Technology Acceptance Modeling of Electronic Library (e-Library) Usage by Undergraduate Students

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ABSTRACT

Given the spate of the usage of the novelty of e-library information systems by undergraduate students in a third world scenario severely hampered by operational challenges, this study was undertaken to uncover the dynamics involved in the motivation and behavioral intentions of the student-users. The Technology acceptance model was adapted to the environmental context of study by introducing a new external variable: Economic expediency. The TAM model was analysed using the structural equation modeling (SEM) statistical technique in the AMOS statistical software. A questionnaire survey measuring for the constructs of the TAM research model was conducted upon a sample size of 207 undergraduates. The measuring scale was validated using confirmatory analysis, with results establishing the causal path of Economic Expedience on e-library usage, with the model having good overall fit parameters (GFI=0.918,RMSEA= 0.045, CFI=0.934, $\chi 2$/df =1.822).

Keywords: Economic expedience, e-library Structural equation modeling, Technology acceptance model

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1. INTRODUCTION

There has been an urgent need for the creation of e-libraries in tertiary institutions in developing countries as a means of enhancing the teaching/learning process and empowering students through information and technology resources towards better education and research. In countries like Nigeria, it is a welcome development that corporate bodies in partnership with universities are refurbishing libraries and equipping them with e-library capabilities through the provision of computers, internet facilities and e-resources. At the present, such utilities are limited and centred in public universities; ideally such facilities are prescribed to ensure easy access to the library resource from anywhere via the internet, but observations have shown that most times, usage of these facilities are restricted in a formal-library setting where users are required to register manually and use computer desktops and laptops equipped with internet connectivity to assess e- library resources. In a socio-economic context of constrained economic resources on the one hand, with the affordability and scaling down of the price of internet services in the highly competitive telecoms industry with laptops becoming increasingly affordable.

On the other hand; there exists a differential distribution of motivation for e-library users (mostly students) of these free internet services, which might explain the usage of e-libraries which is a contributory component of the e-library technology acceptance. Thus, it is necessary to evaluate the behavioral intentions of users of these libraries so as to assess the perceived usefulness and impact of these facilities by applying variables reflecting the specialized contexts in third world countries. Such investigations will help specify highly effective interventions reflecting the true needs of the intended users. This study aims to explore the validity of the Technology acceptance model using external variables reflecting the socio-economic environment of an educational setting in Nigeria and also to examine the extent to which the external variables impact on the model using structural equation modelling.

2.. Background/ Conceptual Model

Technology acceptance was defined in [4] as the "verifiable disposition within a user group to utilize information technology (IT) for the tasks it was designed" [17]. The Technology Acceptance Model (TAM) is a much used and validated framework that investigates the factors implicit in technology adoption. By specifying the causal relationships between perceived usefulness, perceived ease of use, attitude towards computer use, and behavioural intention to use technology, the model evaluates the eagerness and motivation for a given technological adoption [6].

