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Comparing pre-service and in-service teachers' acceptance of technology: Assessment of measurement invariance and latent mean differences

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ABSTRACT

This study examines the factors that explain pre-service and in-service teachers' technology acceptance. A sample of 817 participants (387 pre-service, 430 in-service teachers) gave their responses to a 23-item, self-reported, 7-point scale designed to measure seven variables: perceived usefulness; perceived ease of use; attitude towards computer use; subjective norm; facilitating conditions; computer self-efficacy; and technological complexity. Results of this study showed the seven variables were valid in explaining the technology acceptance of the teachers from both service groups. Tests for measurement invariance revealed that scalar invariance in the data was not supported for facilitating conditions and technological complexity and those for latent mean differences found no significant differences between pre-service and in-service teachers for the remaining five variables. The findings suggest that pre-service and in-service teachers had reacted to the items for measuring facilitating conditions and technological complexity with significantly different intensities. Implications of this study are discussed and future research possibilities proposed.

1. Introduction

Since the 1970s, technology acceptance has been a key area of interest among researchers in the business and information systems disciplines. Among the research themes has been a focus on identifying the conditions or factors that drive technology integration among business users (Legris, Ingham, & Collerette, 2003). Arising from these efforts, several theories and models have been proposed as frameworks to enable researchers to identify significant variables that both explain and predict technology acceptance at individual and organizational levels. In their review of 99 studies on information technology acceptance/adoption, Jeyaraj, Rottman, and Larcity (2006) identified at least 10 theories that had been proposed between 1983 and 2003. In addition, these authors reported 135 independent and 8 dependant variables in their review. In recent years, researchers have adapted some of these theories to investigate their capabilities in understanding technology acceptance of users in education (e.g., Hammond, 2011; Teo, 2009; Teo, Koh, & Lee, 2011). Of these theories, the technology acceptance model (TAM) (Davis, 1989), the theory of planned behaviour (TPB) (Ajzen, 1991), and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh Morris, Davis, & Davis, 2003) have received much attention and been widely applied and tested in educational contexts with students and teachers as user groups.

In any school, teachers play a key role in the effective integration of technology for teaching and learning. Teachers decide on the type, frequency, and quantity of technology tools they use in their curriculum design and lesson delivery. Although it may appear that technology integration is part of their job description, teachers exercise complete volition over their intention and actual usage of technology within their professional space (Yang & Huang, 2008). With rapid advancements in technologies, there is greater pressure on teachers to engage with various types of tools in conceptualising, preparing, and delivering their lessons. In addition, with covert expectations from their increasingly technology-savvy students, teachers may feel that engaging technology in the instructional process as an option that they cannot exercise (Teo, 2013).

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Despite the significant role of technology in effective instruction, there is evidence to suggest that teachers had lacklustre responses towards using technology for teaching and learning in many parts of the world (Zhao & Cziko, 2001). For example, Becker (2001) found that teachers in the United States were not regular users of the computer for teaching and, when they did, the computers were used for low-level purposes such as games and drills in the classroom. In the United Kingdom, BECTA (2004) found that teachers cited a lack of technical support, their own lack of confidence, and a lack of belief in the advantages of using technology for instruction as some of barriers they faced in achieving technology integration in the classroom. In Australia, Birch and Burnett (2009) cited a lack of clear institutional direction concerning course design and delivery time as major issues teachers have to cope with in the development of e-learning environments. From the literature, an individual's acceptance of technology here is referred to as the level at which he or she is willing to use the technology for its intended purpose (Teo, 2010).

Many acceptance studies have found various factors that explain users' technology acceptance. These included personal factors such as: attitudes towards using computers (Teo, 2009); perceived enjoyment thereof (Teo & Noyes, 2011); emotional attachment (Read, Robertson, & McQuilken, 2011); technical factors such as technological complexity (Thong, Hong, & Tam, 2004); and environmental factors such as facilitating conditions (Venkatesh, Brown, Maruping, & Bala, 2008).

