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Incorporating Technology Using Web Application Tools As An E-Learning Culture In Accredited Higher Education Institution In Timor Leste

Joaninho Xavier Hei

Abstract

This study aimed to investigate the Incorporating Technology of web application tools as e-learning culture in accredited higher education institutions in Timor-Leste. Since regaining its restoration of independence in 2002 until the present, Timor-Leste still faces the challenges of adapting and transforming to the new era of digitalization, especially e-learning. This research focused on identifying the factors influencing the effectiveness of incorporating e-learning and the usage of different web application tools in higher education. A mixed-methods approach was employed, and a survey conducted among faculty members and students from eight accredited higher education institutions in Timor-Leste. There were 200 samples however, only 170 people of (respondents) who involved in this research. Analysis method used was statistic descriptive and SEM-AMOS (Software). 4 independents variables and 1 dependent variable with total indicators were 60 that developed in the questionnaire. The findings revealed that several factors significantly influenced the implementation of e-learning; Human Resources on Technological Skills variable with the influence of 14% on E-Learning for 8 accredited HEI in Timor-Leste with the most dominant and influential indicator. Institutional Policy on policy issues for technological variable with the influence of 11% on E-Learning. PRSICT variable had the influential of 10% on E-Learning. And IDIR variable with the influence on E-Learning was .03%. Moreover, the study explored the usage of web application tools in higher education institutions. So, the web 1.0 and web 2.0 tools were predominantly used. However, the adoption of web 3.0 tools, such as multimedia tools for presentations, online lectures, and video conferencing, was relatively low among faculty members. Similarly, the integration of web 4.0 tools, including services interaction, virtual reality services, and natural-language services, was limited.

Keywords: *Incorporating Technology, Web Application, E-Learning Culture and Accredited Higher Education Institution*

Introduction

Since regaining its restoration of independence in 2002 right at the 21st century until the present, Timor-Leste still faces the challenges of adapting and transforming to the new era of digitalization, especially e-learning. Timor-Leste, with its current population of 1,341,296, is a newly liberated nation emerging in the 21st century in the midst of a booming age of digitalization, (UN[1]PFA, 2022). The intense development of technology has made most things much easier, especially in education. As such, technology has

[1]Universidade da Paz

become an integral part of our daily lives and the culture of teaching and learning in universities and institutes. Culture in its broadest sense is the set of ideas, beliefs, values, and knowledge that characterize a society. It shows how people interpret their environment, (Ahmadi, 2018). However, the developing countries considered it a huge challenge, moreover Timor-Leste, there has a lack of infrastructure and professional human resources who can master the ICT to keep up with and compete with other countries. The scenario of this technological transition affected the education of about half of the student population globally, (Leste, 2020). So, one of the most important aspects demanded is in the education area which is to prepare, develop and produce human resources to tackle the jeopardies mentioned because human resources are a renewable asset that must be developed and must be supported with training, facilities, and infrastructure, (Taha, 2020).

To realize the freedom achieved after the independence, there are already eight (8) accredited higher education institutions namely Timor-Leste National University, Universidade Dili, Universidade da Paz, Universidade Oriental Timor-Leste, Dili Institute of Technology, Institute of Business, Instituto Superior Cristal, and Instituto Superior Filosofia e Teologia (ISFIT). These higher education institutions that consisted of 4 universities and 4 institutes were established a few years after the independence of Timor-Leste. They have played a very important role in the development and sustainability of human resources within the country. However, the quality of education in terms of human resources and infrastructure for public and private universities or institutes in Timor-Leste is still under international quality standards; (cited from https://anaaa.gov.tl/akreditasaun-institusional/).

In this regard, the poor quality of education is due to the fact that developing countries often lack the necessary policies, infrastructure, resources, and funding to provide higher education in teaching and learning technology. The Issues such as limited financial resources for purchasing technical equipment, Provision of computers or mobile devices installed in the classrooms and offices, faculty and staff; lack of technical knowledge of ICT teachers; insufficient government support for technology projects; access to electronic information services from limited communication networks; limitations (no reliable internet connection) are all common challenges in Timor-Leste to incorporate modern technology into the educational model. These are the hallmarks of Web 1.0, 2.0, 3.0, and Web 4.0, these types of web are the application models of higher education institutions used as tools to teach students (Khaleel Ibrahim, 2021). The web application tools need to be identified that applied Higher Education institution were; Web 1.0 was called the web of information or perception with functions ("a read-only web."), Web 2.0 as a verbal network ("read-write" network), is a two-way communication model, Web 3.0 as a connected web (The Semantic Web) and Web 4.0 as an integrated network, which was considered a knowledgeable electronic agent with functions; intelligent substances; mobile technologies; and cloud computing services that are more intelligent and collaborative and based on an agent-centric paradigm, some of these features are being used as e-learning application tools in Timor-Leste's higher education institutions.

