Exploring Users’ Attitudes and Intentions toward the Interactive Whiteboard Technology Environment

Chia-Cheng Shen, Huan-Ming Chuang

Abstract – Interactivity is the key characteristic in interactive whiteboard technology (IWT). This study aims to provide a better understanding of communication behavior in IWT. This research’s objective is to investigate the effects of the interactivity level on a user’s attitude and intention toward the use of IWT. As a result, we cite the technology acceptance model (TAM) to support this research. However, traditional TAM ignores intrinsic motivation, so we introduce perceived self-efficacy as the factor that reflects the user’s intrinsic motivation in IWT tool acceptance. Specifically speaking, our test consisted of system characteristics (interactivity), extrinsic motivation (TAM), and intrinsic motivation (perceived self-efficacy), in an integrated theoretical framework of IWT behavior. Data collected from 350 elementary school students in Taiwan were tested against the extended TAM, using the structural equation modeling approach. The results strongly support the extended TAM in predicting users’ intentions to adopt IWT. Attitude and behavioral intentions are directly/indirectly affected by interactivity, perceived self-efficacy, perceived ease of use, and perceived usefulness. Several implications for IWT acceptance research and management practices are discussed. Copyright © 2010 Praise Worthy Prize S.r.l. - All rights reserved.

Keywords: Interactive Whiteboard Technology (IWT), Interactivity, Technology Acceptance Model (TAM), Human-Computer Interaction, E-Learning

I. Introduction

E-learning has recently become a promising alternative to traditional classroom learning, helping society move toward a vision of lifelong and on-demand learning [1]. It has become one of the fastest-moving trends and aims to provide a configurable infrastructure that integrates learning materials, tools, and services into a single solution to create and deliver training or educational content quickly, effectively, and economically [2].

In a small-scale study of Information and Communication Technology in primary schools, interactive whiteboard technology (IWT) was found to be the predominant information communication technology (ICT) tool used by teachers [3]. Many studies reported on the significance of IWT in classrooms [4], [5]. IWT can help teachers, students, trainers, and school district office personnel with their work. It can save every step of student's work, which can be played back and used for assessment. It cites that collaboration on complicated problems have become much easier to understand when it is done with a whiteboard [4]. Furthermore, it points out that some interactive whiteboard software can hide portions of the screens to be revealed at one's discretion [4]. The early interactivity studies; however, did not propose a complete theoretical framework and only concerned the perception of its users. Some studies primarily offered guidelines [6], but waited for others to specify their findings. Moreover, other studies solely focused on the characteristics or dimensions of interactivity [7], [8]. Teo et al. offered a structure model, but didn’t concern the interactivity of users’ perceptions [9]. However, McMillan and Hwang validated the measures of perceived interactivity (MPI) offering researchers a tool for measuring a consumer perception [10]. For the model of Technology Acceptance Model (TAM) [11], [12], usefulness is believed to be fundamental in determining the acceptance and use of new technology. However, these beliefs alone cannot fully explain the users’ behaviors toward technology. Davis and Wiedenbeck [13] stated intrinsic motivation might be characterized as a driver arising within the self to carry out an activity whose reward is derived from the enjoyment of the activity itself. From the Social Cognitive Theory (SCT), self-efficacy is a major factor that affects individual use of technology [14]-[17]. As the results mentioned above, in this research, we adopted MPI to measure the user perceived interactivity, self-efficacy, and proposed an integrated model combined with a technology acceptance model [11] to provide a better understanding of IWT. In this paper, we use a quantitative modeling framework to develop a structure model that embodies the components of a compelling IWT experience. We use data collection from a sample which is an experienced elementary school student survey. We use this sample to measure these constructs and fit a series of
II. Literature Review

II.1. E-learning

Extensive research has shown that students benefit from e-learning [18]. Some of the benefits are that it: provides time and place flexibility; results in cost and time savings for educational institutions; fosters self-directed and self-paced learning by enabling learner-centered activities; creates a collaborative learning environment by linking each learner with physically dispersed experts and peers; and allows knowledge to be maintained and updated in a more timely and efficient manner [19].

