

EXPLORING MALAYSIA TEACHERS' ICT INTEGRATION: A PATH ANALYSIS

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ABSTRACT

A survey involving 1,318 Malaysian teachers was conducted and data were analysed using Structural Equation Modeling (SEM) to investigate the factors leading to the adoption or integration of Information and Communications Technology (ICT) into teaching and learning. The results revealed that Basic ICT skills, Advanced ICT skills and Internet skills have significant direct and indirect effects on ICT Integration into Teaching and Learning and into Everyday Work. Also, Belief towards ICT effects on students, Belief towards the benefits of ICT and Belief towards the importance of ICT are significant mediating factors in ICT Integration into Teaching and Learning and into Everyday Work. This indicated that teachers' belief is an important mediating factor in ICT integration and should be included and stressed in teachers' ICT development and training.

Keywords: ICT in education; ICT integration; path analysis.

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1. INTRODUCTION

1.1. ICT Integration

Malaysian teachers' level of technology integration was still low despite years of



government's various technology initiatives implemented in Malaysian education systems [1]. Furthermore, despite numerous studies in Malaysian context on in-service teachers' technology integration in teaching and learning, there are no studies on the direct and indirect effects of certain factors on technology integration have been carried out and reported. Thus, it is essential for this current research to provide a holistic view of the complex relationship of factors affecting teachers' ICT integration. Instead of merely providing a list of significant factors, the alternative model of this research would reveal the importance of each factor in terms of its direct, indirect and also mediating effects on ICT integration. Hence, this study investigated whether the exogenous variables (Teacher ICT Skills and ICT Training) had significant direct effects on the endogenous variable (ICT Integration) and significant indirect effects through Teacher Beliefs.

1.2. Factors Affecting ICT Integration

The theory of diffusion of innovations [2] and the technology acceptance model [3] were reviewed and examined to justify the relationships of the factors affecting ICT integration. For instance, diffusion of innovations' theory was applied to explain the direct effects of Teacher *ICT Skills* and *ICT Training* on *ICT Integration* whereas the technology acceptance model was applied to describe the effects of the mediating variable in this study, *Teacher Beliefs* on *ICT Integration*. In [2] further describe a model of the Innovation-Decision Process which started with knowledge stage that occurs when an individual know the existence and understand the function of the innovation to make the next step in the model of Innovation-Decision Process either to accept or reject the new technology. Thus, knowledge in the Innovation-Decision Process refers to *Teacher ICT skills* that can be distinguished into (1) Basic ICT Skills (e.g.: word processing, spreadsheet, presentation packages), (2) Advanced ICT Skills (e.g.: programming, authoring packages, animation packages) and (3) Internet Skills (e.g.: Web camera, video conferencing, online news group) and *ICT Training* in this recent study.

The technology acceptance model depicts the relationship of the factors affecting a users' acceptance and use of technology. There are two fundamental determinants that influence users in technology acceptance which are perceived usefulness and perceived ease of use [3]. According to [3], perceived usefulness refers to "the degree to which a person believes that

using a particular system would enhance his or her job performance”. In contrast, perceived ease of use is defined as “the degree to which a person believes that using a particular system would be free of effort”. Hence, *Teacher Beliefs* refers to perceived importance (e.g. Expenditure on ICT is worth) and benefits of ICT (e.g. I feel this school has progressed due to the use of ICT) and perceived usefulness of ICT for learning (e.g. My student can conduct research more effectively using ICT). Based on a review of factors that influenced technology integration [4], there were three interlocking factors that affect teachers’ successful implementation of ICT in classrooms namely institution or school organisation, resources and the teacher. In this recent study, three factors were identified as the determinants of teachers’ ICT integration in the classrooms. The factors were *Teacher ICT Skills*, *ICT Training* and *Teacher Beliefs*

Thus, the research questions were as follows:

- 1) Do teachers’ ICT skills have significant direct effects on their ICT integration?
- 2) Does ICT Training have significant direct effects on teachers’ ICT integration?
- 3) Do teachers’ beliefs have significant mediating effects of their ICT skills on ICT integration?