This research study attempted a statistical analysis assessment across eight universities/institutes regarding the embedding of technology as a teaching and learning (E-Learning) culture. It aims to identify the influences in current educational institutional policy about e-learning, infrastructure, human resources, and financial, web application tools that use by eight accredited Universities or Institutes to ensure the quality of education by incorporating technology as E-Learning approaches in Higher Education in Timor-Leste.

- Consistency or appropriate policy from the government or operating body to embed technology as an e-learning culture for 8 accredited higher education institutions in Timor-Leste.
- Appropriate financial support from governments (governmental bodies, private institutions) for technical projects, and infrastructure. Computers, mobile devices, internet, human resources; Competent trainers in ICT are a very important aspect to integrate the latest technology for teaching and learning culture in a university/institution recognized as an education model in Timor-Leste.
- This research will enable the government/operating bodies of each university/institute to train the awareness and behavior of educators on the fundamentals of e-learning and make effective changes.
- This study will use the data obtained to ensure rational use of resources by designing and tailoring interventions considering specific infrastructure; Computers, Mobile Devices, and Human Resources. Technical competence of ICT educators, operating body to support technical projects and access to electronic information services via communication networks/internet that has influences on E-Learning.
- This study also provides information on the availability of technology incorporation in universities/institutes for teaching and learning cultures. It enables a researcher to identify technology applications on-campus and to produce data that influences E-Learning in the eight accredited universities/institutes in Timor-Leste.

The objective of this study is to explore the knowledge, attitude, and practices of the eight accredited higher education institutions in Dili, Timor-Leste; to identify common policy, infrastructure, and human resources that influence e-learning, to assess the needs of 4 universities and 4 institutes of higher education in incorporating technology for e-learning culture. The specific objectives will include:

- To identify the institutional policy about e-learning from universities and institutes.
- To explore the knowledge of human resources and services; teachers/lecturers modeling for the students, new additional skills or literacies and alternative paths in integrating technology with the classroom experience, technical competence of ICT educators that hinder the effectiveness of e-learning in 8 accredited universities and institutes.
- To identify current infrastructure; Computers, mobile devices, and the internet regarding e-earning in eight accredited higher education institutions.
- To identify web application tools apply in 4 accredited universities and 4 institutes in Timor-Leste.

Literature Review

Numerous research findings (Salam et al., 2019). Following that, Islam et al. (2019) cited by (Akram et al., 2021) technological integration in pedagogical practices and suggest that it facilitates not only the students but also the teacher in the learning process.

E-Leaning according to the Electronic Content report (2004), cited by (Martin Kwadwo Gyambrah, 2007)

1. As a means of communication. So, EL is used to support communication between students, teachers, and tutors or within a peer group.
2. Share common educational resources, such as determining who does what, how, and when.
3. E-learning is used as a learning management system (LMS). It is software that deploys, manages, tracks, and reports interactions between learners and content as well as between learners and teachers.

However, an important aspect from the point of view of this research is that the challenges related to the use of technology in teaching and learning differs between developed and developing countries. Developing countries often present contextual factors in organizational culture and social structures that are very different compared to developed countries. (Andersson and Grönlund, 2009), and (Kesh Bahadur Rana, 2017). cited by (Akram et al., 2021).

As the evidence showed on ICT & Innovation Survey revealed that students were unable to access online classes due to limited access to the internet. The socio-economic background of parents also limits students' access to online learning opportunities, (Afonso de Almeida, 2020). The lack of training for teachers/lecturers on ICT, infrastructures, resources to access the internet, and digital platforms which are the main challenges to the teaching and learning process, (UNICEF, 2020).

Methods

A mixed-methods approach was employed, and a survey conducted among faculty members and students from eight accredited higher education institutions in Timor-Leste. There were 200 samples however, only 170 people of (respondents) who involved in this research.

- Analysis method used was statistic descriptive and SEM-AMOS (Software).
- 4 independents variables and 1 dependent variable with total indicators were 60 that developed in the questionnaire..

