A Model Based on Data Science for Analysis and Improving Accreditation Processes at the Higher Education Authority

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***Abstract*— The study was conducted to establish the factors influencing the adoption and acceptability of implementing accreditation processes through the HEA-IMIS. The research study assessed the factors in order to establish and identify whether adoption and acceptability of implementing accreditation processes through the HEA-IMIS were affected by the five constructs/predictors of the UTAUT model. The research used a mixed method research design and data captured was qualitatively and quantitatively through a questionnaire. The study was conducted in Lusaka, the capital city of Zambia, and the sample size of 126 is all the current active users of the HEA-IMIS. The target population was the registered, recognized and proposed HEIs. The questionnaire used was generated based on the UTAUT conceptual model and took into account the five predictors: PE, SI, EE, FC, and BI, to determine the adoption and acceptability of implementing accreditation processes through the HEA-IMIS. The response rate was 88% of 112 respondents through the survey questionnaires, with 76 (67.8%) being male and 36 (32.2%) being female. The findings were eventually analysed by SPSS and the Chi-Square test to determine the relationship between variables. Two out of the five (5) hypotheses were accepted as they showed a statistically significant relationship between the variable for actual usage. The measure of the p-value was at $\leqslant$ 0.05. The research implications suggest how the findings may be important for improving the implementation of the accreditation processes through the HEA-IMIS.**

Keywords— Unified Theory of Acceptance and Use of Technology (UTAUT), Higher Education Authority – Integrated Management Information System (HEA-IMIS), Accreditation Process, Data Science, Information System, Education Data Management

I. INTRODUCTION

The development of national education systems in developing countries over the past decades has prompted an increased need for information and data [1]. National education system or Education management information systems (EMIS), has become the main tool used by countries to collect, process, analyse, and disseminate data, they are crucial to this process [1].

Data science research methodology is becoming even more important in an educational context. The use of information communication and technologies, especially management information systems in the higher education sub-sector is very important to improve public services [1].

The Higher Education Authority makes use of technology by implementing the Higher Education Authority – Integrated Management Information System (HEA-IMIS), this is a web-based application system that combines all aspects of the Authority's requisite and technical systems, processes and standards into one smart system. This study will attempt to determine the major factors that influence the adoption and acceptance of the HEA-IMIS and develop a model based on data science for management and sharing of data with relevant stakeholders.

This paper is organized as follows:

In Section II we presented the related works and review of literature. In Section III the paper considers what the study intends to achieve. Section IV the paper discusses the results of the study. In Section V the paper presented the conclusion and recommends area's for further study.

II. RELATED WORK

This section of the paper gives a review of literature that focuses on similar research work as well as how similar challenges have been addressed elsewhere. The literature review mainly focuses on Unified Theory of Acceptance and Use of Technology (UTAUT) Model and areas in educational data science applications.

A. An Application of the UTAUT Model for Analysis of Adoption of Integrated License Service Information System collection and pre-processing

With variables for Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behavioral Intention to Use, Gender, and Age, this study employs the Unified Theory of Acceptance and Use of Technology (UTAUT) methodology. [2].

According to N. Puspitasari, M. B. Firdaus, C. A. Haris, H. J. Setyadi [3], this study was done to identify the factors that influence users' use of the Integrated Licensing Service Information System. After that, it offered feedback and recommendations to Samarinda City Investment and Integrated One-Stop Service so that the system's implementation in the future could be improved and accepted in accordance with the requirements of its users. [3].

According to the study's findings, performance expectations are the main factors that have a big impact on whether or not this information system is accepted and used. Where the Integrated Licensing Service Information System may enhance the standard of public services, particularly

licensing services, and this system becomes essential in fostering productivity and effectiveness at work [3].

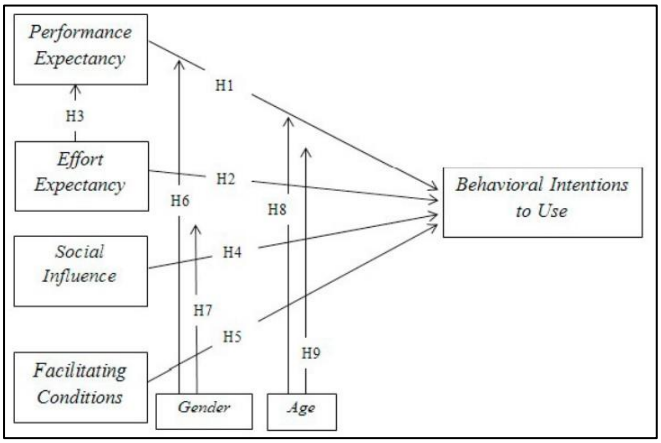

Figure 1. Research Model

B. *Data science for analyzing and improving educational processes*

Numerous learning-related activities are involved in the educational environment, and educational institutions constantly produce large amounts of potentially rich data. The usage of DS technique is valuable and required to extract knowledge from those data for a better understanding or learning-related processes [3].

