

Interactive Electronic Whiteboards Impacts on Language Learning Performance

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Keywords: Educational technology, Interactive whiteboard (IWB), Mother tongue, Taiwanese language, Minnan/Hokkien dialect.

Abstract: Due to powerful technical support for both teaching and learning, interactive whiteboards (IWBs) have been increasingly employed in schools. Using IWBs leads to multi-sensory learning synergy, supported by the perspective of Gestalt theory. Accordingly, the purpose of the study described in this article was to explore the effects that IWBs have on students in regards to the learning of the Taiwanese language (i.e., Minnan/Hokkien dialect). To achieve this purpose, a non-equivalent pretest-posttest quasi-experimental design was employed. The subject group consisted of one hundred students in four 3rd grade classes in southern Taiwan. A total of four intact classes participated in this study. Two classes, with a total of 51 students, were assigned to the experimental group, while two classes, consisting of 49 students were assigned to the control group. Research instruments employed included a learning achievement test, a learning attitude inventory and a semi-structured interview form. After conducting an analysis of covariance (ANCOVA) on the data collected, the performance on learning achievement and learning attitude (including learning confidence, learning motivation and learning anxiety) of the experimental group was higher when compared to the control group. This result indicates that the application of IWBs for the instruction of Taiwanese language is effective and integration/adaptation worthwhile.

1. Introduction

The Taiwanese language (i.e., Minnan/Hokkien dialect), is still fully or partially spoken by approximately 70% of the population of Taiwan as a mother tongue. However, Taiwanese youngsters have increasingly become disconnected with the Taiwanese language (Dupré, 2013). That is, Taiwanese language has declined from generation to generation. This may be due to the various foreign nationalities that have ruled Taiwan and oppressed the mother tongue while promoting the use of languages brought by the immigrants. This oppression may exist because language is a vehicle of cultural heritage that contains memories as well as images of a nation and/or culture from which it stems. As such, native dialects transmit spiritual bonds with people's ethnic, cultural, emotional, behavioral as well as creating living identity from generation to generation (Arens, Yeung, & Hasselhorn, 2014). Ethnic cultures and customs not only exist as gifts and heritage, but also include the contexts to which ethnicnicity bonds a child to a particular culture in which they may become a valuable asset.

The adoption of the mother tongue as the language of instruction has been advocated by the United Nations Educational, Scientific and Cultural Organization as such languages are the most natural tools for communicating ideas (Suina, 2004). Taiwanese mother tongues have been integrated as school subjects since 2001, when the new national curriculum for elementary and junior high school took effect. Each week, with only one hour of instruction, the efficiency and effectiveness of instruction are imperative.

Recent advancements of information and communication technologies (ICTs) have aided the infusion of ICTs into teaching and learning for various subjects, in turn creating more efficient and effective instruction. This has been evident in recent years by the many countries, i.e., the United Kingdom, the United States, Australia, Hong Kong, Singapore and Japan, which have invested large amounts of educational resources enhancing instructional effectiveness through the use of ICT. Among various educational resources and ICTs, interactive whiteboards (IWB) have been one of the leading teaching aids for basic education as well as language instruction (Schmid, 2008). The integration of IWB into language courses fosters student interest leading to a more positive learning atmosphere. The integration of such technology into Taiwanese language courses may enhance and efficiate the learning and instruction of the Taiwanese language and culture. Furthermore, students from non-Taiwanese speaking families could effectively learn about the Taiwanese language and culture recognizing and respecting the diversity; mutually beneficial for the coexistence of various ethnic groups with in Taiwan (Dupré, 2013).

