Unanticipated Software Use by Adolescents Following Mandatory Adoption

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UNANTICIPATED SOFTWARE USE BY
ADOLESCENTS FOLLOWING
MANDATORY ADOPTION

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Abstract

This research proposes a model to predict unanticipated use of software by high school students after mandatory adoption. We define unanticipated use as voluntarily extending the use of a software product to new tasks and new settings after mandatory adoption for a specific task in a specific setting. We are basing our model on TAM2 (Venkatesh and Davis 2000), which is an extension of the original technology acceptance model (TAM) (Davis 1986). Typically, research in this area investigates technology acceptance in voluntary settings. However, a few studies have looked at acceptance in mandatory settings (Rawstorne et al. 2000). Our research involves actual behavior so we have removed the intention to use construct from the original TAM2 model. Due to the nature of our subjects and the educational setting, we have also removed the following original TAM2 constructs: output quality, voluntariness, and job relevance. We have added personal innovativeness in the domain of information technology (PIIT) (Agarwal and Prasad 1998) and computer self-efficacy (CSE) (Compeau and Higgins 1995).

1 INTRODUCTION

This study is based on an interesting observation regarding the unanticipated use of a software application, Geometer's Sketchpad® (GS), after it was required in a high school Geometry class. We define unanticipated use as voluntarily extending the use of a software product to new tasks and new settings after mandatory adoption for a specific task in a specific setting. Students at an all girls' private high school were observed using the software for other class assignments (i.e., Biology) and for tasks outside of school (i.e., landscape design).

This high school recently implemented a totally immersed technology curriculum. During the summer, entering ninth graders receive laptops, learn to set up and configure them, and install software applications required for their classes. Teachers are evaluated by the degree of technology immersion in their classes and lesson plans.

The faculty and administrators are interested in unanticipated software use because of their desire to help students learn to creatively solve problems using existing tools. We believe that helping educators understand factors that influence unanticipated technology use will assist in developing classroom strategies to encourage creative problem solving techniques through experimentation and extended use of existing software tools. We further believe that the development of effective strategies in the educational environment could be extended to training and educational programs in the business environment.
While this research appears new to MIS, the Education literature contains numerous studies about software adoption in classrooms and innovation. Rogers’ (1995) diffusion of innovations, self-efficacy, and CBAM (concerns based adoption model) are a few examples of the models and constructs used in such literature. (For additional information, please see Dumestre [1999], Hall et al. [1973], and Surry [1997], as well as proceedings from the Computer Supported Cooperative Learning and American Educational Research Association conferences.)

2 THEORETICAL FOUNDATIONS

Our initial investigation proposed a model (Figure 1) to predict unanticipated use of a software application by adolescents following mandatory adoption. We based our model primarily on the technology acceptance model (TAM) and its extension TAM2 (Davis 1986, 1989; Venkatesh and Davis 2000). Since this model is well known, and space is limited, we will not explain the constructs but refer the reader to the original authors. Our justifications for including many of the classic key determinants of technology acceptance and usage are more thoroughly described in an AMCIS research-in-progress paper (Singletary et al. 2002) and based on existing literature (Table 1).

Table 1. Literature Sources and Support for Retained TAM2 Constructs

<table>
<thead>
<tr>
<th>TAM2 Construct</th>
<th>Literature Source and Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results Demonstrability</td>
<td>• Venkatesh and Davis 2000&lt;br&gt;• Agarwal and Prasad 1998</td>
</tr>
<tr>
<td>Social Norms</td>
<td>• Venkatesh and Morris 2000&lt;br&gt;• Taylor and Todd 1995&lt;br&gt;• Hartwick and Barki 1994&lt;br&gt;• Mathieson 1991</td>
</tr>
<tr>
<td>Image</td>
<td>• Venkatesh and Davis 2000</td>
</tr>
<tr>
<td>Prior Computer Experience</td>
<td>• Rawstorne et al. 2000&lt;br&gt;• Igbaria and Livari 1995&lt;br&gt;• Robinson-Staveley and Cooper 1990</td>
</tr>
<tr>
<td>Perceived Usefulness (PU) and</td>
<td>• Venkatesh and Davis 2000&lt;br&gt;• Venkatesh and Morris 2000&lt;br&gt;• Davis 1989</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
<td></td>
</tr>
</tbody>
</table>

We chose to ignore some of the original TAM2 constructs for the following reasons:

Behavior intention/attitude—precedence for ignoring this construct exists in the literature (Lederer et al. 2000), the fact that initial software use is mandatory and that we are observing actual behavior.

Voluntariness—the original software use is mandatory and we believe experience during mandatory use influences unanticipated use.

Job relevance and output quality—ignored due to the educational setting, the youth and inexperience of the subjects in addition to the original mandatory use requirement.
Based on feedback from faculty and administrators, and our own observations, we included computer self-efficacy (CSE) (Compeau and Higgins 1995) and personal innovativeness in the domain of information technology (PIIT) (Agarwal and Prasad 1998) to our model.

