The Impacts of Workplace Advantage, Learning Intentions, and Technology Skills on the Use of Information Technology-Assisted Instruction by Early Childhood Pre-Service Teachers

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ABSTRACT
The practical value and usefulness of IT-assisted instruction for Taiwanese preschool children are popular topics in academic and practical settings. The purpose of this study was to survey early childhood pre-service teachers' attitudes regarding the workplace advantage of IT-related pedagogy and their learning intentions regarding IT-based applications for teacher education in Taiwan. The researcher used a survey to collect data, and analyzed the data through structural equation modeling. The value obtained for the model fitness indices using the confirmatory factor analysis indicated that the measurement model demonstrated an acceptable level of fitness. The results demonstrate positive relationships among the hypotheses for pre-service teachers' attitudes regarding preschool infrastructure, workplace advantage, and utility value. The findings revealed that pre-service teachers consider IT-assisted instruction to be a useful tool for enhancing their teaching knowledge and abilities. Their perceptions of IT-related applications as useful positively influenced their learning intentions in IT-related courses in teacher education and their perception of the importance of advancing their technology skills to assist young children in preschool learning. The implications of the findings are also discussed.

INTRODUCTION
The integration of information technology (IT) into teaching and learning activities is an important pedagogical innovation and a practical development for young children. IT-applied instruction helps young children have more learning opportunities, motivates them to learn, increases their interest in learning, and gives them a sense of autonomy in the advancement of their cognitions and skills (Abramovich & Cho, 2009; Ljung-Djarf, 2008). When provided with the ability to access IT applications for assistance during instructional activities, young children acquire more vocabulary, and develop useful language skills (Bittman, Rutherford, Brown, & Unsworth, 2011). Their access to IT significantly correlates with higher performance in the verbal, perceptual-performance, and general cognitive domains (Fish et al., 2008). Interest in the use of IT applied instructions is positively correlated with cognitive and social development in young children. Some preschools in Taiwan have begun to integrate IT-related applications into their teaching practices, constructing user-friendly IT-assisted learning environments, and advancing teachers' technology skills to improve student's learning experiences.

A critical factor for applying IT to instructional development and pedagogical advancement for young children is the attitude of the early childhood teacher regarding the advantages of using IT-related applications in the preschool classroom. The early childhood teachers' experiences with IT during professional development and teacher education influences their perceptions regarding its integration into their pedagogical approach. Their intentions to use IT in their teaching activities also affects their instructional beliefs and practices (Chai, 2010; Wong, Gao, Chai, & Chin, 2011). Most early childhood in-service teachers indicate that IT-related courses in their prior pre-service education did not significantly improve their IT literacy or aid them in developing superior IT-related competencies. Thus, they do not perceive themselves as being competent in basic or advanced applications of IT-related instruction (Goktas, Yildirim, & Yildirim, 2009).

The availability of IT in preschool classroom affects the development of young children's computer skills and the understanding of early childhood pre-service teachers. The workplace experiences of early childhood pre-service teachers encourage their interest in preschool instructional strategies and advancements in classroom activities and constructive learning styles. Their experiences with IT-assisted learning during their teacher education, influences their attitudes regarding the usefulness and the ease of use of IT in both the university context and future work environments (Edmunds, Thorpe, & Conole, 2012; Sackes, Trundle, & Bell, 2011; Sims & Walsh, 2009).

Following other trends in the innovative use of IT, teacher education increasingly uses IT applications to provide pre-service teachers more opportunities for learning and training to advance their level of IT literacy in academic and practical settings (Gomez, Sherin, Griesdorn, & Finn, 2008). Teacher education plays an important role in preparing pre-service teachers with the necessary knowledge and skills to improve their academic, social, and intellectual development through the application of IT. Teacher education also develops pre-service teachers'

pedagogical approaches in the field of preschool teaching, and provides more opportunities for them to learn to work productively with young children (McDonald et al., 2011).

It is generally accepted that there has been an increasing interest in IT-related pedagogical applications as innovative tools in preschool settings. This study focused on early childhood pre-service teachers' perceptions of the advantages of IT-related learning activities in their teacher education and professional development, and explored the relationships between their attitudes toward IT-related teaching activities and their professional literacy. Because of the importance of preschool teaching and learning practices for young children, the researcher addressed these issues by examining the impacts of early childhood pre-service teachers' attitudes toward the workplace advantage associated with the use of IT in the preschool classroom on their learning intentions and expectations with regard to IT-based methods for teacher education.

The relationships between preschool infrastructure, workplace advantage, and utility value are fostered through the use of IT-assisted instruction

The workplace practicum experience provides an opportunity for pre-service teachers to apply the knowledge and skills acquired in teacher education to actual teaching practices. Pre-service teachers consider the relationships between their utility value and outcomes, and reflectively construct their performance to develop effective teaching behaviors (Koc, 2012). Pre-service teachers should develop the ability to apply their learning experiences from training situations to professional teaching situations, transforming their professional knowledge into practical workplace experience, and articulating the training of supervisors and teachers (Chalies, Bruno-Meard, Meard, & Bertone, 2010).