However, research regarding the use of IWBs for the instruction of Taiwanese language and culture is not found while such research regarding the teaching of mandarin Chinese and English abound. While there exists studies regarding Taiwanese mother tongues which focus on: the formulation and evolution of native languages courses after the annulment of martial law (Yang, 2011); students' attitudes toward, usage of and identity toward their mother tongues (Arens et al, 2014); as well as the activity design, curriculum and assessment of Taiwanese language instructional model (Lu, Liu, Chuang, & Peng, 2012), there is an apparent lack of studies regarding IWB for Taiwanese language instruction. Therefore, the purpose of this study is to fill this apparent research gap. An empirical investigation explores the impacts of the integration that IWBs have on students' learning achievement as well as attitude towards Taiwanese language and culture instruction.

2. Literature Review

2.1. Retrospect And Problems Of Taiwanese Language Instruction

During Taiwan's long colonial period, foreign rulers assigned foreign languages as official while suppressing native dialects, such as Minnan. For instance, when the Japanese ruled Taiwan from 1895 to 1945, the Japanese language was made official while the Taiwanese dialect was suppressed although it remained active amongst the Taiwanese people (Tsurumi, 1977). From 1945 to now, Taiwan has been ruled by the Nationalist government, Kuomintang (KMT). The KMT moved to Taiwan from mainland China and invoked martial law. *At that time*, Mandarin Chinese became the official language while the Taiwanese language experienced severe repression. Furthermore, the belief proliferated that the Taiwanese language was a tasteless dialect and should be disregarded. This proliferation resulted in the removal of the instruction of Taiwanese language and culture from the education system until martial law was revoked in 1987.

Since 2001, in an effort to preserve Taiwan's diverse languages and culture, the national curriculum has required Taiwanese language instruction to be incorporated into both elementary and junior high school instruction. However, the instruction of Taiwanese language and culture still faces many challenges. Mandarin Chinese and English, in comparison, receive more government and financial support. Taiwanese language education has been continually updated nevertheless numerous difficulties in regards to such instruction persist. This sentiment has been echoed in studies regarding curriculum planning of Taiwanese language instruction (Lu et al., 2012), Taiwanese teaching materials development (Yang & Lin, 2012), and the status of and teachers' attitudes toward Taiwanese language instruction in elementary schools (Mathews-Aydinli & Elaziz, 2010). The main barriers to instruction include: lack of teaching capabilities, shortage of teachers, lack of instructional time, and insufficient parental/school support. Furthermore, there exist inadequacies covering the four components (i.e., listening, speaking and reading) of Taiwanese language arts while there are no objective criteria regarding the assessment of instruction (Lu et al., 2012).

2.2. Potential Advantages And Drawbacks of IWB-Integrated Language Instruction

With the advancement of technology, IWB unifies the advantages of traditional blackboard with computer-aided instruction. IWBs deepen the functions of traditional blackboard by adding color along through the aid of computer graphics. On IWBs, students and teachers conduct more diverse interactions with enriched student participation while increasing instructional effectiveness. In addition, using IWBs for language instruction transforms teacher-centered and a one-way-communication mode to a student-centered and interactive mode. IWBs also provide a way of giving students immediate feedback and more interesting educational exploration reaching a higher order of cognitive learning and motivation (Mathews-Aydinli & Elaziz, 2010).

However, such technology is not without its drawbacks. Schmid (2008) analyzed the integration of IWB into English instruction and found that various as well as excessive multimedia messages did not benefit learning. Plass, Chun, Mayer and Leutner (2003) pointed out that in some cases, some multimedia materials may even hinder learning due to variations in both learning conditions and students' educational backgrounds. Thus, instructors using IWBs must hold sufficient knowledge regarding multimedia-aided content in order to meet students' learning requirements.