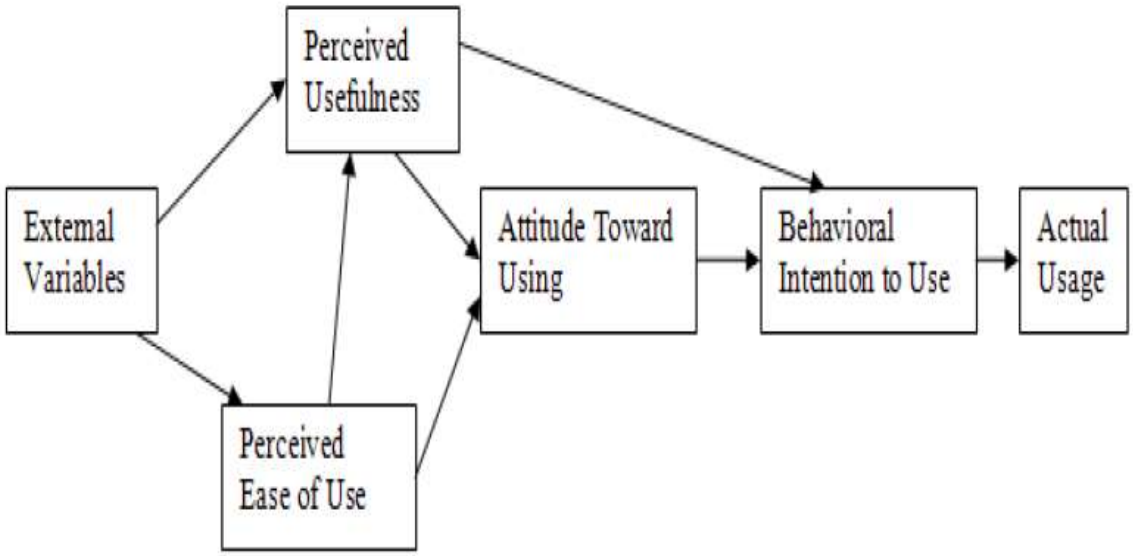

Figure 1: The technological acceptance model.

TAM has been used in several studies: Shroff et al., analysed the technology acceptance model in examining students' behavioural intention to use an e-portfolio system [17], while Teo tested the model in examining technology acceptance by pre-service teachers educators in Indonesia with results indicating a good model fit [18]; similar results were obtained in [1]. Where the tested model predicted the power of technology acceptance among pre-service teachers. Jiang, Chen and Lai, in their study [11] found that individual behaviour of technology acceptance was valuable but incomplete without looking at social factors and personal environment.

This point is further highlighted in [9] where it was suggested that in modelling perceptions regarding new technologies, subjective and social norms influence should be considered. Dishaw and Strong noted in [5], that the predictive ability of TAM could be improved by exploring the nature and specific influences of technological and usage-context factors involved in the user's acceptance.

It is against this background that this study proposes to evaluate the theoretical validity of the TAM for an educational context in Nigeria, using structural equation modeling to evaluate the relationships of the three external variables: economic expediency, technological complexity and computer self-efficacy and the other variables in the TAM.

3. RESEARCH MODEL

3.1 The TAM model

The basic assumption of the model is that behavioural intention is an outcome of a conscious decision making processes [20]. In the model, usage is determined and correlated to behavioural intention which has been established by research [23]. The behavioural intention, in turn, is affected by attitude toward usage, as well as the direct and indirect effects of perceived usefulness and perceived ease of use (PEU). Both perceived usefulness and perceived ease of use jointly affect attitude, whilst perceived ease of use has a direct impact on perceived usefulness [18]. The primary aim of studying external variables is to determine their effect on behavioral Intention or information resource usage.

3.2 TAM components

3.2.1 Perceived usefulness (PU) defines the extent to which an individual has faith that using a specific system will improve his or her efficiency or daily activities [2].

3.2.2 Perceived ease of use (PEOU) refers to "the extent or degree to which an individual has faith that using a specific system would be painless and hassle free [2, 25].

3.2.3 Attitude towards usage (ATU) refers to the "the degree to which an individual evaluates and associates the target system with his or her work which informs future behaviour" [3].

3.2.4 Behavioural Intention to use

Behavioural intention to use and apply new skills is the willingness or extent to which an individual is consciously prepared to execute or not execute a particular action [20].

3.3.4 External variables

There are several external variables that can be used in the TAM. Winarto enumerated more than 70 external variables in the literature that have been used in TAM [22]. Yousafzai, Foxall and Pallister, classified the variables into four categories, namely: organizational characteristics, system characteristics, user`s personal characteristics, and other variables [24].

Table 1: Some external variables [24]

Organisational characteristics	System characteristics	User characteristics	Other variables
Competitive environment	System design	Age	Cultural affinity
Users support	System operation	Cognitive ability	External computing support
Internal training	System maintenance	Information anxiety	Computer self efficacys
Management support	System development	Computer anxiety	Subjective norms
Policy support	System auditing	Computer literacy	Social pressure
Organisational composition	Access cost	Educational level	Social influence
Peer influence	Interface	Experience	Argument for change
Training and development	Convenience	Gender	
	Information quality	Intrinsic motivation	
	Cyber security	Tenure	
	System quality	Perceived playfulness	
		Perceived enjoyment	
		personality	
		Self efficacy	

3.3.4.1 External variables used in study

The external variables used in this study are economic expediency (which is proposed by the researcher), technological complexity and computer self-efficacy found in literature.