The pre-service teachers' attitudes regarding IT influence their perceptions of field training. The IT provisions within a school's infrastructure help pre-service teachers develop positive attitudes regarding IT self-efficacy, proficiency, and usefulness, and stimulate them to apply IT to their classroom practices (Abu Al-Ruz & Khasawneh, 2011). The pre-service teachers' beliefs regarding the frequency of use of IT also influence their self-efficacy and their ability to integrate IT-assisted instruction into their teaching practices. Teachers' pre-service experiences and beliefs are important predictors of their potential integration of technology in their future classrooms (Anderson, Groulx, & Maninger, 2011; Yildirim, Kececi, & Bulduk, 2011).

Current IT-based pre-school environments provide more opportunities for young children to learn about both subject matter and IT (Sackes, Trundle, & Bell, 2011). With the increasing number of opportunities to access, understand, and use IT both within and outside the preschool classroom, young children develop positive attitudes toward IT, and become more proficient at using IT to learn. Early childhood teachers should recognize the benefits of IT-related applications, and increasingly integrate IT into age-appropriate lessons in preschool classrooms (McKenney & Voogt, 2010).

The early childhood pre-service teachers' beliefs regarding teaching approaches in future workplaces are closely related to their learning experiences in teacher education and their teaching outcomes in preschool, and influence their ability to integrate learning conceptions, approaches, motivations, and competencies for teaching young children through the use of IT-based applications. Their orientations and perceptions of the learning contexts affect their learning motivation, learning styles, and the use of cognitive strategies in teacher education (Chan, 2010; Lyke & Young, 2006).

Teacher education institutions should focus on how the pre-service teachers' thoughts affect their transition between teacher education and the workplace. Educators should provide pre-service teachers with more opportunities to experience the academic, social, and career aspects of teaching, encouraging them to make innovative contributions in teaching practices, and develop their thoughts regarding how the use of IT-related applications may affect their future employment and professional opportunities (Garraway, Volbrecht, Wicht, & Ximba, 2011; Swanson, Broadbridge, & Karatzias, 2006). Teacher educators should provide them with occupational specific courses that engage them in authentic instances of workplace practices to help them transition more smoothly into the workplace (Billett, 2009). Teacher education should also supply them with some useful means to prepare them for professional development, and facilitate the accumulation of their work experiences and job-related knowledge (Santiago, 2009).

According to the results of previous studies, early childhood pre-service teachers' perceptions of the ability of a preschool's infrastructure to support IT-related pedagogical applications corresponds with their beliefs regarding the workplace advantage associated with the integration of IT into their teaching practices. Their perceptions of the advantages of IT-related pedagogical applications in assisting young children's cognitive and academic performances also affect their utility value of IT-related courses in teacher education. Because of the relationship

between their attitudes regarding preschool infrastructure and their perceptions regarding the workplace advantage associated with using IT, early childhood pre-service teachers' learning intentions in IT-related courses in teacher education are influenced by their perception of the workplace advantage. Thus, the researcher proposes the following hypotheses:

Hypothesis 1: Preschool infrastructure positively influences workplace advantage.
Hypothesis 2: Preschool infrastructure positively influences utility value.
Hypothesis 3: Workplace advantage positively influences utility value.

The relationships between utility value, learning intentions, and technology skills are fostered through the use of IT-assisted instruction

The accessing, supporting, and modeling of IT use in the classroom can help pre-service teachers to improve their performance using IT, and help them to develop positive attitudes toward IT-assisted teaching and learning (Hammond et al., 2009; Nikolopoulou & Gialamas, 2009). The intrinsic and extrinsic motivations of pre-service teachers also affect their attitudes toward the use of technology, such as the integration of IT and its role in the classroom (Cullen & Greene, 2011; Sahin, 2011). Pre-service teachers' perceptions regarding self-efficacy and the usefulness of IT influence their intentions to use IT in educational contexts (Luan & Teo, 2009; Teo, Ursavas, & Bahcekapili, 2012; Teo, 2009).

Teaching approaches and course objectives also influence pre-service teachers' attitudes toward the use of IT for learning in teacher education. Pre-service teachers use IT as a tool to advance their academic performance and improve their affective engagement in learning. Their learning cognitions appear to conform to the lecturers' instructions, and are maintained by the continued use of IT during their teaching careers (Hammond, Reynolds, & Ingram, 2011; Margaryan, Littlejohn, & Vojt, 2011). Lesson planning in teacher education helps them develop professional competence in effective classroom management, and acquire relevant knowledge of pedagogical content, which allows them to make reasonable pedagogical choices to scaffold the instructional constructions (Rusznyak & Walton, 2011).

Pre-service teachers' perceptions of program experiences influence their pedagogical dispositions and teaching practices (Kidd, Sanchez, & Thorp, 2008). Teacher educators should identify pre-service teachers' learning styles, and provide training or experiential courses to improve their personal and professional knowledge (Petersen, 2007). Teacher educators must learn to design instructions and scaffold authentic experiences to integrate IT into teacher education. Pre-service teacher education should provide the necessary institutional support to help teachers develop competencies in planning, leadership, and cooperation (Tondeur et al., 2012).