II.2. Interactive Whiteboard Technology (IWT)

Most IWT literatures are highly positive about the impact and the potential of the technology [20]-[22]. Therefore, some of the advantages associated with the use of IWT that it identifies are: (a) it facilitates the effective integration of multimedia in the traditional ICT classroom [20], it facilitates the design of activities/materials which are tailored to meet the needs of students with diverse learning styles [22], (b) its ability to enhance motivation, interaction and collaborative learning in the classroom [23], and (c) it has a positive impact on students’ and teachers’ development of ICT skills and attitudes towards the use of computers for teaching-learning [24]. However, these studies also mention some drawbacks of interactive whiteboard technology, such as, (a) teachers’ concern about making lessons more teacher-centered if too much focus is given to the interactive whiteboard technology [25] and (b) teachers’ feeling of ineptitudes and lack of competence concerning their knowledge of ICT [24].

II.3. Interactivity

Interactivity is a person-to-person or person-to-technology exchange designed to effect a change in knowledge or behavior of at least one person [26]. The degree to which a communication system can allow one or more end users to communicate alternatively as senders or receivers with one or many other users or communication devices, either in real time or on a store-and-forward basis, or to seek and gain access to information on an on-demand basis where the content, timing and sequence of the communication are under control of the end users, as opposed to a broadcast basis [27]. Hoffman and Novak identified two levels of interactivity: machine interactivity at the low end and person interactivity at the high end [28]. Machine interactivity refers to the extent to which users can participate in modifying the form and content of a mediated environment in real time. Person interactivity is defined as interactivity between people that occurs through a medium or is unmediated, such as in the case of face-to-face communication [9].

Therefore, machine interactivity is interactivity with the medium, while people interactivity is the interactivity through the medium. Szuprowicz [29] further divides machine interactivity into two different levels: user-document interactivity at which level users are not able to influence or manipulate file contents and user-system interactivity at which level users can manipulate the content by changing its characteristics. At the level of user-user interactivity defined by Szuprowicz [29], users operate real time to create responses among two or more users.

II.4. Self-Efficacy

Kinzie, Delcourt, and Powers defined self-efficacy as an individual’s confidence in his/her abilities that may impact the performance of tasks [30]. They noted that self-efficacy reflected an individual’s confidence in his/her ability to perform the behavior required to produce specific outcomes. This is thought to directly impact the choice to engage in a task, the effort that would be expended and the persistence that would be exhibited. In addition, Bandura defined self-efficacy as a generative capability in which cognitive, social, and behavioral subskills must be organized into integrated courses of action to serve innumerable purposes [15]. This definition highlights a key view of the self-efficacy construct. Furthermore, Wood and Bandura stated that self-efficacy refers to beliefs in one’s capabilities to mobilize the motivation, cognitive resources, and courses of action needed, to meet given situational demands [30]. Essentially, if serious suspicions regarding performance of necessary activities existed in efficacy contemplations, the efficacy contemplations would no longer impact behavior. Thus, the greater people perceive their self-efficacy to be, the longer they work and the more persistent they are. Murphy, Coover, and Owen [31] stated computer self-efficacy as an individual’s perception of their computing capabilities.

SCT is based on the premise that environmental influences such as social pressures or unique situational characteristics, cognitive and other personal factors (including personality characteristics, demographic characteristics, and behaviors) are reciprocally determined [14]-[17]. Thus, people choose the environments where they exist in addition to being influenced by them. Additionally, any behavior in a given situation is affected by environmental or situational properties, which are in turn affected by behavior. In addition, it is influenced by cognitive and personal factors, and in turn, it affects those same factors [17]. Furthermore, SCT explicitly acknowledges the existence of a continuous reciprocal interaction between the environment in which an individual operates his/her cognitive perceptions and the behavior [15], [17].
II.5. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was conceived to explain and predict an individual’s acceptance of IT. TAM is based on Fishbein and Ajzen’s Theory of Reasoned Action (TRA), which suggests that social behavior is motivated by an individual’s attitude toward carrying out that behavior, a function of one’s beliefs about the outcome of performing that behavior, and an evaluation of the value of each of those outcomes.