Since the knowledge extracted from educational data would be helpful to deal with educational problems like student performance improvement, high churn rates in educational institutions, learning delays, and so on, the application of DS in the field of education may result in a great deal of interest for involved stakeholders (students, instructors, institutions, among others). There are other fields that fall under the umbrella of educational data science, including educational data mining and learning analytics, and they are all crucial. [3].

The goal of this special issue, according to S. Aljawarneh and J. A. Lara [3], is to present original contributions of studies on the application of DS techniques in order to extract knowledge of interest for educational stakeholders, provided that the analysed data represent a specific educational process and the knowledge extracted is used to enhance that process in some way.

C. *Data Analytics in Higher Education: An Integrated View*

Higher education offers exceptional opportunity to analyze, comprehend, and model instructional processes through the use of data analytics [4]. As a result, distinct, highly correlated terminologies like Learning Analytics (LA), Academic Analytics (AA), and Educational Data Mining (EDM), where the output of one may become the input of another, have been developed to support data analytics in higher education [4]. This study aims to provide IS educators and researchers with a summary of the state of the art in research and theoretical viewpoints on educational data analytics. A set of uniform standards and an integrated framework for data analytics in higher education are suggested in this study. [4].

Table 1: Types of Analytics

Types of Analytics	Level or Object of Analysis	Who Benefits
Learning analytics	Course-level: social networks, conceptual development, discourse analysis, intelligent curriculum	Learners, faculty
	Departmental: predictive modelling, patterns of success/failure	Learners, faculty
Academic analytics	Institutional: learner profiles, performances of academics, knowledge flow	Administrators, funders, marketing
	Regional (Provincial): comparisons between systems	Funders, administrators
	National and international	National governments, education authorities

D. *Educational data mining and learning analytics: An updated survey*

Data mining in education was the subject of a previous survey that was revised and refined and published in this journal in 2013. It examines how Educational Data Mining and Learning Analytics have been used on educational data in a clear and fairly general approach. This field of study has advanced significantly over the past ten years, and a variety of related terms, including Academic Analytics, Institutional Analytics, Teaching Analytics, Data-Driven Education, Data-Driven Decision-Making in Education, Big Data in Education, and Educational Data Science, are now used in the bibliography [5].

Academic program activities such courses and degree programs, as well as research, student fee revenue, course evaluation, resource allocation, and management, are collected, analyzed, and visualized as part of institutional analytics (IA), which aims to produce institutional insight. [5].

E. *Innovative Smart Phone Learning System for Graphical Systems within COVID-19 Pandemic*

The Technology Acceptance Model (TAM) was employed in this study as an m-learning model, and applications used the Bresenham's line algorithm as a computation system. Technology is used in the study technique to verify the accuracy of the acceptance method for the contents. [6] The outcomes show that the suggested model has considerable positive effects on producing reasonable,

quick, and accurate solutions for the challenges presented and creating a more interactive m-learning platform [6]

F. The acceptance level of Hospital Information Management System (HIMS) among the nursing officials working in a teaching hospital.

Hospital staff acceptance of the usage of hospital information management systems (HIMS) is a developing study subject that can shed light on how well HIMS development and implementation projects in hospitals turn out. This study's objective was to determine how well-liked HMIS was by nursing administrators at a teaching hospital. [7]

G. An Application of Machine Learning Algorithms in Automated Identification and Capturing of Fall Armyworm (FAW) Moths in the Fieldducational data mining and learning analytics: An updated survey

This research examined the literature on object identification algorithms and pheromone traps. Then, using CNN, a modified pheromone trap, and a Raspberry PI fitted with vision and motion sensors, we suggested an automated system for identifying and catching FAW moths in motion. Then, we discussed the process and provided information on how our CNN would be replicated [8].

