

## THE EFFECT OF COVID-19 ON E-LEARNING DELIVERY AS AN APPLICATION PROJECT IN RWANDAN HIGH SCHOOLS

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### ABSTRACT

The study adopted descriptive research design using quantitative and qualitative approaches. Agent theory of E-Learning projects planning, and Project management theory of change were used in this study. The population involved in this was staff from NU Vision High School. The total population for this study was therefore composed by 214 persons. Purposive sampling technique was used to sample 139 respondents taken as sample size. Descriptive statistics with frequency distribution and correlation and regression analysis were used to analyse the data. Frequency tables were used to present the data to facilitate understanding and interpretation. The qualitative data was consolidated, analysed in terms of content and a narrative report was produced presenting the respondents' views on explore effect of COVID-19 on E-learning delivery: As an application of project based at NU Vision High School. The study will be a great important to the existing knowledge in E-Learning delivery and will contribute to increasing E-Learning projects planning standards amongst the project management professionals and the entire project industry. Findings indicated that of Access point, internet security database have an effect on E-Learning delivery in NU Vision High School. Besides, findings also revealed the coefficient of correlation equal to  $r= 0.802$ ,  $p \text{ value}=0.000$ . In this regard, regression analysis was used to conclude the results of the undertaken study and to provide some recommendations. This study recommends that prevent issues regarding the session security, NU Vision High School, should use session ID which is adequately long and unpredictable.

### 1.0 INTRODUCTION

As the world becomes increasingly interconnected, so do the risks we face. The COVID-19 pandemic has not stopped at national borders. It has affected people regardless of nationality, level of education, income or gender. But the same has not been true for its consequences, which have hit the most vulnerable hardest. Education is no exception. Students from privileged backgrounds, supported by their parents and eager and able to learn, could find their way past closed school doors to alternative learning opportunities. Internet technologies and mobile applications have transformed the education system from the traditional structure to the modern method of teaching. Self-efficiency of the teachers in terms of technology, subject knowledge, and content developments reflect on the students' attitude towards the teachers.

Technological advancement has evolved the face of education in creating learning opportunities. Technology in education is not only beneficial for the students but also the teachers in subject delivery and makes the classroom environment more enjoyable. Also, the

advancement in educational technology has crossed the classroom boundaries and ensures the learning available all the time.

Educational technology helps students in distance learning and mobile learning. Also, educational technology enables the teachers to access the students at any time across boundaries and vice versa. Many educational institutions, like universities, colleges, and training centers, adopt online education and create a virtual classroom environment.

Online education supports the students in attending the classes during their free time even they are at any other work. Several social supporting sites such as Twitter, Instagram, Facebook, WhatsApp have been beneficial to the teacher and students to have supportive, collaborative learning with knowledge sharing. Even though social support provides a positive effect on team sharing, there is no evidence to prove that it has an impact on knowledge sharing (Liu & Lee, 2012). The higher education systems opted for e-learning to replace the face-to-face classroom teaching; there is a relationship between students' motivation and e-learning (Harandi, 2015).

## 2.0 PROBLEM STATEMENT

Majority of developing countries do not have long term policies on the development and support of E-Learning projects, which proceed to be undertaken without the necessary E-Learning projects planning and policy. Rwandan E-Learning projects are still facing many barriers in accessing financial services, including restrictions in the legal and regulatory environment, lack of financial training; inappropriate and inaccessible products and services, and low financial capabilities. Financial capability is serious challenge that E-Learning projects performance faces in order to make sound personal finance decisions, suited to their social and financial circumstances. Projects don't have enough access to formal financial services, reasons include legal restrictions, high transaction costs and low funds.