For early childhood teachers, previous studies have indicated that pre-service teachers' confidence level and competency in the use of technology influences their pedagogical beliefs regarding the use of IT in the classroom (Gao, Chee, Wang, Wong, & Choy, 2011; Gao, Choy, Wong, & Wu, 2009; So & Kim, 2009). Pre-service teachers have a theoretical understanding of the pedagogical knowledge of the integration of IT competency and teaching performance, but they often feel challenged in the use of IT-related tools and resources for the development of instructional designs and relevant activities. Pre-service teachers need more knowledge, guidance, and modeling to enable them to develop effective skills and pedagogical practices using IT-related techniques by advancing their technology skills.

The early childhood teachers' intentions to apply IT-based teaching activities can determine their instructional planning, designing, practicing, and evaluating directions and developments. Teacher education programs should provide more opportunities for pre-service teachers to use IT-based methods, construct pedagogical content, increase their knowledge of pedagogical models, and advance their IT competencies in the use of preschool infrastructure (Abramovich & Cho, 2009). Their beliefs and knowledge regarding pedagogy influence the quality of their professional practices. In addition, the connections between their epistemological beliefs and their pedagogical training during teacher education are very important (Brownlee, Boulton-Lewis, & Berthelsen, 2008; Ljung-Djarf, 2008; Yurdakul, 2011). The uses of IT-related learning activities in teacher education foster pre-service teachers' understanding of IT-based educational learning objectives, and enhance their teaching competencies. The educational courseware and learning materials used in teacher education can provide pre-service teachers with more teaching methods to develop their technology skills (Ma, O'Toole, & Keppell, 2008).

The findings of previous studies have collectively shown that pre-service teachers' utility value of IT-related courses substantially influence their perceptions of the benefits of integrating IT-based techniques into their learning activities in teacher education. Thus, the more positive their intentions are regarding the use of IT to

advance their own learning performance, the more positive their attitudes are regarding the use of IT-assisted pedagogical activities for young children in future workplaces. If they value the use of IT to promote their own academic performance in teacher education, they are likely to have positive intentions regarding the integration of IT-related teaching competencies into their professional development, and support the use of IT-based instructional practices. Therefore, the researcher proposes the following hypotheses:

Hypothesis 4: Utility value positively influence learning intentions.
Hypothesis 5: Utility value positively influence technology skills.
Hypothesis 6: Learning intentions positively influence technology skills.

Study objectives

IT applications have been employed in early childhood education, and teachers have made efforts to use it as a critical pedagogical and administrative tool. IT-applied instruction provides teachers with the means for enhancing pedagogical skills and improving their efficacy and performance. Previous studies have stated that understanding IT-based teaching and learning can assist early childhood pre-service teachers in developing their teaching practices and provides workplace advantages in their future teaching endeavors (McKenney & Voogt, 2010; Sackes, Trundle, & Bell, 2011). These studies have also reported that their preferences regarding the use of IT-based instruction positively influence their expectations of preschool practices that will be integrated IT into learning activities for young children (Gao et al., 2011; Gao, Choy, Wong, & Wu, 2009; So & Kim, 2009). Other studies have shown that IT can provide opportunities and useful benefits for advancing academic performance and social development in teacher education, and can improve teacher preschool-teaching methods (Abramovich & Cho, 2009; Ma, O'Toole, & Keppell, 2008).

As mentioned in this literature review, the needs of early childhood pre-service teachers' perceptions in Taiwan regarding the workplace advantages of IT-rich instruction and their learning attitudes toward IT-related applications have not been studied. In this respect, it is essential for early childhood pre-service teachers to explore in greater depth their attitudes and intentions toward the impact of IT-related applications on their preschool instructional and learning practices and their expectations of pedagogical professional development. In this study, the researcher examined teachers' attitudes regarding the contributions of preschool infrastructure, workplace advantage, utility value, learning intentions, and technology skills to their perceptions of the advantages associated with the integration of IT into their preschool teaching practices.

The researcher developed a questionnaire to survey early childhood pre-service teachers' attitudes in Taiwan regarding their intentions to integrate IT into their professional development and to use IT-based instruction for teaching young children. The data that were collected using the questionnaire were examined using structural equation modeling, and the researcher assessed the quality of the measurement and structural models based on fitness indices. The relationships between the observed variables and the latent constructs were tested by confirmatory factor analysis using the measurement model. The total effects of the hypothesized relationships between the latent constructs in the responses were further explored using the structural model. The research model and the study hypotheses are presented in Figure 1.

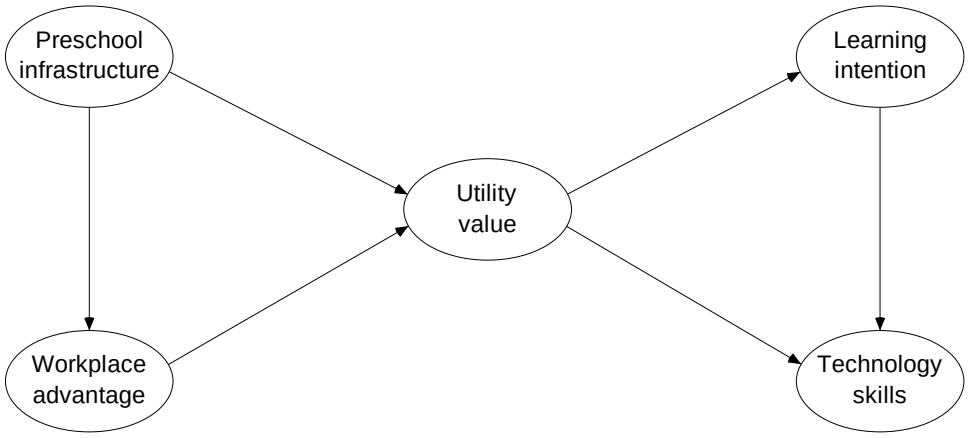

Figure 1: Research model and hypotheses

METHODS

Measurement instrument

The researcher designed a Chinese language questionnaire to assess early childhood pre-service teachers'