According to TRA, behavior is determined directly by the intention to perform; because people, in general, behave as they intend to do within available context and time. TAM adopts TRA’s causal links to explain individual’s IT acceptance behaviors. It suggests that perceived usefulness and perceived ease of use of IT are major determinants of its usage. Davis defined perceived usefulness as “the degree of which a person believes that using a particular system would enhance his/her job performance” and perceived ease of use as “the degree of which a person believes that using a particular system would be free of effort” [11]. Consistent with TRA, user’s beliefs determine the attitudes toward using the system. Behavioral intentions to use, in turn, are determined by these attitudes toward using the system. Finally, behavioral intentions to use IT lead to actual system use. Previous research has demonstrated the validity of this model across a wide variety of corporate IT [11], [32], [33]. One obstacle to TAM usage is applying it beyond the workplace. This is because TAM’s fundamental constructs do not fully reflect the variety of user task environments. Recently, Dishaw and Strong pointed out that a weakness of TAM is its lack of task focus [34]. Therefore, to increase the external validity of TAM, it is necessary to further explore the nature and specific influences of technological and usage-context factors that may alter the user’s acceptance.

III. Research Model and Hypotheses

System characteristics have the potential to directly affect both perceived ease of use and perceived usefulness of information system (IS) [11]. Studies that included system features, such as external variables of TAM, have found significant relationships between the system variables and the TAM’s beliefs construct [35]. There is a need to identify specific system characteristics and examine its effects on both perceived ease of use and perceived usefulness in IWT environments. In this study, we define interactivity as the most important of system characteristics. Cross and Smith also indicated that increased interactivity may lead to time saving [36]. We propose the hypothesis as follows:

H1: Greater interactivity corresponds to greater perceived ease of use.

In the literature reviewed, several authors have emphasized the potential of IWT for facilitating more interactive lessons [25], [37], [38]. An ideal class using IWT would feature students and teachers working together to construct the content of the lesson by using the resources available by the technology and relying on the expertise of the whole class [25], [37], [38]. They argue that teachers should adopt a more interactive approach to teaching if they want the IWT to become a transformative device to enhance learning. Bell also emphasized the potential of IWT for promoting higher levels of interactivity [37]. We propose the hypothesis as follows:

H2: Greater interactivity corresponds to greater perceived usefulness.

Perceived ease of use is one major determination of attitude toward use in the TAM model, and many empirical studies confirmed the effect of ease of use on attitude toward using [11], [32], [33]. This internal belief ties to an individual’s assessment of the mental effort involved in using a system [11]. Perceived usefulness and perceived ease of use are distinct but related constructs. Improvements in perceived ease of use will contribute to improved performance. Since improved performances define perceived usefulness that is equivalent to usefulness, perceived ease of use will have a direct and positive effect on perceived usefulness.

Extensive research over the past decade provides evidence of the significant effect of perceived ease of use on intention, either directly or indirectly through its effect on perceived usefulness [32], [33], [39], [40], [41]. Accordingly, the following hypotheses were proposed:

H3: Greater perceived ease of use corresponds to greater perceived usefulness.

H4: Greater perceived ease of use corresponds to greater attitude toward using.

Perceived usefulness in the TAM model originally referred to job related productivity, performance, and effectiveness [11]. This is also an important belief identified as providing diagnostic insight into how user attitude toward using and intention to use are influenced - perceived usefulness has a direct effect on intentions to use over and above its influence via attitude [11], [32], [33], [39], [40], [41]. Accordingly, the following hypotheses were proposed:

H5: Greater perceived usefulness corresponds to a greater attitude toward using.

