integration, 3) providing training sessions based on the different needs of teachers in the two locations (e.g., urban teachers need more strategies in delivering difficult and complex content while rural teachers need more strategies in increasing student motivation and student-teacher interaction), and 4) increasing student experience and expectation for rural students so that they can catch up to the advance of technology integration.

Several limitations need to be acknowledged in the interpretation of these results. This study was based on self-reported data which can be subjectively biased by respondents. In addition, this study was restricted in its sample size. Also, the frequency of technology use and quantity of facilities may not necessarily correspond to the quality. Different dependent variables where the quality of teaching with high-tech facilities is measured should be involved in future studies. Notwithstanding the limitations, the findings of this study provide direction for policy and practice about the next steps that are necessary for the successful integration of high-tech facilities in elementary education.

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