2. METHODOLOGY

This study employed the Structural Equation Modelling (SEM) methodology to evaluate the direct and indirect effects of three identified factors: (a) *Teacher ICT Skills* (b) *ICT Training* and (c) *Teacher Beliefs* towards *ICT Integration*. This technique enables the researchers to provide empirical evidence that exhibit the relationships among the factors and also to determine if the causal relationships implied by the model structure fit the actual relationships given by the data collected.

The target population for this study were teachers in primary and secondary schools nationwide. In order to attempt a nationwide study on the factors affecting ICT integration after several initiatives launched by the Malaysian government, stratified random sampling was applied to select the teachers as the respondents for this study. Firstly, the administrative zones of all the states in Malaysia were identified to attempt fairness in selecting the schools according to the number of schools located in the zones. There are three types of school

identified in this study, namely smart schools, non-smart secondary schools and primary schools. Besides these schools, several smart schools were also involved. A total of 20 smart schools were randomly selected, with four schools from each zone. A total of 20 teachers from each school were selected as the respondents to participate in this study. Hence, the total of 7,320 teachers was the respondents in this study.

The instrument for this study was adopted and modified from the Teachers' Use of and Attitudes towards ICT Questionnaire developed by the Scottish Executive Education Department in 2004 for the phase three of their research on the impact of ICT initiatives in Scotland. There are six sections included in the Scottish's questionnaire namely background information and remit, using ICT at home, using ICT in teaching and learning, ethical and legal issues, attitudes and aspirations and staff development. There were also sub-items for each section which included scale and written answer type of question.

Firstly, only question with interval scale data were chosen and used in this current study as Structural Equation Modeling were applied. There were too many items for each section ranging up to 20 items per section. Hence, an exploratory factor analysis (EFA) was conducted to refine and elaborated on the actual relationships between the extracted factors from the general model. After employing EFA, the items were analysed and recoded to a relevant variables name. There were three factors loaded for *Teacher ICT Skills* (exogenous variables), namely, Basic ICT Skills, Advanced ICT Skills and Internet Skills. There were also three factors loaded for *Teacher Beliefs* (mediating variables) namely Belief towards ICT Effects on Students, Belief towards ICT Benefits and Belief towards ICT Importance.

Finally, two factors loaded for teachers' *ICT Integration* (endogenous variables) namely ICT Integration into Teaching and Learning and ICT Integration into Everyday Work. All the factors loaded with eigenvalues over 1. The results of the exploratory factor analysis provide sufficient confidence that the items were assessing the respective factors. Further refinements were made to suit Malaysian educational context and were translated into Bahasa Malaysia. Several experts in the instructional technology field and the context of Malaysian education were gathered in a workshop to review and validate the translated instrument.

The adopted and modified questionnaire consists of 44 items including the demographic section. There are five sections; (A) Demographic Information, (B) Teachers' ICT Skills, (C)

ICT Training, (D) Teachers' Beliefs towards the Effects of ICT, (E) Teachers' ICT Integration. There are three types of five Likert-scale used. The teachers responded to a scale ranging from Strongly Disagree (1) and to Strongly Agree (5) for ICT Training and Teacher Beliefs. A scale ranging from No Skills (1) to Excellent Skills (5) was used as teachers' self-reported ICT Skills. Furthermore, a scale ranging from Never (1) to More than 10 times (5) in a week was used for ICT Integration. The questionnaires were later collected from respondents and the data were keyed-in Statistical Packages for the Social Sciences (SPSS) environment and analyzed using Analysis of Moment Structure (AMOS).

3. RESULTS AND ANALYSIS

The targeted sample for this study was 7,320 teachers nationwide. But only 1,668 teacher respondents were obtained due to time constraint. Thus, response rate was 22.79 %. A total of 350 participants data were deleted in handling the missing data value. Therefore, for the final analysis, only 1,318 respondents' data were involved in the analysis.

