Analyzing Different Factors Affecting Users' Adoption of DOST STARBOOKS in Region 12 Using Technology Acceptance Model

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Abstract

Digital technologies have been bridging the gap   terms of convenience, reliability, and timeliness on these current settings (Kapur 2006). It is extensively used by majority of individuals due to its technical functions n wide array of transactions. Like in education, the use of digital technology is imperative aspects that has gained more prominence due to global pandemic. In Philippines, Digital technology has been adopted by Department of Science and Technology through its Science and Technology Academic and Research-Based Openly Operated Kiosk Station or STARBOOKS. The latter is primarily developed to share digitized resources of S&T library materials specifically to marginalized populations all over the country. This study aims to test the framework of Technology Acceptance Model or TAM feature of DOST-STARBOOKS such as Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) towards the users in identified sites in the Philippine countryside. There were one hundred seven (107) total respondents of the study from University of Southern Mindanao (USM), – Kabacan Mindanao State University (MSU) – General Santos City, Sultan Kudarat State University (SKSU) – main campus, and Notre Dame Hospital and School of Midwifery (NDHSM) – Cotabato City.

The study reveals that there is a significant difference among groups (age, sex, and school) with regards to Perceived Usefulness (PU) of STARBOOKS and Perceived Ease of Use (PEOU) STARBOOKS based on One Way Analysis of Variance or ANOVA Based on the findings generated from Exploratory Factor Analysis is acceptable with a determinant value of 0.005 that is higher than 0.001. This interpret that the respondents' answer data is free of multicollinearity issues. All of the variables are significant, according to research hypothesis testing based on regression weights using CFA results. The study concluded that undergraduate students found STARBOOKS as a useful (PU) and user-friendly (PEOU) mode of technology most especially for feasibility study and thesis purposes.

Keywords
DOST-STARBOOKS, Perceived Usefulness (PU) Perceived Ease of Use (PEOU) – TAM, ANOVA, CFA, EFA, TAM

1. Introduction
The use of digital tools has set a technological platform and brought significant impact on learners in multiple ways. The reason behind shifts traditional libraries to adopt innovative methods to disseminate digital format information while creating free access to what is available on the World Wide Web. Digital libraries (DLs) can be defined as sites and software dedicated to creating and preserving electronic book collections and other kinds of materials without users' need to purchase materials to read (Kapur, 2018). According to Higgins, Xiao & Katsipataki (2012), digital technology is effectively and widely used from nursery to university level which can be done in groups and pairs. Generally, Digital

Libraries is the adoption from physical and traditional library converted to electronic information that offers a state-of-the-art level of accessibility to wide range of users (Higgins, Xiao, & Katsipataki, 2012).

In 2011, the Department of Science and Technology through Technology Information Institute (DOST-STII) established the first science library in the Philippines as part of its mandate in the form of STARBOOKS. This initiative addressed the need for Digital Library in the Philippines in fields of science, technology, and mathematics.

STARBOOKS is designed to offer academic assistance towards marginalized community in the Philippines. The digitized resources in Science, Technology, Engineering, Agriculture, Mathematics, and other related fields are installed in a kiosk for the easy access of data and information through online and offline sources. Moreover, STARBOOKS also contain science news and information, educational and livelihood videos, DOST agencies' programs and projects, research, and thesis. According to Wani, S. (2019), multi-purpose kiosks can improve the student experience by providing multiple information and resources in one place while saving time.

Of the 4,884 STARBOOKS sites nationwide, 153 sites are situated in SOCCSKSARGEN Region where this study will be conducted (DOST XII, n.d). The STARBOOKS users vary from students, teachers, and researchers but also can be accessed online by anyone. In other words, STARBOOKS users may have diverse backgrounds, knowledge, and skills. In this aspect, their adoption to STARBOOKS can be affected and the usability of this digital library can also differ. A study revealed users widely enjoy the unique features of DLs that are absent in the traditional environment, such as remote access, 24 hours access, and faster access (Liu Z. & Luo L. 2011).

