Factors affecting student adoption of microblogging tools: A test of competing models

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ABSTRACT
As new technologies develop, educators explore the feasibility of using these technologies to improve learning. Microblogging is one such technology. Given the propensity of students to use microblogging sites such as Twitter, it is important to understand whether these technologies would be adopted by students for educational use. This study explores whether students will adopt twitter as a supplemental learning tool. The Technology Acceptance Model (TAM) has been used extensively to understand adoption but it has been criticized for being too parsimonious to generalize across gender and culture. An alternate model, the Unified Theory of Acceptance and Use of Technology (UTAUT) has since been proposed to address this failing. Hence, in this study, two competing models were tested using two samples: a sample of US students and a sample of female Qatari students. Hence, the study will not only inform practice by providing information about a potential educational delivery method, it will provide additional evidence on the generalizability of studies based on these two models of technology adoption.

Keywords
Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Microblogging, Twitter

INTRODUCTION
As new technologies develop, educators explore the feasibility of using these technologies to improve learning. Microblogging is one such technology. Given the propensity of students to use microblogging sites such as Twitter, it is important to understand whether these technologies would be adopted by students for educational use. This study explores whether students will adopt twitter as a supplemental learning tool. The Technology Acceptance Model (TAM) has been used extensively to understand adoption but it has been criticized for being too parsimonious to generalize across gender and culture. An alternate model, the Unified Theory of Acceptance and Use of Technology (UTAUT) has since been proposed to address this failing. Hence, in this study, two competing models were tested using two samples: a sample of US students and a sample of female Qatari students. Hence, the study will not only inform practice by providing information about a potential educational delivery method, it will provide additional evidence on the generalizability of studies based on these two models of technology adoption.

THE TECHNOLOGY ACCEPTANCE MODEL
The adoption of technology has been studied extensively. Arguably the most used theory in information systems literature, the Technology Acceptance Model (TAM), has been used as the basis for much of the research on adoption of various technologies. For example, TAM has been used to explain adoption of email (Davis, 1989; Gefen & Straub, 1997; Kautz, 1996), database management systems (DBMS) (Alexander & Hoffer, 1986), executive information systems (EIS) (Bajwa, Rai & Ramaprasad, 1998), group decision support systems (GDSS) (e.g., Briggs, Adkins, Mittleman, Kruse et al., 1998; Chin & Gopal, 1995; Gert-Jan, Noel & Rabson, 1998), Structural Equations Modeling (SEM) software (Chin & Todd, 1995), telecommuting technologies (Cynthia & Howard, 1998), the World Wide Web (Fenech, 1998), object-oriented software development methods (Fichman & Kemerer, 1993), e-commerce (Gefen & Straub, 2000), enterprise resource planning (ERP) systems (Gefen, 2000), telemedicine technology (Hu, Chau, Liu Sheng & Yan Tam, 1999), digital imaging technology (Liberatore & Breem, 1997), stock broker workstations (Lucas & Spitler, 1999), and online banking (Shao, Yuan, Wang & Chen, 1999).
The TAM model theorizes that perceived ease of use of a given technology increases its perceived usefulness. The perceived usefulness and the perceived ease of use influence the behavioral intention to use the technology. This intention is the direct precedent of actual use. Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989).

However, Davis’ model has been criticized for not generalizing across various demographic variables such as gender and culture. These criticisms have resulted in research to validate TAM across gender and culture (e.g., Morris, Venkatesh & Ackerman, 2005; Rose & Straub, 1998; Straub, 1994; Straub, Keil & Brennan, 1995, 1997). In addition, TAM has been subject to numerous replications and confirmatory studies (e.g., Adams, Nelson & Todd, 1992; Brock & Sulsky, 1994; Doll, Hendrickson & Deng, 1998; Hendrickson, Massey & Cronan, 1993; Karahanna, Straub & Chervany, 1999; Keil, Beranek & Kosynski, 1995; Segars & Grover, 1993; Subramanian, 1994; Szajna, 1994) and extensions (e.g., Agarwal & Prasad, 1999; Chau, 1996; Dishaw & Strong, 1999; Gefen & Keil, 1998; Gefen & Straub, 1997; Szajna, 1996; Venkatesh & Davis, 1994; Venkatesh & Davis, 1996). Furthermore, TAM has been compared to other models including TPB (e.g., Davis, Bagozzi & Warshaw, 1989; Jaakkola, 1996; Mathieson, 1991; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatraman, Loh & Koh, 1994). The result of this research has led to a more comprehensive model: The Unified Theory of Acceptance and Use of Technology.

THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

The Unified Theory of Acceptance and Use of Technology (UTAUT) was formulated from eight prominent competing user acceptance models. Those models include: the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behavior, a model combining the technology acceptance model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory. The researchers tested the eight models using data from four organizations in a longitudinal within-subjects comparison. Commonalities across the models were examined and out of the seven constructs that were determined to be significant, four new constructs were developed as "determinants of user acceptance and user behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions" (Venkatesh, Morris, Davis and Davis, 2003, p447). The four construct were affected by four moderators: gender, age, voluntariness, and experience.

The first construct, performance expectancy, is defined as “the degree to which an individual believes that using the system will help him or her to attain gains in job performance” (Venkatesh et al., p. 447.) Performance expectancy is moderated by gender and age. The predictor, effort expectancy, defined as “the degree of ease associated with the use of the system” (p 450), is moderated by gender, age and experience. The third construct, social influence, is defined as “the degree to which an individual perceives that important others believe he or she should use the new system” (p 451). All four of the moderators affect social influence. The fourth construct in the UTAUT model, facilitating conditions, is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system”
Facilitating conditions are moderated by age and experience. These constructs, as moderated by gender, age, experience and voluntariness of use, are considered to be determinants for predicting intent to use technology, labeled behavioral intention and for predicting use behavior.

![Figure 2. The Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003)](Image)

**METHOD**

For this study, a survey was developed and fielded to 187 students enrolled in introductory business courses at a university in the southern United States (US) and a university in Qatar. The instrument contained items for both the TAM model and the UTAUT model. The dependent variable in both cases was self-reported intention to use optional podcasts. Because actual use of podcast was not measured, the facilitating conditions construct was not measured for the UTAUT model.

The study resulted in 77 usable responses from the US sample and 99 usable responses from the Qatari sample. Demographic data was collected to obtain an assessment of the differences (if any) between groups of individuals. Demographics included age, gender, education level, nationality, and major. In addition, data was collected regarding subjects use of various types of social media.

The Qatari sample had a mean age of 21 years and all (100%) were female. Ninety-two (92) percent were business majors. Sixty (60) percent were Qatari. The remainder included Algerian, American, Bahraini, Canadian, Egyptian, Iranian, Jordanian, Lebanese, Mauritanian, Palestinian, Sudanese, Syrian, Tunisian, Turkish, and Yemeni students. Sixteen (16) percent were freshmen; forty-five (45) percent were sophomores; twenty-eight (28) percent were juniors; ten (10) percent were seniors and the remainder did not disclose their class.

The US sample had a mean age of 29 years but the mode was 21 years. Fifty-nine (59) percent were male and forty-one (41) percent were female. Ninety-six (96%) percent were business majors. Ninety-three (93) percent were American of which 40% self-identified as African-American and 26% self-identified as Caucasian. Seven (7) percent were sophomores; twenty-two (22) percent were juniors; and eleven (11) percent were seniors; and fifty-five (55) percent were graduate students and the remainder did not disclose their class.

Model estimation was conducted using AMOS 5.0. AMOS reports several fit indices of the structural model including Chi-squared goodness-of-fit, Root Mean Squared Error of Approximation (RMSEA), Adjusted Goodness-of-Fit Index (AGFI), and the Comparative Fit Index (CFI). Both the Chi-squared goodness-of-fit and AGFI are susceptible to problems when the sample size is small. Chi-squared goodness-of-fit index will tend to overestimate the model fit whereas the AGFI will tend to
underestimate the fit. The RMSEA and CFI are relatively insensitive to sample size issues. However they are interpreted differently. A better fit is indicated by a smaller number with the RMSEA. Brown and Cudeck (1993) recommend a RMSEA 0.08 or less. On the other hand, a larger number is indicative of a better fit with the CFI. Bentler (1990) recommends a standard of 0.90 as the minimum number to indicate adequate fit using the CFI. AMOS also calculates the path coefficients and the level of statistical significance for each. In this study, the critical alpha threshold to establish statistical significance for each hypothesis will be set at 0.05.