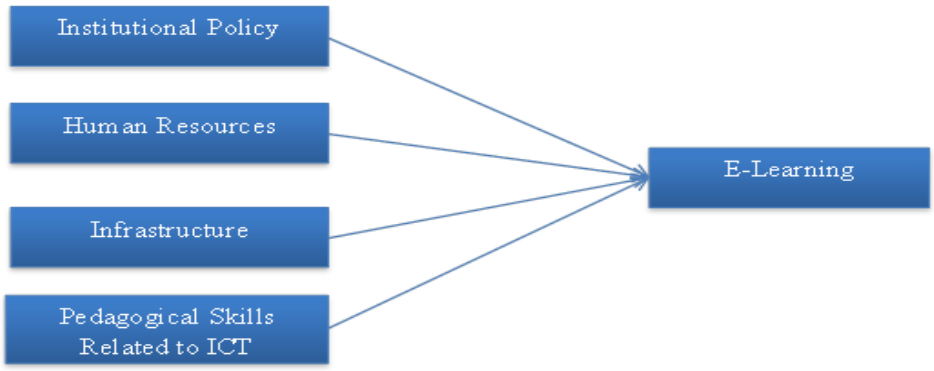

Figure 1. Research Model

Scale of Measurement

The 5-points measurement scale was used in this study, this scale as a psychometric tool contains a set of statements about the research hypothesis. Survey participants are asked to indicate whether they agree with the statement; very poor, poor, fair, good, and excellent for 60 indicators. A 5-point measurement scale (Brier & lia dwi jayanti, 2020b).

Distribution of the questionnaire

If the questionnaire is prepared considering the work process of the following variable, the distribution of the questionnaire will take place directly at the research site to the target respondents (teachers and students) in 8 HEI (4 accredited universities and 4 accredited institutes).

Data Collection Process

This type of data used in this study was quantitative data and primary data as data sources which were then analyzed and also obtained from responses of survey respondents during data collection. The questionnaire was distributed to HEI (universities and institutes) in the

Capital City of Dili, Timor-Leste. In this study, data was collected through an online questionnaire (Google form).

Data Processing Phase

In general, this second step was a series of processing questions about policy, infrastructure, human resources and e-learning, analysis process, and primary data processing with a questionnaire tool, following rules and statistical tests.

Validity and Reliability Test

Validity test

(Brier & lia dwi jayanti, 2020b) explains that the validity test is carried out to show the extent to which a measuring instrument can be used to measure what will be measured. This study tested the validity using the Pearson bivariate correlation. This test is conducted by correlating each question item score with a total score. The total score in this case is the sum of all instrument items. At this stage, a validity test was carried out with a total of 200 respondents. Calculation of the validity test can be done with the following equation:

$$r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{\{n\sum X^2\} - (\sum X)^2\{n\sum Y^2 - (\sum Y)^2\}}}$$

Description:

rxy: Correlation coefficient of an item or question item.

n: Number of subjects

X: Score of an item or question item.

Y: Total score.

Calculation of the validity test is carried out using the equation described above. The way to test the validity is then done by comparing the value of r count with r table for each research indicator. In this study, with a total of 200 respondents for the value of N and a significance level of 5%, the value of the r table is 0.138. So that it can be concluded that for each indicator with a value of the r count> r table, the indicator is said to be valid. Furthermore, testing was carried out on each indicator on each research variable.

Reliability Test

The reliability testing was conducted to find out whether the results of the questionnaire given to respondents internal Universidade da Paz spread across faculties were reliable. This test was done using the Alpha-Cronbach equation with the following equation:

$$r = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum s^2}{S_t^2}\right]$$

Description:

r: Instrument reliability coefficient.

k: Number of question items.

∑Si2: Number of grain variants.

St2: The total number of variants.

Designing a Structural Model

In this study, the authors used the structural equation modeling (SEM) method; this is because the SEM method can identify correlations in variables that cannot be measured directly, so the SEM method is a suitable method to be used in research. The structural model describes the relationship between latent variables based on the theory substantive. The structural model was evaluated using the R-square for the dependent construct, the Stone-Geisser Q-square test for predictive relevance, and the t-test and the significance of the structural path parameter coefficients.

Designing a Measurement Model

In this section, the preparation of a measurement model or frame of mind results from the analysis of previous research and the results of observations in the field are implemented. The measurement model in this study is to seek influences by using exogenous variables according to this study, namely (policy, infrastructure, human resources, and web application) on endogenous variables, namely (e-learning).

Path Diagram Construction

Path diagram construction is to describe the research conceptual framework model and then construct it into a path diagram. Construction of a partial least square path diagram is employed to explain how each indicator reflects its variables and how latent variables influence each other.

Convert Path Charts to Equations

Path diagram conversion to a system of equations is conducted on the path diagram model. Diagram conversion is done in two stages, namely the outer model (measurement) stage and the inner model (structural) stage.

Parameter Estimation

Estimation is a parameter estimation method in partial least squares which is the least squares method. The process of performing calculations by means of repetition (iteration) where the iteration will stop if convergent conditions are reached. Parameter estimation in partial least squares consists of:

1. Weight estimate is calculating latent variable data that creates latent variable scores.
2. Path Estimate (path estimation) that is connecting between latent variables and loading estimates between latent variables and their indicators.
3. Means and location parameters are intercepted regression constant values for indicators and latent variables.