Empirical research by Tozcu (2008) on multimedia-aided instruction in computer-based environments found that the digital learning environment helped to better understand the language learning process. Mayer (2001) argued that humans have mutually-independent but limited sensory systems to simultaneously deal with words and pictures as well as distinguish the connections between words and pictures. However, individuals have differing capacities in regards to cognitive load for both visual and verbal messages. In other words, the learning derived from text and pictures tend to be unequal. That is, words and pictures are complementary but cannot replace each other. This implies that multimedia, contiguity, and coherence principles be complied when applying multimedia instruction on IWBs so that words and pictures are well-coordinated reducing memory load while promoting meaningful learning (Clark & Mayer, 2008). Based on the such findings, appropriate multimedia materials can improve learning outcomes. Thus, the current study assumes that the appropriate use of IWBs to link multimedia and multiple senses will enhance student interest and motivation, in turn making Taiwanese language courses more stimulating, thus further motivating students to learn Taiwanese.

2.3. Research Studies Regarding IWB-Integrated Language Instruction

As for other countries, Britain Education Communications and Technology Agency (BECTA, 2007) entrusted Manchester Metropolitan University to conduct a survey and the results indicate that using IWB has a positive effect on students' learning in mathematics, science, and language. A study on how teachers use IWBs was completed by Demirli and Turel (2012), Isman, Abanmy, Hussein and Al Saadany (2012) and Schmid and Whyte (2012). These research studies showed how IWBs enhance learning in the following areas: elementary-school English learning (Duran & Cruz, 2011); Australian children's Chinese learning (Xu & Moloney, 2011); improving English learner's math and reading skills and resulting in higher ELL (English Language Learners) scores (Lopez, 2010).

In the above studies using IWB in language instruction, the effectiveness of IWB has been mentioned, as well as how it can effectively help teachers improve instructional skills while significantly enhancing student learning. As such, students are not the only benefactors of the use of IWBs, instructors benefit as well through the instantaneous recording and responding to students' learning problems and repeating learning emphases. The IWBs also aid instructional reflection, self-assessment, and instructional design. Thus, the current study explores the effects on students achievement and attitude during instruction of the Taiwanese language with integrated IWBs.

3. Research Design And Procedure

3.1 Research Design

A non-equivalent pretest-posttest quasi-experimental design was employed, as shown in Table 1. The participants were one hundred 3rd grade elementary students in four classes at a school in southern Taiwan. Of the participants, 48 were male and 52 female. Two classes were assigned to the experimental condition with a total of 51 participants (25 boys and 26 girls) and two classes were assigned to the control group with a total of 49 participants (23 boys and 26 girls).

3.1.1. Research Instruments

The research instruments included in this study are: (1) an Achievement Test, (2) Attitude Inventory. Further details are provided for these instruments in the following subsections.

3.1.2. Achievement Test

The Achievement Test (AT) assesses students' cognitive domain of the Taiwanese language. In this 20-item test, four types of questions (fill-in-the-bank, true/false, multiple choice, and listening-and-picture matching) are included and each type has five items. The AT was designed based on both the teachers' handbook and its CD-ROM. A two-way table of specification was employed to map and draft the questions. Two senior teachers were subsequently invited to review the questions. Based on an item difficulty and discrimination analysis of the top 27% of and the bottom 27% of performers' scores in the pre-test results, the average item difficulty and item discrimination of AT are .69 and .35, respectively. These items are considered acceptable in terms of item difficulty and discrimination (Ebel & Frisbie, 1991).

3.1.3. Attitude Inventory

The Attitude Inventory (AI) was adapted from the "Minnan-infused Situational Teaching Questionnaire" (Gao, 2013) and "Learning Attitude Inventory" (Wang, 2010). In order to detect acquiescence bias of questionnaire responses, some items were phrased in reverse. The AI used in the current study is composed of 29 items, containing the following three sub-scales: confidence, motivation, and anxiety. Among these, 11 questions are presented in the reverse. In order to examine the reliability of the AI, fifty-two students from the same grade and school but not in either experimental or control groups were selected to become the subjects of a pilot test. The results from this study revealed Cronbach's Alpha coefficients are as follows: confidence subscale .819, motivation subscale .718, anxiety subscale .719 and together .906, showing that this inventory has good internal consistency (Chen & Wang, 2011). Both the experimental and control groups received the pre-test and post-test.

