CRITICAL FACTORS IN ELECTRONIC LIBRARY ACCEPTANCE: EMPIRICAL VALIDATION OF NATIONALITY BASED UTAUT USING SEM

Rita Oluchi Orji*, Yasemin Yardimci Cetin** and Sevgi Ozkan**
*Computer Science Department, University of Saskatchewan, Canada
**Informatics Institute, Middle East Technical University, Ankara, Turkey

ABSTRACT

While millions of dollars are spent building digital libraries, research findings indicate that millions of potential users may still be ignoring them. Researchers have applied different Technology Acceptance Models to determine the acceptance of Information System (IS). In this research, we recognized the existence of different groups of users of Electronic Library System (ELS) with different usage behavior and, therefore, developed and validated a Nationality based Unified Theory of Acceptance and Use of Technology (NUTAUT) model adapted from UTAUT model to account for each group of users’ acceptance. Nationality was introduced based on the assumption that the UTAUT independent variables will impact the acceptance and usage differently when moderated by nationality. The result from 116 (58 international and 58 national) student participants provides support for NUTAUT by showing that the various UTAUT constructs exert varying degree of effects. It not only confirms the NUTAUT robustness in predicting acceptance of both National and International Students (91% and 98% respectively) but also determines the importance of each independent construct to each group in determining acceptance. Performance Expectancy (EE) and Social Influence (SI) are significant factors for International students while Effort Expectancy (EE) and Facilitating Conditions (FC) have the same effect for the two groups. Structural Equation Modeling (SEM) was used as the main technique for data analysis.

This study is useful to school managers, bank managers and other Information Science designers that make decision about IS that are used by people of different nationalities. The NUTAUT model can also be applied in cross-cultural acceptance and so we provide more insight into the understanding of Technology Acceptance through this study.

KEYWORDS

Digital Library, Information Retrieval, Technology Acceptance, Structural Equation Modeling

1. INTRODUCTION

Real world libraries are hard to use. Attempts to reduce the accessibility problems associated with real world libraries led to the concept of Electronic Library Systems (ELS) (also referred to as Digital Library). ELS have become an inevitable part of today’s educational systems. ELS aims to acquire, store, organize and preserve information for easy access. Leedy [16] found that information seekers often need the assistance of a librarian, especially when the catalogue and guides are difficult to use. In recognition of this, many attempts have been made towards the establishment and improvement of the structure of a library to achieve both a high degree of usefulness and easier access to information.

Consequently, many universities have digitized their library systems. However, while many resources have been devoted to developing these systems, library researchers have observed that digital libraries remain underutilized [28] and if these systems are not widely utilized, it will be difficult to obtain corresponding return on investments. Therefore, there is a clear need to identify and compare factors that can influence ELS acceptance and use by people from different nations so that information system designers, school managers, library managers and others can formulate strategies to design systems that can be acceptable by all (international and national). In this regard, Tibenderana and Patrick [23] found that relevance moderated by awareness plays a major role in acceptance of ELS services. In addition, James et al [13] developed a model of digital library user acceptance based on the technology acceptance model and concluded that acceptance is preceded by a user’s perception of a system’s usability and this is directly dependent on interface
characteristics, organizational contexts, and individual differences. However, no study has recognized the
existence of different group of users of ELS and the factors that affects the acceptance of each group.

In this paper, we argue that national and international users will exhibit different usage behaviors. We
thus, developed a NUTAUT Model to account for the moderating effect of nationality on the UTAUT model.
This was motivated by the observation that different groups of users (national and international students)
exhibit different use behavior towards ELS. Our research model not only predicts the varying degrees of
acceptance for each user groups but also shows the degree of importance of each independent construct
(Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Condition (FC))
in determining acceptance for each group. The study contributes significantly towards understanding of the
acceptance of ELS in academic environments and can also be useful to school managers, bank managers and
other IS designers that make decisions about IS that are used by people of different nationalities.

This paper is organized as follows: In Section 2, we discuss the theoretical background of the study and
present our NUTAUT model in Section 3. Section 4 highlights methods employed in our research and
Section 5 presents the analysis of the result and discussion. Section 6 concludes by presenting our findings
followed by limitations and recommendations for future work.