attitudes toward IT infrastructure in a preschool environment, the occupational benefits of employing IT in the workplace, their own learning experiences with IT-assisted instructions, and importance of technology skills for teaching young children. According to the review of the literature and the theoretical assumptions, the researcher proposed the following five latent constructs to represent the early childhood pre-service teacher's attitudes regarding the integration of IT-based methods for teacher education: preschool infrastructure, workplace advantage, utility value, learning intention, and technology skills.

The questionnaire addressed the pre-service teachers' knowledge of both IT and early childhood education to assess and correct the observed variables of the latent constructs. The original survey instrument included a total of 18 observed variables that comprised the five latent constructs, with three to four variables contributing to each latent construct. The questionnaire statements were based on a 5-point Likert scale, with 1 indicating strongest disagreement and 5 indicating strongest agreement. The respondent's score on the questionnaire positively correlated with positive thoughts and intentions regarding the integration of IT-based methods into their teaching practices for young children in Taiwan. Detailed descriptions of the five latent constructs are as follows:

1. Preschool infrastructure: assessed the pre-service teachers' attitudes regarding the provisions for the implementation of IT-related pedagogical tools for preschool education in Taiwan.

2. Workplace advantage: assessed the pre-service teachers' perceptions regarding the occupational benefits of the use of IT-assisted teaching methods.

3. Utility value: assessed the pre-service teachers' expectations regarding the benefits of increasing their IT-related knowledge through teacher education.

4. Learning intentions: assessed the pre-service teachers' willingness to learn about applications of IT-assisted instructions in teacher education.

5. Technology skills: assessed pre-service teachers' attitudes regarding the importance of their competency in the use of IT-assisted instruction.

Research design and sample characteristics

During the spring of 2012, the questionnaire was distributed among pre-service teachers teaching various grades and levels of IT competency, who were studying in the early childhood care and education departments at three universities in Northern Taiwan, which were offering 4 years of preschool pre-service teaching education. According to the parameters of the latent constructs and observed variables, the researcher selected an initial sample of 600 completed questionnaires. After excluding questionnaires that lacked responses (total non-responses and item non-responses), the final sample size was 476, with a response rate of 79%. In Taiwan, the early childhood pre-service and in-service teachers are predominantly female. This study sample adequately represented the demographic characteristics of the target population (Table 1).

Table 1: Sample demographics

Respondent characteristic	Number	Percentage
Gender		
Male	3	.6
Female	473	99.4
Grade		
First Grade	96	20.2
Second Grade	119	25.0
Third Grade	128	26.9
Fourth Grade	133	27.9
Numbers of IT devices owned		
1 or None	110	23.1
2	306	64.3
3 and more	60	12.6
Amounts of time spent in IT use per day		
Less than 2 hours	121	25.4
2~4 hours	150	31.5
4~6 hours	85	17.9
Over 6 hours	120	25.2

Data analysis

This study used structural equation modeling to analyze the survey data, and performed a two-stage test of the measurement and structural models (Bollen, 1989; Byrne, 2010; Kline, 2010; Schumacker & Lomax, 2004). In the first stage, the researcher used the Amos 17.0 structural equation modeling program to analyze the measurement model with the raw data as input to assess the fitness of the measurement model by testing the relationship between the latent constructs and the observed variables. The researcher used a maximum likelihood estimation to examine the statistical parameters and model fitness indices in the confirmatory factor analysis. ML is a consistent method for parametric estimation problems and is statistically well founded. ML yields lower variance than other methods do, and tends to be robust regarding numerous assumption violations that occur in confirmatory analysis. Curran, West, and Finch (1996) suggested that ML estimation can be used in confirmatory factor analysis. When sample data have not met multivariate normality assumptions, ML statistics have been proposed as a useful measure for dealing with non-normal data. Based on the estimations of the individual variable factor loadings, statistical significances, and measurement errors, this approach also assessed the extent to which the hypothesized pattern of relationships between the observed variables and the latent constructs were supported by the sample data.

The fitness indices that were used to assess the measurement model were as follows: the chi squared (χ^2) test, the chi squared per degrees of freedom (χ^2/df) test, the root mean square error of approximation (RMSEA), the root mean square residual (RMR), the standardized root mean square residual (SRMR), the comparative fit index (CFI), the normed fit index (NFI), the goodness of fit index (GFI), the Tucker-Lewis index (TLI), and the incremental fit index (IFI). The reliability (alpha) coefficients were used to estimate the reliability of the latent constructs in the measurement model.

In the second stage, path analysis was performed to evaluate the fitness of the structural model based on the path coefficients and the measures of explained variances. The fitness indices for the structural model indicate the degree to which the modeling results were supported the sample data. Examinations of the total effects of the hypothesized relationships between the various latent constructs were used to test the research hypotheses.

