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Madison N. Ngafeeson
Northern Michigan University

Jun Sun
The University of Texas Rio Grande Valley, jun.sun@utrgv.edu

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E-Book Acceptance among Undergraduate Students:
A Look at the Moderating Role of Technology Innovativeness

Madison N. Ngafeeson, Walker L. Cisler College of Business, Northern Michigan University, Marquette, MI, USA

Jun Sun, Department of Information Systems, College of Business and Entrepreneurship, University of Texas - Rio Grande Valley, Edinburg, TX, USA

ABSTRACT

This paper utilizes the technology acceptance model (TAM) to uncover the moderating roles of technology innovativeness. A study of 158 undergraduate students revealed that the original TAM constructs and relationships were reliable, supported, and applicable in the measurement of e-book acceptance. Interestingly, personal technology innovativeness was found to moderate in a significant way, the relationship between behavioral intention to use e-book and actual usage of e-book. These findings suggest that while individuals who are more open to technology (adopters) as well as less technologically innovative individuals (late adopters and non-adopters) are likely to have the intention to use web-based instructional technologies like e-book, only highly innovative individuals, may actually translate intention into actual usage. These results have serious implications on adopters, implementers and users of instructional technologies who would need to factor into their decision-making the role of the individual technology innovativeness of its users.

Keywords: Instructional Technologies, Technology Acceptance Model, Technology Innovativeness, User Acceptance, Web-Based Learning Technology

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INTRODUCTION

The question as to why some people adopt new information technologies while others do not has been widely studied in the last three decades. While labels like information systems implementation, technology adoption, and technology acceptance (see Agarwal & Prasad, 1998) have all been used to describe this phenomenon, the undergirding purpose has remained the same. Instructional technologies, without exception, have also gained increased attention as a consequence. About a decade ago, a new construct, *technology innovativeness* (TI) was both conceptualized and operationalized under the name, *personal innovativeness in the domain of information technology* (Agarwal & Prasad, 1998). *Personal innovativeness in the domain of information technology* has been defined as the "willingness of an individual to try out any new information technology" (Agarwal & Prasad, 1998). Because technology acquisition does not automatically translate to technology usage, the subject of technology acceptance has, and continues to garner research attention as can be seen in the works of Davis, Bagozzi and Warshaw (1989); Taylor and Todd (1995); and Moore and Benbasat (1991). The technology acceptance model (TAM), first proposed by Fred Davis (1989), has received so much theoretical and empirical support through the years as an important framework to gauge user's behavioral intentions to use a particular technology (Venkatesh & Davis, 2000).

The TAM has been used to predict user acceptance of technology in different information systems studies (Venkatesh & Davis, 2000; Mathieson, 1991; Selim, 2003; Adams, Nelson & Todd, 1992). Developed by Davis (1989) from the theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) the TAM has become a generally accepted model for examining technology acceptance. Because of the failure of user technology acceptance (Kiel, 1995), organizations as well as technology manufacturers must consider the crucial subject of user acceptance.

New technologies for classroom usage require a careful choice of between the technology options being offered (Chilton & Gurung, 2008). Since the implementation of the e-book as an instructional technology, very little research has focused on its acceptance, let alone, the moderating factors. E-book has been defined as any piece of electronic text, excluding journal publications, regardless of size or composition, made available electronically for any device that includes a screen (Armstrong, Edwards & Londale, 2002, p. 217).

The idea of the e-book was first defined by Bush (1945) when he conceptualized the hypertext engine, Memex. However, it was Alan Kay who in 1968 (Kay, 2000) proposed the idea of Dynabooks—a device that could provide connections to online libraries—enabling both the search and reading of books. The 1971 start of Project Gutenberg (Hart, 1992) became a major achievement in this regard delivering electronic texts and other forms to the public for free

consumption. Today, library collections in the United States of America and across the world are implementing the concept of e-books—both in academic and non-academic circles (Hernon, Hopper, Leach, Saunders, & Zhang, 2006).