Assess the Goodness of Fit

The performance on the measurement model (outer model) and structural model (inner model). To evaluate the outer model is the reflection of the indicators on the variables. The tests performed on the outer model are as follows:

It is done with a measurement model (external model) and a structural model (internal model). To evaluate the external model, the indicators are reflected in the variables. The tests performed on the external model are as follows:

1. Chi-Square ($\chi 2$) as a Test for Comparing Variance. In AMOS, the Chi-square value is returned by the \CMIN command. The expected value is small or less than the chi-square in the table. The chi-square table is shown in the table, and if it is not in the table (because tables usually only contain degrees of freedom up to 100 or 200), it can be calculated using the CHINV menu in Microsoft Excel. In the CHINV menu, fill the

probability row with 0.05 and the number of degrees of freedom observations. Chi-square values in the table were calculated using Microsoft Excel.
2. Probability. Shown with menu \p. The probability value is expected to be greater than 0.05 (5%).
3. Root Mean Square Error Approximation (RMSEA). We raise it with the \RMSEA command. The expected value is less than 0.08.
4. Goodness of Fit index (GFI). This is done with a measurement model (external model) and a structural model (internal model). The expected value is > 0.90. To evaluate the external model, the indicators are reflected in the variables. The tests performed for the external model are as follows:
   a. Convergent validity measure value, i.e. the external loading value of the latent variables with indicators having an expected value > 0.7.
   b. A measure of discriminant validity, i.e., a cross-loading factor value that is useful to determine if a construction has sufficient discriminating power by comparing a loading value with a design value greater than the constructed value of the cross-loading value of others. Structures.
   c. The reliability of the reliability composite value is good if its value is greater than 0.7.
5. Adjusted Good of Fit Index (AGFI). Returns the \AGFI command and the expected value is greater than 0.90.
6. Minimum sample deviation function or degrees of freedom (MSDF/DF). Gives \MSDF/DF and the expected value is less than 2 or 3.
7. Tucker Lewis Index (TLI). \TLI is guaranteed and the expected value is greater than 0.95.
8. Proportional Fit Index (CFI). Enter \CFI and the expected value is greater than 0.95.

The Assumptions in the SEM Model include:

Sample Size.

It is recommended those more than 150 samples or at least 3 times the number of indicator variables be used.

Normality

Univariate normality is seen by the value of the critical ratio (CR) on skewness and kurtosis with a limit value below + 2.58. Multivariate normality is seen in the assessment of normality in the lower right row and has a limit value of + 2.58.

Outliers

Multivariate outliers are seen in the Mahalanobis distance and the assumption of multivariate outliers is met if the highest Mahalanobis d-squared value is below the critical value. The actual critical value is the chi-square value at the degree of freedom of the number of samples at a significance level of 0.001. The value can be searched with Microsoft Excel as stated above. Univariate outliers are seen by transforming the observation data into the Z-score form. The transformation can be carried out with the SPSS program and the assumptions are met if there are no observations that have a Z-score value above + 3 or + 4.

Multicollinearity

Multicollinearity is seen in the determinant of the covariance matrix. A value that is too small indicates the presence of multicollinearity or singularity.

The method above is for testing if the indicators used are reflective. If the indicator has a formative model, then the test looks at the Significance of weights. The formative indicator weight value with its construction must be significant. Multicollinearity testing is used to

determine the relationship between indicators. To discover whether formative indicators experience multicollinearity by knowing the VIF value. VIF values between 5 until 10 can be said that the indicator has multicollinearity.

Implementation and Analysis

Implementation and analysis of the results of the discussion of data is a determination to obtain results as desired in the main research objectives, using the SEM-AMOS method. This stage consists of three stages, namely:

Structural Model Analysis

When the model has been declared acceptable, structural model analysis can be carried out and at the same time considers model modifications to improve the theoretical explanation or goodness of fit and other parameters. Modification of the initial model must be made after reviewing many considerations.

Hypothesis Testing

Hypothesis testing in this study was used to test the research hypothesis as proposed in Literature Review previously on the evaluation of the goodness of fit test. Hypothesis testing is based on research data processing using SEM analysis, by analyzing the regression values as shown in the steps in the SEM model mentioned above. Testing this hypothesis was carried out by analyzing the value of Critical Ratio (CR) and value of P (Probability) on the results of data regression weights, compared with the required statistical limits, namely the value of Critical Ratio (CR) above 2.00, and the value of P (Probability) at below 0.05. If the output shows a value that meets these requirements, then the proposed research hypothesis can be accepted.