H6: Greater perceived usefulness corresponds to greater behavioral intentions.

Attitude has long been identified as a cause of intention. Attitude toward using in the TAM model is defined as the mediating affective response between usefulness and ease of use and behavioral intention to use a target system. In other words, a prospective user’s overall attitude toward using a given system is an antecedent to intention to adopt [11], [32], [39], [40], [42]. Accordingly, the following hypothesis was proposed:

H7: Greater attitude toward using corresponds to greater behavioral intention.

In general, prior research has suggested a positive relationship between experience with computing technology and a variety of outcomes, such as effects concerning computers and computer usage [43], [44]. A
related construct, called computer self-efficacy, has been examined in IS literature [17], [45].

Continuing research efforts on computer self-efficacy can be observed in recent IS research, which confirms the critical role that computer self-efficacy plays in understanding individual response to information technology tools [46], [47]. Our study has focused on whether respondents believed they had the required knowledge, skill or ability to use IWT. Thus, perceived self-efficacy is defined as the judgment of one’s ability to use IWT. Therefore, based on the theoretical and empirical support from the IS literature, we propose the hypothesis as follows:

H8: Greater perceived self-efficacy corresponds to greater attitude toward using.

Fig. 1 illustrates our model, which is based on TAM and related literature.

IV. Methodology

IV.1. Sample

To test the hypotheses, an online field survey was conducted. It used a questionnaire designed to be placed on a web site. Javascript and asp.net programming was developed to handle the data collection process. Our research subjects were IWT using fifth and sixth grade elementary school students in Taiwan. The formal questionnaire survey was expected to generate 300 respondents at least, with around 100 respondents for each online communication tool.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Items</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>192</td>
<td>54.9</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>158</td>
<td>45.1</td>
</tr>
<tr>
<td>Place of IWT</td>
<td>General class</td>
<td>215</td>
<td>61.4</td>
</tr>
<tr>
<td></td>
<td>ICT class</td>
<td>135</td>
<td>38.6</td>
</tr>
<tr>
<td></td>
<td>Under 3 months</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>Experience in IWT</td>
<td>3–6 months</td>
<td>140</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>6 months–1 year</td>
<td>95</td>
<td>27.1</td>
</tr>
<tr>
<td></td>
<td>Over 1 year</td>
<td>45</td>
<td>12.9</td>
</tr>
<tr>
<td></td>
<td>Under 10 h</td>
<td>200</td>
<td>57.1</td>
</tr>
<tr>
<td>Time in IWT per week</td>
<td>11–20 h</td>
<td>105</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Over 21 h</td>
<td>45</td>
<td>12.9</td>
</tr>
</tbody>
</table>

Telecommunication Laboratories and the questionnaire collection were kept running continuously for two weeks of the survey period.

The online questionnaire’s web address was first sent to students.

The contents of this message requested them to fill out the questionnaire and also forwarded the web address in hopes of increasing the sample size of study.

The online survey generates raw data automatically in a database. It saved a lot of time and avoided the possibility of human mistakes during data coding. Table I summarizes the respondents’ profile.

IV.2. Measurement Development

The questionnaires were developed from material discussed and tested previously; the list of items is displayed in Appendix.

The items were slightly modified to suit the context of IWT. Our scale items for perceived ease of use, perceived usefulness, attitude, and behavioral intention to IWT were from [11], [48], [49]. Interactivity was measured by items adapted from Liu, McMillan and Hwang [10].

Items for the perceived self-efficacy construct were adapted from the original instrument of computer self-efficacy developed by Compeau and Higgins [17]. Each item was measured on a five-point Likert scale, ranging from “disagree strongly” (1) to “agree strongly” (5), except for the items measuring perceived self-efficacy, which ranged from “not at all confident” (1) to “totally confident” (5). Before conducting the main survey, we performed a pre-test and a pilot to validate the instrument.