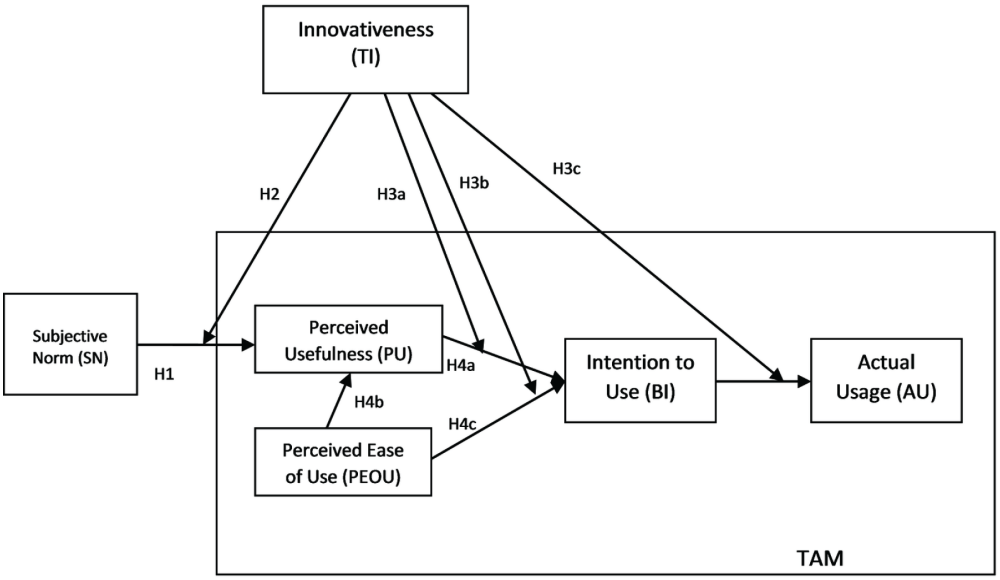
Given, the enormous resources that are being pumped into acquiring e-books for academic use, some researchers have begun to investigate as to the actual use of e-books (Chu, 2003; Ismail & Zainab, 2005). If not for anything else, evidence is needed for the justification of expenditures by academic institutions to this end (Hernon et al., 2006) or for the increasing use of e-book learning approach in universities across the United States of America—for example. E-book acquisition and usage seems to be increasing especially in higher education (Chu, 2003; Hernon, Hopper, Leach, Saunders, & Zhang, 2006). The increase in e-book usage as an instructional and learning tool necessitates its examination for its general acceptance, and more specifically elements that affect this user acceptance.

This study utilizes the technology acceptance model: first, to examine e-book acceptance among undergraduate students in a university in the Southern region of the United States of America. Additionally, the study tests the moderating role of personal innovativeness in information technology on the original TAM constructs. This model would be useful to e-book technology implementers in understanding how learner attitudes towards e-book learning systems affect usage intentions of this technology.

LITERATURE REVIEW

Adoption behaviors have been a long time focus of behavioral sciences. This subject has however gained increasing attention in information systems within the past thirty years partly due to the increase in new and innovative technologies. Questions like: "Why do people accept new technology?" or "Why do people reject new technology?" has in itself triggered a lot of research. Rogers (1983) found out that there are five groups of adopters of innovations namely: innovators, early adopters, early majority, late majority and laggards. The term *adoption* is used here to describe the initial acceptance of an object. Many theories have been used over the years to explain the adoption behaviors of humans. The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) are two commonly used theoretical frameworks in the understanding of this phenomenon (Ajzen & Fishbein, 1980; Ajzen, 1985; 1991). Both theories postulate that actual human behavior is best predicted by the intention to perform a particular behavior, while these intentions in themselves are predicted by the individual's attitudes or beliefs towards the object of that behavior. The TRA however differs from the TPB in that reasoned action is considered to be completely voluntary behavior, while planned behavior assumes deliberate actions. These two theories have become instrumental in our understanding of technology adoption behaviors and have been incorporated

Figure 1. Research model and hypotheses



into what is now called the technology acceptance model.

Fred Davis (1986), hypothesized the "technology acceptance model for empirically testing new end-user information systems." In his original work, he introduced a quite parsimonious model consisting of perceived usefulness (PU), perceived ease of use (PEOU), and user acceptance in information technology. Basically, Davis (1989) hypothesized that *technology acceptance* was a function of *perceived usefulness* of a technology and its *perceived ease of use*. The technology under study was electronic email. Perceived usefulness was defined as "the degree to which a person believes that using a particularly system would enhance his or her job performance", while perceived of ease was use was seen to be "the degree to which a person believes that using a particular system would be free of effort." Drawing from previous research on self-efficacy, cost-benefit paradigm, adoption of innovations, the channel disposition model, and non-MIS studies; he established that there existed a convergence of findings: namely that PU and PEOU were both fundamental and distinct constructs in determining decision-making in information technology (Davis, 1989). He concluded that these two constructs both played determinant roles in computer use.