Structural Equation Modeling (SEM) was conducted to assess the fit of the hypothesized model using the computer program AMOS 16. Based on AMOS 16 model summary, the chi-square (χ^2) value is provided as a quick overview of the model fit. This model fit determines the degree to which the hypothesized model fits the sample data [5]. The χ^2 was 32.76 ($\chi^2 / df = 2.18$). The final alternative model statistics of the goodness of fit criteria were summarized in Table 4.5. The CFI is 0.996, NFI is 0.992, TLI is 0.989 and RMSEA is 0.03 indicated a good fit of the final alternative model with the sample data.

The alternative model is shown in Figure 1 and standardized path coefficients and R^2 values are reported in Table 1. The entire paths in the final alternative model were statistically significant. From the final alternative model, it was found that Basic ICT Skills, Advanced ICT Skills and Internet Skills have significant direct and indirect effects on ICT integration into Teaching and Learning and into Everyday Work. ICT Integration into Teaching and Learning was based on a significant direct effect of Basic ICT Skills with $\beta = 0.25$ and significant indirect effect of $\beta = 0.06$ through Belief towards ICT Effects on Students and Belief towards ICT Benefits giving a total effect of $\beta = 0.31$. There were also a significant direct effect of Advanced ICT Skills and Internet Skills with $\beta = 0.11$ and $\beta = 0.18$

respectively on ICT Integration into Teaching and Learning.

Furthermore, ICT Integration into Everyday Work was based on a negative significant direct effect of ICT Training with $\beta = -0.05$ and a negative significant indirect effect of $\beta = -0.01$ through Belief towards ICT Benefits and ICT Integration into Teaching and Learning and through Beliefs towards ICT Importance giving a total effect of $\beta = -0.06$. There was also a significant indirect effect of Basic ICT Skills with $\beta = 0.16$ on ICT Integration into Everyday Work. Additionally, Advanced ICT Skills and Internet Skills had a significant direct effect on Integration into Everyday Work with $\beta = 0.09$ and $\beta = 0.22$ respectively.

The bootstrap technique was performed to investigate whether the indirect effects from the exogenous to the endogenous variables and the mediating variables were significant. The findings are presented in Table 3 Basic ICT Skills had significant indirect effects on Belief towards ICT Importance ($\beta = 0.005$), Belief towards ICT Benefits ($\beta = 0.031$), Integration into Teaching and Learning ($\beta = 0.045$) and Integration into Everyday Work ($\beta = 0.118$). Advanced ICT Skills had significant indirect effects on Integration into Everyday Work ($\beta = 0.034$). Internet Skills had significant indirect effects on Integration into Everyday Work ($\beta = 0.046$). ICT Training significant indirect effects on Integration into Teaching and Learning ($\beta = 0.013$) and Integration into Everyday Work ($\beta = -0.021$).

Table 2 also report the total effects of the exogenous on the mediating variables and endogenous variables. Basic ICT Skills had total effects of $\beta = 0.129$ on Belief towards ICT Importance, $\beta = 0.224$ on Belief towards ICT Benefits, $\beta = 0.310$ on Integration into Teaching and Learning, and $\beta = 0.160$ on Integration into Everyday Work. Advanced ICT Skills had a total effect of $\beta = 0.145$ on Integration into Everyday Work. Internet Skills had a total effect of $\beta = 0.307$ on Integration into Everyday Work. ICT Training total effects of $\beta = 0.006$ on Integration into Teaching and Learning and $\beta = -0.061$ Integration into Everyday Work.