The pre-test included thirty-five elementary school students who were experienced IWT participants. Respondents were asked to comment on list items that corresponded to the constructs, including scales wording, the questionnaire format, and the instrument’s length. Finally, to reduce any possible ambiguity, a pilot test was performed.

V. Results

V.I. Descriptive Statistics

Descriptive statistics were calculated and are shown in Table II. These show that, on average, our sample responded positively to participating in IWT (the averages of all constructs were greater than 3 out of 4).

<table>
<thead>
<tr>
<th>N=350</th>
<th>Means</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactivity</td>
<td>3.76</td>
<td>0.79</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>3.29</td>
<td>0.91</td>
</tr>
<tr>
<td>Ease of use</td>
<td>3.79</td>
<td>0.78</td>
</tr>
<tr>
<td>Usefulness</td>
<td>3.84</td>
<td>0.71</td>
</tr>
<tr>
<td>Attitude</td>
<td>3.76</td>
<td>0.66</td>
</tr>
<tr>
<td>Behavioral intention</td>
<td>3.60</td>
<td>0.69</td>
</tr>
</tbody>
</table>
V.2. Analytic Strategy for Assessing the Model

The proposed model was evaluated using SEM analysis, which is a powerful second-generation multivariate technique for analyzing causal models with an estimation of the two components of a causal model, measurement and structural models.

The measurement model is estimated using confirmatory factor analysis (CFA) to test whether the constructs possess sufficient reliability and validation. The structural model is used to investigate the strength and direction of the relationship between the theoretical constructs. Such analyzed techniques have been widely applied in recent years. In our study, LISREL 8.7 was the software used to assess the confirmatory factor analysis (CFA) and the structural models [50].

V.3. The Measurement Model

The measurement model was tested using confirmatory factor analysis (CFA). Segars and Grover [51] suggested that the measurement model should be evaluated first and then changed as necessary to generate the ‘best fit’ model. The initial assessment of the model indicated that some items should be removed. So, after changing the instruments, 17 items were retained, as shown in Table III.

Item reliability ranged from 0.56 to 0.90, which exceeded the acceptable value of 0.50 recommended by Hair et al. [52]. The internal consistency of the measurement model was assessed by computing the composite reliability (CR). Consistent with the recommendations of Bagozzi and Yi [53], all composite reliabilities were above the 0.60 benchmark. The average variance extracted all constructs exceeded the threshold value of 0.5 recommended by Fornell and Larcker [54]. Additionally, the values of reliability were above the recommended thresholds, and the scales for evaluating the constructs were deemed to exhibit convergence reliability. Variances extracted by constructs exceeded the threshold value of 0.5 recommended by Fornell and Larcker [54].

In summary, the measurement model testing, including convergent and discriminate validity measures, was satisfactory. The fitness measures for the measurement models as shown in Table V. \( \chi^2 \), GFI (goodness-of-fit index), AGFI (adjusted GFI), NFI (normalized fit index), CFI (an incremental fit index of improved NFI) and RMSEA (root-mean-square error of approximation) were used to test the fit of the proposed model. It is suggested that \( \chi^2/\text{d.f.} \) should not exceed 3 [55] while GFI and AGFI should be greater than the recommended value of 0.8 [55], [56]. Bentler further suggested that model fit indices should be used, and scores of 0.9 or higher on NFI and CFI should be considered evidence of a good fit. Accordingly, all the fitness measures in this study fell into acceptable ranges. Consequently, the proposed model provided a suitable fit condition.
V.4. Tests of the Structural Model

We examined the structural equation model by testing the hypothesized relationships among the research variables; see Fig. 2.

The results show that attitude and perceived usefulness identification had significant effects on the intention to use ($\beta = 0.41, p < 0.001$; $\beta = 0.55, p < 0.001$), supporting hypotheses 6 and 7. Together, these two paths accounted for 0.70 of the variance in intent to use.

