**Diffusion Innovation, Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology**

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**Abstract**

In recent years, more and more people have various information technology products of their own such as e-Portfolio system, notebook, laptop, PDA, mobile phone etc. Valid measurement scales for predicting user acceptance of computers are in short supply. Most subjective measures used in practice are invalidated, and their relationship to system usage is unknown. The present research develops and validates new scales for three specific variables, perceived usefulness and perceived ease of use, diffusion innovation, which are hypothesized to be fundamental determinants of user acceptance. Therefore, this research, which chooses college student as subject, aims to meet students’ urgent need to have a thorough information technology. This research utilizes Innovation Technology Acceptance Model (ITAM) to research college students’ acceptability to information technology, and collect out data through questionnaire. Definitions for these three variables were used to develop scale items that were pretested for content validity and then tested for reliability and construct validity in three studies involving a total of 100 users and four application programs. The measures were refined and streamlined, resulting in six-item scales with perceived usefulness and information technology is plus ($\gamma=0.96$, $p>0.1$); that of perceived ease of use and information technology is plus ($\gamma=0.16$, $p<0.1$); that of compatibility and information technology is also plus ($\gamma=0.15$, $p<0.1$). Regression analysis suggest that perceived ease of use may actually be a causal antecedent to perceived usefulness, as opposed to a parallel, direct determinant of system usage. Implications are drawn for future research on user acceptance.

**Keywords:** User acceptance, User measurement, Technology Acceptance Model, Diffusion of Innovation Theory

1. **Introduction**

Telecommunication has gradually changed the way of people’s lifestyle; traditional lifestyles and work mode have been superseded by the more flexible ones, such as mobile office, hotel, satellite office, work center etc. In the U.S., where it is first adopted by enterprises, telecommunication-based work mode is at present estimated
to be used by 25,000,000 work forces. While in Taiwan, telecommunication-based office is rather new, and is now adopted by enterprises such as HP, IBM, Xerox and CPC. Other enterprises such as Taiwan Business Consulting implements e-Office, while Sun building Flexible-Office. Several researches have been done on information technology, but few of them go further to discuss teenagers’ intention of using the systems and how acceptable to them. Thus in this research we adopt ITAM to discuss and analyze the factors affecting teenagers’ use of information technology. We take the students of N school as the object of study, using questionnaire to collect the data to study the factors influencing teenagers’ intention of using information technology.

In the face of information-mobilization trend, the need of a well-developed information technology service is rather urgent. However, a systematic research project on information technology is not yet done, and this fact will leave the users and to-be users of it high-and –dry. In the light of this, our project, based on the Innovation Diffusion Theory of Rogers (1981), alongside with Technology Acceptance Model, will discuss “information technology” — a newly-arrived technique, with environmental, organizational and personal factors, respectively. Special attention will be paid on the practicum of information technology so as to satisfy the learning activity of individual, organization, or even the whole society. By doing so, we hope to establish a well-formed strategy that benefits school teaching and development, campus management.

The primary subject of the project is college student, and the focus of information technology will be on school subjects. Due to limited staff, funds, time, the willingness of the respondents etc., this study cannot adopt random sampling. The remainder of the study is organized as follows. Section 2 introduces the related literature. The concept ITAM is developed in Section 3. Section 4 presents the performance study. Section 5 discusses the issues and points out some future research plans.

2. Literature Review

2.1 Technology Acceptance Model

In the TAM model, Davis (1989) proposed that the influence of other variables on technology acceptance is mediated by two individual beliefs: perceived ease of use (PEOU) and perceived usefulness (PU). The actual system usage is determined by the
users’ behavioral intention (BI), which is jointly determined by the users’ attitudes towards using the system and their perceived usefulness of the system. In order to predict and explain teenagers’ telecommunication technology using behavior, it is Theory of Reasoned Action (TRA) to make it suitable for situations of using information technology (Ajzen&Fishbein, 1980). The adapted theory, technology acceptance model (TAM), effectively simplifies TRA. It also focuses on analyzing variables influencing teenagers’ orientation towards information technology and explaining it. Since TAM is based on TRA, it brings further TRA’s hypothesis about individual behavior, presuming that individual behavior is a result of free will and careful consideration of possible consequences. However, TAM does not adopt the concept like “normative beliefs and motivation to comply” and “subjective norm”. Instead, according to the concerning documents, it presumes that belief-attitude-intention is affected by “perceived usefulness” and “perceived ease of use”.