Since then, numerous studies have been carried out using different technologies, in different countries: cross-sectionally and longitudinally. A continuous stream of research continues to examine possible antecedents of the original TAM constructs (Venkatesh & Davis, 2000; Venkatesh, Morris & Ackerman, 2000; Venkatesh, 2000; Lee, Yoon & Lee, 2009). With several technolo-

gies having been studied, one area that is now receiving a growing attention, owing probably to its relative newness is electronic books. Few researchers have specifically examined e-book use and user perceptions (e.g. Hernon et al., 2006; Chu, 2003).

Adoption behaviors as hypothesized in the TAM have been thought of to be devoid of individual differences (Agarwal & Prasad, 1998). In other words, while general differences in adoption decisions are important, Agarwal and Prasad (1998) have argued that individual assessments and value of the outcome of adoption are significantly important in impacting usage intentions. *Personal innovativeness in the domain of information technology* (PIIT) was first conceptualized and operationalized by Agarwal and Prasad (1989) to include the role of individual traits in adoption decisions. Agarwal and Prasad (1989) utilized existing frameworks like Rogers' (1993) theory of diffusion of innovations; Moore and Benbasat (1991) extensions on the theory; and the technology acceptance model (Davis et al. 1989; Taylor & Todd, 1995), to define and operationalize PIIT. In this study, PIIT is abbreviated simply as *technology innovativeness* (TI). Agarwal and Prasad (1989) have argued that the inclusion of an individual difference variable such as personal innovativeness, would help our understanding of how individual perceptions are formed, and how their corresponding usage intentions are created. Hence, this research separates *general* innovativeness from *domain-specific* innovativeness as called for, by researchers (Flynn & Goldsmith, 1993). Consistent with this reasoning, TI is therefore defined as the willingness of an individual to try out any new information technology.

THEORY DEVELOPMENT AND HYPOTHESES

The research model is proposed as indicated in Figure 1. More specifically, the model proposes that personal technology innovativeness (TI) will moderate the relationship between subjective norm and the TAM constructs (Perceived Usefulness-PU and Perceived Ease of Use-PEOU); between the TAM constructs (PU and PEOU) and Behavioral Intention to Use-BI; and finally between Behavioral Intention to Use-BI and Actual Usage-AU.

Subjective Norm

The "perceived social pressure to perform or not perform a behavior" (Ajzen, 1991, p. 188) is called the subjective norm. In business organizations, though the use of technology might be considered voluntary, the reward systems and the desire for promotion can cause employees to want to comply by especially superiors (Taylor & Todd, 1995). Here, influence is accepted to gain a favorable response from a person or group (Venkatesh & Davis, 2000). In an academic milieu, the desire for students to use a system through influence from teachers or peers in order to succeed is very possible. Subjective norms have been hypothesized to have an impact on perceived usefulness and behavioral

Table 1. Descriptive statistics: Implementation-type

	Full (n = 77)		Partial (n = 81)	
	Mean	**SD**	**Mean**	**SD**
SN	3.97	0.05	3.85	0.07
PU	4.16	0.14	4.16	0.16
PEOU	3.45	0.06	3.37	0.05
BI	3.86	0.14	3.83	0.07

intention to use (Venkatesh & Davis, 2000). Thus:

H1: Subjective norms (SN) will positively affect perceived usefulness (PU) of e-textbook learning.

Technology Innovativeness (TI)

Technology Innovativeness is defined as "the willingness of an individual to try out any new information technology" (Agarwal & Prasad, 1998). Derived from the works of Midgley and Dowling (1987) and Flynn and Goldsmith (1993), TI is conceptualized as a trait. TI is conceptualized to be a stable descriptor of individuals, not varying across situational considerations. Arguing for the existence of TI in technology acceptance, Agarwal and Prasad (1998) assert that this happens through TI's relationships with beliefs or perceptions. So, while concurring with Midgley and Dowling that the trait-behavior model is an inadequate representation of technology adoption behavior, they propose that TI serves as a key moderator for the antecedents as well as the consequence of perceptions. In other words, *TI* moderates the input processes (antecedents) of the TAM model as well as the output processes. More specifically, in the proposed model, TI will moderate the relationships between antecedent (subjective norm) and the consequence of perceptions (behavioral intention to use—BI and actual use—AU. Hence, it is proposed:

H2: Technology innovativeness (TI) will moderate the relationships between subjective norm (SN) and perceived usefulness (PU);

H3a: Technology innovativeness (TI) will moderate the relationship between perceived usefulness (PU) and behavioral intention (BI);

H3b: Technology innovativeness will moderate the relationship between perceived ease of use (PEOU) and behavioral intention (BI);

H3c: Technology innovativeness will moderate the relationship between behavioral intention (BI) and actual usage (AU).

Table 2. Descriptive statistics: Gender and ANOVA results

	Male (n = 70)		Female (n = 88)		Significance of Difference between Women and Men (F Ratios)
	Mean	SD	Mean	SD	
SN	3.44	0.04	3.39	0.06	.683 n.s.
PU	3.96	0.08	3.88	0.04	.507 n.s.
PEOU	4.15	0.11	4.18	0.17	.091 n.s.
BI	3.84	0.14	3.85	0.09	4.788*

Note: n.s. = not significant; * $p < 0.05$

Perceived Usefulness, Perceived Ease of Use and Intention to Use

In the e-textbook learning context, perceived usefulness refers to the belief by an individual that the e-textbook is useful in order to enhance their performance (c.f. Davis, 1989). It has also long been established in literature that there exists a relationship between perceived usefulness and the behavioral intention to use a system (Davis, 1989; Venkatesh and Morris, 2000; Venkatesh & Davis, 2000). Perceived ease of use, defined in literature as the belief that a use of a particular technology is free of effort (Davis, 1989), points to the end that perceived ease of use is will both affect perceived usefulness and the behavioral intention to use a system (Davis, 1989; Venkatesh & Morris, 2000; Venkatesh & Davis, 2000). The use of a system has been long hypothesized to be dependent on behavioral intention to use (Davis, 1989). Since intention is predicted by attitude towards an act (Ajzen, 1975; 1991), it is reasonable to predict that favorable attitudes will lead to a favorable behavior. Therefore, we propose:

H4a: Perceived usefulness (PU) will positively affect the behavioral intention (BI) to use e-textbook learning technology;

H4b: Perceived ease of use (PEOU) will positively affect the perceived usefulness (PU) of e-textbook learning technology;

H4c: Perceived ease of use (PEOU) will positively affect the behavioral intention to use (BI) e-textbook learning technology.

Table 3. Standardized regression weights (CFA), and reliability tests

Item	PU	BI	PEOU	SN
1	.930	.916	.828	.833
2	.922	.946	.826	.905
3	.768	.870	.713	.848
Reliability (Standardized Crombach's α)	.90	.93	.83	.90

Table 4. Goodness-of-fit indices

Goodness-of-Fit Measure	Recommended Value	Entire Sample	Comment
Chi-square/df	<= 3.00	2.82	Adequate
Goodness-of-fit (GFI)	>= 0.9	.87	Marginally adequate
Adjusted GFI	>= 0.8	.80	Adequate
Normed fit Index (NFI)	>= 0.9	.90	Adequate
Comparative Fit Index (CFI)	>= 0.9	.93	Adequate
Tucker-Lewis Index (TLI)	>= 0.9	.91	Adequate
Root Mean Square Error of Approximation (RMSEA)	<=0.08	.11	Not adequate

Actual Usage of Technology

Much of previous research has established the importance of PEOU and PU in determining acceptance of technology and actual usage. Low usage of installed programs has triggered the curiosity of both practitioners and researcher of alike to want understand the role of acceptance and even more importantly the link between acceptance and actual usage. In other words, use of technology is dependent on intention which, of itself is dependent on user perceptions. In most research however, although the link between intention and usage is quite evident, the link has been more or less assumed than tested. Hence, it can be hypothesized that:

H5: Behavioral intention to use (BI) e-textbook learning technology will positively affect actual usage.

