

Extending the Technology Acceptance Model to Account for Social Influence, Trust, and Integration for Pervasive Computing Environment: A Case Study in University Industri Selangor

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ABSTRACT

The aims of this study are to develop ubiquitous computing environment using Bluetooth (UCEB) and measure the validity and reliability on in order to support student admission services in Universiti Industri Selangor (UNISEL). This study is based on the descriptive survey research using revised Technology Acceptance Model (TAM), known as Pervasive Technology Acceptance Model (PTAM). This research involved all the aspects of PTAM which are namely perceived usefulness, perceived ease of use, social influence, trust, integration, attitude, behavioral intention and actual use towards using the UCEB. A total of 111 respondents were selected as a sample for this study. This research is also conducted on the same respondents to find out the user acceptance on UCEB to support student admission services. The respondents were the academic committees consist of students, academicians and non-academician of UNISEL. A questionnaire was used to collect information from the respondents based on Likert scale to measures the extent to which a person agrees or disagrees with the question. The quantitative data were analyzed using SPSS system to produce statistical inference for Pearson correlation test.

Keywords

Technology Acceptance Model (TAM), Pervasive computing environment

1.0 INTRODUCTION

The whole world is going mobile. Phones, computers, and media devices now fit in our pockets and can connect us to a variety of information sources and enable communication nearly everywhere we go. There is considerable interest in exploiting the almost universal

appeal and abundance of these technologies for the educational use. With respect to the technologies, 'mobile' generally means portable and personal, like a mobile computers, including devices such as handheld computers, mobile gaming devices, and cell phones.

Handheld computers, the devices used in this study, are roughly the size of a small calculator, easily portable, resemble computers in that they have an operating system and software applications, and often depend on a touch screen for user input.

Initial evaluation reports and academic research have yielded baseline data that indicate that a large majority of teachers across subject areas considers handhelds to be effective tools in the classroom, and believes that they can have a positive impact on student learning, especially because it is more realistic now than ever to attain a 1:1 computer to student ratio (Soloway et al., 2001; Vahey & Crawford, 2002; van 't Hooft, Diaz, & Swan, 2004).

2.0 PERVASIVE COMPUTING

Pervasive computing embeds computing and information technologies into our environments by integrating them seamlessly into our everyday live. For over fifteen years, there has been work on novel technologies, infrastructures and applications under the heading of pervasive computing. While design has flourished in this domain resulting in entirely new areas such as *calm technology*, *tangible computing*, and *context-aware computing*, evaluation of pervasive computing has struggled because of the inherent challenges posed by evaluating systems that are designed to be *woven into the fabric of our everyday lives*. Traditional evaluation techniques such as laboratory studies allow researchers to study and refine

specific aspects of a design (such as an interface), but are not satisfactory for evaluating a technology's actual use in real life over time. In a laboratory, it is impossible to reproduce the richness of everyday life where unexpected events occur that can affect a person's interaction with a particular system [18]. For example, when evaluating a system that automatically turns off a cell phone ringer depending on the context of the receiver, it is difficult to reproduce all factors that would affect a user's experience with the system, such as who is calling, why they are calling, what the receiver is doing, the other people in the vicinity.

To compensate for these problems, many researchers have turned to *in-situ* evaluation, where participants interact with the system during their normal lives over a period of time. Researchers utilize techniques such as experience sampling, cultural probes, observations, recall diaries, logs, questionnaires and interviews to obtain both qualitative and quantitative data about user experiences. In-situ evaluations tend to be resource intensive and of short duration (i.e. a few days or weeks). Indeed, many in-situ studies utilize prototypes that are difficult to deploy for any length of time because portions of the system rely on non-existent infrastructure and must be simulated.

While both laboratory and in-situ studies provide valuable information during the design phase, neither currently provides insight into user acceptance and usage after the initial novelty wears off. Since the majority of proposed pervasive computing applications rely heavily on infrastructure that is not yet widely available, understanding long-term usage and acceptance is of utmost importance for determining if a technology/application is worth the required investment. Yet performing such an evaluation is difficult before the necessary infrastructure is available. The problem, then, is circular, requiring an evaluation to justify the necessary infrastructure investment and requiring the infrastructure to perform such an evaluation. Thus, a technique for predicting long-term usage after minimal exposure to a prototype system is needed to help direct researchers and industry towards those technologies with the most chance of gaining user acceptance.