H. An E-Governance Systems: A Case Study of the Development of a Small-Scale Farmer Database

In this study, a system for storing and managing farmer data on cloud infrastructure is proposed. Knowing this information will make the operations of organizations that work with farmers, such the Farmer Input Support Programme and the Food Reserve Agency, more efficient [9].

I. An E-Governance Systems: A Case Study of the Development of a Small-Scale Farmer Database

The purpose of the study was to identify the variables influencing the uptake of e-PACRA services via the Government Service Bus. In order to design and generate the five hypotheses as determinants and predictors, the study modified the UTAUT model, and the survey questionnaire was employed for data collection [10].

III. METHODOLOGY

The proposed work aims to determine what influences acceptability and adoption of the HEA-IMIS by higher education institutions of learning in implementing accreditation processes. Figure 3 shows the conceptual framework for the baseline study. Where both qualitative and quantitative data were acquired, the mixed method technique was applied. The quantitative method helped to generalize the findings while the qualitative method helped to gather in-depth information. In order to validate the techniques that were employed to achieve the goals of the research study, both qualitative and quantitative methods were utilised.

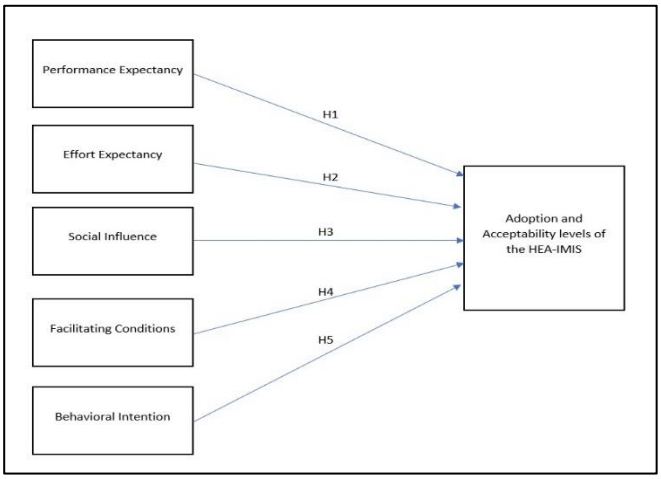

Figure 2: The conceptual framework for the baseline study

A. Baseline Study

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was created by Venkatesh, Morris, Davis, and Davis [11] to integrate earlier TAM-related studies (see Figure 1). The dimensions of perceived utility and ease of use from the original TAM study were incorporated into the UTAUT model using performance expectancy and effort expectancy. The UTAUT model suggests that the Effort Expectancy construct can be relevant in predicting user acceptance of information technology, but over time and continuous use, concerns about usability may lose their significance. As a result, perceived ease of use can be anticipated to be more prominent just during the initial phases of employing a new technology, and it can positively influence perceptions of the device's utility.

Based on the Venkatesh, et al. [11] tool, an online survey was created. Data was gathered between July 2022 and September 2022. The users of the HEI-IMIS system from higher education institutions and the Higher Education Authority were the research subjects. These users included institutional administrators, quality assurance reviewers, departmental submitters, learning program experts, and authority staff. The poll included one hundred and twelve (112) users who took part. In addition, 32.2% of people were female and 67.8% were men. The following constructs were taken into account when evaluating the Venkatesh, et al. [11] approach, as summarized in table 1.

Table 1: UTAUT Construct

No	UTAUT Construct
1	Performance Expectancy
2	Effort Expectancy
3	Social Influence
4	Facilitating Conditions
5	Behavioral Intention

The study further considered an independent variable for the actual use of the HEA-IMIS. The independent variable had features as summarized in Table 2.

Table 2: Features Description

No	Features Description	Values of Features
1	Have you been using the HEA-IMIS	Yes or No
2	If no, why don't you use the HEA-IMIS?	Explain
3	If yes, how long have you been using the facilities?	Under 3 months 6 months 1 year More than 1 year
4	On a weekly basis, how many times do you use the HEA-IMIS?	Not at all Once a week 2-3 times More than 3 times
5	How frequently do you use the HEA-IMIS for the following services? ✓ View Only ✓ HEI updates ✓ Learning Programme Updates ✓ Quality Assurance Reviewer ✓ Departmental Submitter ✓ Application for new campus ✓ Application for accreditation ✓ Institutional Census ✓ Receiving Messages	Never Rarely Sometimes Often Always

B. The Proposed Data Science Based Model

The higher education institutions (HEIs) are providing input to the HEA-IMIS. Inputs such as teaching staff qualifications, teaching and learning plans and learning programme curriculums among other data. This data will be preprocessed and converted in the proper format for storage.