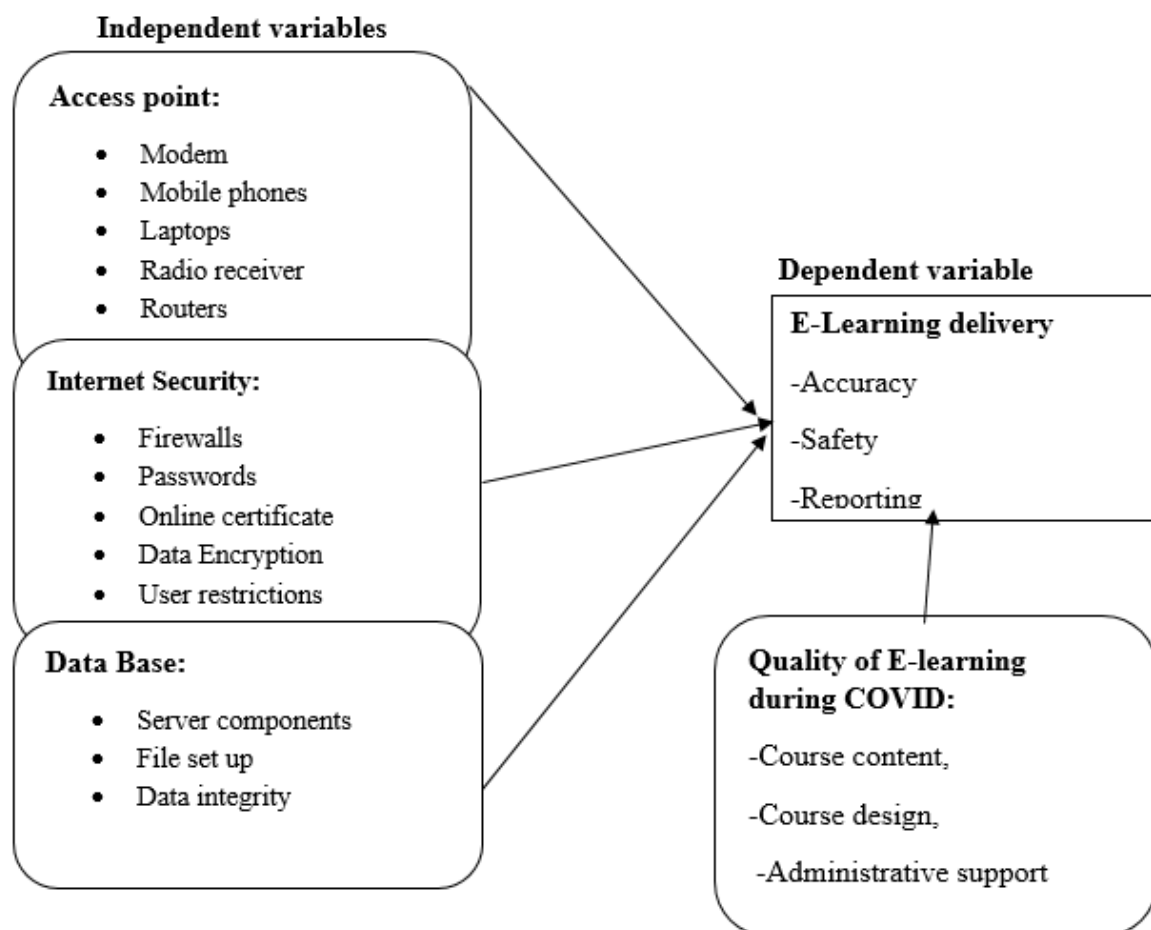
## 3.0 EMPIRICAL REVIEW

Rebane and Barham (2011) analyze the factors that determines the performance of project systems awareness and adoption in Nicaragua. They identify the determinants of four measures of project systems knowledge. The study was limited to how various factors of perception effects adoption of E-Learning projects and thus does not explain how it effects performance and as such performance is more critical than adoption from the researcher's point of view. The study addressed how community perception effects the E-Learning.

Caird et al (2018) in his study on E-Learning delivery concluded that the performance is effected by various factors such as the socio-economic context, consumer variables, communication sources, and product and system properties to determine whether to adapt to project. The research was found not to substantially single out and exhaust on the various factors that affect E-Learning. This research particularly focused on projects in Nicaragua and provide a deep insight of how the various factors will effect E-Learning. From the reviewed literature, it is evident that much research has not been carried on the study topic. Also, the studies in the literature review have limited information on the extent to which various factors effect E-Learning.