1.1 Objectives
This study was aimed to test the framework of Technology Acceptance Model or TAM feature of DOST-STARBOOKS such as Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) towards the users in identified sites in the Philippine countryside. Analyzing such factors can improve how Digital Libraries empowers its users through a more responsive and effective means of disseminating Science and Technology information and content to a specified and personalized user experience of STARBOOKS.

2. Literature Review
The Digital Libraries or DLs have been recognized by society in playing vital role to enhance the learnings of the users (Candela et al. 2011). But before digitalization, libraries are already the frontlines institutions to provide educational resources. This source of vast information has adopted to the advances of computer science when digital representation of documents had captured human knowledge and culture thus "digital libraries" soon become coined to digital counterparts of traditional libraries. Library kiosk service saves time of the users and help library users for smooth functioning [9]. According to Buckland (2003), library design for Digital Libraries has been concentrated on creating a database and enable individual to search a database.

The Technology Acceptance Model or TAM is extensively used and widely accepted model in testing or developing context of technology such as Digital Libraries (Miller, 2010). This model has been used primarily to assess productivity of technology being introduced for adoption. It is also utilized and develop to predict or generate acceptance model to the particular study in adoption or utilized new information technologies. Moreover, according to Hindagolla (2017), TAM is the key tool or model to assess and predict users' technology usefulness or behavior).

3. Methods
Data Gathering
This study was conducted using the Technology Acceptance Model 2 (TAM2) framework by Venkatesh and Davis (1996). The survey questionnaire was administered online to identified undergraduate students of four (4) universities and Colleges in Region 12, including the University of Southern Mindanao in Cotabato Province, Mindanao State University in General Santos City, Sultan Kudarat State University in Sultan Kudarat Province, and Notre Dame Hospital and School Midwifery in Cotabato City. These universities represent the Region 12, where DOST STARBOOKS has been implemented.

4. Data Collection

The questionnaire that used was the Post-Study System Usability Questionnaire that consists of two parts. The first records subject's demographic information. The second measures the subject's perception of each variable in the proposed model. Demographics that assessed were gender, age, course, and research activities done or currently working on. The second section was asking the subject to rate the degree of agreement with each item provided in a Seven-point Likert-type scale, where -1 extremely disagree; - 2 strongly disagree; -3 disagree; 4 stands for uncertain or neutral; 5 agree; 6 – strongly agree; 7 – extremely agree. The questionnaire was pilot tested at Notre Dame of Marbel Univesity (NDMU), Koronadal, South Cotabato.

The identified universities have adopted offline STARBOOKS to cater different users with their research needs. With Technology Acceptance Model (TAM), the study was able to determine, based on purposive sampling, factors affecting the usage of STARBOOKS and how users' perceived ease of use and perceived usefulness of STARBOOKS affect the attitude toward using and the intention to use of STARBOOKS.

Validity and Reliability of the Research Instrument

The survey questionnaire undergone Content validity. The latter is the degree to which items in an instrument reflect the content universe to which the instrument was generalized (Straub, Boudreau et al. 2004). The researcher consulted a statistician to validate the survey questionnaire. In IS, it is highly recommended to apply content validity while the new instrument is developed. According to Lewis et al. (1995) and Boudreau et al. (2001), content validity involves evaluating a new survey instrument to ensure that it includes all the essential items and eliminates undesirable items to a particular construct domain. The judgmental approach to establish content validity involves literature reviews and then follow-ups with expert judges or panels' evaluation.

The reliability of the questionnaire was employed to assure quality results of the study. Thus, A Standardized Cronbach's α: .887 and α: .839 for the Perceived of Usefulness and Perceived Ease of Use, respectively, must be obtained during pilot testing. Testing for reliability is important as it refers to the consistency across the parts of a measuring instrument (Huck, 2007). A scale is said to have high internal consistency reliability if the items of a scale "hang together" and measure the same construct (Huck, 2007 & Robinson, 2009). The most commonly used internal consistency measure is the Cronbach Alpha coefficient. It is viewed as the most appropriate measure of reliability when making use of Likert scales (Whitley, 2002, Robinson, 2009). No absolute rules exist for internal consistencies, however, most agree on a minimum internal consistency coefficient of .70 (Whitley, 2002, Robinson, 2009).