<table>
<thead>
<tr>
<th>Qatari Sample</th>
<th>US Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Average)</td>
<td>21</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>100</td>
</tr>
<tr>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>92</td>
</tr>
<tr>
<td>Non-Business</td>
<td>8</td>
</tr>
<tr>
<td>Nationality</td>
<td></td>
</tr>
<tr>
<td>Qatari /American</td>
<td>60</td>
</tr>
<tr>
<td>Other</td>
<td>40</td>
</tr>
<tr>
<td>Level</td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>16</td>
</tr>
<tr>
<td>Sophomores</td>
<td>45</td>
</tr>
<tr>
<td>Juniors</td>
<td>28</td>
</tr>
<tr>
<td>Seniors</td>
<td>10</td>
</tr>
<tr>
<td>Graduate</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1. Descriptive Statistics

RESULTS

Technology Acceptance Model Analysis

Analysis of the TAM model met the assumptions of independence of observations and exogenous variables have multivariate normal distributions. All factors loaded cleanly with no cross-loadings. High reliability was demonstrated by Cronbach's alpha values greater than .95.
The Chi-squared Goodness of Fit index indicates a good fit. However, due to the limitations of $\chi^2$ (subjectivity to sample size and basis on the $\chi^2$ centrality distribution), other fit indices are also consulted. All other fit indices indicate a good fit. Examination of the Comparative Fit Index (CFI) indicates a good fit at .964 as does the Tucker-Lewis Index (TLI) of .953 and the Parsimony-adjusted Comparative Fit Index (PCFI) at .754. Furthermore, the Root Mean Squared Error of Approximation (RMSEA) is .049 with a confidence interval of .032 - .064 with a p-value of .531.

<table>
<thead>
<tr>
<th>Fit Index</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>247.517, 183df, p=.001</td>
</tr>
<tr>
<td>CFI</td>
<td>.964</td>
</tr>
<tr>
<td>TLI</td>
<td>.953</td>
</tr>
<tr>
<td>PCFI</td>
<td>.754</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.049, CI .032-.064, p = .531</td>
</tr>
</tbody>
</table>

Table 2. Fit Statistics for the Technology Acceptance Model

There was a statistically significant relationship between Perceived Usefulness (Usefulness) and Behavioral Intention (Intent) to Use Twitter at the $p<=.10$ level for both groups (Qatari: 1.228, P-value: .005 and US: .738, p-value .018). However, the relationship between Perceived Ease of Use (Ease) and Behavioral Intention to Use (Intent) was not statistically significant for either group (Table 2). While Perceived Ease of Use (Ease) had no direct effect on Behavioral Intentions (Intent), there was a statistically significant ($p<=.00$) relationship between Perceived Ease of Use (Ease) and Perceived Usefulness (Usefulness) resulting in a statistically significant indirect relationship with Behavioral Intentions (Intent).

The squared multiple correlation indicates that the model explains 87.4% of the variance in the Behavioral Intention to Use Twitter for the Qatari sample and 85.3% of the variance for the US sample.
Table 3. Standardized Regression Weights for TAM Model

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Qatari</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>p</td>
<td>Estimate</td>
</tr>
<tr>
<td>Usefulness &lt;- Ease</td>
<td>.981</td>
<td>***</td>
<td>1.044</td>
</tr>
<tr>
<td>Intent &lt;- Usefulness</td>
<td>1.047</td>
<td>.005</td>
<td>1.228</td>
</tr>
<tr>
<td>Intent &lt;- Ease</td>
<td>-.188</td>
<td>.623</td>
<td>-.485</td>
</tr>
</tbody>
</table>

Table 4. Standardized Effects for TAM Model

<table>
<thead>
<tr>
<th></th>
<th>Indirect Effect</th>
<th>Direct Effect</th>
<th>Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ease Usefulness</td>
<td>Ease Usefulness</td>
<td>Ease Usefulness</td>
</tr>
<tr>
<td>All Subjects</td>
<td>.000</td>
<td>.945</td>
<td>.945</td>
</tr>
<tr>
<td>Usefulness</td>
<td>.000</td>
<td>.935</td>
<td>.935</td>
</tr>
<tr>
<td>Intent</td>
<td>1.003</td>
<td>.000</td>
<td>-.184</td>
</tr>
<tr>
<td>Qatari Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usefulness</td>
<td>.000</td>
<td>.923</td>
<td>.923</td>
</tr>
<tr>
<td>Intent</td>
<td>1.186</td>
<td>.000</td>
<td>-.449</td>
</tr>
<tr>
<td>US Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usefulness</td>
<td>.000</td>
<td>.923</td>
<td>.923</td>
</tr>
<tr>
<td>Intent</td>
<td>.660</td>
<td>.000</td>
<td>.235</td>
</tr>
</tbody>
</table>

Unified Theory of Acceptance and Use of Technology Analysis

Analysis of the UTAUT model also met the assumptions of independence of observations and exogenous variables have multivariate normal distributions. All factors loaded cleanly with no cross-loadings. High reliability was demonstrated by Cronbach's alpha values greater than .95.
The Chi-squared Goodness of Fit index indicates a good fit. However, as stated earlier, other fit indices were also examined and suggest that the model does have an adequate fit: CFI of .939, TLI of .925, PCFI of .766, and RMSEA of .052 with a confidence interval of .040 - .062 and a p-value of .401.