FINDINGS

Measurement model

The researcher used confirmatory factor analysis of the measurement modeling of the questionnaire data to evaluate the relationships between the observed variables and theoretical latent constructs. The model fitness statistics for the initial measurement model with 18 items were as follows: $\chi^2 = 432.24$ ($p < .001$), $\chi^2/df = 3.46$, RMSEA = .07, RMR = .05, SRMR = .09, CFI = .93, NFI = .90, GFI = .91, TLI = .91, IFI = .93. The standardized factor loadings for each variable ranged from 0.33 to 0.88. The values of χ^2/df and SRMR confirm that the initial model fit poorly. Based on the results of the factor loadings and model fitness indices for each latent construct, variables with load values greater than 0.50 for the relevant construct were retained, and the fitness indices suggested an acceptable degree of fitness for the sample data. Consequently, the initial 18 observed variables were reduced to 15 variables (Table 2).

Table 2: Retained variables on the questionnaire

Latent construct	No.	Observed variables
Preschool infrastructure	V1	The preschool provides teachers with access of IT.
Preschool infrastructure	V2	The preschool provides teachers with IT-related tools about teaching practices.
Preschool infrastructure	V3	The preschool establishes the teaching environment about IT integrated into instructions.
Workplace advantage	V4	Teachers with IT-applied teaching competence have more employment opportunities.
Workplace advantage	V5	Teachers with IT-applied teaching competence have the higher degree of work efficacy.
Workplace advantage	V6	Teachers with IT-applied teaching competence have the better work performance.
Utility value	V7	Learning IT-related courses could develop my educational professions.
Utility value	V8	Learning IT-related courses could advance my information literacy.
Utility value	V9	Learning IT-related courses could improve my academic performance.
Learning intention	V10	I intend to participate in IT-related pedagogical activities.
Learning intention	V11	I want to learn more knowledge about IT-assisted instructions.
Learning intention	V12	I prefer to use IT to solve learning problems.

Technology skills	V13	I know how to use IT into instructions in preschool.
Technology skills	V14	I know how to design IT integrated into instructions in preschool.
Technology skills	V15	I know how to teach young children via IT-related applications in preschool.

The means of the retained 15 observed variables ranged from 3.15 to 3.84, and the standard deviations ranged from 0.68 to 0.82. The measures of skewness ranged from -0.58 to 0.31, and the kurtosis for these variables ranged from -0.43 to 1.04. The standardized factor loadings for each variable ranged from 0.67 to 0.88, and the measurement errors ranged from 0.22 to 0.55. The researcher also used the bootstrapping method based on 2,000 samples to test the level of significance of the standardized factor loadings. The results showed that the standardized factor loadings for all selected variables had a *p* value less than .01, and the measurements were described by a normal distribution. The researcher used a confirmatory factor analysis based on maximum likelihood estimates to test the parameters of the latent constructs and observed variables.

All the observed variables had positive values for the measurement error variances. The standard errors of the observed variables were less than 1.0. The non-standardized factor loadings of the latent constructs and observed variables were statistically significant ($p < .001$). These statistics show that the measurement model demonstrated an acceptable level of fitness, and conformed to the rules of model identification. All of the theoretical latent constructs reasonably explained the variations of each variable. These results also suggest that the observed variables reflected the descriptions of the theoretical latent constructs.

The researcher used confirmatory factor analysis to evaluate the measurement modeling of the questionnaire data, and assessed the model fitness indices of the sample data. The analysis of the latent constructs based on the measurement model with the standardized parameter estimates are shown in Figure 2. The model fitness statistics for the measurement model were as follows: χ^2=153.25 ($p < .001$), χ^2/df = 1.92, RMSEA = .04, RMR = .02, SRMR = .04, CFI = .98, NFI = .96, GFI = .96, TLI = .97, IFI = .98. The value obtained for the model fitness indices using the confirmatory factor analysis indicated that the measurement model demonstrated an acceptable level of fitness. According to the power analysis of the structural equation modeling based on the RMSEA (MacCallum, Browne & Sugawara, 1996), the statistical power of the model was 1.00, based on null RMSEA values of .05. The reliability (alpha) coefficients for each construct were .79, .85, .87, .82, and .89, with an overall reliability of .88, suggesting that these latent constructs demonstrated satisfactory reliability in assessing early childhood pre-service teacher attitudes toward their learning intentions regarding IT-based instructional applications.