Treatment of the Data

 This study used descriptive analytics to evaluate the demographics of the STARBOOKS users in region 12. It also used regression analyses to measure TAM framework's applicability to DOST STARBOOKS while testing the hypotheses that both perceived ease of use and perceived usefulness can predict intention to use. It   tested the best predictors of perceived ease of use and perceived usefulness concerning the actual use of the STARBOOKS.
One-way ANOVA between-group was used to test two groups to see if there's a difference among the following variables.

This study employed Structural Equation Modeling, or SEM, to view combination of factor analysis and regression or path analysis. The interest in SEM is often on theoretical constructs, which are represented by the latent factors. The relationships between the theoretical constructs are represented by regression or path coefficients between the factors. The structural equation model implies a structure for the covariances between the observed variables, which provides the alternative name covariance structure modeling.

Factor Analysis used to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables. Factor analysis will help the researcher search for such joint variations in response to the unobserved latent variables. Thus, this study was conducted one type of factor analysis, the EFA.
Exploratory factor analysis (EFA) is used to identify the complex interrelationships among items and group items that are part of unified concepts. The researcher makes no "a priori" assumptions about the relationships among factors. A determinant value of 0.005, which is greater than 0.001, reflects that the respondents' response data do not have any multicollinearity problems. Prior to the extraction of the factors, several tests were used to assess the respondent data's suitability for factor analysis. These tests included Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity.

5. Results and Discussion
5.1 Numerical Results

Table 1. Indicating the Profile of the Respondents

Variables	Total Number	Percentage
Name of School		
Mindanao State University – General Santos City (MSU)	58	*53.09*
University of Southern Mindanao – Kabacan (USM)	19	*17.09*
Sultan Kudarat State University – Main Campus (SKSU)	13	*12.3*
Notre Dame Hospital and School of Midwifery (NDHSM)	16	*15.1*
Age		
16 – 19 yrs. old	17	*15.9*
20 -23 yrs. old	75	*70.1*
24 -27 yrs. old	10	*9.3*
28 yrs. old up	5	*4.7*
Sex		
Male	64	*60.4*
Female	43	*39.6*
Research Activity Done (RAD)		
Thesis	53	*52.5*
Feasibility Study	59	*58.4*
Project Proposal	1	*1*
School Projects	1	*1*
Research Paper	1	*1*
Other Research Related Stuff	1	*1*

Table 2. The Mean and Standard Deviation of Perceived Usefulness of STARBOOKS

Items	Mean	Interpretation	SD
1.1. DOST STARBOOKS can be seen and accessed easily each time I want to do some research in our library.	**5.47**	**Agree**	**1.25**
1.2. I am familiar with DOST STARBOOKS and I am comfortable in operating it to do my researches at school.	**5.27**	**Agree**	**1.41**
1.3. I heard from a friend/colleague/instructor that DOST STARBOOKS is useful and I intend to use to it too.	**5.81**	**Strongly Agree**	**1.27**
1.4. I trust all information and data from DOST STARBOOKS are truth and useful and I am confident that it is from legitimate sources.	**6.28**	**Strongly Agree**	**1.01**
1.5. The research output(s) I can gather from DOST STARBOOKS is/are relevant to my actual research problems or assignment.	**6.26**	**Strongly Agree**	**0.99**
1.6 I find DOST STARBOOKS very useful and I will be using this for my research needs and assignment.	**6.33**	**Strongly Agree**	**1.00**

Value Allocation

1.0 – 1.49 Extremely Disagree   (ED)
1.50 – 2.49 Strongly Disagree   (SD)
2.50 – 3.49 Disagree   (D)
3.50 – 4.49 Neutral   (N)
4.50 – 5.49 Agree   (A)
5.50 – 6.49 Strongly Agree   (SA)
6.50 – 7.00 Extremely Agree   (EA)