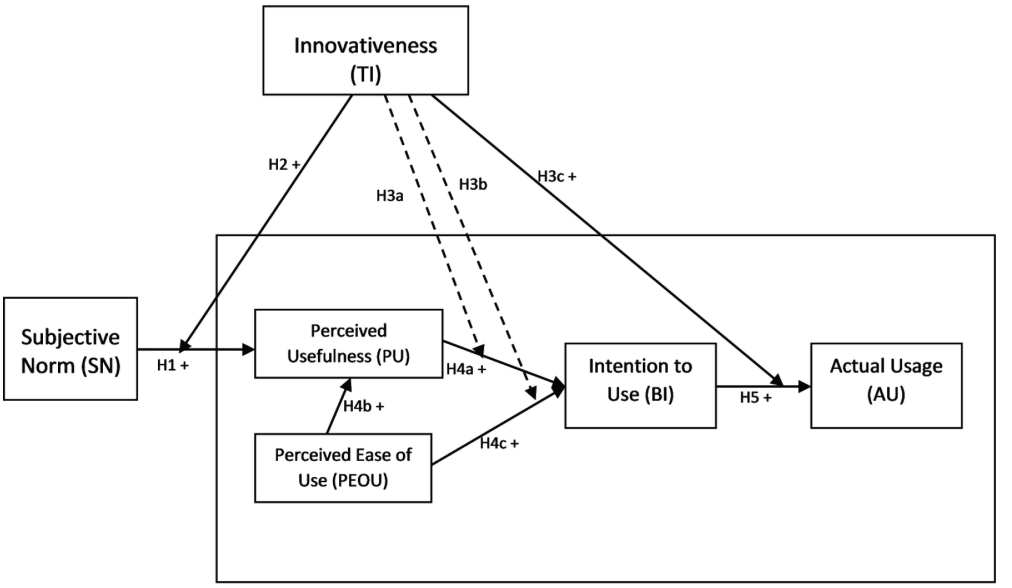
METHODOLOGY

Sample

Previous research has pointed to undergraduate students as regular users of e-book (Hernon et al., 2006). The sample frame from which the sample was drawn for this research was undergraduate students—the frequent users. The sample for this research was drawn from a group of undergraduate students using e-book technology for instruction in a university in Southern Region of the United States of America. The drawn sample of 158 undergraduate students from an e-book statistic course comprised 70-male and 88-female business students each having a higher educational computer experience of at least 3 years. The number of survey questionnaires collected totaled 158 from a distributed total of 167 questionnaires, from five sections of an upper-level undergraduate business statistics course. The response rate from the 16-item questionnaire was 94.6%.

The original survey was pretested with on some undergraduate students to check for clarity of items and feedback.

Figure 2. Research model and hypotheses results



These students were asked to check the response that best described their level of agreeableness to each item on the survey. Three sections of this course, totaling 77 students were undergoing a complete e-book learning implementation program. Full implementation of this program meant that the students' learning, assignments, examinations and feedback were completely supported online i.e. paperless. For the remaining 81 students drawn from and additional three sections of the course, e-book learning implementation was partial: students studied online, but carried out assignments and testing in a pen-and-

Table 5. Summary of hypotheses testing results

Hypothesis	Relationship	Proposed Relationship	Result
H1	SN-PU	Positive	Supported
H2	SN-PU	Moderated by TI	Supported
H3a	PU-BI	Moderated by TI	Not Supported
H3b	PEOU-BI	Moderated by TI	Not supported
H3c	BI-AU	Moderated by TI	Supported
H4a	PU-BI	Positive	Supported
H4b	PEOU-PU	Positive	Supported
H4c	PEOU-BI	Positive	Supported
H5	BI-AU	Positive	Supported

paper fashion, analogous to a regular traditional learning style. The ratio of full-to-partial implementation was 1:1.1. These students were asked to check the response that best described their level of agreeableness to each five-item answer choice on the survey. Overall the male-to-female ratio was nearly even; 1:1.3. A summary of the descriptive statistics are included in Tables 1 and 2.

Measures

The survey items were implemented through a five-point Likert scale measure, and scales used were adopted from validated scales of the previous studies of (Venkatesh & Davis, 2000; and Taylor & Todd, 1995). All scales were adapted to fit the e-book context of study. Consistent with social research, demographic variables were also collected especially gender. The fully itemized questionnaire is provided in the Appendix.