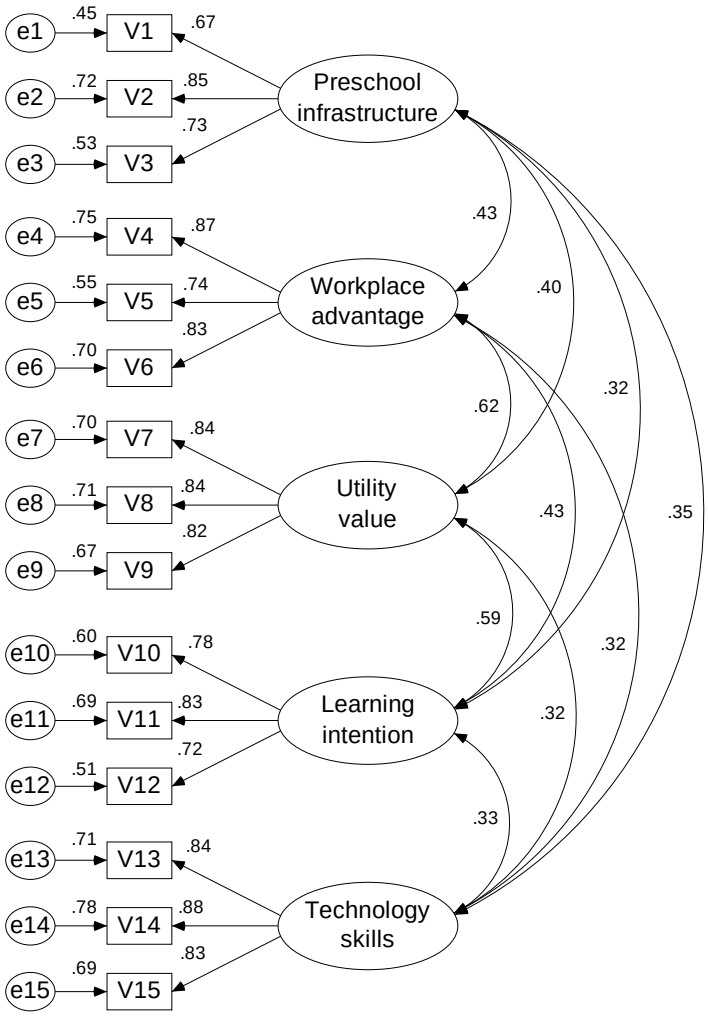

Figure 2: Measurement model

Structural model

Because the estimates of the measurement model indicated reasonable fitness for the sample data, the researcher analyzed the relationships of the structural paths to test the research hypotheses. Figure 3 shows the structural paths of the latent constructs and the path coefficients in structural model of the questionnaire data with the standardized parameter estimates. The following values for the model fitness indices demonstrated an acceptable level of fitness for the sample data: χ^2 = 180.25 (p < .001); χ^2/df = 2.15; RMSEA = .05; RMR = .03; SRMR = .06; CFI = .97; NFI = .95; GFI = .94; TLI = .97; and IFI = .97. Thus, the model fitness statistics provide an acceptable level of support for the structural model.

The standardized regression coefficients, the direct effects, and the measures of explained variance are presented in Figure 3. The latent construct of preschool infrastructure explained 19% of the variance in the latent construct of workplace advantage, with a standardized regression coefficient of .43. The latent constructs of preschool infrastructure and workplace advantage jointly explained 42% of the variance in the latent construct of utility value, with standardized regression coefficients of .18 and .55, respectively. The latent construct of utility value explained 36% of the variance in the construct of learning intentions, with a standardized regression coefficient of .60. The latent constructs of utility value and learning intentions jointly explained 14% of the variance in the latent construct of technology skills, with standardized regression coefficients of .23 and .19, respectively. The p values of the latent constructs were less than .05, indicating statistical significance.