Table 3. The Mean and Standard Deviation of Perceived Ease of Use of STARBOOKS

Items	Mean	Interpretation	SD
2.1. I am familiar with basic computer operation and DOST STARBOOKS can be easily operated with the skills that I have.	5.53	Strongly Agree	1.41
2.2. DOST STARBOOKS can be used anytime with access to electricity and environment that is comfortable to work and do my research.	5.41	Agree	1.32
2.3. DOST STARBOOKS can be easily accessed in the library and I do not see any problem in accessing it anytime I want to.	5.33	Agree	1.42
2.4. I can easily understand research contents in english and I do not find any problem in operating computer-based english language instructions.	5.50	Strongly Agree	1.36
2.5. I can do research on my own without the need of supervision since I am familiar with the features of DOST STARBOOKS.	5.13	Agree	1.57
2.6. I find DOST STARBOOKS easy to use and I feel I can use it to do my research and assignment.	5.51	Strongly Agree	1.41

Value Allocation

1.0 – 1.49 Extremely Disagree	(ED)
1.50 – 2.49 Strongly Disagree	(SD)
2.50 – 3.49 Disagree	(D)
3.50 – 4.49 Neutral	(N)
4.50 – 5.49 Agree	(A)
5.50 – 6.49 Strongly Agree	(SA)
6.50 – 7.00 Extremely Agree	(EA)

Table 4. Analysis of Variance among ages

SUMMARY

Groups	Count	Sum	Average	Variance
16-18yo	17	106.5682	6.268717	0.649579
20-23yo	75	411.0551	5.480734	0.931604
24-27yo	10	61.16667	6.116667	0.926235
28 and above	5	30.83333	6.166667	0.611111

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	11.92856	3	3.976186	4.544844	0.004936
Within Groups	90.11248	103	0.874878		
Total	102.041	106			

*Significant at the .05 level

Table 5. Analysis of Variance among Schools

SUMMARY

Groups	Count	Sum	Average	Variance
MSU	58	301.9717	5.206409	0.852372
USM	19	115.75	6.092105	0.780783
SKSU	13	85.98485	6.614219	0.057961
ND	16	99.75	6.234375	0.419647

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	32.4809	3	10.82697	15.86038	0.00154624	2.693721
Within Groups	69.62953	103	0.682642			
Total	102.1104	106				

Table 6. Analysis of Variance among Sex

SUMMARY

Groups	Count	Sum	Average	Variance
Male	64	358.5121	5.601752	1.006746
Female	43	221.7444	5.156848	0.870967

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.09094	1	5.09094	5.345189	0.022731	3.931556
Within Groups	100.0056	105	0.952434			
Total	105.0965	106				

Table 7. Overall Fit Indexes from CFA Output.

Model valid (N=100)	df	X^2	X^2/df	TLI	NFI	IFI	CFI	RMSEA	SRMR
Suggested cutoff values			<3	>0.90	>0.90	>0.90	>0.90	<0.08	<0.08
Proposed model score	28	32.837	1.172	0.924	0.913	0.962	0.962	0.0391	0.02

Table 8. Regression Weights from CFA outputs

		Estimates	p	Relationship
H3a ←	PU	0.79	***	Significant
H3b ←	PU	0.99	***	Significant
H3c ←	PU	0.98	***	Significant
H3d ←	PU	0.96	***	Significant
H3e ←	PU	0.94	***	Significant
H4a ←	PEOU	0.99	***	Significant

H4b	← PEOU	0.98	***	Significant
H4c	← PEOU	0.96	***	Significant
H4d	← PEOU	0.96	***	Significant
H4e	← PEOU	0.98	***	Significant