The model as shown in figure 3, will use the inputs provided by the higher education institution to help make a decision on various processes of a submission in the application for accreditation such as which staff is qualification for a particular course or which teaching staff is available based on the workloads of the teaching staff.

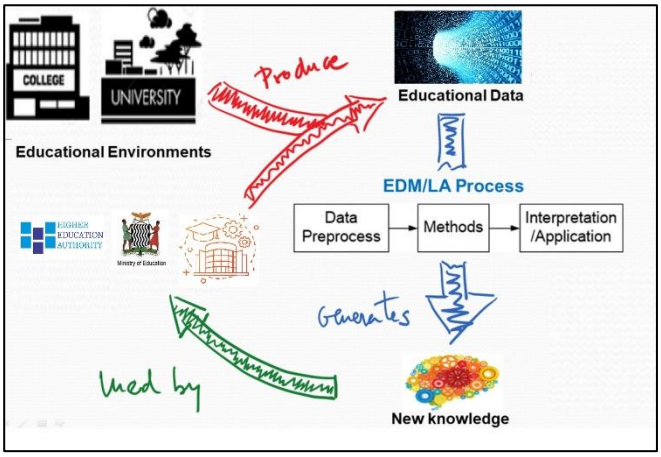

Figure 3: The proposed data science model

IV. RESULTS AND DISCUSSION

The baseline study's findings presented in this section will contribute to the creation of the requirements specifications for the prototype of the model in Figure 3. The model in Figure 3 is discussed in the context of institution accreditation in higher education, but it is applicable to other industries as well, including marketing, banking, and health care. Our methodology is employed to minimize the need for human intervention in the data collecting and analysis processes for accreditation. To address the data's diverse character, the model broadens the range of information gathered. Last but not least, our approach aids in comparing the data to a benchmark established by the Higher Education Authority.

A. Case Processing Summary

Case processing summary table below shows any missing data of any respondent input in SPSS. The results showed that 102 respondents completely filled all required fields while ten (10) did not complete all the required fields.

Table 3: Case Processing Description

Case Processing Summary			
		N	%
Cases	Valid	102	91.1
	Excluded[a]	10	8.9
	Total	112	100.0

B. Data Analysis

The study implored the rule of thumb based on Figure 4 for interpreting alpha for dichotomous questions (i.e. questions with two possible answers) or Likert scale questions.

Cronbach's alpha	Internal consistency
α ≥ 0.9	Excellent
0.9 > α ≥ 0.8	Good
0.8 > α ≥ 0.7	Acceptable
0.7 > α ≥ 0.6	Questionable
0.6 > α ≥ 0.5	Poor
0.5 > α	Unacceptable

Figure 4: Interpretation of alpha

The scales underwent a reliability investigation using Cronbach's Alpha. Since the computed performance is above.80, the scales that describe the UTAUT constructs appear to have a good or exceptional degree of reliability, as summarized in Tables 4 and 5.

Table 4: Reliability Analysis for all the scales

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.960	.966	24

Table 5: Reliability Analysis for the UTAUT Constructs.

No	UTAUT Construct	Cronbach's Alpha	No. of Items
1	Performance Expectancy	.967	4
2	Effort Expectancy	.910	5
3	Social Influence	.935	5
4	Facilitating Conditions	.863	5
5	Behavioral Intention	.861	5

C. Descriptive Statistics

According to the analysis's findings, which are represented in Figures 5, 6, 7, 8, 9 and 10 below, gender, age, experience, actual use, and services significantly moderate the relationships between performance expectations, effort expectations, social influence, facilitating conditions, behavioral intention, and the acceptance and acceptability of adopting accreditation procedures through the HEA-IMIS. The demographic data also emphasizes those relationships that are favorable between performance expectations, effort expectations, social impact, enabling circumstances, behavioral intention, and the acceptance and acceptability of implementing accrediting procedures using the HEA-IMIS.