Interpretation of Results

Based on the hypothesis testing previously disclosed, interpretation of the test results can be made from the data that has been collected and analyzed. The results of the analysis and interpretation of the data are finally used to provide input for research improvement. At the end of the research activity, the results of data analysis and interpretation are used to draw conclusions in the research.

Data interpretation techniques can be done as follows:

1. Expand the results of the analysis by asking questions regarding the relationships, differences between the results of the analysis, causes, and implications of the results of the previous analysis.
2. Gives a critical view of the results of the analysis carried out.
3. Linking the results of the analysis with theories and models according to the literature study conducted.
4. Connecting or reviewing the theory that is relevant to the problem at hand.

Results and Discussion

The results of this study are presented in the discussion and findings below.

Information of Respondents

This study was conducted across 8 accredited higher education institutions that consisted of 4 universities and another 4 accredited institutes) in Dili, Timor-Leste which was to explore about institutions that “Incorporating Technology Using Web Application Tools as an E-Learning Culture in each of Institutions in Timor-Leste in terms of policy, human

resources of technical competencies on ICT for educators, infrastructure, and web application tools for e-learning".

In this study, the sample size was 200 respondents who were lecturers and students that were taken and targeted by the researcher from 8 accredited higher education institutions as if universities and institutes. The e-questionnaires were distributed to the target of 8 institutions to be expected with 200 respondents; however, there were only 170 respondents that answered the E-questionnaires and submitted them.

The questionnaires were distributed and collected, next was to proceed to data testing for its validity and reliability. After the data was tested, then the data was assessed for the significance of the construct variable. Testing the validity, reliability and significance was carried out using SEM-AMOS 24 software.

Gender of Respondents

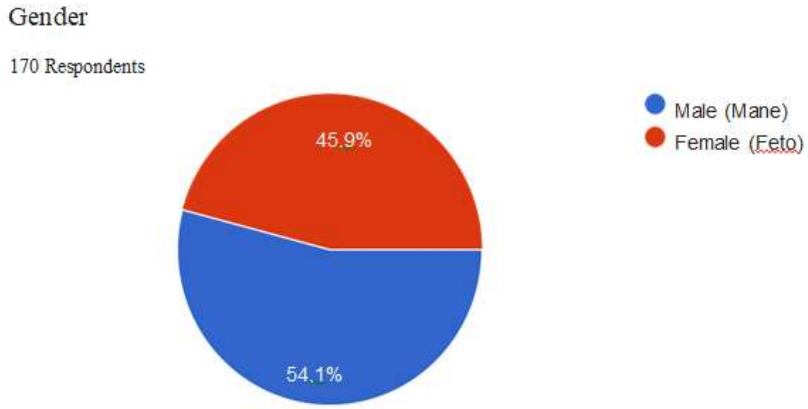

Figure 2. Gender of Respondents

The respondents in this study were the students and lecturers taken from the 8 higher education institutions with the total respondents based on gender were 170 people. The largest gender as respondents for this study was Male with the total respondents of 92 people with its percentage was 54.1%. Then, for female were only 78 respondents with the total percentages was 45.9%. So, it can be concluded that male as the highest number respondents in this study.

The Age of Respondents

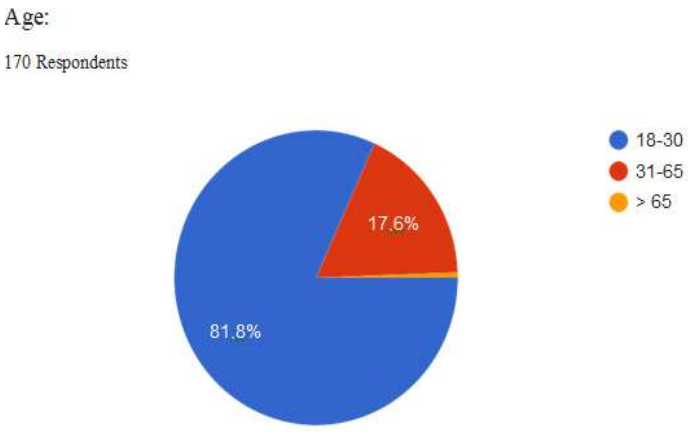

Figure 3. the Age of Respondents

This study results showed that the age of respondents between 18 - 30 years old were 130 people with the percentage of (91.8%) and the respondents with the age of between 31-65 years old were merely 30 people with the percentage of 17.6%. then, the age above 65 was

0 respondent with the percentage was 0%. Hence, the highest numbers of respondents were mostly students between 18 - 30 years old.