## 3.1 Conceptual framework

COVID-19 has affected education all over the world. Universities and schools are remained closed (Murphy, 2020). Consequently, the upsurge of e-learning is happening in the education system (Bozkurt et al., 2020). Though online learning helps to teach or learn in the pandemic period, implementation of a planned and structured online learning system is essential to have a successful e-learning system. Many universities already have a significant transition to e-learning in the pandemic period. This conceptual framework presents the main variables and their indicators; this study consists research variables including access point; internet security and database as independent variables and E-Learning delivery as dependent variable.



**Source:** Researcher, 2023

Effect of internet security on E-Learning delivery in NU Vision High School

In this study the researcher attempts to assess the effect of internet security on E-Learning delivery in NU Vision High School. The following table gives details:

**Level of agreement on effect of internet security on E-Learning delivery during Covid period**

Variables	SA	A	N	D	SD
	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)

<b>Encryption standard</b>					
I use Installed or encryption standard to protect data stored on computers and storage devices	106 (88)	3 (3)	11 (9)	0 (0)	0 (0)
In my institution, I used encryption standard to reorganize data of a computer file to make it unreadable	9 (7)	15 (13)	79 (66)	7 (6)	10 (8)
<b>Company user warrantly</b>					
Company user warrantly is used to promote the reliability and quality of a product in my institution	36 (30)	81 (66)	3 (2)	0 (0)	0 (0)
My institution has a company user warrantly to cover computers against defects	112 (93)	8 (7)	6 (5)	0 (0)	0 (0)
<b>Genuine software</b>					
I always used genuine software to protect against viruses, spywar”e, malware and risks	3 (2)	7 (6)	82 (68)	20 (17)	8 (7)
I use genuine software to prevent virus detention	23 (19)	40 (33)	50 (42)	8 (7)	1 (1)
Genuine software provides real-time protection to address the ongoing security needs	6 (5)	10 (8)	99 (82)	2 (1)	3 (2)
<b>Original operating system</b>					
I used an original operating system to control the operation of a computer	115 (95)	5 (5)	0 (0)	0 (0)	0 (0)
I used original operating system in institution to direct the inputs and output of data and to keep tracks of files	6 (5)	95 (79)	9 (8)	4 (3)	6 (5)
<b>Online certificate</b>					
I use online certification to improve connectivity of students in my institution	3 (2)	7 (6)	82 (68)	20 (17)	8 (7)
Online certification is used to enable students in my institution to save their time and money	23 (19)	40 (33)	58 (48)	0 (0)	1 (1)
I always used online certificate to encrypt online data/information communications between end-user’s browser and a website	13 (11)	6 (5)	72 (60)	19 (16)	8 (7)

**Source:** Primary data, 2023.

The table above highlights level of agreement on effect of internet security on E-Learning delivery during Covid period. On the first variable which is encryption standard, respondents were asked which level of agreement they use to protect data stored on computers and storage devices as the majority of 88% strongly agreed and 3 agreed but 9 were neutral on that statement. Moreover, more than a half of some respondents (66%) were neutral on the statement that to use encryption standard help to reorganize data of a computer file to make it unreadable, respectively 6% of respondents disagreed and 8% of respondents strongly disagreed but 24% strongly agreed and agreed.

The second variable concerning company warranty, respondents were asked if it is used to promote the reliability and quality of a product in my institution as the majority, 66% agreed and 30% strongly agreed but only 2% were neutral on that statement. Additionally, the warranty used, was to cover computers against defects as 93% respondents strongly agreed and 7% agreed but 5% were neutral.

Regarding genuine software as third variable of internet security, if it protects against viruses, spyware, malware and risks as the, respondents (68%) were neutral, respectively 17% disagree, 7% strongly agreed whereas 10% agreed that statement as well as 33% agreed that genuine software to prevent virus detention but also a big number of 42% were neutral about that statement but also 8% of them agreed that it has role of providing a real-time protection to address the ongoing security needs.