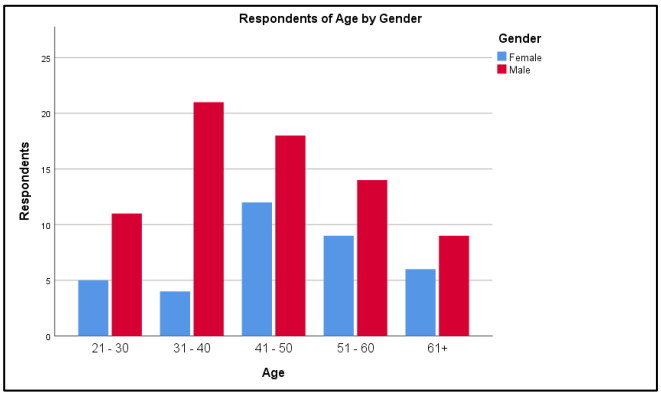

Figure 5: Age by Gender

According to figure 5 above, the respondents (HEIs) are primarily between the ages of 41 and 50, with respondents (HEIs) above the age of 61 making up the least number of respondents (HEIs). The respondents' (HEIs) median age spans from 31 to 40. It can be seen from the age ranges those responders ranged from 18 years old as a prerequisite on the lower end to 61 years or older on the upper end.

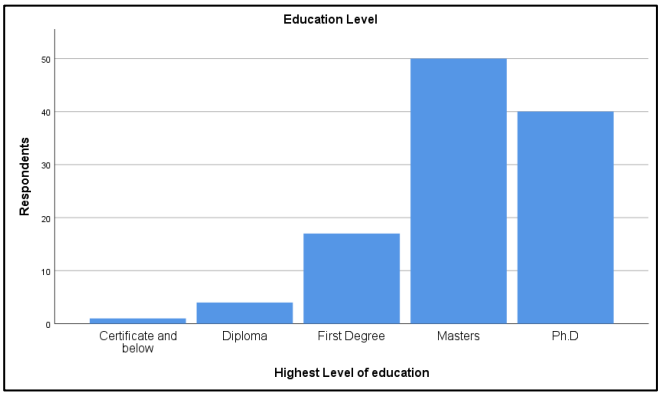

Figure 6: Summary of the Highest level of education

Figure 6, shows the higher level of qualification of the respondents. The majority hold a masters degree followed by a Ph.D.

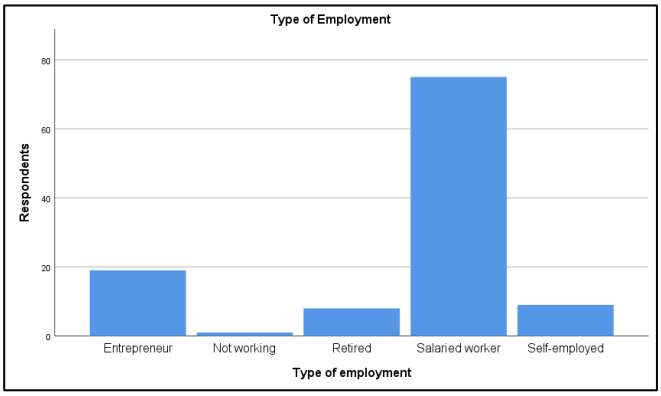

Figure 7: Summary of type of employment

The Figure 7, above indicates a summary of the type of employment of the respondents and findings shows that most respondents are salaried workers, with a few being

entrepreneurs, self-employed and retired. The least was not working.

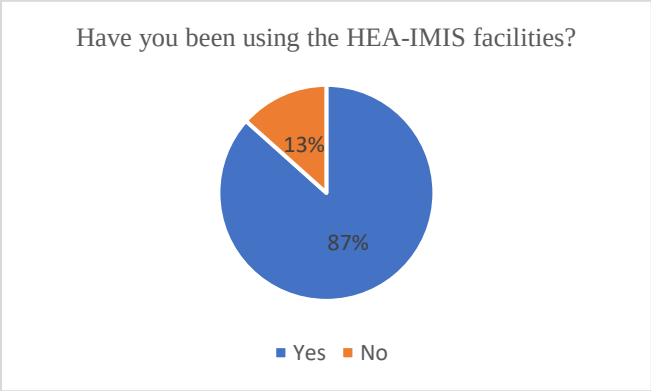

Figure 8: Summary of the respondents that use the HEA-IMIS

Figure 8, shows a summary of the respondents that actually agreed to be using the HEA-IMIS.