3.2 Research Procedure

Both the experimental and control groups received the pre-test and post-test. During the treatment period, all participants experienced eight weeks, 40 minutes per week, of traditional or IWB-integrated Taiwanese language instruction which had identical conditions such as objectives, textbook and instructor. Following the post-test, 51 students in the experimental group were categorized into three sub-groups based on the results from the post-test scores: (1) high-achievers, whose scores are in top 25%, (2) intermediate-achievers, whose scores are in middle 50%, and (3) low-achievers, whose whose scores are in bottom 25%.

The instructional activities in both experimental and control groups were student-centered. Five or six students were grouped into a team and each team member was assigned tasks to ensure that every student concentrated on learning. Both groups used the same textbooks and learned the same unit "Things in Our School". The manipulated variable is instructional strategy in which the experimental group used IEW-integrated instruction while the control utilized traditional instruction. Mainly, impacts of IEWs on students' performance is investigated.

Table 1 the four steps of this study

Groups	Step 1: Pre-test	Step 2: Treatment	Step 3: Post-test
Experimental	AT + AI	IEW Instruction	AT + AI
Control	AT + AI	Traditional Instruction	AT + AI

Notes: AT-Achievement Test; AI-Attitude Inventory.

4. Findings And Discussions

4.1 Students Performance On Learning Achievement

4.1.1. The Subjects In The IEW-Integrated Instruction Group Obtain Higher Scores On Learning Achievement Test

The average scores of experimental group on the pre-test and post-test of the AT are 76.760 and 84.706, respectively, while the control groups' scores are 76.460 and 79.592, respectively. As a result of a homogeneity test of the within-group regression coefficients, the statistics, $F(1, 96) = .000$, $p = .984 > .05$, show the students' learning achievements in the two groups are homogenous. It means that the variances of the dependent variable is equal for all levels of the independent variable and covariance as well as the covariance does not have differential effects on the dependent variable at different levels of the independent variable. Thus, analysis of covariance (ANCOVA) was suitable to be employed to examine whether the two groups' learning achievements are significantly different.

The covariates of the pre-test, as shown in Table 2, $F(1, 97) = 1.725$, $p = .192 > .05$, does not reach a significance level. This indicates that the two groups' performance on the pre-test was not significantly different, while two groups' performance on post-test are significantly different, $F(1, 97) = 5.850$, $p = .017 < .05$.

Table 2 The ANCOVA of learning achievement

Source	SS	df	MS	F	Sig.
Pre-test	192.406	1	192.406	1.725	.192
Group	652.597	1	652.597	5.850	.017*
Error	10820.019	97	111.547		

* $p < .05$

That is, when the two groups' performance on pre-test are considered as equal, the experimental group's performance on the post-test (adjusted mean scores and standard error: $M = 84.704$, $SE = 1.479$) is significantly better than the control group's performance (adjusted mean scores and standard error: $M = 79.594$, $SE = 1.509$).

4.2 Students Performance On Learning Attitude

4.2.1. The Subjects In The IEW-Integrated Instruction Group Obtain Higher Scores On Learning Attitude Scale

The experimental groups' average scores on the pre-test and post-test of the AI are 112.608 and 116.373, while the control groups' scores are 103.245 and 101.245. As a result of a homogeneity test of the within-group regression coefficients, the statistics, $F(1, 96) = .262$, $p = .610 > .05$, indicate the students' learning attitudes in the two groups are homogenous. Thus, analysis of covariance (ANCOVA) was suitable to examine whether the two groups' learning achievements are significantly different.

As shown in Table 3, the covariates of pre-test, $F(1, 97) = 44.333$, $p = .000 < .05$, reaches the significance level. This indicates that the two groups' performance on the pre-test is significantly different. When the difference of two groups' performance on pre-test is controlled, two groups' performance on post-test are significantly different, $F(1, 97) = 12.336$, $p = .001 < .05$.