The conciseness of TAM was generally approved of by scholars, but it is in fact insufficient for full understanding of teenagers’ telecommunication technology using behavior if only discussing “normative beliefs and motivation to comply” and “subjective norm”. If other variables are taken into account, the explanation would be easier. Therefore, in this research we adopt TAM and Theory of Diffusion of Innovation as a way to understand teenagers’ orientation towards information technology.

2.2 Diffusion of Innovation

Rogers (1981) defines diffusion as "the process by which an innovation is communicated through certain channels among the members of a social system." Four vital factors are included in the definition: Innovation, communication channels, time and social system. In the process of diffusion, new information is constantly brought to potential users, so at different stages of the process, variables are different, too. At “knowledge” stage, the primary variables are decision unit. Decision unit refers to the prior experience of adopting innovation, problems confronted at present, needs for solution, and the attitude towards innovation of the potential user, as well as social norms and views towards the innovation. At “persuasion” stage, Rogers has five innovation perception features, and argues that “persuasion” stage is mainly affected by these five features. The five features are respectively Relative advantage, Compatibility, Complexity, Absorbability and Trialibility. TAM also lays much emphasis on similarity. Rogers defines similarity as something the innovators and
potential users share, for example goals, strategy, norms, beliefs and culture. Many research results indicate that between two or more units that share similar traits, diffusion of innovation processes at great speed, since they are most likely to share Relative advantage, Compatibility, Complexity, Operability and Trialibility. Rogers’ model and innovation perception features are widely used by scholars, for example in information technology or telecommunication construction and development.

In Rogers’ theory, primary variables influencing individual adopting innovation are Relative advantage, Compatibility, Complexity, Observability and Trialibility. “Relative advantage” is the same concept as “perceived usefulness” in TAM, while “Complexity” and “perceived ease of use” are two different extremes on the same scale. Trialibility is not included in information technology. Therefore, in this paper, we will only focus on “Compatibility”. In this section some documents concerning TAM and Theory of Diffusion of Innovation will be discussed as a base for further analysis of variables influencing teenagers’ orientation towards information technology.

3. Methodology

In this section we will elaborate on the research structure, research hypothesis, reliability examination and Structural Type Model. In this research we adopt TAM and Theory of Diffusion of Innovation to discuss and analyze the factors affecting teenagers’ use of information technology. We take the students of school N as the object of study, use questionnaire to collect the data, and study the factors influencing teenagers’ intention of using information technology. The Statistical Analysis Systems which been used in this project are SAS and LISREL. In the following, we will explain more about the hypothesis, questionnaire source, and methods of statistical analysis. The questionnaire is designed according to the documents and information technology environments. The data are shown in figure 1.

![Innovation Technology Acceptance Model](image)
As for research subject and research method, we distribute 100 questionnaires to teenage students who use information technology in school N, and retrieve 100 questionnaires.

The central theme of the above studies is that the design of an online course directly or indirectly affects learning efficiency. Therefore, in this research, we discuss the relationship between Online Course Design and Perceived Usefulness, Perceived Ease of Use, and Perceived Interaction individually. Every variable is scaled according to Likert Scale, from “strongly disagree” to “strongly agree”. The research hypothesis is explained in the following:

H1. Online Course Design will positively affect the Perceived Usefulness of an information technology.
H2. Online Course Design will positively affect Perceived Ease of Use of an information technology.
H3. Online Course Design will positively affect Compatibility with an information technology.

In this project, Cronbach’s α value is used to analyze reliability. The coefficient of reliability is as suggested by Hair (1998), sufficient if α value is above 0.6, so is it in researches in exploration stage. If α value is below 0.3, it should be deleted to maintain reliability. The α value of teenager using information technology is 0.8; perceived usefulness and compatibility 0.7, as shown in table1. In terms of individual item reliability, when Square Multiple Correlations is above 0.5, it is reliable. Reliability analysis of every aspect is shown in table 2.

<table>
<thead>
<tr>
<th>Table1. Reliability examination</th>
</tr>
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<tbody>
<tr>
<td>Variable number</td>
</tr>
<tr>
<td>Users’ behavioral intention</td>
</tr>
<tr>
<td>Perceived usefulness</td>
</tr>
<tr>
<td>Perceived ease of use</td>
</tr>
<tr>
<td>Compatibility</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Reliability analysis of every aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Y1</td>
</tr>
<tr>
<td>Squared Multiple Correlations</td>
</tr>
</tbody>
</table>
4. Experiments and Discussion

4.1 The Development and Construction of Structural Type Model

In this project we rely on LISREL (Joreskog&Sorbom, 1993) to examine research hypothesis. There are two major variables in LISREL analysis mode, which are observed variables and latent variable. Latent variable can be further divided into exogenous variable, represented by $\xi$, and endogenous variable, represented by $\eta$. Equation models can also be divided into two types: measurement model and structural equation model. Measurement model is used to define the relation between observed variable and latent variable, while structural equation model is used to represent relations between latent variables. LISREL can make precise inference about the intensity between variables. We use the statistics shown by ISREL to observe the cause-and-effect relation between the latent variables and observed variables.