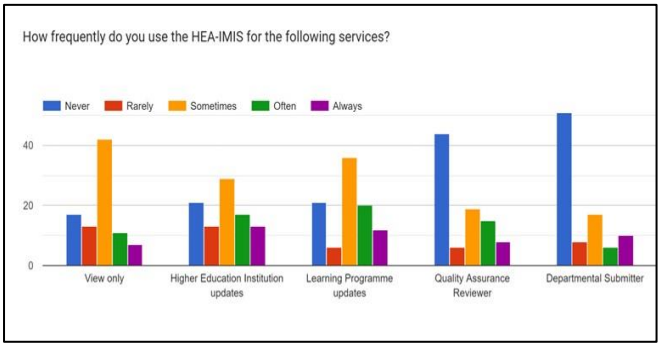

Figure 9: Summary of the frequency of the use of various services on the HEA-IMIS

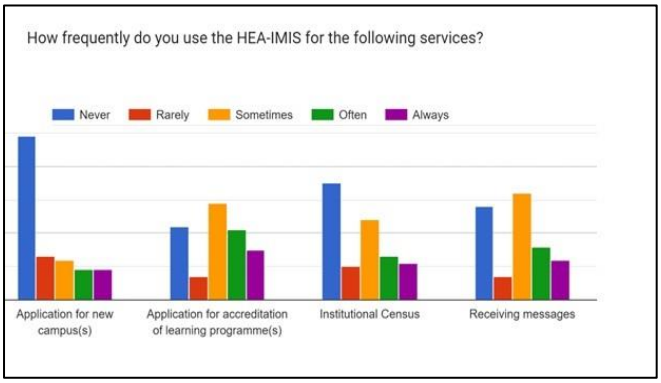

Figure 10: Summary of the frequency of the use of various services on the HEA-IMIS

Figure 9 and 10, show the summary of the use of various services on the HEA-IMIS by users. The services such as view only, learning programmes updates, receiving messages and application for accreditation all had a high frequency of sometimes this shows that the user is not often and always using the HEA-IMIS services for various reasons. Quality Assurance Reviewer, Departmental Submitter and Application for new campus all had high frequency of never been used, this shows areas where they maybe challenges.

D. Thematic Analysis

Correlation was used as a way to ascertain if there is a mutual relationship between two or more attributes of the adopted hypotheses generated using the UTAUT framework model. The hypotheses tests endeavour to especially establish whether the specified predictors Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Behavioral Intentions, one way or the other influence the factors affecting the acceptability and adoption of implementing the accreditation process through the HEA-IMIS. In this study the researcher used Pearson's Correlation to prove the impact and relationship predictors have on the acceptability and adoption.

Table 6. Model Summary

	Goodness-of-Fit	Pseudo R-Square	Pearson Chi-Square	Asymptotic Significance (2-sided)
H1	.231	.329	43.682[a]	.003
H2	.809	.327	34.445[a]	.001
H3	.516	.211	20.134[a]	.115
H4	.535	.111	23.334[a]	.105
H5	.526	.366	40.791[a]	.006

Hypothesis 1 (H1)

The initial analysis aimed to determine whether Performance Expectancy and the acceptance and acceptability of adopting accreditation processes through the HEA-IMIS were positively correlated. Here, the acceptance and actual use of the HEA-IMIS, the dependent variable, were put to the test against the independent variable, PE.

Hypothesis 1: Using Pearson's correlation coefficient, it was determined whether users' performance expectations and their adoption and acceptance of adopting accreditation procedures using the HEA-IMIS were related. Because the value is greater than.05., the Goodness of Fit result shows that the model matches the dataset well. According to the findings in Table 14 (R Square =0.329, n=112, p value .05), there is a correlation between performance expectations and the adoption and acceptability of adopting accrediting processes through the HEA-IMIS. This indicates that performance expectancy determines 32.9 percent of the acceptance and acceptability of implementing accreditation processes through the HEA-IMIS, although this cannot be taken literally because the relationship is not significant.

Hypothesis 2 (H2)

The purpose of the second analysis was to determine whether Effort Expectancy and user adoption and acceptance of adopting accreditation processes through the HEA-IMIS were positively correlated. The adoption and actual usage of the HEA-IMIS by users, the dependent variable, was compared to the independent variable, Effort Expectancy.