**PIIT**—defined as the “willingness of an individual to try out new technology” (Agarwal and Prasad 1998, p. 206). Agarwal and Prasad differentiate between global innovativeness and domain specific innovativeness and conceptualize PIIT as a “relatively stable descriptor of individuals that is invariant across situational considerations” (p. 207). Research suggests that individuals with higher PIIT require fewer positive perceptions to accept a new technology than individuals who are less innovative, that higher levels of PIIT result in increased levels of technology use and experimentation, and that higher PIIT is positively related to the CSE of the individual (Agarwal and Prasad 1998).

**CSE**—defined as “an individual judgment of one’s capability to use a computer” (Compeau and Higgins 1995, p. 192). Research suggests that CSE is an important determinant in computer usage decisions and effective computer skill development (Compeau and Higgins 1995; Hill et al. 1987) although results vary. Igbaria and Iivari (1995) for example, did not find a significant direct relationship between self-efficacy and computer use or between self-efficacy and PU. Even though self-efficacy had no direct effects on computer usage, it had a strong indirect effect on usage through PEOU and PU.

Our proposed model is presented in Figure 2. We plan to test all paths indicated in the model (a total of 20 paths or hypotheses although four may be eliminated because PCE will not load using pilot data.)

We considered diffusion of innovation as an alternative underlying theory. According to this theory, relative advantage, compatibility, complexity, observability, and trialability can be used to explain the adoption and diffusion of IT innovations (Rogers 1995). Kwon and Zmud (1987) demonstrated that only compatibility, relative advantage, and complexity appear to be critical adoption factors. Moore and Benbasat (1991) identified similar characteristics to study the initial adoption and eventual diffusion of IT innovations within organizations by individuals.

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**Notes**

1. The shaded area is based on TAM2.
2. The boxes outside the shaded area have been added.
3. The dotted lines denote newly hypothesized relationships.

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**Figure 2. Proposed Model of Unanticipated Software Usage**
3 METHOD

The study is part of a multifaceted effort that has quantitative and qualitative components. This piece focuses on the collection of quantitative (survey) data to test our proposed research model. A survey instrument was created to measure unanticipated use and to test relationships between the constructs. Questions were primarily derived from previously tested survey instruments to take advantage of well-tested constructs (Straub 1989). We operationalized many constructs by modifying previously validated questions, as direct use of previous instruments was not possible. We created a few new questions based on literature concepts (e.g., some PCE and CSE questions). PIIT questions were taken from Agarwal and Prasad (1998). PU, PEOU, and results demonstrability (RD) questions were taken directly from TAM2 (Venkatesh and Davis 2000). Social norms (SN) questions were based on Taylor and Todd’s (1995) instrument.

We define usage behavior as normal use (required in geometry class) or unanticipated use if used for any purpose other than for class. Unanticipated use is self-reported data. We ask students if they use GS for non-Geometry classes and/or for non-school purposes.

We collected pilot data in April 2002 from seniors and revised the survey instrument as necessary. In September 2002, we plan to administer the questionnaire to all students who have completed Geometry. Also, in September 2002, we will supplement the quantitative results with qualitative information as suggested by Kaplan and Duchon (1988). The qualitative research should help us better understand the quantitative results and provide additional information such as why students chose to use GS for other purposes. We will collect the data in focus groups and create cognitive maps during interviews.

4 PRETEST AND PILOT STUDY

Five domain experts examined our initial survey for content and to ensure proper wording. These included people with expertise in methodology, questionnaire design, information systems, management, and statistics, as well as teachers and administrators of the high school. Changes were made based on feedback received. The pilot survey was administered on-line to twelfth graders, using WebSurveyor 3.6 software. We obtained 122 usable cases out of 175 students surveyed. Only one survey was rejected due to incomplete data. Pilot results were used to further validate the survey, using factor loading to determine if the constructs held for our population. We were particularly interested in validating newly created questions. Reliability and convergent and discriminant validity were tested.

5 PILOT TEST DATA ANALYSIS

Guidelines suggested by Hair et al. (1998), including missing data patterns, adherence to statistical assumptions, identification of outliers, skewness, and kurtosis, were used when analyzing the results. The psychometric properties of the measurement scales were acceptable. Based on pilot data, all factors exhibited satisfactory reliability (Table 2). Final survey results should improve due to questionnaire revisions and a larger sample size. Construct reliability was tested using Cronbach’s alphas, which ranged from .742 to .959 (PU had the highest score). Since an alpha value greater than 0.80 is considered acceptable in the MIS domain (Straub 1989), all construct reliabilities except for RD and CSE were deemed acceptable.

In this population, social norms and image were closely intertwined. We will combine them and rename the factor social norm/image. One PU question and two of the five newly created CSE questions would not load satisfactorily and were dropped. We assessed construct and discriminant validities by performing principal component factor analysis with varimax rotation. All items loaded on the appropriate factor with loading typically above .770 (greater than the recommended .500 minimum).