2.1 Origins of Technology Acceptance Model

Research into factors that predict Information Technology (IT) acceptance has received much attention because a major goal for many organizations is IT adoption and use (Money & Turner, 2004). The Technology Acceptance Model (TAM) is one such research model. Fred Davis developed TAM in the mid - 1980s under contract with IBM Canada to evaluate the market potential and product development for emerging personal computer - based applications in the areas of multi - media, image processing, and pen - based computing (Davis & Venkatesh, 1996). TAM is specifically designed to study IT - adoption and use, and to predict and explain user acceptance of information technologies (Davis, 1993; Morris & Dillon, 1997). With TAM, researchers and

practitioners can identify why a particular system may be unacceptable to the users, and pursue appropriate corrective steps (Davis, Bagozzi, & Warshaw, 1989).

TAM has origins in the Theory of Reasoned Action (TRA), articulated by Fishbein and Ajzen in 1975 (Davis, 1993; Davis et al., 1989; Morris & Dillon, 1997). TRA is a model from social psychology, which is concerned with the determinants of consciously intended behaviors. TRA postulates that intentions to perform a behavior are a function of two basic determinants, one personal (attitude toward the behavior) and the other reflecting social influence (subjective norms). Subjective norms are defined as the person's beliefs that specific individuals or groups approve or disapprove of performing the behavior (Roberts & Henderson, 2000). TRA posits that people would perform a specific behavior such as using computers, if they believe that it would lead to positive outcomes associated with using them (Compeau & Higgins, 1995). The behavioral intentions to use actually lead to actual system usage.

TAM has deep roots from a wide variety of theories such as the adoption of innovations, the cost - benefit paradigm, expectancy theory, and self - efficacy theory (Davis, 1989). The main goal of TAM is to provide an explanation of the determinants of computer acceptance and user behavior across a broad range of end - user computing technologies and user populations (Davis, 1989; Davis, 1993; Davis et al., 1989). Original Technology Acceptance Model (TAM) posits that system design characteristics, quality of the system, and training are among the external stimuli (variables) about which the user formed certain cognitive responses (Davis, 1993; Davis et al., 1989; Davis & Venkatesh, 1996). These responses are perceived usefulness and perceived ease of use of the system; and they are of primary importance and relevance for computer acceptance behaviors (Davis et al., 1989):

Perceived usefulness (PU) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context.

Perceived ease of use (PEOU) refers to the degree to which the prospective user expects the target system to be free of effort.

Further, PEOU also has a causal effect on PU, and factor analyses suggest that PU and PEOU are statistically distinct dimensions (Davis et al., 1989). The two variables PU and PEOU are, in turn, predicted to be linked to the affective response that is the attitude (A) toward the use of the system and to behavioral intention (BI), and ultimately the actual user behavior: use of the system or rejection of the system (Davis et al., 1989). In addition, TAM also proposes a direct relationship between perceived usefulness and the behavioral intention to use

(Morris & Dillon, 1997). System acceptance is defined by researchers as the potential user's predisposition toward personally using a specific system, and system acceptance leads to system usage (Davis, 1993; Davis et al., 1989; Morris & Dillon, 1997). The ultimate objective of TAM is to measure and explain the system usage behavior. (Davis et al., 1989; Legris, Ingham, & Colletette, 2003). TAM posits that the influences of external stimuli are mediated through PU, PEOU, and BI leading to performance of the behavior: actual system usage. See Figure 1.0 for a visual representation of Davis' (1989) TAM.

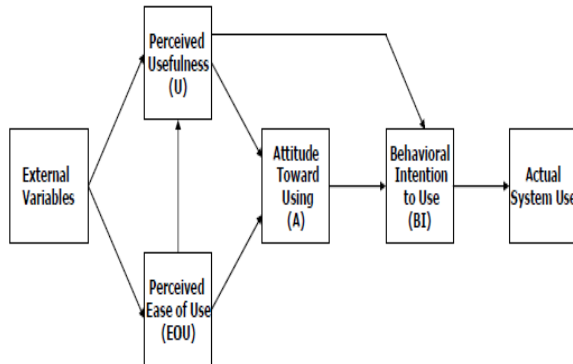


Figure 1.0: Original Technology Acceptance Model

The causal chain linking external variables to actual use via the mediating variables namely perceived ease of use, perceived usefulness, attitude toward using, and behavioral intention to use.

