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Impact of ICT and Curriculum Development (University Students from Nigeria) using Modified Technology Acceptance Model -TAM

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Abstract— The Education system is taking a new dimension, the ICT based teaching and learning. ICT is one of the contemporary factors which shapes the education system and has the ability to transform the system of education. To study the impact of ICT, acceptance level from the measure of intention of the users (i.e. students) has to be surveyed. Hence, Technology Acceptance Model (TAM) is used with the introduction of a latent variable for improvisation within the university settings. Data is collected using questionnaire, which is prepared to keep in mind all the variables in TAM. Various machine learning techniques have been imposed on the dataset and found that Decision tree has exhibited high accuracy in classification. The results prove that the factors impacting on user acceptance are availability of ICT, perceived ease of use, perceived impact in teaching & learning, perceived inhibitors in teaching & learning and perceived pleasure or arousal, availability, and inhibitor to use the system, which is also affected by inhibitors in the use of ICTs in the universities.

Keywords — Decision tree, Information Communication Technology, Machine Learning, Technology Acceptance Model

I. INTRODUCTION

The impact of ICTs on the effective operation of most systems be it corporate or private originations cannot be overemphasized. However, the popularization of IT has resulted in an overabundance of applications suggesting unlimited alternative items for users, which tend to emphasize the need for adequate and effective modelling systems. The modelling system in this context is the Technology Acceptance Model (TAM) with the introduction of some latent variables to improve a recommendation system within the university settings. Although the main objective has been placed on improving the model to generate high acceptance and use of a particular system, it is well possible to understand that a model itself is not enough to provide the user with a satisfying experience. However, many researchers have started to explore the factors that might have a direct impact on a user's acceptance of ICTs [2]. The Technology Acceptance Model (TAM) postulates that the adoption of a system strongly depends on its perceived ease of use and perceived usefulness. The paper tends to establish the fact that other latent variables rather than the fore mentions mediate with the model such as pleasure/arousal or attractiveness, availability, inhibitors facilitate or otherwise determines the propensity of intention to use a system. Nonetheless, the Technology Acceptance Model (TAM) has been the one that has met with approval from the information systems community [3].

The purpose of this paper is to explore the potential users' acceptance issues in some universities from Nigeria recommended ICTs facilities, using the TAM. Within the basic term model, we incorporate a new latent variable representing perceived pleasure or arousal, availability, and inhibitor. A questionnaire was prepared for all the variables in TAM (including the new latent variable) and was answered by various university students of Nigeria from two major groups, *viz.* arts and science. The dataset has been pre-processed and an effort has been made to compare the classification accuracy of various machine learning techniques which includes Naïve Bayes, Support Vector Machine (SVM) and Decision tree (C4.5). The Decision tree has exhibited more accuracy and hence it has been taken forward to understand the relationship and measure the technology acceptance in the university system.

II. MATERIALS AND METHODS

A. Dataset and data pre-processing

The dataset comprises of five variables namely Availability of ICT infrastructure (AICT), Perceived ease of use of ICT (PE), Perceived impact of ICT in teaching & learning

(PITL), Perceive inhibitors of ICT use in teaching and learning in IAUE (PCULT) and Perceived pleasure or arousal, availability, and inhibitor of ICT facility (PPAD). Each of the variables includes a questionnaire and were answered in ordinal form (Strongly Disagree - 1, Disagree - 2, Undecided - 3, Agree - 4 and Strongly Agree - 5). These prepared questionnaires were sent to various universities in Nigeria namely Federal College of Education (Technical), Omoku Rivers State (FCET), Ignatius Ajuru University of Education Port Harcourt (IAUOE), Rivers State University of Science & Technology, Port Harcourt (RSUST) and University of Port Harcourt, Port Harcourt (UNIPORT). The questionnaires were answered by university students of Nigeria from arts and science group, which is considered as the class variable with two discrete values. The mode (statistics) is applied to all the variables except class variable, since the variables consist of six sub-variables each and hence most frequent value is fixed.