Perceived self-efficacy ($\beta = 0.21, p < 0.001$), perceived ease of use ($\beta = 0.22, p < 0.01$), and perceived usefulness ($\beta = 0.30, p < 0.001$) identification had significant effects on attitude toward using, supporting hypotheses 4, 5, and 8. Together, these three paths accounted for 0.33 of the variance in attitude toward using.

Also the results showed that interactivity ($\beta = 0.16, p < 0.001$) and perceived ease of use ($\beta = 0.68, p < 0.001$) significantly affected perceived usefulness, providing support for hypotheses 2 and 3. Together, these two paths accounted for 0.60 of the variance in perceived usefulness.

Finally, interactivity ($\beta = 0.48, p < 0.001$) significantly affected perceived ease of use, providing support for hypothesis 1. It accounted for 0.24 of the variance in perceived ease of use. The results of testing hypotheses are summarized in Table VI.

VI. Conclusions and Recommendations

An individual’s attitude and behavioral intention toward the use of the IWT tools are directly or indirectly affected by the individual’s perceptions about the interactivity, perceived self-efficacy, ease of use, and usefulness. At the same time, behavioral intention to use the IWT tools is highly related to the attitude and perceived usefulness. These results imply that the individual’s acceptance of the IWT tools is significantly related to motivation factors.

VI.1. Conclusions

The purpose of this study is to propose an integrated theoretical model, including interactivity, perceived self-efficacy, and the factors of TAM, to examine the IWT behavior, especially the acceptance of IWT tools. We verified the effect of interactivity, perceived self-efficacy, perceived ease of use, and perceived usefulness on the behavior of IWT tools. The conclusions drawn from the present exercise can be placed into two categories: methodological and theoretical.

On the methodological front, we have demonstrated the development of a reliable and valid measure to capture a critical construct to understand IWT behaviors [57]. On the theoretical front, our study makes several contributions to the literature. First, we investigate how constructs (including perceived ease of use, and perceived usefulness) are influenced by the interactivity. We found that increased levels of interactivity will lead to increased levels of perceived ease of use, and perceived usefulness. Similar findings have been reported in other studies [9], [58]. The most telling finding would appear to be, that we have identified three relevant constructs (including perceived self-efficacy, perceived ease of use, and perceived usefulness) that may influence intent to use IWT tools. In judging direct and indirect (i.e., via attitude) effect on behavioral intention, perceived usefulness was proposed as one of the determinant of acceptance. Therefore, the user friendly interface of an
IWT tool also played a critical role in determining perceptions of usefulness and attitude toward using. Our study indicates that interactivity, perceived self-efficacy, perceived ease of use, and perceived usefulness are salient beliefs about IWT, which support our hypotheses and such results reinforce previous findings [11], [12], [15], [17], [32], [33], [40], [41].

VI.2. Implications: Theoretical and Practical

From the standpoint of individual-level technology acceptance research, this study extends TAM with the SCT theory. Although TAM-related hypotheses are supported here, the results challenge some of the basic tenets of TAM. TAM emphasized the importance of perceived usefulness as the key determinant of user acceptance of IT, and our study had the same result. Besides, perceived self-efficacy had a significant effect on individuals’ attitudes. This means that the intrinsic and extrinsic motivational factors have significant effects on individuals’ attitudes. As a result, for academic researchers, this study contributes to a theoretical understanding of factors that promote not only task-oriented IT but also entertainment-oriented IT. Entertainment-oriented IT differs from task-oriented IT in terms of the reason to use it. Task-oriented IT usage is concerned with improving organization productivity. Therefore, TAM emphasizes the importance of perceived usefulness and perceived ease of use as key determinants. However, concerning entertainment-oriented IT, this study demonstrated the importance of an individual intentions to need the other variable, such as an interactivity experience. Furthermore, this dominance was strong, and explained most of the variance in technology usage.