Data Analysis and Results

Collected data was assessed for missing or incomplete values and imputational methods used as recommended by Hair, Black, Babin and Handerson (2009; pp. 42-64). The TI construct, which was originally measured in metric scale using a 5-Likert measure, was transformed to nominal scale such that values less than 2.5 were coded as "low" in technological innovativeness and those with measures higher than 2.5 were rated as "high" on technological innovativeness.

Using the SPSS software, reliability measures were computed for all items. Taking Crombach's α as the unit of measurement, the reliability of each construct was measured. As can be seen from Table 3; all the reliability test results were above the .7 threshold recommended by most research standards (Nunnally, 1978; Hair et al., 2009). Table 3 contains the summary of the standardized regression weights from which the discriminant and convergent validity measures were calculated. Factor loadings all constructs were greater than the 0.5 threshold level; the variances extracted were also all greater than the 0.5 recommended levels (actual values were SN: 0.74; PU: 0.77; PEOU: 0.63; BI: 0.83) and construct reliability measurements were all higher than the 0.7 level; hence, convergent validity was ascertained. Discriminant validity is attained when the variance extracted for each factor is greater than all the squared inter-factor correlations associated with that factor (Hair et al., 2009). Variances extracted all exceeded the inter-factor correlations and therefore confirmed discriminant validity. All of the TAM relationships except for subjective norms were strong and significant. However, except for behavioral intention to use, all the individual constructs did not show any differences based on gender. Results are summarized in Table 2.

Confirmatory factor analysis (CFA) and structural equation modeling (SEM) technique were conducted using AMOS statistical software. Both CFA and SEM have been used extensively in information systems related research (Compeau & Higgins, 1995; Venkatesh & Morris, 2000; Chin & Todd, 1995). CFA was conducted instead of exploratory

factor analysis because the model had already been validated through previous research. Through CFA it was hoped that the items will load highly on TAM constructs with an adequate model fit. Also, with an adequate CFA model fit, SEM technique could then be used to estimate the model. The standardized regression weight estimates from the CFA analysis are included in Table 3.

The CFA model was further assessed for model fit. Typically, there is no one index that can solely determine fitness. Consequently, different fit indices must be considered to capture the fitness as recommended by most researchers (Hair et al., 2009; p. 670). In Table 4, the results of fit indices are displayed alongside recommended values and a comment on their fit. Two of the three major fit index categories are represented namely: absolute indices (chi-square statistic and GFI); incremental indices (NFI, TLI) and parsimony indices were used. While some indices were less than adequate, most indices were acceptable, hence confirming the validity of model.

Using the SEM technique the proposed model was then ran. First, a check was done to see if the items of the constructs loaded significantly; also, another check was conducted to verify that the original TAM relationships would be significant as proposed in the proposed model. All the items were found to load to their corresponding factors in a significant way. Additionally, the TAM relationships were highly validated with significant relationships at over 99% confidence interval. With all these in place, the moderating effect of TI was also tested as proposed in the research model.

DISCUSSION OF FINDINGS

The results of this study reveal that the original TAM relationships were clearly supported. The TAM relationships were highly validated with significant relationships at over 99% confidence interval. Additionally, the relationship of subjective norms to the TAM constructs was also supported by data. These imply that the TAM constructs are quite reliable as could be evidenced from the reliability estimates; model fit estimates of CFA, and the construct validity values (see Table 3 and Table 4).

The means of PU were generally higher than those of other constructs in both types of implementation programs. In contrast, when the sample was split according to gender, the EOU constructs had the highest mean values. Additionally the results showed that females rated EOU of the e-book higher than men. The proposed hypotheses testing results are presented in Table 5; while the final model is shown in Figure 2.

Results showed TI was a significant moderator of the relationships SN-PU, and BI-AU. TI did not moderate the relationships: PU-BI and PEOU-BI.

CONCLUSION AND IMPLICATIONS

The purpose of this study was to investigate the moderating role of technology innovativeness on e-book acceptance among undergraduate students. We used

the key constructs of the well-known technology acceptance model to understand the nature of these relationships. All of the results of this study must, however, be interpreted within the confines of the limitations of this research: namely, the sample size and the research setting. The use of diverse settings and larger sample sizes over time has been shown to increase greater validation and generalization of conclusions.