Hypothesis 2: The acceptance and acceptability of implementing accreditation processes using the HEA-IMIS by

users are positively correlated with Effort Expectancy. Because the value is greater than.05., the Goodness of Fit result shows that the model matches the dataset well. According to the findings in Table 14 (R Square =0.327, n=112, p.05), there is a correlation between Effort Expectancy and adoption and acceptability of implementing certification processes through the HEA-IMIS. This suggests that effort expectations only account for 32.7% of the uptake and acceptability of implementing accreditation processes through the HEA-IMIS. However, since the connection is insignificant, this cannot be taken literally.

Hypothesis 3 (H3)

The third analysis was to determine whether Social Influence and the acceptance and acceptability of implementing accreditation procedures through the HEA-IMIS were positively correlated. Here, the adoption and actual use of the HEA-IMIS, the dependent variable, were put to the test against the independent variable, Social Influence.

Hypothesis 3: The acceptance and acceptability of implementing accreditation processes through the HEA-IMIS by users are positively correlated with Social Influence. Because the value is greater than.05., the Goodness of Fit result shows that the model matches the dataset well. According to the findings in Table 14 (R Square = 0.211, n=112, p >.05), there is a modest but significant correlation between Social Influence and the acceptance and acceptability of adopting accreditation processes through the HEA-IMIS. Since the link is significant, this suggests that Social Influence only accounts for 21.1% of the adoption and acceptance of implementing accreditation processes through the HEA-IMIS.

Hypothesis 4 (H4)

The purpose of the fourth analysis was to determine whether there was a correlation between the Facilitating Conditions and users' acceptance of the implementation of accreditation procedures through the HEA-IMIS. Here, the dependent variable, actual usage of the HEA-IMIS, was compared to the independent variable, Facilitating Conditions.

Hypothesis 4: The adoption and acceptability of implementing accrediting processes using the HEA-IMIS by users is positively correlated with the Facilitating Conditions. Because the value is greater than.05., the Goodness of Fit result shows that the model matches the dataset well. According to the findings in Table 14 (R Square = 0.111, n=112, p >.05), there is a correlation between the adoption and acceptance of adopting accrediting processes through the HEA-IMIS. Since the link is considerable, this suggests that only 11.1% of the acceptance and acceptability of adopting accreditation processes through the HEA-IMIS is determined by facilitating conditions.

Hypothesis 5 (H5)

The goal of the fifth study was to determine whether there was a correlation between Behavioral Intentions and users' acceptance of the implementation of accreditation procedures through the HEA-IMIS. Here, the dependent variable, actual usage of the HEA-IMIS, was compared to the independent variable, Behavioral Intentions.

Hypothesis 5: The acceptance and acceptability of implementing accreditation processes using the HEA-IMIS by users are positively correlated with Behavioral Intentions. Because the value is greater than.05., the Goodness of Fit result shows that the model matches the dataset well. According to the findings in Table 14 (R Square = 0.366, n=112, p.05), there is a correlation between the adoption and acceptance of adopting accreditation processes through the HEA-IMIS. This indicates that Behavioral Intentions only account for 36.6% of the acceptance and acceptability of implementing accrediting processes through the HEA-IMIS. However, since the connection is insignificant, this cannot be taken literally.

V. CONCLUSION

When the Venkatesh et al. [11] model was used, this study offers insights into how users of the Higher Education Authority's Integrated Management Information System behaved toward its acceptance and acceptability. Performance Expectancy, Effort Expectancy, and Behavioral Intentions are found to favorably influence acceptance and acceptability of adopting accrediting processes using the HEA-IMIS, according to the study's conclusion. The study strongly predicts the intention to apply the accreditation processes using the HEA-IMIS and acceptability, respectively, with the help of social influence and facilitating conditions. Therefore, it is crucial for the Higher Education Authority to make sure that the HEA-IMIS supplied for HEIs' accreditation process is friendly, simple to use, equipped with the essential knowledge of the services, has an increased social status, and has the necessary technical assistance. More HEIs will decide to adopt the offered HEA-IMIS accreditation process, and they'll go on to use it for other quality assurance procedures.

In light of this, the researcher suggests that future studies take into account the additional higher education institutions that the Higher Education Authority currently oversees as a result of the Amendment to the Higher Education Act No. 4. of 2013. Because research environments differ, the study also suggests incorporating additional variables to enhance the variance explained by the predictors.

VI. ACKNOWLEDGMENT

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