B. Machine learning approach

Machine learning is applied in the multidisciplinary field [6], which focus on fuzzy problems and its algorithms are best suitable to knowledge discovery from data (KDD) applications. Nowadays it is emerging vastly in the field of research and development, both in the academic world as well as in business. Various machine learning techniques, *viz*. Naïve Bayes, Support Vector Machine (SVM) and Decision tree (C4.5) have been imposed on dataset formulated from questionnaire and found that Decision tree has exhibited more accuracy in classification, which is depicted in Table I

TABLE I

CLASSIFICATION ACCURACY OF VARIOUS MACHINE LEARNING TECHNIQUES

Methods	FCET	IAUOE	RSUST	UNIPORT
Naive Bayes	0.6571	0.6842	0.6857	0.6333
SVM	0.6714	0.6794	0.6476	0.4095
Decision Tree	0.7333	0.7225	0.7143	0.6667

Orange is a machine learning platform which uses Python script for data analysis [4]. The procedure used in the classifiers (Naïve Bayes, Support Vector Machine and Decision tree) is

```
import Orange
from Orange.classification import svm
from Orange.evaluation import testing, scoring
//Read data
data = Orange.data.Table("TAM.tab")
// Construct the learning algorithm and input to Naïve Bayes classifier
learner = Orange.classification.bayes.NaiveLearner(data)
results = testing.cross_validation([learner], data, folds=5)
print "CA: %.2f" % scoring.CA(results)[0]
// Construct the learning algorithm and input to Support Vector Machine classifier
learner = svm.SVMLearner(data)
results = testing.cross_validation([learner], data, folds=5)
print "CA: %.2f" % scoring.CA(results)[0]
// Construct the learning algorithm and input to Decision Tree classifier
learner = Orange.classification.tree.TreeLearner(data)
results = testing.cross_validation([learner], data, folds=5)
print "CA: %.2f" % scoring.CA(results)[0]
```

Decision trees are most suitable for knowledge discovery from the dataset which is easy to interpret [7] since they generate closely resemble human reasoning [8]. Decision tree is one of the most widely used supervised learning methods and its method is based on information theoretic measure. Information Gain Ratio as a variable selection measure [5], is used to calculate the essential information upon Information Gain since it reduces the bias towards multi-valued variables with more distinct values. According to information gain ratio value, the variable PCULT has more impact on the class variable of RSUST and UNIPORT, PITL has more impact on the class variable of IAUOE and AICT has more impact on the class variable of FCET. Respective decision trees in binary form were constructed with these variables as the root node. Further, If-Then rules are extracted from Decision tree, since it is considered as the most expressive and human readable representations for learned hypotheses [1]. These rules were effectively used to understand the relationship between variables in TAM in accordance with the technology acceptance of the university students. The IF-THEN rules extracted from all five decision trees of its respective dataset were depicted in Table II to Table V

TABLE II

IF-THEN RULES (FCET)

IF THEN	CLASS	P(Class)
AICT=1	ARTS	0.571
AICT=1 AND PCULT=1	ARTS	1
AICT=1 AND PCULT=2	ARTS	0.857
AICT=1 AND PCULT=3	ARTS	0.667
AICT=2	ARTS	0.639
AICT=2 AND PCULT=1	ARTS	0.75
AICT=2 AND PCULT=2	ARTS	0.727
AICT=3	ARTS	0.833
AICT=4	SCIENCE	0.573
AICT=4 AND PCULT=2	SCIENCE	0.667
AICT=4 AND PCULT=3	SCIENCE	0.875
AICT=4 AND PCULT=4	SCIENCE	0.52
AICT=4 AND PCULT=4 AND PE=4	SCIENCE	0.6
AICT=4 AND PCULT=4 AND PE=4 AND PITL=4	SCIENCE	0.696
AICT=4 AND PCULT=4 AND PE=4 AND PITL=5	ARTS	0.714
AICT=4 AND PCULT=4 AND PE=4 AND PITL=5 AND PPAD=3	ARTS	1
AICT=4 AND PCULT=4 AND PE=4 AND PITL=5 AND PPAD=4	ARTS	1
AICT=4 AND PCULT=4 AND PE=5	ARTS	0.556
AICT=4 AND PCULT=5	ARTS	0.615
AICT=5	SCIENCE	0.613

TABLE III
IF-THEN RULES (IAUOE)

IF THEN	CLASS	P(Class)
PITL=1	ARTS	0.657
PITL=1 AND PPAD=3	ARTS	0.6
PITL=1 AND PPAD=4	ARTS	0.8
PITL=2	ARTS	0.562
PITL=3	ARTS	0.658
PITL=3 AND PE=3	ARTS	0.889
PITL=4	SCIENCE	0.536
PITL=4 AND PE=3	SCIENCE	0.714
PITL=4 AND PE=4	SCIENCE	0.583
PITL=5	SCIENCE	0.706