2.2 Revised Technology Acceptance Model: Pervasive Technology Acceptance Model (PTAM)

With technologies becoming pervasive in our lives, both at work and at play, there is a need to extend technology acceptance models to account for this broader domain and user group. Pervasive computing moves away from the traditional desktop model of computing towards having technology embedded in the environment. Pervasive computing environments differ significantly from traditional workplace and academic settings in several ways: studied in other user acceptance models. The constructs have not previously been studied in a model.

2.2.1 Social Influence

Kelman's study of **social influence** was motivated by his interest in understanding the changes brought about in individuals' attitude by external inputs, such as information communicated to them. Specifically, his research attempted to understand if the change in attitude resulting from external stimuli was a temporary superficial change or a more lasting change that became integrated in the person's value system. He suggested that changes in attitudes and actions produced by **social** influences may occur at different "levels." In his view, the nature or level of changes that took place correspond to

differences in the *process* whereby the individual accepts **influence** (or "conforms"). In other words, the underlying processes in which an individual engages when he adopts induced behavior may be different, even though the resulting overt behavior may appear the same.

Kelman distinguished between three different processes of **social influence** that affect individual behavior: compliance, identification, and internalization. *Compliance*: when an individual adopts the induced behavior not because she believes in its content but with the expectation of gaining rewards or avoiding punishments. *Identification*: when an individual accepts **influence** because she wants to establish or maintain a satisfying self-defining relationship to another person or group. *Internalization*: when an individual accepts **influence** because it is congruent with her value system.

2.1.2 Trust

Pervasive computing introduces an entirely new set of issues related to trust. First, pervasive computing environments often gather very intimate and personal data about its users. Indeed, many pervasive computing applications rely on gathering information about a user's physical and social context. Trusting the system to keep that information confidential and not to abuse it is an aspect of trust that must now come to the fore.

Second, the applications studied in the MIS domain have been relatively simple, static applications that behave according to users' expectations (once trained). Many pervasive computing applications, however, attempt to tailor their behavior based on the context of the user and physical environment, resulting in behavior that is not always predictable. An application that does not behave as a user expects causes the user to believe the application is not functioning properly. Thus, the notion of trusting an application to behave a certain way may play into user acceptance.

2.2.3 Integration

Pervasive technologies are no longer situated on the desk, but are embedded in the environment around us requiring interactions as we go about our daily lives. It is essential for a model to account for how well the technology is integrated into our lives. A person may reject a technology if it unduly distracts from or interferes with their other activities.

3.0 RESEARCH DESIGN

The research uses two phases in doing this research. The first phase is the development of Ubiquitous Computing Environment using Bluetooth (UCEB). This new system will be set up in selected place in the UNISEL. The second phase of this research is survey on this system implementation.

This research is based on the descriptive survey research. Meaning that researcher need the information from the people. The population chosen for this study is members of the academic community who are involve in student admission system. However, the researcher has chosen the Universiti Industri Selangor (UNISEL) as the target population for the study. This is due to the fact that from the researcher's observation, this institution has an online student admission system compare to any other institution. Besides that, the reason why this institution are chose is simply because the researcher is actually teaching in this institution and therefore knows the institutions well.

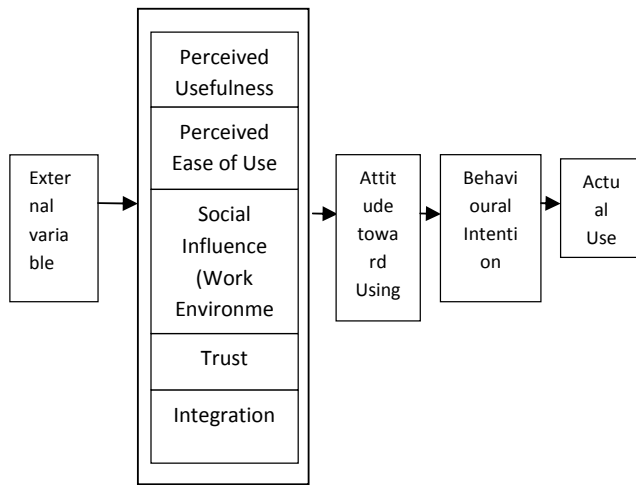


Figure 2: Proposed Pervasive Technology Acceptance Model

In order to obtained information for this study, a questionnaire was used. The questionnaire will be distributed to all respondents concerned through their respective lecturer who is academic advisor. The set of questionnaires will be delivered personally by the researcher to all the head of faculty so that these questionnaires can then be distributed to all the respondents through their respective academic advisors. Each respondent is given one week's grace to complete these questionnaires. Upon the estimated time frame, the researcher will personally collect all the questionnaires that have been sent out. This done to simply make sure that all the questionnaires were returned accordingly and within the stipulated time frame.