3.5 Operational definition of these variables

- **Economic expediency:** Predisposition to IT resource usage due to being optionally constrained by economic means i.e this variable says' "I am not considering the quality of the internet (if it is fast or slow) or if the systems there are limited and old or if I am given a short time to use it and it may be inconvenient with my timetable Or even if the service may not be certainly available when I need it due to power outage, Or it may be inconvenient to use this facility due to location **" I HAVE NO OTHER OPTION!**
- **Technological complexity :** Technological complexity is defined as the extent to which technology is perceived as difficult or easy to use and understand [19]. System complexity is related to affect behavioral intentions negatively.
- **Computer self-efficacy:** Computer self-efficacy is a significant factor affecting technology acceptance, and refers to the confidence and ability demonstrated in the use of computer resources by individuals in using such resources to achieve intended goals. An individual with high computer self-efficacy usage will be unimpeded by technological complexities, and will have a higher perceived ease of use of such technology, than a less efficacious user.

4. METHOD

4.1. Research design

This study utilizes a survey research methodology for which a questionnaire instrument was designed, which contained different items (questions) for each variable of the research model: perceived usefulness (PU)(3 items), perceived ease of use (PEU) (3 items), attitudes towards computer use (ATCU) (3 items), technological complexity (TC) (3 items), computer self-efficacy (CSE) (3 items) , economic expediency (EE) (3 items) and behavioral intention (2 items),each measured on a five-point Likert scale with 1 = strongly disagree to 5 = strongly agree.

4.2. Study area and Participants

Study subjects comprise of under-graduate students of the University of Benin, in Edo state in Nigeria, which has an e-library centre equipped with computer systems and internet connectivity. The e-library opens at 8 am and closes at 4pm.

4.3 Sample and sampling technique

A random sampling technique was utilized for this survey. A total of 207 students were used for the survey. The sample size exceeds 170 which is the minimum sample size required for structural equation modeling for a TAM research model with seven constructs and 20 items, as calculated using SEM survey calculator.

4.4 Method of Data analysis

The fit of the data collected using the questionnaire, was tested using Structural equation modeling (SEM) which is a multivariate statistical analytical method used for analyzing structural relationships within the constructs in a model or framework. The validity of the TAM model involving the choice of external variables used in this study was tested by implementing SEM in the AMOS statistical software environment to see if the data collected using the measuring items in the questionnaire fits the research model for explaining technology acceptance.

4.5 Research model

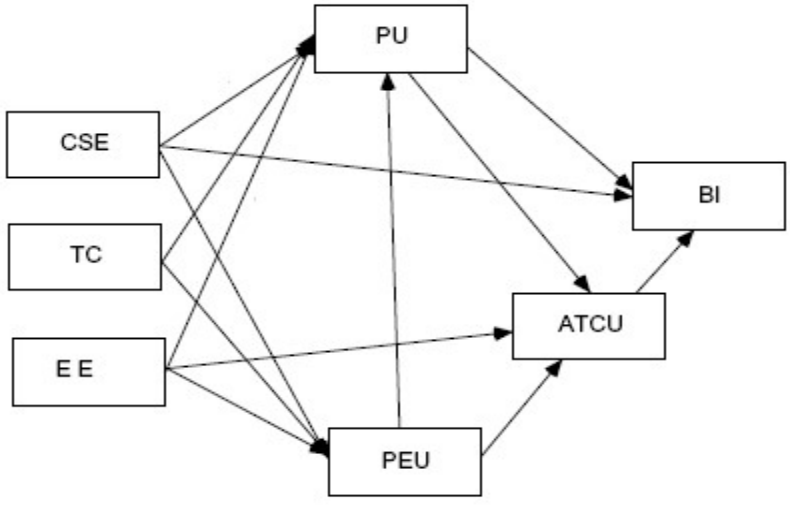

Figure 2: Research model

5. RESULTS

This section describes the outcome of the data analysis and the breakdown of different aspects of the SEM methodology in evaluating the model fit of the research model as an explanatory structure modeling TAM. Demographic information of the respondents