2. THEORETICAL BACKGROUND AND RELATED WORK

2.1 Digital Library Systems

There have been significant advances in the technical development of digital libraries in areas such as
information storage, information retrieval, and system integration, resulting in dramatic improvements in
their performance. While many resources have been devoted to developing these systems, library researchers
have observed that ELS remain underutilized [28]. ELS have received a lot of attention from researchers.
Neuman [20] in her naturalistic inquiry detailed some of the difficulties 92 high school freshmen and
sophomore displayed as they interacted with ELS. Her data revealed the basic differences between structures
inherent in database and the conceptual structure that students bring to searching. These differences are so
compelling that they seriously hamper students’ independent use of these resources (p.74). The students’ lack
of understanding of the organization of information hampered their access of appropriate information for
their research. The study demonstrated that information search has not become easier with the advent of
technology.

2.2 Technology Acceptance Theories

It is a common belief that introducing a new technology automatically results in its acceptance and use.
However, several research findings dispute this claim, showing that there are several other factors that affect
technology acceptance and use [5]. Many IS researchers have published on various theories that could explain
the acceptance of information systems. These theories include the Technology Acceptance Model (TAM) by
Davis et al [7]; the Theory of Reasoned Action (TRA) by Fishbein and Ajzen [9]; the Theory of Planned
Behavior (TPB) by Ajzen, [1] and the UTAUT by Vakentash [26] which is the most recent of all the
technology acceptance theories. The TAM model is the most widely used and has “perceived usefulness” and
“perceived ease of use” as its main elements. The model suggests that when users are presented with
technology, “perceived usefulness” and “perceived ease of use” influence their decisions about how and
when they will use the technology. The perceived usefulness is defined as “the degree to which a person
believes that using a particular system would enhance his or her job performance,” while perceived ease of
use is defined as “the degree to which a person believes that using a particular system would be free of
effort” [7].

Since the development of UTAUT model, it has attracted attention of many scholars in IS research
because of its predictive performance of 70% [26]. This is a major improvement over the widely used TAM
model with predictive capacity of 35% [18, 25]. Various researchers [2, 17] validated the model and others
[6, 12, 19, 23] extended it in different contexts, including multicultural studies [21], and all found its
constructs highly predictive [19]. This, in addition to the fact that the moderating variables offer flexibility to
allow the introduction of new dimensions into the model, was the major motivation for the use of UTAUT
model in the current investigation. We approached the adoption and discovery of critical factors that affect adoption of ELS from the perspective of technology acceptance.

3. MODEL FORMULATION

3.1 Nationality based UTAUT (NUTAUT)

NUTAUT was adapted from UTAUT by introducing a new modulating variable *nationality*. The definition of the NUTAUT constructs is as given in Table 1 and Table 2 and the model is shown in Figure 1. *Nationality* was introduced based on the assumption that the UTAUT independent variables PE, EE, SI and FC will impact on *behavior intention* (BI) differently and BI with FC will also impact on *use behavior* (UB) differently when moderated by nationality.

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Performance expectancy</em> (PE)</td>
<td>Degree to which an individual believes that using the system will help attain gains in job performance</td>
</tr>
<tr>
<td><em>Effort expectancy</em> (EE)</td>
<td>The degree of ease associated with the use of the system</td>
</tr>
<tr>
<td><em>Social influence</em> (SI)</td>
<td>The degree to which an individual perceives that important others believe he or she should use the new system</td>
</tr>
<tr>
<td><em>Facilitating conditions</em> FC)</td>
<td>The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system</td>
</tr>
<tr>
<td><em>Behavioral Intention</em> (BI)</td>
<td>The measure of the likelihood of an individual to employ the system.</td>
</tr>
<tr>
<td><em>Use Behavior</em> (UB)</td>
<td>This measures the acceptance of the system.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gender</em></td>
<td>Gender roles have a strong psychological basis and are enduring.</td>
</tr>
<tr>
<td><em>Age</em></td>
<td>Age has an effect on attitudes.</td>
</tr>
<tr>
<td><em>Experience</em></td>
<td>Deals with how long the user has used the system.</td>
</tr>
<tr>
<td><em>Voluntariness of use</em></td>
<td>If usage is voluntary or mandated</td>
</tr>
<tr>
<td><em>Nationality</em></td>
<td>Whether the user is in the national or international students category</td>
</tr>
</tbody>
</table>

![Figure 1. Nationality Based UTAUT (NUTAUT)](image)