Occupation of Respondents

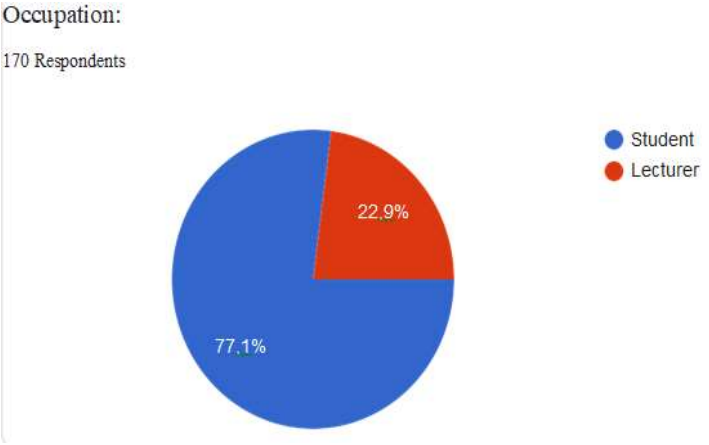

Figure 4. Occupations of Respondents

Based on the results of this study regarding occupation of respondents indicated that the highest respondents were students with the total of 131 people with the percentages were 77.1%. And for lecturers were merely 39 people with the percentages were 22.9%.

Institution of Respondents

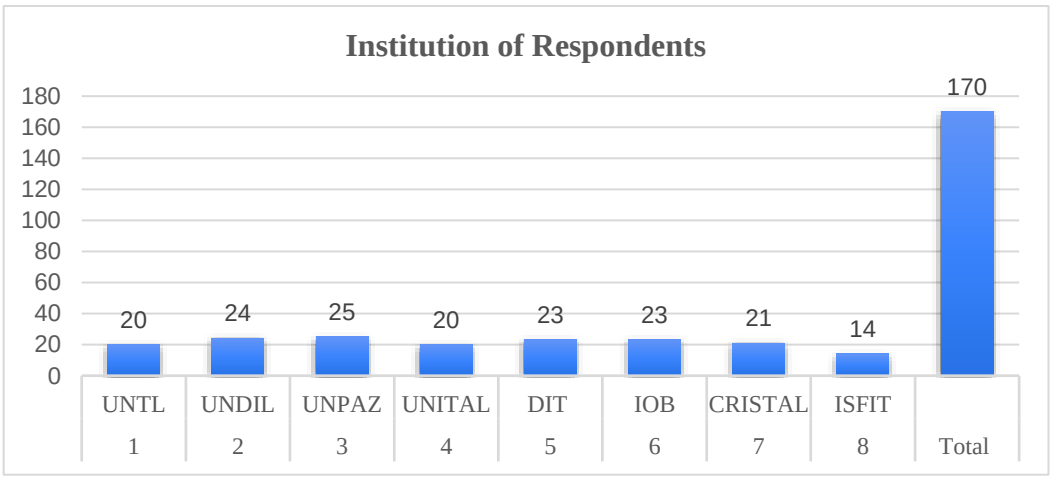

Figure 5. Institutions of Respondents

This study showed that that the highest number of the respondents regarding Your Institution, the highest was 25 people from Universidade da Paz (UNPAZ) with the percentage was 14.5%. Then, it followed by Universidade Dili (UNDIL) with the respondents where 24 people with its percentage were 13.7%. And, Institute of Business and Dili Institute of Technology both where 23 respondents with the percentages were 12, 9%. Afterwards, Universidade Timor-Lorosae (UNTL) and Universidade Oriental (UNITAL) both where 20 respondents with the total percentages were 11, 8%. Then, Cristal was only 14 respondents with the percentages were 10% and ISFIT as the institute with lowest respondents of 14 and its percentages were 8, 2%.

Data Processing And Analysis

Instrument Test (Validity Test and Reliability Test)

Validity Test

Table 1. Validity Test Results of Institutional Policy Variable

Questionnaire Item	Sig Value	Significance Level	r count	r table	Reference
IP 1.1	0,000	0,05	0,832	0,1497	Valid
IP 1.2	0,000	0,05	0,884	0,1497	Valid
IP 1.3	0,000	0,05	0,871	0,1497	Valid
IP 1.4	0,000	0,05	0,873	0,1497	Valid
IP 1.5	0,000	0,05	0,748	0,1497	Valid
IP 1.6	0,000	0,05	0,840	0,1497	Valid
IP 1.7	0,000	0,05	0,831	0,1497	Valid
IP 1.8	0,000	0,05	0,859	0,1497	Valid

Source: Primary Data Processing, 2023

From Table 1 it showed that the sig value < 0.05 and the r count value > r table for each indicator. So, all question items for the institutional policy variable can be stated to be valid.