*** significant at the 0.01 level

5.2 Graphical Results

This study fully supports the Technology Acceptance Model (TAM) argument because the researcher finds that PU and PEOU are all important for STARBOOK acceptance towards the users based on the model presented in figure 1. This finding is consistent with a study on Digital Library implementation by Matusiak (2017), which found that usefulness and easiness have a positive significant relation with usage. Perceived usefulness and perceived ease of use are users' subjective assumptions and opinions of the system and do not necessarily reflect objective reality.
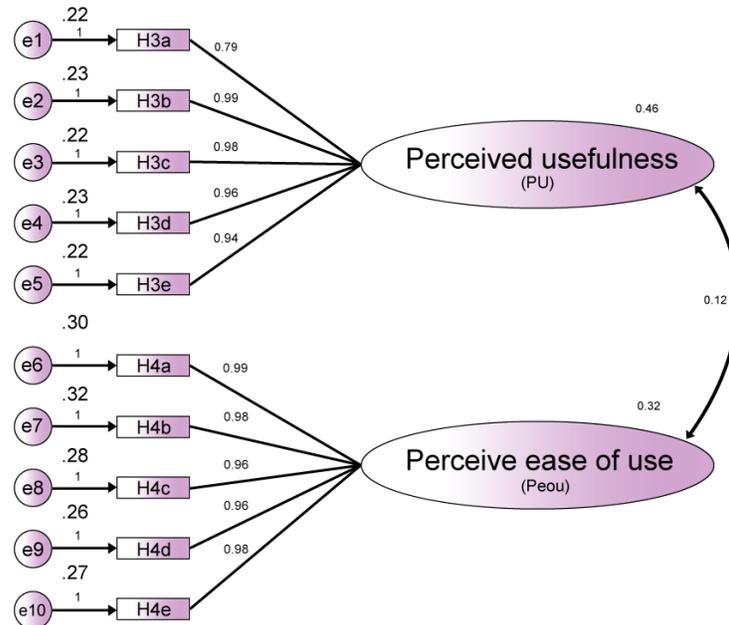
Figure 1. Confirmatory Factor Analysis of User Acceptance Factors

Perceived usefulness of an information system is understood as the extent to which a person believes that using the system will contribute to meeting his/her information needs or solving a problem. Potential users can believe that a system is useful, but at the same time be convinced that it is hard to use. Perceived ease of use is defined as 'the degree to which a person believes that using a particular system will be free of effort (Davis 1989).
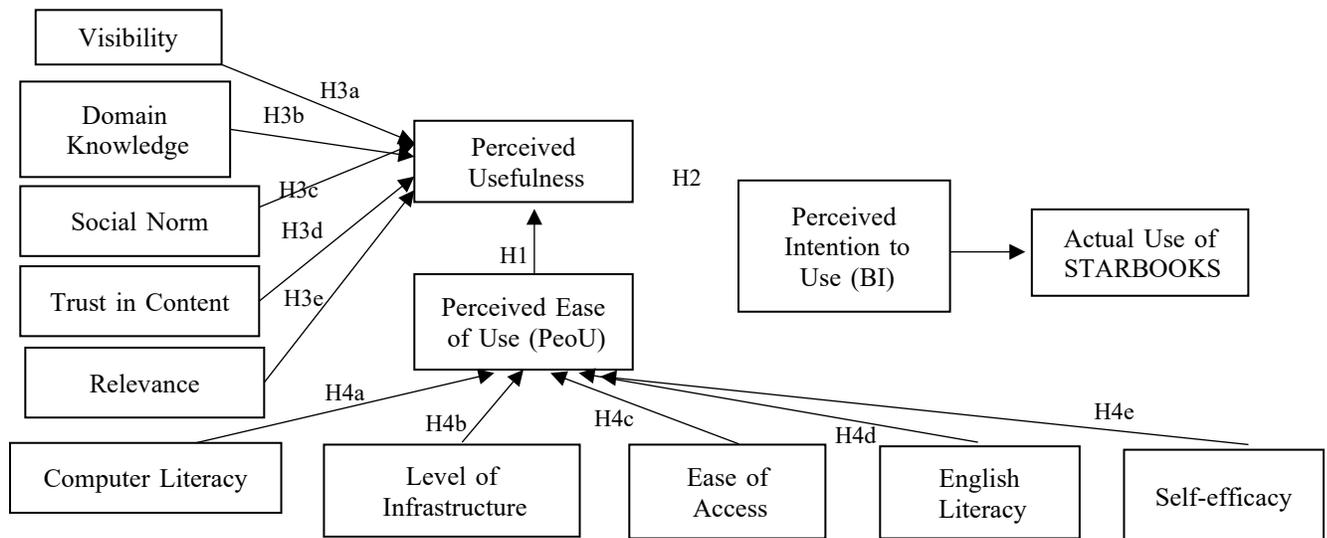
Figure 2. Proposed TAM 2 Framework for STARBOOKS Adoption