This study has provided support to the research in confirming the positive effects of interactivity including user-machine interactivity and user-user interactivity. When user-user interactivity is incorporated into an IWT environment, designers need to be aware of the highly dynamic interaction between social and technological factors and how they influence technology acceptance. Although ease of use and usefulness are conceived as important issues in traditional IT environments; interactivity experience plays an important role in increasing usability in the IWT environment, which contains entertainment-oriented applications. Therefore, for IWT tool practitioners, the results suggest that developers should not try to emphasize intrinsic motivation over extrinsic motivation. The level should be optimized for the constraints of users’ neural bandwidth and skills. If too much interactivity is provided than the user can take, it is unlikely to keep their attention very long. Furthermore, the bandwidth of the infrastructure delivering the interactivity must be taken into consideration to ensure that the access speed is not hampered by the increased interactivity. In conclusion, designers should keep users in a flow state.

The results also have significant implications for advertisers. Because IWT environments could be taken as a new media, it has the capacity of making and impact on attitude formation and change, and therefore can be interesting and potentially powerful outlets for learner communication. However, in conventional vehicles, the “more-is-better” approach does not necessarily lead to enhanced communication effectiveness. As the complexity of advertisement increases, the challenge increases, and users may feel that it is hard to use. Therefore, the possibility of returns on its effectiveness diminishes. However, if the interactive features and design elements are properly balanced, the new media has the ability to impact favorably on involvement, which has been traditionally hard to achieve in conventional media.

VI.3. Research Limitations

Although our findings provide meaningful implications for IWT environment, our study does have some limitations. First, the use of self-reporting scales to measure study variables suggests the possibility of a common method bias for some of the results. In order to pursue further investigation, it would be appropriate to develop a more direct and objective measure for user acceptance of the IWT tools.

Second, although the structured equation modeling technique used was able to handle small samples, more statistical conclusion validity could be achieved with a larger population. Furthermore, this study was conducted with one-shot experimental design, so a longitudinal approach should also be considered.

Third, we used Taiwanese elementary school students, who were appropriate for this research. But, results should be able to be generalized across different populations. However, currently, we cannot offer empirical support that they do.

Finally, we investigate how beliefs, including perceived ease of use, and perceived usefulness, are influenced by interactivity. Attitudes toward using are influenced by perceived self-efficacy, but there are still a lot of other controllable factors that we didn’t discuss, such as individual and task characteristics, and cultural factors which would allow us to better understand the usage of communication technology.

References


[37] M. A. Bell, Impact of the electronic interactive whiteboard on students attitudes and achievement in eighth-grade writing instruction (Baylor University, 2000).


Appendix

Interactivity (INT)
1. This IWT facilitates two-way communication.*
2. The IWT gives me the opportunity to talk back.*
3. The IWT facilitates concurrent communication. *
4. The IWT enables conversation.
5. The IWT does not encourage visitors to talk back.

Perceived self-efficacy (PSE)
1. I could conduct my learning environment using the IWT if I had just the built-in help facility for assistance. *
2. I could conduct my learning environment using the IWT if I had seen someone else using it before trying it myself. *
3. I could conduct my learning environment using the IWT if someone showed me how to do it first. *
4. I could conduct my learning environment using the IWT if someone helped me get start.

Perceived ease of use (PE)
1. Learning to operate IWT is easy for me.*
2. I find it easy to get IWT to do what I want to do.
3. It is easy to remember how to use IWT.*
4. Overall, it will be easy to use IWT.*

Perceived usefulness (PU)
1. Using IWT improves my purpose quality.
2. Using IWT enables me to accomplish purpose more quickly.*
3. It enables me to satisfy the purpose of using IWT easier.*
4. Overall, it will be useful using IWT.

Attitude toward using (ACT)
1. I’ll like to use IWT.*
2. Using IWT will bring profit for me.*
3. I’ll be positive about using IWT. *
4. Using IWT is a pleasant idea.

Behavioral intentions to use (BI)
1. I will frequently use IWT in the future.
2. I will strongly recommend others to use IWT.*
3. I’ll intend to use IWT as soon as possible. *
4. It is worth to using IWT.*

Notes: R = Reverse coding.
*: Denotes the retained items for data analysis.

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