Table 3 The ANCOVA of learning attitude

Source	SS	df	MS	F	Sig.
Pre-test	9306.485	1	9306.485	44.333	.000***
Group	2589.510	1	2589.510	12.336	.001***
Error	20362.498	97	209.923		

*** $p < .001$

That is, when the two groups' performance on the pre-test are considered as equal, the experimental group's performance on the post-test (adjusted mean scores and standard error: $M = 114.091$, $SE = 2.058$) is significantly better than the control group's performance (adjusted mean scores and standard error of $M = 103.619$, $SE = 2.100$).

4.2.2. The Subjects In The IEW-Integrated Instruction Group Obtain Higher Scores On The Three Sub-Scales Of Learning Attitude

In terms of the three sub-scales of learning attitude, the experimental group's average pre-test scores are higher than that of the control group: confidence $38.961 > 36.694$, motivation $41.314 > 37.571$, and anxiety $32.333 > 28.980$. The experimental group's average post-test scores are also higher than the control group's: confidence $40.961 > 35.939$, motivation $42.863 > 37.143$, and anxiety $32.549 > 28.163$.

The homogeneity test results on the three subscales shows that all are not significantly different (confidence $F(1, 96) = .911$, $p = .342 > .05$, motivation $F(1, 96) = .019$, $p = .889 > .05$, and anxiety, $F(1, 96) = .008$, $p = .931 > .05$). Therefore, ANCOVA was suitable to examine whether the two groups' learning attitudes are significantly different on each sub-scale.

All covariates of the pre-test on the three sub-scales, as shown in Table 4, reach the significance level, confidence $F(1, 97) = 21.633$, $p = .000 < .05$, motivation $F(1, 97) = 35.764$, $p = .000 < .05$, and anxiety $F(1, 97) = 41.110$, $p = .000 < .05$. This indicates that two groups' performance on the pre-test of three sub-scales is significantly different. When the difference between two groups' performance on the pre-test of three sub-scales is controlled, two groups' performance on the post-test are significantly different, confidence $F(1, 97) = 11.157$, $p = .001 < .05$; motivation $F(1, 97) = 9.882$, $p = .002 < .05$; anxiety, $F(1, 97) = 9.296$, $p = .003 < .05$.

Table 4 The ANCOVA of the three sub-scales of learning attitude

Source	SS	df	MS	F	Sig.
<u>Confidence</u>					
Pre-test	798.837	1	798.837	21.633	.000***
Group	411.980	1	411.980	11.157	.001***
Error	3581.901	97	36.927		
<u>Motivation</u>					
Pre-test	1335.070	1	1335.070	35.764	.000***
Group	368.874	1	368.874	9.882	.002**
Error	3620.969	97	37.330		
<u>Anxiety</u>					
Pre-test	802.290	1	802.290	41.110	.000***
Group	181.424	1	181.424	9.296	.003**
Error	1893.032	97	19.516		

** $p < .01$; *** $p < .001$

That is, when the two groups' performance on the pre-test of the three subscales of learning attitude are considered as equal, the experimental group's performance on the post-test (adjusted means scores and standard errors: $M = 40.515$, $SE = .856$, motivation $M = 41.997$, $SE = .868$, anxiety $M = 31.771$, $SE = .630$) is significantly better than the control group's performance (adjusted means scores and standard errors: $M = 36.403$, $SE = .874$, motivation $M = 38.044$, $SE = .886$, anxiety $M = 28.973$, $SE = .644$).

In summary, the above findings echo the results from Huang (2009) and Kao (2009), which explored the impact of an IEW application for Mandarin Chinese and English, respectively.

Therefore, this study verified that the IEW-integrated Taiwanese language instruction may also improve students learning achievement and attitude.