3.2 Hypotheses

The expectations are that there are varying degrees of acceptance by international and national students. Four hypotheses have been postulated to guide this study:
H1: UTAUT moderated by Nationality will demonstrate varying degrees of acceptance by these groups
H2: Social Influence will be an important predictor for international students when moderated by nationality
H3: Facilitating Condition mediated by Nationality will demonstrate more effect on Use Behavior for international students
H4: Effort Expectancy impacts behavioral intention more than performance expectancy when moderated by nationality

4. METHODOLOGY

The data-gathering instrument used for this study was a self-administered online questionnaire. The questionnaire was based on the pre-existing tool developed by Venkatesh [25] and has been used by Anderson and Schwager [2], Moran [19], and Tibenderana & Ogao [23]. The research question was divided into three sections. Section 1 contained 18 close questions which collected the participant demographic information and their experience with computers and ELS. Section 2 contains a total of 21 questions about ELS hardware and services provided by Middle East Technical University (METU) library. These questions collected the student’s awareness of these facilities and services. The respondents chose either a “Yes”, “No” or “Not Sure” answer in response to each ELS services and facilities indicated. Section 3 contained 25 questions with a 5-point Likert scale where a 1 represented ‘strongly agree’ and a 5 represented ‘strongly disagree’. There were a total of 116 participants: 58 International and 58 National graduate students. Moreover, the number of male and female participants was fairly evenly distributed across the disciplines. A pilot study was carried out on 10 participants to reassure absence of ambiguity in the questions.

5. RESULT ANALYSIS AND DISCUSSION

5.1 Validation of the Survey Instrument and Nutaut

The data analysis was done using SPSS and Linear Structural Relations (LISREL) structural equation modeling tool. SPSS was adopted to conduct Principal Components Analysis (PCA) and to assess the validity of the scale. The Cronbach’s Alpha was calculated to examine the reliability of each factor. The Alpha values of the questionnaire exceeded 0.8 (Table 3, column 4), demonstrating the good reliability. Before conducting PCA, Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity test was checked to measure for the sampling adequacy [14]. The KMO were all >0.700 and the result of Bartlett sphericity test was significant at <0.001 (Table 3, column 2 and 3). Thus data were suitable to conduct factor analysis [11]. The factor loadings and the corresponding factor scores (weights) for each variable were generated. Each factor has larger loading on its corresponding factor (>0.7) than cross-loadings on other factors (<0.4). Thus these items could effectively reflect factors since they had good validity including convergent validity and discriminant validity [10].

Structural Equation Model software LISREL was employed to estimate the path coefficients and to validate and test model hypotheses. We used Confirmatory Factor Analysis (CFA) to test for the model fitness on the data. The results show that the hypothesized model is recursive, uni-directional (Table 3 & 4). Also as shown in the Figure 2 and 3, all the standardized loadings of items on their corresponding factor were larger than 0.7, further proving good convergent validity [4]. The fit indices of the model are listed in Table 4 and Table 5. The tables list the recommended value and actual value of each fit index; the actual value was better than the recommended value. Thus the model was a good fit to the data. Table 5 summarizes the results of the t-test analysis which further confirms the validity of the models.
Table 3. Construct validity and reliability measures

<table>
<thead>
<tr>
<th>Group Comparison</th>
<th>KMO</th>
<th>Bartlett Sphericity</th>
<th>Cronbach’s Alpha</th>
<th>P-Value</th>
<th>( \chi^2/df )</th>
<th>RAMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended</td>
<td>&gt;0.5</td>
<td>&gt;0.05</td>
<td>≥ 0.7</td>
<td>&lt;0.05</td>
<td>&lt;3</td>
<td>≤0.08</td>
</tr>
<tr>
<td>International</td>
<td>0.758</td>
<td>000</td>
<td>0.879</td>
<td>0.00005</td>
<td>1.31</td>
<td>0.081</td>
</tr>
<tr>
<td>National</td>
<td>0.702</td>
<td>000</td>
<td>0.921</td>
<td>0.00007</td>
<td>1.45</td>
<td>0.069</td>
</tr>
</tbody>
</table>

Table 4. Goodness-of-Fit Results of the LISREL models

<table>
<thead>
<tr>
<th></th>
<th>GFI</th>
<th>AGFI</th>
<th>CFI</th>
<th>NFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended</td>
<td>&gt;0.90</td>
<td>&gt;0.80</td>
<td>&gt;0.90</td>
<td>&gt;0.90</td>
</tr>
<tr>
<td>International</td>
<td>0.951</td>
<td>0.851</td>
<td>0.946</td>
<td>0.950</td>
</tr>
<tr>
<td>National</td>
<td>0.935</td>
<td>0.901</td>
<td>0.995</td>
<td>0.943</td>
</tr>
</tbody>
</table>