A total number of 110 respondents were selected as a sample. In addition to this, an experimental research is conducted on the same respondents to find out the user acceptance on UCEB to support student admission services. The respondents were the academic committee. The academic committees are student, academician and non academician in UNISEL which have the handheld devices embedded with the Bluetooth technology. The responses from the respondents were very good. The

researcher received 90 percent responses from the respondents.

4.0 FINDINGS BASED ON CORELATION ANALYSIS

According to G Darren and M. Paul (2006) stated that a correlation is often called a bivariate correlation to designated a simple correlation between two variables, as frequently observed in multiple regression analysis or structural equation modelling. A correlation is also frequently called the Pearson product –moment correlation or the Pearson. According to Karl S. Pearson has credited on the assumption that two variables involved are approximately normally distributed, the formula often performs well even when assumptions of normality are violated or when one of the variable is discrete. The Pearson correlation analysis is used to analyse the relationship between the variables as shown on the chart 1.0

The variables include Score A that there will be a positive relationship in perceived usefulness towards using the system, Score B that there will be a positive relationship in perceived ease of use towards using the system, Score C that there will be a positive relationship in social influence towards using the system, Score D that there will be a positive relationship in trust towards using the system, Score E that there will be a positive relationship in integration towards using the system, Score F that there will be a positive relationship in behavioral intention towards using the system, Score G that there will be a positive relationship in attitude towards using the system and finally Score H that there will be a positive relationship in actual use towards using the system.

According to the correlation analysis, it is found that Score A perceived usefulness towards using the system has a positive relationship between Score B that is perceived ease of use towards using the system, Score C that is social influence towards using the system, and Score F that is behavioral intention towards using the system at 1% significant level. Whereas Score A has a positive correlation with Score E that is integration towards using the system at significant level of 5%. Score D that is trust towards using the system, and Score G that is attitude towards using the system has a weak positive correlation with Score A and finally Score H that is the actual use towards using the system has a weak negative relationship towards Score A perceived usefulness.

Among all the factors that are being tested on the relationship towards perceived usefulness of using the system, we identify that perceived ease of use has strongest association with perceived usefulness towards using the system that is 40.2% as compared to social influence 29.4%, and behavioral intention 28.4%.

Test on association with Score B perceived ease of use, it is found that Score B has a positive correlation with

factors such as Score C social influence towards using the system 38.5%, Score D trust towards using the system 24.9%, and Score E integration towards using the system 28% at alpha of 1%. Score F that is behavioral intention towards using the system, has a positive correlation with Score B while Score H that is the actual use towards using the system has a weak negative correlation at 5% level of significant. Score G that there will be a positive relationship in attitude towards using the system and finally Score H that there will be a positive relationship in actual use towards using the system.

When it comes to the relationship between Score C Social Influence and Score E that is integration towards using the system, it is found that there is a strong positive correlation 55.5% and Score F that is behavioral intention towards using the system 3.6% significant at 1%, Score D trust towards using the system and Score G attitude towards using the system has a positive relationship with Score C and finally Score H the actual use towards using the system has a weak negative correlation with Score C

Score D that is trust towards using the system has a weak positive relationship with Score E integration towards using the system, Score F the behavioral intention towards using the system, Score G the attitude towards using the system and Score H the actual use towards using the system.

As for Score E the integration towards using the system is significantly correlated with Score F the behavioral intention at 5% level. Score G the attitude towards using the system and Score H the actual use towards using the system has a weak positive and weak negative relationship respectively with Score E.

Score F the behavioral intention towards using the system has a weak positive relationship with Score G, attitude using the system and Score H the actual use towards using the system.

Last but not least, Score G which is the attitude towards using the system also has a weak positive correlation against Score H the actual use towards using the system.

5.0 CONCLUSION

There is no doubt that technological change brings about social change. It is obviously that computers appear to be everywhere today. By examining the Pearson correlation, it is found that social influence has the highest value in correlation when it relates to the integration towards using the system that is 55.5% at 1% significant level. There is a positive relationship as well between perceived usefulness and perceived ease of use towards using the system, 40.2%. The third highest value in relationship that is 38.5% is between perceived ease of use towards using the system and social influence in using the system. With

these results, we can conclude that computer acceptance and user behavior across a broad range of end - user computing technologies and user populations has a greater impact when it comes to the relationship with social influence.

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