Miller and Khera (2010), employed Technology Acceptance Model or TAM to investigate user approval of digital library system adoption at agricultural institutions in two developing countries: Kenya and Peru, in a study published in 2010. TAM was found to be effective in characterizing elements that influence the use of digital libraries, with perceived utility being the most important predictor of intention to utilize the system (The Essential Electronic Agricultural Library, or TEEAL). It was also discovered that many determinants of perceived utility and ease of use are universal across cultures.

5.3 Proposed Improvements

From seven model fit indexes, the chi-square value produced significant results, which were not consistent with a good model fit. However, the values of TLI, IFI, and CFI exceeded those that pointed to an overall good model fit (See table 7). The combination of factor analysis and regression or path analysis is through this modeling. The interest in SEM is often on theoretical constructs, which are represented by the latent factors. The relationships between the theoretical constructs are represented by regression or path coefficients between the factors. The structural equation model implies a structure for the covariances between the observed variables, which provides the alternative name covariance structure modeling.

5.4 Validation

Factor analysis was used to identify a small number of factors that explained most of the variance observed in a much larger number of manifest variables. This study conducted two types of factor analysis. These are EFA or Exploratory Factor Analysis and Confirmatory Factor Analysis.

Exploratory Factor Analysis (EFA)

A total of twelve (12) questions from the questionnaire were subjected to Exploratory Factor Analysis. The results show that the determinant value of 0.005 that is greater than 0.001 is acceptable. This would also indicate that the respondents' response data have no multicollinearity problems. The extracted determinant value was first test using Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy which has a value of 0.756 greater than 0.5 standard value and Bartlett's Test of Sphericity to assure that is fit for factor analysis.

Confirmatory Factor Analysis (CFA)

Based on EFA results, the researcher computed CFA to test if the data is fit the hypothesized measurement model. The results of the chi-square / df, Tucker–Lewis index (TLI), normed fit index (NFI), IFI = incremental fit index, comparative fit index (CFI), root mean square error approximation (RMSEA) and standardized root mean square

residual (SRMR) are acceptable (see table 7). Comprehensively the results are as follows; the CFI was 0.962 which is greater than 0.90 is acceptable; the RMSEA was 0.0391 which is less than 0.08 is acceptable. This reflected that the models of user acceptance factors (see figure 1) could be considered a very good fit for the observed data.

6. Conclusion

This research assesses the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of STARBOOKS among undergraduate students. The study concluded that undergraduate students found STARBOOKS as a useful (PU) and user-friendly (PU) mode of technology most especially for feasibility study and thesis purposes. Specifically, the study concluded the following:

1. Perceived ease of use is a significant predictor of DOST STARBOOKS' perceived usefulness.
2. Perceived usefulness is a significant predictor of perceived intent to use DOST STARBOOKS.
3. Visibility has a positive relationship on perceived usefulness of DOST STARBOOKS.
4. Domain Knowledge has a positive relationship on perceived usefulness of DOST STARBOOKS.
5. Social Norm has a positive relationship on perceived usefulness of DOST STARBOOKS.
6. Trust in Content has a positive relationship on perceived usefulness of DOST STARBOOKS.
7. Relevance has a positive relationship on perceived usefulness of DOST STARBOOKS.
8. Computer literacy has a positive relationship on the perceived ease of use of DOST STARBOOKS.
9. Level of Infrastructure has a positive relationship on the perceived ease of use of DOST STARBOOKS.
10. Ease of Access has a positive relationship on the perceived ease of use of DOST STARBOOKS.
11. English Literacy has a positive relationship on the perceived ease of use of DOST STARBOOKS.
12. Self-efficacy has a positive relationship on the perceived ease of use of DOST STARBOOKS.

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