(Note: \( \chi^2/df \) the ratio between Chi-square and degrees of freedom, GFI is Goodness of Fit Index, AGFI is Adjusted Goodness of Fit Index, CFI is Comparative Fit Index, NFI is Normed Fit Index, RMSEA is Root Mean Square Error of Approximation)

Table 5. T Test and P Values for participant groups

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>T-test</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intention</td>
<td>National</td>
<td>2.49</td>
</tr>
<tr>
<td>Use</td>
<td>International</td>
<td>3.20</td>
</tr>
<tr>
<td>Behavioral Intention</td>
<td>National</td>
<td>4.37</td>
</tr>
<tr>
<td>Use</td>
<td>International</td>
<td>5.40</td>
</tr>
</tbody>
</table>

5.2 International versus National Students

The two groups’ result estimations using LISREL are shown in Figures 3 and 4 and the comparison of the results from the two analyses is summarized in Table 6 and 7. The contributions of the various independent construct PE, EE, FC and SI for both International and National students are shown in Table 7 column 2 and 3. It shows that FC condition is the most important predictor of acceptance for the two groups. The National students model shows predictive efficiency of 25% and 73% for the dependent construct of behavioral intent and use behavior (a total predictive capability of 91% for the dependent variable) and the International students model shows predictive efficiency of 25% and 66% (a total predictive capability of 98% for the dependent variable) as shown in Table 7. This means that the two groups accept ELS. This study reveals a rich set of pattern and results. Due to space limitations, we will only highlight the most important points.

H1: UTAUT moderated by Nationality will demonstrate varying degree of Acceptance by these groups

This hypothesis is supported. There is a significant difference between international and national groups. National students exhibit a use behavior of 73% and international students exhibit use behavior of 66%. This shows that national students accept and use the library more than the international students. Though the two groups demonstrate the same degree of behavioral intent, their results suggest that appropriate facilitating
condition and reduction in the amount of effort expectancy for ELS user enhances the acceptance and use of technology. This agrees with the finding of Tibenderana & Ogao [23] that library end-users in the university accept and use electronic library system. The difference in acceptance between the two is mostly attributed to facilitating condition which is the most important construct for the two groups. A plausible explanation is that the facilitating condition includes the generality of all the assistance and supports that foster usage rather than just external controls related to the environment; therefore, use behavior cannot occur if objective conditions in the environment prevent it [24] or if the facilitating conditions make the behavior difficult. This is consistent with the empirical studies of Thompson et al [22] and others [25, 26] who found the direct effect of facilitating condition on usage behavior. International students need to be provided with some additional assistance which national students might require. This assistance includes training and librarian assistance, especially at the early stages of their enrolment. This was explained by Neuman [20] statement which states that there is a basic difference between structures inherent in ELS and conceptual structures that students bring to searching; these differences are so compelling that they seriously hamper students. Most of the national participants of this research also did their undergraduate degrees in the university and therefore have working knowledge of the ELS.

Table 6. Comparison of national and international model contributions

<table>
<thead>
<tr>
<th>Constructs</th>
<th>International (N=58)</th>
<th>National (N=58)</th>
<th>No. of Questions Asked</th>
<th>No. of Questions Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>0.50</td>
<td>0.30</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>EE</td>
<td>0.52</td>
<td>0.52</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>SI</td>
<td>0.12</td>
<td>0.02</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>FC</td>
<td>0.78</td>
<td>0.76</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>BI</td>
<td>0.25</td>
<td>0.25</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>UB</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 7. Comparison international student and national students models

<table>
<thead>
<tr>
<th>Model</th>
<th>Behavioral Intention</th>
<th>Use Behavior</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>25%</td>
<td>66%</td>
<td>91%</td>
</tr>
<tr>
<td>National</td>
<td>25%</td>
<td>73%</td>
<td>98%</td>
</tr>
</tbody>
</table>

H2: Social Influence will be an important predictor for international students when moderated by nationality