Table 1. Standardized path coefficients (direct effects) and R^2 values for the alternative model

Path	Standardized Coefficient	R^2
To Belief towards ICT Effects on Students from		0.06
Basic ICT Skills	0.24**	
To Belief towards ICT Benefits from		0.24
Basic ICT Skills	0.12**	
ICT Training	0.06**	
Belief towards ICT Effects on Students	0.44**	
To Belief towards ICT Importance from		0.07
Basic ICT Skills	0.12**	
ICT Training	0.22**	
Belief towards ICT Effects on Students	0.07**	
To Integration into Teaching and Learning from		0.34
Basic ICT Skills	0.25**	
Advanced ICT Skills	0.11**	
Internet Skills	0.18**	
Belief towards ICT Effects on Students	0.15**	
Belief towards ICT Benefits	0.09**	
To Integration into Everyday Work from		0.50
Advanced ICT Skills	0.09**	
Internet Skills	0.22**	
ICT Training	-0.05*	
Belief towards ICT Effects on Students	0.07**	
Belief towards ICT Importance	-0.06*	
Integration into Teaching and Learning	0.49**	

**significant at $p= 0.001$ *significant at $p= 0.05$

Table 2. Standardized indirect effects of the exogenous variables on the mediating and endogenous variables

Exogenous Variables		Endogenous and Mediating Variables	Indirect Effects	Total Effects
Basic ICT Skills	→	Belief towards ICT Importance	0.005*	0.129
	→	Belief towards ICT Benefits	0.031**	0.224
	→	Integration into Teaching and Learning	0.045**	0.310
	→	Integration into Everyday Work	0.118**	0.160
Advanced ICT Skills	→	Integration into Everyday Work	0.034**	0.145
Internet Skills	→	Integration into Everyday Work	0.046**	0.307
ICT Training	→	Integration into Teaching and Learning	0.006**	0.006
	→	Integration into Everyday Work	-0.010*	-0.061