Table 2: Demographic characteristics of respondents

Variable		Number	%
Gender	Male	83	40
	Female	124	60
Level	100	45	21.7
	200	53	25.6
	300	59	28.5
	400	50	24.2
Computer ownership	Yes	86	41.5
	No	121	58.5

5.1 Model identification

5.1.1 Confirmatory factor analysis

This is the first step in SEM to establish how well the different items as filled by the respondents load under the different variables or constructs. This stage is evaluated by three types of validity: convergent validity, Discriminant validity and nomological validity.

a) Convergent validity
This measures how well the items under a particular variable, load or are reflected by it. It is usually measured using two procedures: Composite reliability and Average variance extracted.

Table 3: Results for convergent analysis

Variables	Factor loadings	Composite reliability = $\sum(\mathbf{x_i})^2 \div \left(\sum(\mathbf{x_i})^2 + \sum \boldsymbol{\partial}\right)$ (should be> 0.7	Average variance extracted= $\sum \mathbf{x_i^2} \ /\mathbf{N}$ (should be > 0.5)	Status
BI	0.904986	0.819	0.654	Established
ATCU	0.838451	0.703	0.525	Established
PEU	0.936483	0.877	0.607	Established
PU	0.831264	0.691	0.501	Established
CSE	0.837257	0.701	0.726	Established
TC	0.942338	0.888	0.856	Established
EE	0.960729	0.923	0.675	Established

To satisfy the criterion of composite reliability a value ≥0.70 is recommended [15]. As shown in table 3, the reliabilities of all the constructs were greater than or approximately equal to 0.70, and ranged from 0.692 to 0.923. The average variance extracted measures the overall amount of variance that is attributed to the construct in relation to the amount of variance attributable to measurement error [7], is judged adequate when values are > than 0.5 [16]. As shown in the table above it is evident that all our variables satisfy this criterion, hence all the items have convergent validity with the variables.

b) Discriminant validity

Discriminant validity is an index that informs if the different variables actually measure different things(which they should) and is deemed to be present when the variance shared between a variable and any other variable in the model is less than the variance that a variable shares with its indicators [8]. It was assessed by comparing the (AVE) of a variable with the square of the factor correlations between that variable and all the other variables. If the square of the factor correlations are less than the AVEs, then discriminant validity is established.

Table 4: Result for Discriminant validity analysis

Variables	Factor loadings	Square of factor loadings	AVE_1	AVE_2	Discriminant validity
BI↔ ATCU	0.127	0.016	0.819	0.703	Established
BI↔PEU	0.342	0.116	0.819	0.877	Established
BI↔PU	0.043	0.002	0.819	0.691	Established
BI↔CSE	0.308	0.094	0.819	0.701	Established
BI↔TC	0.426	0.181	0.819	0.888	Established
BI↔EE	0.223	0.050	0.819	0.923	Established
ATCU↔PEU	0.143	0.020	0.703	0.877	Established
ATCU↔PU	0.334	0.112	0.703	0.691	Established
ATCU↔CSE	0.51	0.260	0.703	0.701	Established
ATCU↔TC	0.436	0.190	0.703	0.888	Established
ATCU↔EE	0.286	0.0817	0.703	0.923	Established
PEU↔PU	0.322	0.104	0.877	0.691	Established
PEU↔CSE	0.213	0.045	0.877	0.701	Established
PEU↔TC	0.541	0.293	0.877	0.888	Established
PEU↔EE	0.327	0.107	0.877	0.923	Established
PU↔CSE	0.134	0.018	0.691	0.701	Established
PU↔TC	0.429	0.184	0.691	0.888	Established
PU↔EE	0.254	0.065	0.691	0.923	Established
CSE↔TC	0.352	0.124	0.701	0.888	Established
CSE↔EE	0.415	0.172	0.701	0.923	Established
TC↔EE	0.334	0.112	0.888	0.923	Established

c) Nomological validity: This measures the overall model validity of the measurement scale given the survey data. Based on the fact that the convergent and discriminant validity has been well established for the different variables, as a rule of thumb, nomological validity is also established.