In LISREL Scale, perceived usefulness, perceived ease of use and compatibility are exogenous variables. The coefficient between exogenous variable and observed variable is represented by Lambda X ($\lambda_x$). The using attitude of information technology is latent variable, and the coefficient between latent variable and observed variable is represented by Lambda Y ($\lambda_y$). Structural Type Model is the perceived usefulness, perceived ease of use and compatibility influence intensity of teenager’s using information technology, represented by Gamma ($\lambda$). The theory model set in this project. The latent variables are marked by oval shaped line, while observed variables rectangle shaped lines.

4.2 Analysis Result

In terms of Structural Type Model, this project uses ($\chi^2$/df), GFI, AGFI, NFI, NNFI, CFI and RMSR as indexes from which to judge if the model correspond to observed data. Since $\chi^2$ is highly sensible, we decide to use $\chi^2$/df as evaluation index. AGFI is a value adapted from GFI, and they are used to explain the amount of variation. RMSR is used to evaluate unexplained variation rate. NFI (Bentler&Bonett, 1980), NNFI and CFI (Bentler, 1990) are used to evaluate this evaluation structure and Null model’s improvement. As for the standard of the indexes, we adopt the judging indexes suggested by Henry and Lacker(1994) to see if the evaluation model is suitable, and it is shown in figure 2 that the overall suitability value of $\chi^2$/df are both 1.2, RMSEA 0.0724, GFI 0.961, and AGFI 0.912, all of which are close to the ideal value. It means that the evaluation result correspond to the real situation. The indexes
and their minimum value are shown in table 3.

<table>
<thead>
<tr>
<th>Index</th>
<th>( \chi^2/df )</th>
<th>RMSEA</th>
<th>GFI</th>
<th>NFI</th>
<th>AGFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>48.98/35=1.2</td>
<td>0.0724</td>
<td>0.961</td>
<td>0.947</td>
<td>0.912</td>
</tr>
<tr>
<td>Threshold</td>
<td>&lt;3</td>
<td>&lt;0.08</td>
<td>&gt;0.9</td>
<td>&gt;0.9</td>
<td>&gt;0.9</td>
</tr>
</tbody>
</table>

We can see from the path coefficient shown in table 4 that that of perceived usefulness and information technology is plus \( (\gamma_{11}=0.96, p>0.1) \); that of perceived ease of use and information technology is plus \( (\gamma_{12}=0.16, p<0.1) \); that of compatibility and information technology is also plus \( (\gamma_{13}=0.15, p<0.1) \). It is important to note that the indirect effect on attitude through perceived ease of use and Compatibility is significant. As a result, H2 and H3 are supported but H1 is rejected.

<table>
<thead>
<tr>
<th>Path</th>
<th>Item</th>
<th>Path parameter ( a )</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma_{11} )</td>
<td>Online Course Design will positively affect the Perceived Usefulness of an information technology</td>
<td>0.96</td>
<td>4.36</td>
</tr>
<tr>
<td>( \gamma_{12} )</td>
<td>Online Course Design will positively affect Perceived Ease of Use of an information technology.</td>
<td>0.16</td>
<td>1.77*</td>
</tr>
<tr>
<td>( \gamma_{13} )</td>
<td>Online Course Design will positively affect Compatibility with an information technology.</td>
<td>0.15</td>
<td>2.48*</td>
</tr>
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</table>

*p<0.1

5. Conclusions

The relation between perceived usefulness and information technology using attitude is positive, which means high perceived usefulness gives teenagers an incentive to use information technology.

This fact corresponds to what is recorded in the documents. It is probably because information technology helps teenagers communicate with each other at anytime and anywhere, thus having great influence on their using attitude. The relation between perceived ease of use and information technology is negative, meaning that high perceived ease of use cannot guarantee teenager’s high willingness towards using information technology, which is against the documents. It is probably because the difficulty of operating or using information technology is not an obstacle intimidating teenagers. The relation between compatibility and information technology is negative,
meaning that high compatibility cannot guarantee teenager’s high willingness towards using information technology, which is against the documents. It is probably because the functions teenagers use are limited, and so the compatibility is not so important to them. Further research will shed more light on the generality of these findings. Another limitation is that the usage measures employed were self-reported as opposed to objectively measured.

References