Table 2. Validity Test Results of Human Resource Variable

Questionnaire Item	Value Sig	Significance Level	r count	r table	Reference
HR 2.1	0,000	0,05	0.850	0,1497	Valid
HR 2.2	0,000	0,05	0.825	0,1497	Valid
HR 2.3	0,000	0,05	0.850	0,1497	Valid
HR 2.4	0,000	0,05	0.886	0,1497	Valid
HR 2.5	0,000	0,05	0.842	0,1497	Valid

Source: Primary Data Processing, 2023

From Table 2 it displayed that the sig value < 0.05 and the r count > r table for each indicator, so all question items for human resource variable could be said to be valid.

Table 3. Validity Test Results of Pedagogical Skills Related to ICT Variables

Questionnaire Item	Value Sig	Significance Level	r count	r table	Reference
PSRICT 3.1	0,000	0,05	0.714	0,1497	Valid
PSRICT 3.2	0,000	0,05	0.738	0,1497	Valid
PSRICT 3.3	0,000	0,05	0.734	0,1497	Valid
PSRICT 3.4	0,000	0,05	0.715	0,1497	Valid
PSRICT 3.5	0,000	0,05	0. 708	0,1497	Valid
PSRICT 3.6	0,000	0,05	0. 697	0,1497	Valid
PSRICT 3.7	0,000	0,05	0. 672	0,1497	Valid
PSRICT 3.8	0,000	0,05	0. 871	0,1497	Valid

Source: Primary Data Processing, 2023

From Table 3 it could be seen that the sig value < 0.05 and the r count > r table for each indicator, so all question items for Pedagogical Skills Related to ICT Variable could be stated to be valid

Table 4. Validity Test Results of Infrastructure (Devices, Internet Accessing, and Space/Source) Variables

Questionnaire Item	Sig Value	Significance Level	r count	r table	Reference
IDIR 3.1	0,000	0,05	0.684	0,1497	Valid
IDIR 3.2	0,000	0,05	0. 640	0,1497	Valid
IDIR 3.3	0,000	0,05	0.685	0,1497	Valid
IDIR 3.4	0,000	0,05	0. 700	0,1497	Valid
IDIR 3.5	0,000	0,05	0.691	0,1497	Valid
IDIR 3.6	0,000	0,05	0, 744	0,1497	Valid
IDIR 3.7	0,000	0,05	0, 693	0,1497	Valid
IDIR 3.8	0,000	0,05	0, 811	0,1497	Valid
IDIR 3.9	0,000	0,05	0, 808	0,1497	Valid
IDIR 3.10	0,000	0,05	0, 613	0,1497	Valid
IDIR 3.11	0,000	0,05	0, 720	0,1497	Valid
IDIR 3.12	0,000	0,05	0, 732	0,1497	Valid
IDIR 3.13	0,000	0,05	0, 686	0,1497	Valid
IDIR 3.14	0,000	0,05	0, 787	0,1497	Valid
IDIR 3.15	0,000	0,05	0, 823	0,1497	Valid
IDIR 3.16	0,000	0,05	0, 750	0,1497	Valid
IDIR 3.17	0,000	0,05	0, 763	0,1497	Valid
IDIR 3.18	0,000	0,05	0, 683	0,1497	Valid
IDIR 3.19	0,000	0,05	0, 795	0,1497	Valid
IDIR 3.20	0,000	0,05	0, 773	0,1497	Valid
IDIR 3.21	0,000	0,05	0, 733	0,1497	Valid

Source: Primary Data Processing, 2023

From Table 4 it presented that the sig value < 0.05 and the r count > r table for each indicator, hence all question items for Infrastructure (Equipment, Internet Accessing, and Space/source) variable could be said to be valid.

Table 5. Validity Test Results of E-Learning Variables

Questionnaire Item	Sig Value	Significance Level	r count	r table	Reference
EL 5.1	0,000	0,05	0. 780	0,1497	Valid
EL 5.2	0,000	0,05	0.845	0,1497	Valid
EL 5.3	0,000	0,05	0.844	0,1497	Valid

Source: Primary Data Processing, 2023

From Table 5 it showed that the sig value < 0.05 and the r count > r table for each indicator, thus all question items for the E-Learning variable could be said to be valid.