5.2 Model Fit

So far we have assessed the content validity of the survey instrument to see if it fits with what it purports to measure, in this regard the results have been good. In this section the structural validity of the model is tested so as to evaluate if the TAM theory as outlined in the research model is valid. Model fit indices that are commonly used in literature which is used in this study are, 1) the goodness of fit index (GFI) which measures how well the proposed model reproduces the observed data, 2) the root mean square error of approximation (RMSEA) which takes into account the complexity of the model in measuring the extent to which model fits observation; 3) the comparative fit index (CFI) which assesses how well a specified model fits relative to an alternative baseline model [18]; also the ratio of $\chi 2/\mathrm{df}$ i.e chi square value degree of freedom is computed. The benchmark values for acceptability based on these measures, as found in literature was compared with values from data to assess model fit.

Table 5: model fit parameters

Model fit parameter	Value	Recommended guidelines	Status
GFI	0.918	≥0.9 [12], [14]	Good fit
RMSEA	0.045	<0.05 [14]	Good fit
CFI	0.934	≥0.9 [12], [14]	Good fit
$\chi 2/\mathrm{df}$ (df=153 and $\chi 2 = 278.4$	1.822	> 3 [13]	Good fit

5.4 Causal path analysis

This section analyses the significance of the causal relationship/path or connection between the variables i.e, between the exogenous and endogenous variables (the exogenous variables are those having arrows in the research model pointing out, while the endogenous variables have arrows from other constructs entering them. In AMOS, the causal path analysis using the maximum likelihood estimation using unstandardized regression weights, returned the paths with significant causality in asterisks *** as will be shown in table 6.

Table 6: causal path analysis

Causal path	p value	Status
PEU←CSE	***	Significant
PEU←TC	***	Significant
PEU←EE	0.54	Insignificant
BI← ATCU	***	Significant
BI←PU	***	Significant
BI←CSE	0.06	Significant
ATCU←PEU	***	Significant
ATCU←PU	***	Significant
ATCU←EE	***	Significant
PU←PEU	***	Significant
PU←CSE	***	Significant
PU←TC	***	Significant
PU←EE	***	Significant

As is shown above, all the causal path are significant except the relationship between Economic expediency and perceived ease of use.

6. DISCUSSION

The results of this study indicate that as shown in previous studies [17, 18] that attitude toward computer usage and perceived usefulness directly impact on behavioural intention to use technology; while perceived ease of use and technological complexity affect behavioural intention indirectly as shown in table 5. The new external variable introduced in this study was found to affect behavioural intention indirectly through the causal route of attitude towards computer usage use. It may be said, considering the fact that Economic expediency was not associated with perceived ease of use or did not cause or influence it, coupled with the fact that the relationship between computer self-efficacy and Behavioral intention was not significant which differs from [10]. It may be inferred that the students, who mostly did not have computer systems at home (59%, table 2) consequently do not have good CSE, but despite this, they intend to use these computer systems, even if ease of use of such systems may be hampered by operational problems, for example, power failure, short operating hours, time-table conflicts, frequent shutdown of university server e.t.c,. In other words, economic expediency forces the case of accepting the available technology as the only option as borne out in the high turnout of these students for e-library registration, and their continued usage of these resources despite constraints and challenges.

Evidently the model fitting parameters as shown in table 5, recommend the applicability of the model and its generalization to bigger populations within the Nigerian demographic as well as other developing countries with similar problems.

7. CONCLUSION AND RECOMMENDATION

Data indicated that the research model is a good fit for modeling e-library technology acceptance among undergraduates in Nigeria. The observed impact of economic expediency precipitates the urgent need for more of these facilities by the students. It also necessitates the provision of more digital libraries in more tertiary institutions, and the expansion of the available ones.
Finally, more studies should be done to uncover other latent variables that may impact e-library usage as well as the use of such information systems in the acquisition of information literacy skills.