<table>
<thead>
<tr>
<th>Fit Index</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>463.179, 333df, p=.000</td>
</tr>
<tr>
<td>CFI</td>
<td>.939</td>
</tr>
<tr>
<td>TLI</td>
<td>.925</td>
</tr>
<tr>
<td>PCFI</td>
<td>.766</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.052, ci .040-.062, p = .401</td>
</tr>
</tbody>
</table>

Table 5. Fit Statistics for the Unified Theory of Acceptance and Use of Technology

Regression weights on the paths from Performance Expectancy (Perf.Expect) to Behavioral Intention (Intent) was statistically significant at $p<=.10$ for both groups (Qatari: .872, p-value: .075, US: .872, p-value: .019). However, the path from Effort Expectancy (Effort Expect.) to Behavioral Intention (Intent) was not significant (Table 5). The path from Social Influence (Influence) to Behavioral Intention (Intent) was significant for the Qatari group at the .10 level (.914, p-value: .008) but was not significant for the US group (-.136, p-value: .695) .The squared multiple correlation indicates that the model explains 86.2% of the variance in the Behavioral Intention to Use Twitter for the Qatari group and 85.8% of variance for the US group.
Table 6. Standardized Regression Weights for UTAUT Model

<table>
<thead>
<tr>
<th>Direct Effect</th>
<th>Performance Expectancy</th>
<th>Effort Expectancy</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intent</td>
<td>.907</td>
<td>.013</td>
<td>.872</td>
</tr>
<tr>
<td></td>
<td>.075</td>
<td></td>
<td>.720</td>
</tr>
<tr>
<td>Qatari Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intent</td>
<td>-.280</td>
<td>.456</td>
<td>-.410</td>
</tr>
<tr>
<td></td>
<td>.419</td>
<td></td>
<td>.282</td>
</tr>
<tr>
<td>US Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intent</td>
<td>.798</td>
<td>.003</td>
<td>.914</td>
</tr>
<tr>
<td></td>
<td>.008</td>
<td></td>
<td>-.136</td>
</tr>
<tr>
<td></td>
<td>.695</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Standardized Effects for UTAUT Model

<table>
<thead>
<tr>
<th>TAM</th>
<th>UTATM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant relationship between Perceived Usefulness (Usefulness) and Behavioral Intention (Intent)</td>
<td>Significant relationship from Performance Expectancy (Perf.Expect) to Behavioral Intention (Intent).</td>
</tr>
<tr>
<td>Non-significant relationship between Perceived Ease of Use (Ease) and Behavioral Intention to Use (Intent)</td>
<td>Non-significant relationship from Effort Expectancy (Effort Expect.) to Behavioral Intention (Intent).</td>
</tr>
<tr>
<td>Significant relationship between Perceived Ease of Use (Ease) and Perceived Usefulness (Usefulness) resulting in an indirect relationship with Behavioral Intention.</td>
<td>Significant relationship from Social Influence (Influence) to Behavioral Intention (Intent) only for the Qatari students.</td>
</tr>
<tr>
<td>The model explains 87.4% of the variance in the Behavioral Intention to Use Twitter for the Qatari sample and 85.3% of the variance for the US sample.</td>
<td>The model explains 86.2% of the variance in the Behavioral Intention to Use Twitter for the Qatari group and 85.8% of variance for the US group</td>
</tr>
</tbody>
</table>

Table 8. Summary of Findings

CONCLUSION

As both models demonstrate, students will use Twitter in an educational context if they perceive it to be useful to their studies (both Perceived Usefulness and Performance Expectancy were significant for both groups). Ease of Use and Effort Expectancy were not significant in either model for either group. However, Ease of Use did have an indirect effect through...
Perceived Usefulness for both groups. This indicates that Twitter must be easy to use to be considered helpful and worth using.

Importantly, our findings show that there is a difference in the factors that come into play between US and Qatari subjects. The Social Influence factor of the UTAUT Model was not a significant factor for US subjects but was significant for Qatari students. This supports cautions that TAM may be too parsimonious to be used with non-US samples. TAM was developed and is extensively used in the US but criticized for not being generalizable across cultures and gender. UTAUT was developed later to address these shortcomings.

REFERENCES