The findings of this study lead to three major conclusions. First, an observable strong connection between *behavioral intentions* and *actual use* of e-books. Although the link between intention and actual use of technology is often theorized in literature, not all studies support these conclusions (Turner, Kitchenham, Brereton, Charters & Budgen, 2010). One of the reason for such discrepancy has been the use of subjective measures as opposed to objective measures of actual use. Turner et al. (2010) have suggested that researchers should only use TAM to measure actual use within the contexts where TAM has been validated. The current study serves to provide a context for the prediction of actual use of e-books from behavioral intentions to use it. Second, the research seems to validate the stability of the original TAM framework. All the hypothesized TAM relationships in the study were strongly supported. This adds to the number of technologies and the context of use of these technologies in validating the technology acceptance model. It is safe, therefore, to say that the TAM framework is versatile enough to predict e-book acceptance and usage in the context of an undergraduate class. Lastly, the positive moderating effect of technology innovativeness on the relationship between social influences (i.e. subjective norms) on perceptions about e-books (i.e. perceived usefulness and perceived ease of use), and behavioral intention on actual use has significant implications on e-book adoption. This showed that the more technologically innovative students are, the greater the influence of significant others in their perception of use of new technology. Additionally, the higher the students' technology innovativeness, the more likely they were to convert their use intentions to use new technology to actual usage. On the other hand, the less technologically innovative students were, the less likely they were to have high perceptions of the usefulness of new technology, and consequently, the less likely they were to translate behavioral intentions to use a new technology to the actual use of it.

The implications of these findings are important to educational pedagogues, who must find a way to move the less technologically innovative students (slow adopters and non-adopters) past the barrier of the *intention to the use* an instructional technology to the *actual usage* of the technology. It might be important for adopters of educational technology to consider the use of motivation in the adoption of technology. Some researchers like Gwebu and Wang

(2007), have proposed human motivation as a way of pushing forward the diffusion of this type of technology. Also, educational technology vendors should make technology more intuitive in order to boost technology innovativeness levels, and thereby increase actual usage. Consequently, educators should identify low adopters of technology and improve on their technology innovativeness so as to move these students towards the actual usage of the technologies. It is the effective actual use of e-book technology system that will improve quality of instruction and enhance the learning experience. Hence, the boosting technology innovativeness among students may be that important link that not only increase system usage, but also to improve academic outcomes.

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Madison Ngafeeson is an Assistant Professor of computer information systems at the Walker Cisler College of Business, Northern Michigan University in Marquette, Michigan. His general research interest is in the area of the adoption, implementation, diffusion and use of information systems in organizations; with a special focus in health information systems management. His works have been published in such outlets as the International Journal of Electronic Healthcare, the International Journal of Electronic Government Research, International Journal of Electronic Finance and the proceedings of the European Conference on Information Systems and the Decision Sciences Institute. He has also served as mini-track reviewer for the Americas Conference on Information Systems and European Conference on Information Systems.

Jun Sun is an Associate Professor of Information Systems at The University of Texas Rio Grande Valley. He received his PhD in Information and Operations Management from Texas A&M University. One of his research interests is the use of information technology for innovative education. Relevant work has appeared in the Decision Sciences Journal of Innovative Education, Information Systems Education Journal, International Journal of Services and Standards, and Learning and Individual Differences.

APPENDIX

Questionnaire Items

Technological Innovativeness

TI1: If I heard about a new information technology, I would look for ways to try it out.
TI2: Among my peers, I am usually the first to try out new information technologies.
TI3: I like to experiment with new information technologies.

Subjective Norms

SN1: People important to me support my use of the e-textbook.
SN2: People who influence me think that I should use the e-textbook.
SN3: People whose opinions I value prefer that I should use the e-textbook.

Perceived Usefulness

PU1: Using the e-textbook can improve my learning performance.
PU2: Using the e-textbook can increase my learning effectiveness.
PU3: I find the e-textbook to be useful to me.

Perceived Ease of Use

EOU1: Learning to use the e-textbook is easy for me.
EOU2: It is easy for me to become skillful at using the e-textbook.
EOU3: Overall, the e-textbook is easy to use.

Behavioral Intention to Use

BI1: I will use e-textbooks for other classes.
BI2: I will continue using e-textbooks in the future.
BI3: I will strongly recommend that others use e-textbooks.

Actual Usage

I have been using the e-book:

ℜ almost every day
ℜ 2-3 times a week
ℜ once a week
ℜ a few times during the semester
ℜ almost never