REFERENCES

[1] Aypay, A, Çelik, H. C. Aypay, A (and) Sever, M. (2012) Technology Acceptance in Education: A Study Of Pre-Service Teachers In Turkey. TOJET: The Turkish Online Journal of Educational Technology. Volume 11 Issue 4
[2] Davis, F. D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly. Volume 13 Issue 3
[3] Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. International Journal of Man-Machine Studies, 38(3), 475- 487. http://dx.doi.org/10.1006/imms.1993.1022
[4] Dillon, A. & Morris, M. (1998). From "can they" to "will they?: Extending usability evaluation to address acceptance. In E. D. Hoadley & B. Izak (Eds.), Proceedings Association for Information Systems Conference. Baltimore, MD.

[5] Dishaw, M. T., & Strong, D. M. (1999). Extending the technology acceptance model with task-technology fit constructs. Information and Management, 36(1), 9–21.
[6] Durodolu, Oluwole Olumide (2016) Technology Acceptance Model as a predictor of using information system' to acquire information literacy skills. Library Philosophy and Practice (e-journal). Paper 1450.
[7] Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 48, 39–50.
[8] Fornell, C., Tellis, G.J., Zinkhan, G.M. (1982). Validity assessment: A structural equations approach using partial least squares. In Proceedings of the American marketing association educators' conference.
[9] Garg, A. K and Garg, D (2013). An Assessment of 3G Internet Service Acceptance in Botswana: Technology Acceptance Model with Social Influence and Price Perception. Pakistan Journal of Social Sciences (PJSS) Vol. 33 (1)
[10] Gong, M., Xu, Y. & Yu, Y. (2004). An enhanced technology acceptance model for Web-based learning. Journal of Information Systems Education, 15(4), 365-373. http://www.highbeam.com/doc/1P3-793505851.html
[11] Jiang, Y., Chen, D and Lai, F (2010) Technological-Personal-Environmental (TPE) Framework: A Conceptual Model for Technology Acceptance at the Individual Level. International Information Management Association
[12] Klem, L. (2000). Structural equation modeling. In L. Grimm & P. Yarnold (Eds.), Reading and understanding multivariate statistics (Vol. II). Washington, DC: AmericanPsychological Association.
[13] Kline, R. B. (2005). Principles and practice of structural equation modeling (2nd ed.). New York: Guilford Press
[14] McDonald, R. P., & Ho, R. H. (2002). Principles and practice in reporting structural equation analyses. Psychological Methods, 7, 64–82.
[15] Nunnally, J. (1967). Psychometric theory. New York: McGraw-Hill.
[16] Segars, A. H. (1997). Assessing the unidimensionality of measurement: A paradigm and illustration within the context of information systems research. Omega International Journal of Management Science, 25(1), 107–121.
[17] Shroff, R. H.. Deneen C. C and Ng E. M. W. (2011); Analysis of the technology acceptance model in examining students' behavioural intention to use an e-portfolio system; Australasian Journal of Educational Technology, 27(4), 600-618
[18] Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. Elsevier, Computers & Education 52; 302–312. doi:10.1016/j.compedu.2008.08.006
[19] Thompson, R., Compeau, D. & Higgins, C. (2006). Intentions to use information technologies: An integrative model. Journal of Organizational and End User Computing, 18(3), 25-43.http://dx.doi.org/10.4018/joeuc.2006070102
[20] Venkatesh, V., Morris, M. G., Davis, F. D. & Davis, G. B. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425-478. http://www.jstor.org/pss/30036540
[21] Walker, S.C and Pearson, J (2012) Intent to Use Technology: Facilitation Effect of Group Presence. International Journal of Business Information and Technology. Vol. 1 No. 1, pp. 1-15
[22] Winarto (2011) Analysis Effect of External Variables on System Usage and User Satisfaction Using Technology Acceptance Model (Empirical Study on Bank Pekreditan Rakyat in Semarang City Region). Faculty of Economics, Diponegoro University Semarang
[23] Yi, M. & Hwang, Y. (2003). Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. International Journal of Human-Computer Studies, 59, 431-449. http://dx.doi.org/10.1016/S1071-5819(03)00114-9
[24] Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007). Technology acceptance: A meta-analysis of the TAM (Part 1). Journal of Modeling in Management, 2(3), 251-280.
Zhu, D. Linb, C. T and Hsu, Y (2012) Using the technology acceptance model to evaluate user attitude and intention of use for online games. Total Quality Management. Vol. 23, No. 8,