The next variable was original operating system. Respondents were asked the level of agreement on whether original operating system is used at NU Vision High School to control the operation of a computer. Almost the whole respondents (95%) strongly agreed and 5% of respondents agreed. Further, 79% of respondents agreed that the original operating system in institution direct the inputs and output of data and to keep tracks of files and 5% of respondents agreed, respectively 8% were neutral, 3% disagreed and 5% strongly disagreed.

Finally, the last variable is online certificate where the respondents were asked which level of agreement online certification is used to improve connectivity of students in the institution. Most of them (68%) were neutral others 2% strongly agreed, 6% agreed, 17% disagreed and 8% strongly disagreed. Besides 33% agreed that that online certification is used to enable students in my institution to save their time and money by eliminating the need for commuting from one place to another and the majority of respondents (48%) were neutral. Moreover, 11% of respondents strongly agreed and 5% agreed that online certificate to encrypt online data/information communications between end-user's browser and a website, respectively 60% were neutral, 16% disagreed, and 7% strongly disagreed that statement

From the findings above, the study showed the effect of internet security on E-Learning delivery in NU Vision High School. The internet security is used in the institution as central aspect of cybersecurity by managing cyber threats and risks associated with the internet, web browsers, web apps, websites and networks. Thus, it should use encryption standard, company user warranty, genuine software, original operating system and online certificate.

Security is essential as a means to retain users' trust in the online learning environment because any risk can dramatically affect students' perceptions of a system's reliability and trustworthiness. As a result, it is crucial to identify the underlying factors that can cause security issues in online learning and to identify the limitations of the current security protection methods. Then, counter-measures can be developed to mitigate the security risks inherent in online learning.

During the interview, on that point the head teacher asserted that:

“The Higher Education sector is increasingly exploring the use of information systems and technology to meet the needs and expectations of diverse learners who demand more than just traditional classroom-based experiences. New course delivery models

attempt to blend face-to-face elements with e-Learning, Webinars and other online digital content during COVID-19 period. Building trust and encouraging engagement amongst users of online learning systems is important because there are opportunities for both synchronous and asynchronous interactions with the system. Synchronous learning occurs in real-time, with all participants interacting at the same time, while asynchronous learning is self-paced and allows participants to engage in the exchange of ideas or information without the dependency of other participants' involvement at the same time."

Ludong (2021) in his study, pointed out that COVID-19 has changed the way cyber security is viewed by corporations in the global community. Not only did COVID-19 make many individuals work at home, sometimes on their own computers, and using their own routers, virus protection, etc., the lack of cyber security protection that individuals can provide against hacker attacks, especially for highly sensitive information can be limited.

Futhermore, the headteacher also argued that:

"Mobile devices are being utilized by the enthusiastic and early adopters of technology, with new devices pervading campuses across the country. Many new and advanced mobile devices (such as, iPads, new Android phones, tablet devices and portable Internet access systems) are launched daily with upgraded versions of operating systems; these are ripe for infection and ready to infect a university's network system. It is then important to support these devices, whilst maintaining complete visibility of their connectivity and interactions with the university system."

The coronavirus pandemic has created new challenges for businesses as they adapt to an operating model in which working from home has become the 'new normal'. Companies are accelerating their digital transformation, and cybersecurity is now a major concern. The reputational, operational, legal and compliance implications could be considerable if cybersecurity risks are neglected.

### **3.2 Effect of database on E-Learning delivery in NU Vision High School.**

In this study the researcher attempts to determine the effect of database on E-Learning delivery in NU Vision High School. The following table gives details

From the data, the study revealed that the majority of 92% agreed that file composition is used in the institution to implement data management policies that conform to standards, respectively 2% strongly agreed, 3% were neutral, 1% disagreed and 3% strongly disagreed. Besides, 87% and 15% of respondents agreed and strongly agreed that file composition is used to encode for storage of a computer but 13% were neutral on that statement.

The second variable that the respondents were asked their level of agreement was historical storage. The big number 108(90%) agreed that archive storage in NU Vision High School is composed of one or more files along with metadata and then it has the purpose of collecting multiple data files together into a single file for easier portability as agreed by 60% and strongly agreed by 35%.