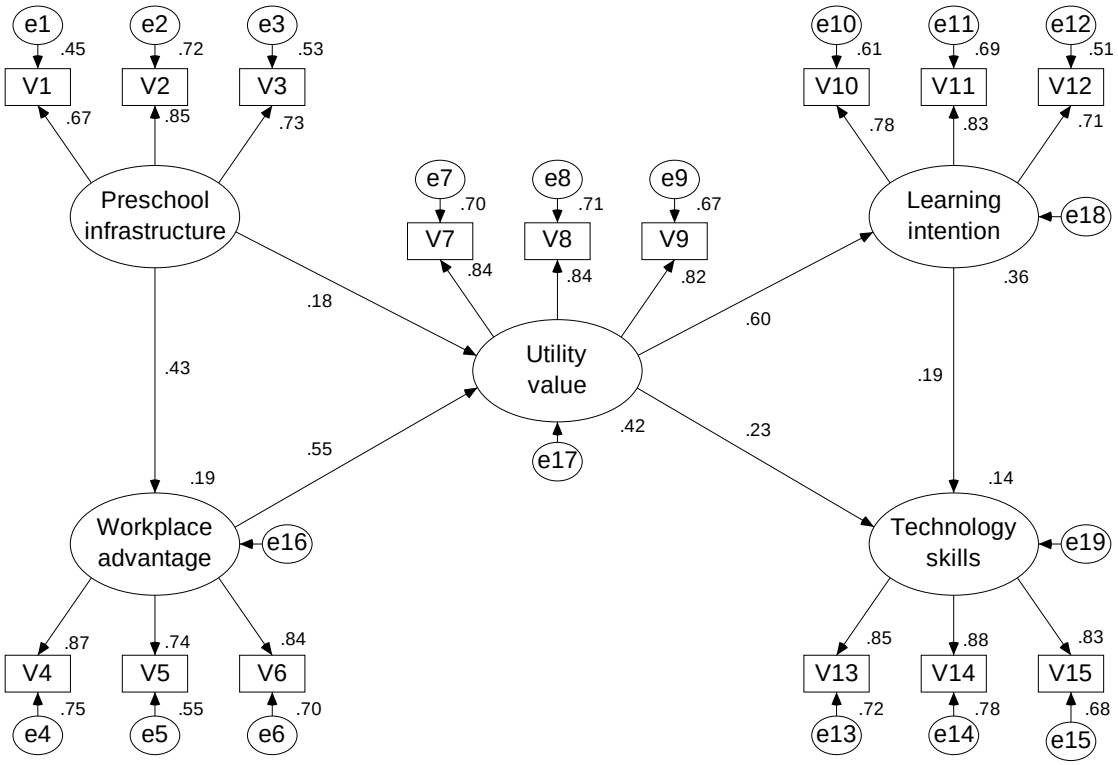

Figure 3: Structural model

The path analysis of H1 (Table 3) suggested that the early childhood pre-service teachers' attitudes toward the provisions for IT-related pedagogical tools for preschool children in Taiwan positively influenced their attitudes regarding the occupational benefits of using IT-assisted teaching practices, with a standardized total effect of preschool infrastructure on workplace advantage of .43. The path analysis of H2 suggested that the early childhood pre-service teachers' attitudes toward the provisions for IT-related pedagogical tools for preschool children in Taiwan positively influenced their attitudes regarding the benefits of increasing their IT-related knowledge through teacher education, with a standardized total effect of workplace advantage on utility value of .42. The path analysis of H3 showed that the pre-service teachers' perceptions regarding the occupational benefits of the use of IT-assisted teaching methods positively influenced their expectations regarding the benefits of increasing their IT-related knowledge through teacher education, with a standardized total effect of workplace advantage on utility value of .55. These results demonstrate positive relationships among the hypotheses for pre-service teachers' attitudes regarding preschool infrastructure, workplace advantage, and utility value.

The path analysis of H4 indicated that the pre-service teachers' expectations regarding the benefits of increasing their IT-related knowledge through teacher education positively influenced their willingness to learn about applications of IT-assisted instructions in teacher education, with a standardized total effect of utility value on learning intentions of .60. The path analysis of H5 indicated that the pre-service teachers' expectations regarding the benefits of increasing their IT-related knowledge through teacher education positively influenced their attitudes regarding the importance of their competency in the use of IT-assisted instruction, with a standardized total effect of utility value on technology skills of .34. The path analysis of H6 indicated that the pre-service teachers' willingness to learn about applications of IT-assisted instructions in teacher education positively influence their attitudes regarding the importance of their competency in the use of IT-assisted instruction, with a standardized total effect of learning intentions on technology skills of .19. This result suggested that their attitudes toward IT-related learning activities have the few impacts on their competences and abilities of using IT into instructions for young children. These results demonstrate positive relationships among the hypotheses for pre-service teachers' attitudes regarding utility value, learning intentions, and technology skills. The bootstrapping analysis indicated the results of all the hypothesis evaluations were statistically significant ($p < .05$).

Table 3: Total effects of path analysis in structural model

Hypothesized relationship among latent constructs	Direct effect	Indirect effect	Total effect
Preschool infrastructure → Workplace advantage (H1)	.43		.43
Preschool infrastructure → Utility value (H2)	.18	.24	.42
Workplace advantage → Utility value (H3)	.55		.55
Utility value → Learning intention (H4)	.60		.60
Utility value → Technology skills (H5)	.23	.12	.34
Learning intention → Technology skills (H6)	.29		.19

The value of the total effect of utility value on learning intentions was the highest among the study hypotheses (standardized total effect of .60; Table 3), indicating the strongest influence among these sets of pre-service teachers' attitudes. In addition, the influence of workplace advantage on utility value was also high (standardized total effect of .55), indicating a strong relationship between these sets of pre-service teachers' attitudes. The total effect of learning intention on technology skills was lowest, compared with the other hypotheses, with a standardized total effect of .19. This result suggests a low level of influence between pre-service teachers' willingness to learn about applications of IT-assisted instructions in teacher education and their attitudes regarding the importance of their competency in the use of IT-assisted instruction. Taiwanese preschool teachers spend a lot of time participating in child-care activities. Consequently, this result limits the time during which they can implement IT-assisted instruction, and this may detract from their attitudes regarding the importance of their competency in the use and development of IT-based teaching methods.

CONCLUSIONS

The practical value and usefulness of IT-assisted instruction for Taiwanese preschool children are popular topics in academic and practical settings. The uses of IT-related applications by pre-service and in-service teachers help young children develop cognitive skills and improve their learning competencies. With the innovative trends in IT-assisted methods, pre-service teachers realize the importance of the workplace advantage associated with the use of IT-assisted instruction both in teacher education and in the classroom.

Because studies of per-service teachers' attitudes regarding IT-related courses in teacher education in Taiwan are scant, the researcher assessed their perceptions of the practical usefulness of IT-related instructions in their work settings and in teacher education. The researcher explored early childhood pre-service teachers' attitudes toward the workplace advantage associated with the use of IT-assisted instruction, and analyzed their intentions to advance their competency in the integration of IT-based methods into their preschool teaching practices.