5. Discussion

5.1. IEW-Integrated Approach Enhances Students' Learning Achievement Of Taiwanese Language

As stated earlier, the subjects in the IEW-integrated instruction group obtained higher scores on the learning achievement test than did the subjects in the traditional instruction group. In addition, the six students from the experimental group gave positive feedback to the IEW-integrated instruction when interviewed following the post-test. These participants mentioned that the IEW-integrated approach helps them to remember new instructional items and allows for learning through games lessening anxieties related to the of learning Taiwanese. Others mentioned that the IEW allows them to enjoy learning assessment in games and greatly facilitates learning, while highlighting the important points allowing for repetition. Other students mentioned how IEW helped individual students to find their own answers, as well as assisting them to self-assess and promoting the feeling of a power for learning. As such, it is worthwhile to help students to internalize Taiwanese language learnings through hands-on experiences such as the IEW-integrated approach described in this study. In particular, the students participating in the current study are in the concrete operational stage (7-11 years old) of Piaget's theory of cognitive development. The IEW-integrated approach can enhance not only intellectual development but also academic achievement in regards to Taiwanese language learning.

5.2. IEW-Integrated Approach Enhances Students' Learning Attitude Of Taiwanese Language

As stated earlier, the subjects in the IEW-integrated instruction group obtained higher scores not only on the overall learning attitude scale but also on its three sub-scales (i.e., confidence, motivation and anxiety) as compared to the subjects in the traditional instruction group. The IEW-integrated approach offers students the opportunity to present and to learn with each other so that the interaction among peers is increased as well as the interactions between teacher and student. The students learning interests are increased as well. Previous research studies have supported that the IEW-integrated approaches are effective when used in Mandarin Chinese or English instructions for junior high or elementary school students. In addition to those, this study found IEW-integrated approach enhances elementary school students' leaning achievement and attitude towards the Taiwanese language.

6. Conclusions And Implications

The study describe here investigated whether the IEW-integrated approach positively affected students' learning performance for Taiwanese. The results from the non-equivalent pretest-posttest quasi-experimental design completed in this study indicate that the experimental group's performance on learning achievement and learning attitude (including learning confidence, learning motivation and learning anxiety) is superior to the control group's performance. In addition, the students in the experimental group experienced the IEW-integrated Taiwanese language instruction. They are obviously satisfied with the IEW-integrated approach.

Based on the above conclusions, the implications of this study can be made as follows:

6.1. For The Practice Of Taiwanese Language Instruction

The official languages in Taiwan have been changed with the ruling governments and the Taiwanese language has been depreciated as a dialect although the population share of Taiwanese is about 70%. There is a great divide in elementary school students' beginning proficiencies in Taiwanese listening and speaking. For those students having good or poor proficiencies, school teachers need an effective and flexible approach to enhance their learnings. This study argues that

the IEW-integrated approach is that one because it unifies the advantages of traditional blackboard and with computer-aided instruction when the adopted in Taiwanese language instruction. However, the teacher working with IEW has to demonstrate the following features: (1) playing as students' role model in using Taiwanese and IEW, causing student's curiosity and interest, (2) valuing IEW's visualization capabilities which can effectively help students to understand and like to learn, (3) creating a pleasant learning environment, continuously encourage students to learn, and (4) make dialogues with students and keeping improving their own teaching and students' learning skills through reflections.

6.2. For Further Study of IEW-Integrated Taiwanese Language Instruction

This quasi-experimental study was conducted in an elementary school in southern Taiwan and its subjects were one hundred third graders. The inference of its results has its limitations. For example, the results might not be inferred to the areas other than southern Taiwan or the 3rd graders. Future studies may be expanded or extended as follows: (1) An extra group is added to provide a sort of triangulation, (2) Focus more specifically on particular issues, (3) Present problems with current uses of technology and then state how the IEW can solve such problems, then do an experiment to find out if the statements are correct, and (4) Similar studies could be conducted for indigenous languages rather than Taiwanese or native languages other than official languages in any country.

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