Hard disc server is also found database used in the NU Vision High School. Respondents (82%) were neutral on the statement that they always pay attention on hard disc server which may fail due to different reasons, 10% strongly agreed and 4% agreed that statement. Moreover, they agreed on the rate of 54% by saying that Hard disc server helps to provide a high level of data integrity but 35% disagreed that statement. They also strongly agreed (55%) and 30% that hard disc server helps me to provide minimum latency, decent speech and performance, gradually 13% were neutral and 7% disagreed that statement.

On the next variable which reporting, the majority of 80% were neutral on the statement that in NU Vision High School, reporting is used to notify the administrator of website or application about a problem but 13% strongly agreed and 3% strongly disagreed. Besides, respondents also agreed that in the institution, reporting is used to stop harmful posts that violate the term of service as agreed by a big percentage off 60(50%) whereas 27(23%) were neutral. Lastly, respondents were asked to provide their level of agreement on tabulation, 79% of respondents agreed that tabulation is used in NU Vision High School to switch between options in a program, respectively 5% agreed, 8% were neutral, 3% disagreed and 5% strongly disagreed that statement.

From the findings, the study revealed that database affects E-learning delivery by file composition, historical storage, hard disc server, reporting and tabulation. The use of distributed databases in e-learning systems has the goal to improve access to information and also rapid collection.

These findings are in agreement with Gees (2012) who stated that because of some processes like information filtering or information access, the database model should have an integrated structure. In every phase of the analyzing process, features and functions of a typical relational database must also be considered. Moreover, handicaps appeared by relation scenarios can jeopardize information integrity and also information security. So, these factors must also be considered.

During the interview with the head teacher, he pointed out:

“Database structure of a distance education system presents a relational and complex structure. Different user types, authorization features and behavior rules also require a relational database model. For instance, if a new user is added to the system, the necessary space, which this new user will need should be arranged automatically according to the user type. Different information depend on a user is kept in different tables like exams, personal information and course lessons in the distance education system. Many studies and research discussed the creation of an e-learning management system. Particularly the design of a database in creating such systems. However, few studies are produced to work as guidelines for designing a database for creating E-Learning systems.”

### 3.3 The quality of E-Learning delivery during Covid 19 period

Education is the central concern of the individuals, institutions, and countries for their development. It is a system that helps to build a relationship between institutions and various countries. The result or outcome of the education system is the critical factor that determines

the quality of education. Moreover, hence, there should be clarity on the curriculum for an in-depth understanding of the course content. The quality of education must be evaluated from the students' perspective because they are the end-users of the product. High quality of higher education is a prerequisite component in delivering knowledge and skill development. The quality of education comprises the visible (course materials) and invisible (delivery to the students) elements. The developing and developed countries need to ensure the quality of education to equip the students to face the competitive world. Educational institutions focus not only on education but also on involving the students in research, creativity, and innovation. Educational institutions need to come up with an exciting way of learning and work closely with the industries to bring innovative ideas for the changing environment. The following table gives details on how the quality of E-learning delivery was during COVID-19 period

Data indicates the quality of E-Learning delivery during Covid 19 period. As stated by the majority of 51.6% of respondents, the quality of E-learning delivery was based on course design. The second group of 45(37.5%) asserted that it was based on course content and the last group of 13(10.8%) accepted that it was based on administrative and technical support.

From the findings, the study revealed that the quality of e-learning delivery was based on course content, course design, administrative and technical support. The pedagogy and course design of the e-learning environment in higher education is in the form of a learner-centered approach rather than a teacher-centered approach. Effective course content in e-learning would include an emphasis on dynamic learning and student engagement. A well-structured and appealing e-learning course design with visual information facilitates students learning through online classes.

These findings go along with Choudhary (2020) who pointed out that strategies need to be adopted in the education section during the COVID-19 pandemic because the higher education sector plays a crucial role in the economic future of a country. Also, COVID-19 affected the classroom studies of the students at a global level, but the education did not halt. Transformation towards e-learning supported the education process with the internet and suitable technology (European Data Portal, 2020). Even though e-learning facilitates continuing education, there is a lack of adequate instructions. Also, instructors were facing difficulty in providing learning materials (Allo, 2020). Since the majority of the higher educational institutions moved to distance education, there is an opportunity to increase the flexible learning model and set standards in e-learning (United Nations, 2020).