6 DISCUSSION

This study has limitations, as it is the first study to use the proposed model. Further validation studies are required. External validity may be limited to adolescents required to use software for a class who later use it in new and unanticipated ways and may be negatively impacted by the unique technology-immersed educational environment.

We plan to analyze the final data using structural equation modeling. The pilot provided statistical support for the proposed model and indicated that PIIT and CSE are important determinates of usage behavior.
Table 2. Principal Component Analysis: Varimax Rotated Component Matrix

<table>
<thead>
<tr>
<th>Question</th>
<th>Component</th>
<th>IM/SN</th>
<th>PU</th>
<th>PIT</th>
<th>PEOU</th>
<th>CSE</th>
<th>RD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Im/Sn1</td>
<td>.809</td>
<td>.321</td>
<td>-.027</td>
<td>.114</td>
<td>.189</td>
<td>.024</td>
<td></td>
</tr>
<tr>
<td>Im/Sn2</td>
<td>.807</td>
<td>.316</td>
<td>.000</td>
<td>.058</td>
<td>.058</td>
<td>.055</td>
<td></td>
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<tr>
<td>Im/Sn3</td>
<td>.787</td>
<td>.373</td>
<td>-.022</td>
<td>.094</td>
<td>.127</td>
<td>.049</td>
<td></td>
</tr>
<tr>
<td>Im/Sn4</td>
<td>.783</td>
<td>.103</td>
<td>.199</td>
<td>-.151</td>
<td>-.138</td>
<td>.017</td>
<td></td>
</tr>
<tr>
<td>Im/Sn5</td>
<td>.762</td>
<td>.008</td>
<td>.109</td>
<td>.018</td>
<td>-.110</td>
<td>.098</td>
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</tr>
<tr>
<td>Im/Sn6</td>
<td>.715</td>
<td>.360</td>
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<td>.111</td>
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<td>-.003</td>
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<tr>
<td>Pu1</td>
<td>.278</td>
<td>.911</td>
<td>.092</td>
<td>.010</td>
<td>.014</td>
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<tr>
<td>Pu2</td>
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<td>.117</td>
<td>.030</td>
<td>.060</td>
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<td>.022</td>
<td>.037</td>
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<tr>
<td>Pu4</td>
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<td>.801</td>
<td>.089</td>
<td>.110</td>
<td>-.027</td>
<td>.144</td>
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<td>Piit1</td>
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<td>.188</td>
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<td>.213</td>
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<td>.030</td>
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<tr>
<td>Piit3</td>
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<tr>
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<td>.177</td>
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<tr>
<td>Peou1</td>
<td>.078</td>
<td>.095</td>
<td>.113</td>
<td>.912</td>
<td>.104</td>
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<td>Peou2</td>
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<td>.868</td>
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<td>Peou3</td>
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<tr>
<td>Peou4</td>
<td>.030</td>
<td>-.095</td>
<td>.318</td>
<td>.541</td>
<td>-.370</td>
<td>-.117</td>
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<td>Cse1</td>
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<td>.129</td>
<td>.380</td>
<td>.043</td>
<td>.805</td>
<td>-.050</td>
<td></td>
</tr>
<tr>
<td>Cse2</td>
<td>.014</td>
<td>-.031</td>
<td>-.043</td>
<td>.123</td>
<td>.733</td>
<td>.035</td>
<td></td>
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<tr>
<td>Cse3</td>
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<td>.047</td>
<td>.451</td>
<td>.062</td>
<td>.687</td>
<td>.007</td>
<td></td>
</tr>
<tr>
<td>Rd1</td>
<td>.159</td>
<td>.021</td>
<td>.178</td>
<td>-.097</td>
<td>.035</td>
<td>.770</td>
<td></td>
</tr>
<tr>
<td>Rd2</td>
<td>-.064</td>
<td>.069</td>
<td>-.035</td>
<td>.087</td>
<td>-.164</td>
<td>.750</td>
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<tr>
<td>Rd3</td>
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<td>.472</td>
<td>.090</td>
<td>.100</td>
<td>.215</td>
<td>.695</td>
<td></td>
</tr>
<tr>
<td>Rd4</td>
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<td>.521</td>
<td>.071</td>
<td>.181</td>
<td>.169</td>
<td>.582</td>
<td></td>
</tr>
</tbody>
</table>

The completed study should add to the MIS literature regarding software usage in a mandatory situation. We believe it is one of the first MIS studies that investigates adolescents’ unanticipated software use after mandatory adoption. Identifying and understanding highly motivated individuals who expand their software use in new and unanticipated ways has clear implications for educators. Teachers can use this knowledge to develop strategies to encourage all students to experiment with technology and develop mechanisms that will increase the entire populations’ voluntary expanded use. We hope to combine the findings from both our qualitative and quantitative studies to identify factors that encourage students to experiment with technology. This should enable faculty to develop educational enrichment strategies that encourage all students to increase their experimentation and innovative use of information technology to facilitate creative problem solving.

7 REFERENCES