This hypothesis is also supported; social influence shows a more significant effect on behavioral intent for international students than national students with a prediction of 12% and 2% respectively. This is expected since international students are likely to move in groups and therefore are easily influenced to use this system by people that matter to them in the environment. This can, to an extent, be likened to the effect of facilitating condition; the groups function as a motivator and can provide necessary assistance especially for those that are new to the system. Practically, the results of this study suggest that organizations should use different strategies in motivating the use of a new technology for different situations/groups. For some information systems whose usage is mandatory, those factors contributing to Social Influence such as the instructors/supervisor's prodding might work. However, when the usage is voluntary, like the case of ELS, the managers might want to think of better ways to promote usage. Though social influence is a factor for all students but show stronger effect for international students, the effect is greatly reduced when moderated by experience and training, and therefore should not be used as a strong motivator. This is consistent with previous studies (e.g., Venkatesh & Davis [25]); the effect of SI to BI is significant under mandatory and inexperienced use situations

H3: Facilitating condition mediated by Nationality will demonstrate more effect on Use behavior for international students

This is only partially supported with 78% and 76% prediction for international and national students respectively. This shows that irrespective of nationality, facilitating condition is still crucial. Our initial assertion that facilitating condition will not be as important for national students owing to the availability of alternatives including resources from friends and families seems to be wrong. This can possibly be explained by the fact that the University invests considerable amount of resources to provide both online, offline and remote access to the ELS, so international students as well as national students still exhibit use behavior on...
the ELS despite availability of alternatives. This is consistent with the empirical studies of Thompson et al [22] who found the direct effect of facilitating condition on usage behavior.

H4: Effort expectancy impacts on behavioral intention more than Performance expectancy when moderated by nationality

This is partially supported by the model. EE contributed 52% compared to 30% of PE for national students which support the hypothesis but there is no significant difference between the two for international student with PE of 50% and EE of 52%. This means that for national students, acceptance is more dependent on EE than PE, while international students attached similar degrees of importance to both. In other words, national students are unlikely to use the system if it is difficult to use even if it is useful. This can also be explained by the fact that the availability of alternatives or competition generates a negative effect, affecting perceived EE. The national students have other sources of getting materials for their research, more easily than international students, and might not afford to spend a lot of time and energy searching through complex ELS, while international students value both ease of use and useful systems alike. This could also mean that in the absence of alternatives, PE becomes as important as EE. This agrees with Andrea and Virili [3]: Technology acceptance is basically a choice among different alternative technologies/tools to accomplish user tasks.

6. CONCLUSION AND FUTURE WORK

The results suggest that Nationality is a significant moderator that affects the acceptance of ELS and that effect exerted by UTAUT constructs on individual group (international and national students) vary considerably. Facilitating condition significantly influences the acceptance and use of ELS.

In general, the NUTAUT does predict the successful acceptance of ELS by graduate students. The participants showed higher inclination to use ELS by showing higher percentage of use behavior. We believe that this is a result of the role played by readily available access and easy to use library facility on-campus compared to off-campus, since the majority of the participants stay on-campus and can easily and conveniently access the ELS as compared to students living off-campus. To increase acceptance of ELS, this research suggests that the universities working towards increasing acceptance of ELS should make accessibility (facilitating conditions and effort expectancy) of the ELS to both outside and inside the campus easy.

This study shows that the variables, facilitating condition, effort expectancy, performance expectancy and social influence (listed in decreasing order of relevance), are the critical components that affect students’ acceptance and use of ELS. However, these factors are shown to have varying effect on different groups. For the two groups (international and national students), facilitating condition and effort expectancy remains the most critical factors that contribute to acceptance, while performance expectancy and social influences were fairly insignificant (30% and 2% respectively) for national graduate students.

Finally, though this research focused on the acceptance of ELS in educational institutions, the findings can be applied to other context like in Government to Citizen (G2C) Systems or websites used for electronic commerce. These findings can be applicable to any systems where the use and acceptance of the system may differ by international and national users. The study has contributed to the development of NUTAUT and by identified the critical factors, in order of importance, that affect acceptance when UTAUT is moderated by nationality. We also showed that nationality is an important moderator that determines the factors affecting acceptance.

In conclusion, for a successful implementation of ELS that will be accepted, more emphasis should be placed on facilitating conditions and effort expectancy but at the same time, performance expectancy and social influence should not be overlooked.

This research was carried out in a university environment and may not reflect ELS acceptance outside the university environment, although we plan to validate NUTAUT elsewhere as future work. The number of participants (116) may indeed be a limitation of this study, and so we want to conduct another study with a larger number of participants and in another environment to confirm the results shown in this research.
REFERENCES