During the interview with the head teacher, on quality of E-Learning delivery during Covid 19 period, he stated:

“At NU Vision High School, trainers took essential measures for refining the quality of e-learning to facilitate students with better learning during the COVID-19 curfew period. The empowerment of teachers in generating, shaping, and incorporating different ideas and practices in the development of online course content helps to achieve successful e-learning in higher education”

### 3.4 Correlation and Regression Analysis



In this section, Pearson’s correlation is employed to examine the relationship between the independent variables (IVs) and the dependent variable (DV). To test the relationship, in this section, the mediator in this study is treated as a dependent variable. Correlation coefficients are able to provide a numerical overview of the direction and strength of the linear relationship between the IVs and DVs. Pearson’s correlation coefficients (r) range from -1 to +1 for the indication of positive or negative correlation. According to Pallant (2007), the size of the absolute value formulates information on the strength of the relationship.

**The correlation between independent variables and dependent variable (N=120)**

Correlations					
		Access point	Internet security	Database	Quality of E-learning
Access point	Pearson Correlation	1	0.012	0.008	0.059
	Sig. (2-tailed)		0.812	0.877	0.262
	N	364	364	364	364
Internet security	Pearson Correlation	0.012	1	.802**	.520**
	Sig. (2-tailed)	0.812		0	0
	N	120	120	120	120
Database	Pearson Correlation	0.008	.802**	1	.668**
	Sig. (2-tailed)	0.877	0		0
	N	120	120	120	120
Quality of E-learning	Pearson Correlation	0.059	.520**	.668**	1
	Sig. (2-tailed)	0.262	0	0	
	N	120	120	120	120

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Findings presented in Table 4.3 reveal correlation between variables. There is a significant, strong and positive correlation between database and internet security (r =0,802, respectively, p =0.000) and insignificant correlation between quality of E-learning and internet security (r=0.520, p=0.006). Besides, there is significant correlation between internet security and database (r=0.802 and p=0.000). Besides, there is also significant correlation between quality of E-learning and database (r=0.668, p value =0.000).

This is relevant since, Ferdinard (2020), stated that E-Learning is widely used as a method of learning that ultimately depends on the Internet in its execution. E-Learning systems epitomise computing systems and networks of the Internet generation. These systems are complex and they aim to guarantee the satisfaction of the learner and maintain the good image of the learning

process. There is clear evidence that innovative educational technologies, such as e-Learning, provide unprecedented opportunities for students, trainees and educators to acquire, develop and maintain core skills and essential knowledge. However, e-Learning systems employ the Internet as a place to obtain all necessary information and knowledge. Unfortunately, the Internet has also become the venue for a new-fangled set of illegal activities, so-called cyber-crime. Information associated with the e-Learning environment, some of which might be personal, protected or confidential in nature, is then continuously exposed to security threats because e-Learning systems are open, distributed and interconnected.

Allan (2021) suggested that Current e-Learning systems supporting online collaborative learning do not sufficiently meet essential security requirements. Collaborative learning experiences are normally designed and implemented with pedagogical principles very much in mind, whilst security issues are largely ignored.

## 4.0 MULTIPLE REGRESSION

A multiple regression analysis was performed in this section to identify the predictor and its contribution towards the criterion. It aims to determine the prediction of a single dependent variable from a group of independent variables. The multiple regression analysis was performed with all the assumptions complied with. The results of the multiple regression are presented in the following tables

### Multiple correlation of independent variables with dependent variable

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.670 <sup>a</sup>	.450	.445	.69075

a. Predictors: (Constant), access point, internet security, database and, quality of E-learning

The table 4.4 below shows the quantity of variance that is explained by the predictor variables. The first statistic, R is the multiple correlation coefficient between all the predictor variables and dependent variable. In is model, the value is .670a, which indicates that there is a great deal of variance shared by the independent variables and dependent variables. The next value, R Square, is simply the squared value of R. This is frequently used to describe the goodness of fit or the amount variance explained by a given set of predictor variables and its value is 44% of the variance in the dependent variable is explained by independent variables in the model.