TABLE IV
IF-THEN RULES (RSUST)

IF THEN	CLASS	P(Class)
PCULT=2	ARTS	0.619
PCULT=2 AND PE=3	ARTS	0.889
PCULT=3	ARTS	0.706
PCULT=4 AND PE=3	ARTS	0.5
PCULT=4 AND PE=5	ARTS	0.55
PCULT=4	SCIENCE	0.553
PCULT=4 AND PE=2	SCIENCE	0.8
PCULT=5	SCIENCE	0.579
PCULT=5 AND PE=2	SCIENCE	0.75
PCULT=5 AND PE=3	SCIENCE	0.636
PCULT=1	SCIENCE	0.538

TABLE V
IF-THEN RULES

(UNIPORT) IF THEN	CLASS	P(Class)
PCULT=4	ARTS	0.571
PCULT=5	ARTS	0.526
PCULT=5 AND AICT=4	ARTS	0.529
PCULT=5 AND AICT=4 AND PITL=5	ARTS	0.636
PCULT=5 AND AICT=5	ARTS	0.714
PCULT=2	ARTS	0.545
PCULT=1	SCIENCE	0.581
PCULT=3	SCIENCE	0.677
PCULT=3 AND AICT=1	SCIENCE	0.8
PCULT=3 AND AICT=2	SCIENCE	0.727
PCULT=3 AND AICT=3	SCIENCE	1

III. RESULTS

The IF-THEN rules extracted from Decision tree revealed that in FCET, AICT has more impact comparing to other variables in the model. The AICT is disagreed and strongly disagreed and few were undecided by the ARTS faculty students. It is also found that few ARTS faculty students who disagree and strongly disagree over AICT were also disagreed and strongly disagreed with PCULT. SCIENCE faculty students agree and strongly agree over AICT, they have also agreed and strongly agreed on PE and PCULT along with AICT. Unfortunately, few ARTS faculty students have agreed with AICT, PCULT, PE, and PPAD and strongly agreed on PITL.

In IAUOE, the IF-THEN rules revealed that PITL has more impact comparing to other variables in the model. The PITL is disagreed and strongly disagreed and few were undecided by the ARTS faculty students also few have undecided with PITL and PE. SCIENCE faculty students agree and strongly agree over PITL.

In RSUST, the IF-THEN rules revealed that PCULT has more impact comparing to other variables in the model. The PCULT is surprisingly disagreed and were undecided by the ARTS faculty students. But some ARTS faculty students agree with PCULT and were undecided with PE and some also agree and strongly agree with PE. Desperately SCIENCE faculty students agree and strongly agree over PCULT, but some strongly disagree over PCULT.

In UNIPORT, again PCULT has more impact comparing to other variables in the model. The PCULT is agreed and strongly agreed by the ARTS faculty students. And also, some who are strongly agreed with PCULT, also agreed on AICT and PITL. Surprisingly some ARTS faculty students also disagree with PCULT. The SCIENCE faculty students strongly disagree and some are undecided with PCULT. Some students, who were undecided with PCULT, disagree on AICT.

IV. CONCLUSION

This work is presented as an approach to evaluate some users' acceptance of recommender systems of ICTs in teaching and learning in some universities in the southern geo-political region in Nigeria West Africa, based on the Technology Acceptance Model. The researchers performed an experiment with some commonly used ICT facilities to enhance teaching and learning. Participants responded to a post treated questionnaire related to a set of variables that influence each latent variable in TAM and new latent variables corresponding to "Perceived affection or arousal, availability and inhibitors" were in use of the recommender system.

The machine learning algorithms adopted show a confirmatory evidence that validates the fact that the data fit adequately in the proposed model though some new latent variable in some universities varies as the case may be. The outcome of the experiments confirmed that perceived usefulness plays a predominant role for users to accept a new recommender system, as proposed in TAM. ICT availability is a key player in the institutions evolution to improve teaching and learning as perceived ease of use is agreed upon by these institutions in the use of ICTs. The result also reveals that at least an institution reflex the fact that perceived affection has a strong correlation with perceived impact that is usefulness in the analysis. There are strong inhibitors that tend to mediate on the application of the model to effectively impact teaching and learning as revealed by the questionnaire finding are teacher's phobia to use the recommender system, lack of manpower (well-trained

teachers), electricity problems etc. These findings would be found effective and useful to recommender systems developers both in the academic and system designers for commercial use.

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