The latent constructs of preschool infrastructure, workplace advantage, utility value, learning intentions, and technology skills were proposed to test early childhood pre-service teachers' attitudes toward IT-assisted instruction. The survey instrument consisted of a questionnaire that assessed the pre-service teachers' attitudes regarding preschool IT infrastructure and workplace advantage in the preschool setting. The questionnaire also assessed pre-service teachers' intentions to use IT-assisted preschool teaching practices and their intentions to continue to develop their technology skills through teacher education.

The factor structure of the latent constructs in the measurement model with the standardized parameter estimates were supported by the model fitness statistics. The results of reliability (alpha) coefficients of the latent constructs showed that the measurement modeling of the questionnaire data demonstrated a higher coefficient of internal consistency. According to the results of hypothesis testing and the evaluation of the total effects in the structural model, the model fitness indices indicated an acceptable level of fitness for the sample data and significant relationships between latent constructs represented in the questionnaire design. The relationship between the perceived workplace advantage of applying IT to preschool teaching activities and the importance of improving technology skills through advancing pedagogical knowledge and teaching competencies is noteworthy. This finding supports previous research on this area of the IT instructional applications (Chan, 2010; Lyke & Young, 2006; Nikolopoulou & Gialamas, 2009).

The integration of IT into preschool teaching practices requires pre-service teachers to learn how to construct a friendly learning space and build a platform to articulate young children's learning motivations, interests, IT literacy, and academic performance through the IT-related teaching practices. When pre-service teachers consider the workplace advantage of using IT-instruction in preschool, they have more positive intentions to learn and implement IT in their teaching practices. They also perceive the importance of acquiring more pedagogical knowledge and resources to provide their students with opportunities to participate in learning activities and enhance their motivation to learn through their participation in IT-based learning activities. This study produced results which corroborate the findings of previous studies in this field (Gao, Chee, Wang, Wong,

& Choy, 2011; Kidd, Sanchez, & Thorp, 2008; Luan & Teo, 2009).

The findings of this study should indicate the importance of IT-related instruction for young children, thereby encouraging us to explore the integration of IT into preschool teaching practices, as an important pedagogical choice. Early childhood teacher education institutions should design and utilize IT-related courses to enrich the pre-service teachers' learning experience, improve their learning effectiveness, and help them to construct and develop their technology skills in a preschool context. Education institutions should also articulate pre-service teachers' IT literacy with their ability to integrate IT into their preschool teaching practices, such as helping them to design IT-based learning activities, constructing IT-assisted learning settings, and advancing their IT-related professional development.

Early childhood teacher education institutions should provide pre-service teachers with more learning opportunities for the practical development of IT-based teaching instruction for young children. The use of IT-related courses in teacher education could help pre-service teachers better understand the importance of using IT-assisted teaching activities in the preschool classroom. The professional development learning space should also be constructed to empower pre-service teachers in the use of IT-assisted preschool teaching practices to advance their teaching performance in preschool settings.

In summary, measuring the attitudes toward IT-related practices and workplace advantage in preschool settings with adequate statistical analysis is critical for the evaluation of the role of early childhood pre-service teachers' thoughts and their intentions for IT-related learning in teacher education. This study represents one of the earliest attempts to address these issues. This study excluded 21% of the sample from analysis because some respondents left the questionnaire completely blank or did not answer all of the items. Such a return rate can introduce bias, which must be considered regarding the results; furthermore, the results must be interpreted cautiously. Future studies should use appropriate imputation methods to estimate missing values and correct any bias caused by missing data.

The subjects in this study were Taiwanese pre-service teachers, and the results of this study address only Taiwanese situations. However, whether these results will apply to pre-service teachers' attitudes regarding IT-assisted instruction internationally cannot be determined based on these study results. Therefore, further research is warranted in other countries or regions. In order to reduce the statistical inference limitations, future questionnaire-based studies can evaluate geographical and cultural differences in pre-service teachers' views about IT-related practices and learning processes in different countries. In addition, questionnaire-based research can explore differences in pre-service teachers' views based on individual demographics, which may shape more appropriate decisions regarding the importance of leaning intentions and technology skills in IT-related professional development and teacher education.
This study addresses some aspects of issues associated with IT-related instructional practices. There is a continuing need for and adequate theoretical basis for developing questionnaire. Moreover, new latent factors or observed variables can be added into the questionnaire for to further explore pre-service teachers' attitudes regarding the relationships between utility value and teaching competencies in IT-related applications and learning accountability in teacher education. Multiple theoretical perspectives can be emphasized in future versions of the survey instrument. A better understanding of early childhood pre-service teachers' views toward IT-assisted pedagogical practices may facilitate the implementation of IT-assisted practices as an essential tool for innovation to maintain a high level of quality in early childhood education.

IT-assisted instruction for young children in Taiwan is an emerging practice. We must emphasize its application and assist pre-service teachers in understanding and learning the appropriate approaches for improving the learning quality of young children. Future research is necessary to explore IT-assisted instructional practices for young children conducted by pre-service and in-service teachers, and to analyze the advantages and disadvantages of various teaching methods for young children in IT-rich environments to develop their learning interests, motivations, and performance. Pre-service attitudes toward IT-assisted instruction merit future research and considerably must be accomplished. We require increased knowledge related to IT-assisted instructional practices, particularly the strengths and weaknesses of such education for teaching young children. A continuing need exists for adequate theoretical and practical bases for IT applications and appropriate instructional uses for young children.

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