These findings are in agreement with Ley (2010) who stated that that a coefficient of <0.1 indicates a negligible and >0.9 a very strong relationship, values in-between are disputable. For example, a correlation coefficient of 0.65 could either be interpreted as a “good” or “moderate” correlation, depending on the applied rule of thumb.

Rodgers (1988) pointed out that in correlated data, therefore, the change in the magnitude of 1 variable is associated with a change in the magnitude of another variable, either in the same or in the opposite direction. In other words, higher values of 1 variable tend to be associated with

either higher (positive correlation) or lower (negative correlation) values of the other variable, and vice versa. A linear relationship between 2 variables is a special case of a monotonic relationship. Most often, the term “correlation” is used in the context of such a linear relationship between 2 continuous, random variables.

**Significance of Independent variables**

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	140.267	3	46.756	97.993	.001 <sup>b</sup>
	Residual	171.768	360	.477		
	Total	312.035	363			

a. Dependent Variable: Project performance

b. Predictors: (Constant), access point, internet security, database and, quality of E-learning

The table above indicated standard regression which provides the effect of individual predictor variables. Those variables are access point, internet security, database and, quality of E-learning. The table shows the output analysis and whether there is a statistically significant difference group mean. As seen, it, the significance value is 0.001 and the mean is 0.447 which is below 0.05. Therefore, there is a statistically significant difference in the mean length of model. These findings concur with Saul (2019) who stated that A p-value less than 0.05 (typically ≤ 0.05) is statistically significant. It indicates strong evidence against the null hypothesis, as there is less than a 5% probability the null is correct (and the results are random). Therefore, we reject the null hypothesis, and accept the alternative hypothesis.

**Regression coefficients and significance of the independent variable**

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.481	.239		6.186	.000
	Access point	.074	.054	.054	1.373	.012
	Internet security	-.031	.047	-.043	-.663	.038
	Database	.551	.051	.702	10.729	.000

a. Dependent Variable: Project performance

Information presented in Table 4.6 evidenced that  $Y=1.481 + 0.54 X_1 + 0.043 X_2 + 0.702X_3 + \epsilon$  Where  $y$ =project performance. The regression output above shows that access point, internet security and database are statistically equal to 0.000. This shows the regression of independent variables are associated with project performance. Multiple analysis regression result above

indicates the influence of independent variables based on the regression coefficient. The unstandardized Coefficients is 1.481 when is constant and at the same time the Std. Error is 0.239 when they are associated with coefficients. The significant predictor out of three independent variables are positively related to the criterion in the regression, as shown in Table 4.6.

Cowles & Davis (2001) investigated why Fisher chose 5 % as a significance level. They believe that he was only using what was already an established concept. The p-value can be perceived as an oracle that judges our results. If the p-value is 0.05 or lower, the result is trumpeted as significant, but if it is higher than 0.05, the result is non-significant and tends to be passed over in silence.

## 5.0 CONCLUSION

The study concluded that the development of the e-learning systems should be done using safety methods and internationally recognized standards. The system needs to implement security services such as authentication, encryption, access control, managing users and their permissions. The data transfer between the system and administrators or content operators should be done on encrypted SSL channels through the web administration interface. It also concluded that, secure learning platform should incorporate all the aspects of security without affecting too much the system performance. Based on the study results, the finding reveals that access point has an impact in e-learning delivery as it helps modem, mobile phone, radio receiver, laptops and routers to access to the internet. Moreover, the findings also showed that there is an effect of internet security on E-Learning delivery in NU Vision High School. The internet security is used in the institution as central aspect of cybersecurity by managing cyber threats and risks associated with the internet, web browsers, web apps, websites and networks. Thus, it should use encryption standard, company user warranty, genuine software, original operating system and online certificate. The study also revealed that database affects E-learning delivery by file composition, historical storage, hard disc server, reporting and tabulation. The use of distributed databases in e-learning systems has the goal to improve access to information and also rapid collection

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