1.1. Theoretical background

From the literature, the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), the theory of planned behaviour (TPB) (Ajzen, 1991), the technology acceptance model (TAM) (Davis, 1989), and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) have been widely reported to be effective in predicting acceptance among users in non-educational settings. Some applications of these models/theories are found studies examining user's acceptance of broadband Internet (Oh, Ahn, & Kim, 2003), Internet Banking (Cheng, Lam, & Yeung, 2006), e-shopping (Shih, 2004), and online tax services (Wu & Chen, 2005).

In the TRA, behaviour is posited to be determined by an individual's intention to perform the behaviour and 'intention' is a function of that person's attitude towards the behaviour and his or her 'subjective norm' (Ajzen & Fishbein, 1980). While 'attitude towards behaviour' refers to the amount of pleasure a person derives from performing a behaviour, subjective norm is defined as the extent to which an individual is motivated to comply with the views others hold about that behaviour. The TPB is an extension of the TRA, which includes perceived behavioural control. It is defined as the factors that influence a person's perception of how easy or difficult it would be to perform a behaviour (Ajzen, 1991).

The TAM was proposed by Davis (1989) with an express desire to explain a user's level of technology acceptance. In the TAM, actual technology use is determined by one's behavioural intention to use a particular technology. Behavioural intention is affected by attitude towards usage, and by the direct and indirect influences of perceived usefulness and perceived ease of use. Both perceived usefulness and perceived ease of use jointly affect attitude towards usage, whereas perceived ease of use has a direct impact on perceived usefulness (Davis, 1989). Having reviewed the above and five other models of technology adoption, Venkatesh et al. (2003) proposed the UTAUT to explain users' intentions to "use technology and subsequent usage behaviour". This theory relies on four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) to predict both usage intention and behaviour.

Considering the evidence drawn from empirical studies that employed the above theories and models, Teo (2010) developed a model depicting technology acceptance as a multidimensional construct comprising five factors: perceived usefulness; perceived ease of use; attitude towards technology use; subjective norm; and facilitating conditions. Using confirmatory factor analysis, these five factors were found to be valid in explaining pre-service teachers' technology acceptance. This was in alignment with Teo (2009) who, using structural equation modelling, found that pre-service teachers' intention to use technology could be explained by six factors: perceived usefulness, perceived ease of use, attitude towards computer use, computer self-efficacy, technological complexity, and facilitating conditions ($\chi^2 = 223.373$; $\chi^2/df = 2.127$; CFI = .971; TLI = .958; SRMR = .043; RMSEA = .049). Following on from this, Teo (2011) modelled in-service teachers' intention to use technology with five constructs: perceived usefulness, perceived ease of use, attitude towards computer use, subjective norm, and facilitating conditions. The results revealed a well-fitting model which suggested that the above constructs were significant contributors in explaining in-service teachers' intention to use technology. From the above literature, seven constructs that have been shown to be adequate in predicting pre-service and in-service teachers' technology acceptance (Table 1) are included in the research model in this study (Fig. 1).

1.2. Pre- and in-service teachers' acceptance of technology

While many have examined the acceptance (or intention to use technology) of pre-service (e.g., Teo, 2012; Teo & Noyes, 2014) and in-service teachers (e.g., Teo, 2014; Wong, Teo, & Russo, 2012) separately, few have examined these two teacher groups simultaneously. Of

Table 1
Constructs and their operational definitions.

Construct	Operational definition
Perceived usefulness	The degree to which one believes that using technology would enhance his or her job performance (adapted from Davis, 1989).
Perceived ease of use	The degree to which one believes that using technology would be free of effort (adapted from Davis, 1989).
Attitude towards technology use	The extent to which one possesses positive feelings about using technology (adapted from Fishbein & Ajzen, 1975).
Subjective norm	The extent to which one perceives that most people who are important to him think he should or should not use technology (adapted from Fishbein & Ajzen, 1975)
Facilitating conditions	The extent to which one believes that factors in the environment influence his or her decision to use technology (adapted from Thompson, Higgins, & Howell, 1991)
Computer self-efficacy	The extent to which one believes one is capable to use the computers (adapted from Compeau & Higgins, 1995)
Technological complexity	The degree to which technology is perceived as relatively difficult to understand and use (adapted from Thompson et al., 1991)