**significant at p= 0.001

*significant at p= 0.05

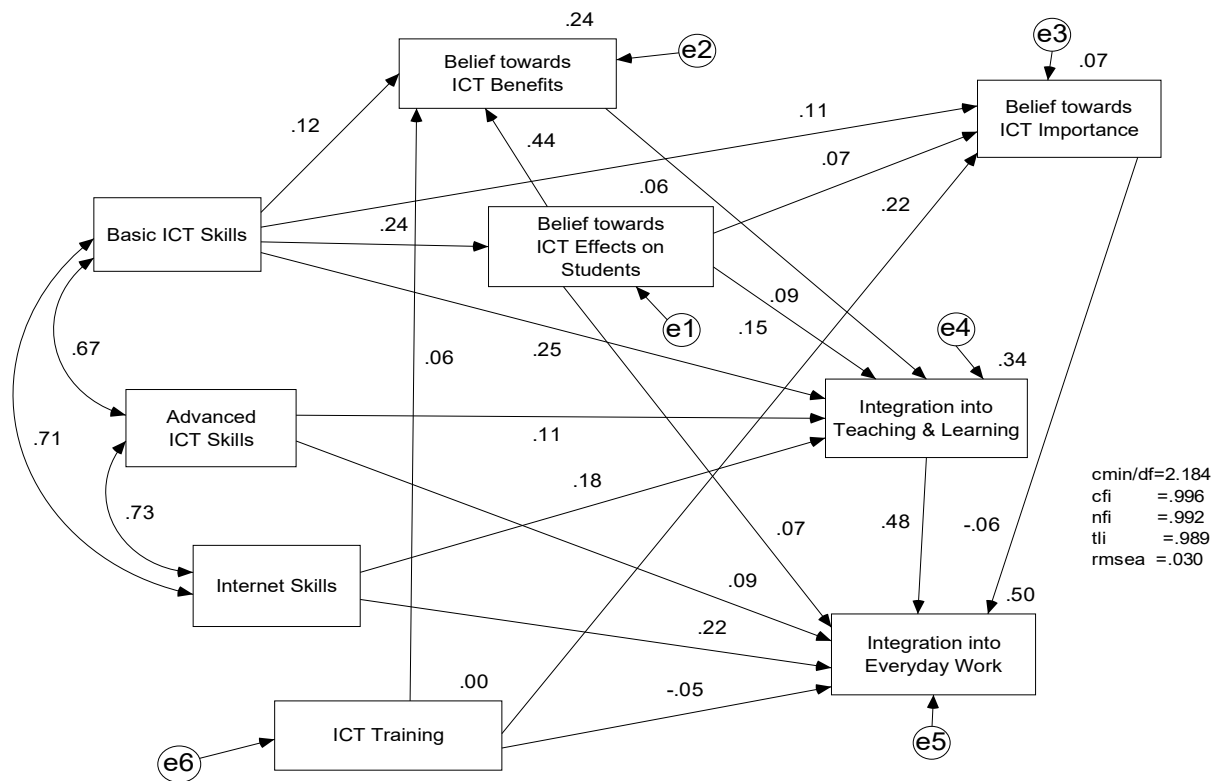


Fig.1. The alternative model with path coefficients

4. DISCUSSION

The current findings of this study showed that Basic ICT Skills, Advanced ICT Skills, Internet Skills, Belief towards ICT Effects on Students and Belief towards ICT Benefits had significant direct effects on Integration into Teaching and Learning. Among these factors, Basic ICT Skills had the strongest influenced on Integration into Teaching and Learning. The diffusion of innovations’ theory [2] which indicated that knowledge is the earliest stages of an individual on accepting to use technology supported this finding. Hence, this study implied that teachers’ basic ICT skills were the main factor that affects their practice of ICT into their teaching and learning activities.

Another finding was that ICT Training had significant negative direct effects on Integration into Everyday Work. This finding was in accordance to previous studies. For instance, teachers’ level of utilizing technology in classroom to assist teaching and learning increase following the training they attended [6]. In addition, teachers’ formal technology training did not lead changes to their attitudes toward educational technology and integration into their practice in the classroom [7]. The negative direct effects might be caused by the gap between

training and practice. Limited access to the equipment and lack of assistance provided by the school staff to maintain the technology were the barriers faced by teachers to implement technology after attending training [6]. Another possibility was that the training attended by the teachers would focus on emerging technologies, where higher and advanced skills that require specific devices for execution. Unfortunately, these specific devices will not be available at schools for them to apply their new knowledge and skills. Additionally, teachers were reluctant to use new technologies in their practices [8]. Therefore, the findings suggested that there was a gap between training and adoption of the new knowledge that has been acquired or that teachers' level of readiness to adopt the new ideas and skills being promoted were low. Further investigation into this issue is recommended.

The results of this study showed that Basic ICT Skills had significant indirect effects on Integration into Teaching and Learning and Integration into Everyday Work through Belief towards ICT Effects on Students, Belief towards ICT Benefits and Belief towards ICT Importance. Among the factors of beliefs, Basic ICT Skills influenced Beliefs towards ICT Benefits and Beliefs towards ICT Importance through Beliefs towards ICT effects on Students. Belief towards ICT effects on Students was an important contributor in establishing teacher beliefs. Teachers developed their beliefs toward ICT based on ICT effects on students. The finding is in line with the technology acceptance model [3] which proposes that belief is the mediating variables in predicting user acceptance of technology.

ICT Training had positive significant indirect effects on ICT Integration into Everyday Work through Belief towards ICT Benefits and Integration into Teaching and Learning, and negative significant indirect effects on ICT Integration into Everyday Work through Belief towards ICT Importance. However, the total effect was negative. This current finding was in line with the tempered findings that showed although teachers had considerable degree of negative reaction towards the training they attended, teachers' confidence in using computer were increased [9]. They further reported that the training provided was a little of relevance to their classroom practice. This indicated that, teachers gained their confidence and changes their perspective of the value of ICT in teaching and learning but unable to implement ICT as there is no relevance to classroom environment.

5. CONCLUSION

The findings supported that the direct method towards ICT integration following Rogers's theory of diffusion of innovation [2] was significant but were obtained only through six regression effects to the factors of ICT integration. The findings also showed that the indirect method following Davis's technology acceptance model [3] was also significant with numerous indirect effects obtained from all the exogenous through the mediating variables of ICT integration. The findings suggested that ICT integration into teaching and learning were significantly driven by direct and indirect effects of the exogenous and mediating variables. Future efforts towards ICT integration should emphasize and employ strategies for harnessing the indirect effects and also investigate the duration of incubation before the direct and indirect effects of the strategies would take effect.

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