Reliability Test of Statistic

Table 6. Reliability Test Results of Statistic

No.	Variable	Alpha	References
1	Institutional Policy	0,941	Reliable
2	Human Resource	0.904	Reliable
3	Pedagogical Skills related to ICT	0,949	Reliable

4	Infrastructure (Equipment, Internet Accessing, and Space/source)	0.956	Reliable
5	E-Learning	0.762	Reliable

Source: Primary Data Processing, 2023

It can be seen in the Table 6 showed that for each variable studied had a Cronbach alpha value that varies. The Institutional Policy variable has a Cronbach alpha value of 0.941, the human resource variable has a Cronbach alpha value of 0.904, the Pedagogical Skills related to ICT variable have a Cronbach alpha value of 0.949, the infrastructure (Equipment, Internet Accessing, and Space/Source) variable has a Cronbach alpha value of 0.956, and the E-Learning variable has Cronbach's alpha value is 0.762. From the total Cronbach's alpha value for each variable it is known that all variables are said to be reliable because the Cronbach's alpha value for each variable has a value greater than 60% or 0.6.

Development of Path Diagrams or Flow Charts

At this stage the SEM model created based on theory could be represented to in mathematical equations in the form of flowcharts or path diagrams. Path diagram in this study was a visual representation of the model described all the relationships between the variables that exist in the study. The used of path diagrams would make it easier to see the relationship between variables that was on the model. In this study used AMOS 24 software to analyze four (4) independent variables and one dependent variable.

Analysis that needed to be made with SOFTWARE (SEM AMOS 24): Create a Development Path Diagram or Flow Chart

SEM Analysis of Exogenous Variables and Recapitulation Table of Exogenous SEM Analysis

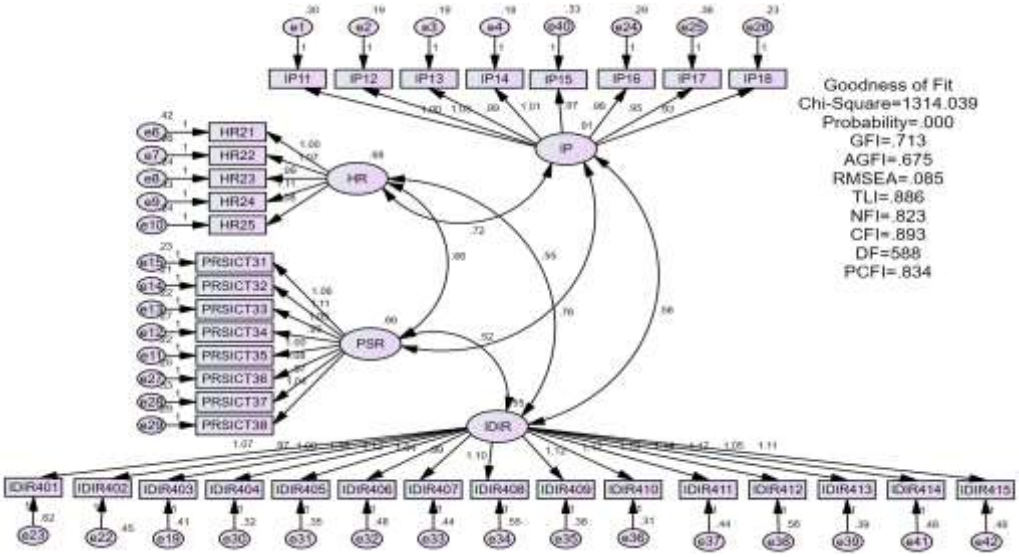

Diagram Flow 1. SEM Analyses of Exogenous Variables and table of Recapitulation of Exogenous SEM Analysis

Table 7. Recapitulation of Exogenous SEM Analysis

Variable Relations			Estimated
IP11	<---	IP	0.866
IP12	**<---**	**IP**	**0.917**
IP13	<---	IP	0.903
IP14	<---	IP	0.912
IP15	<---	IP	0.851
IP16	<---	IP	0.869

IP17	<---	IP	0.837
IP18	<---	IP	0.883
HR25	**<---**	**HR**	**0.876**
HR24	<---	HR	0.836
HR23	<---	HR	0.866
HR22	<---	HR	0.87
HR21	<---	HR	0.782
PRSICT38	<---	PRSICT	0.846
PRSICT37	<---	PRSICT	0.81
PRSICT36	<---	PRSICT	0.866
PRSICT35	<---	PRSICT	0.865
PRSICT34	<---	PRSICT	0.842
PRSICT33	<---	PRSICT	0.879
PRSICT32	**<---**	**PRSICT**	**0.893**
PRSICT31	<---	PRSICT	0.871
IDIR407	<---	IDIR	0.744
IDIR406	<---	IDIR	0.745
IDIR405	<---	IDIR	0.813
IDIR404	<---	IDIR	0.838
IDIR403	<---	IDIR	0.756
IDIR402	<---	IDIR	0.73
IDIR401	<---	IDIR	0.708
IDIR408	<---	IDIR	0.74
IDIR409	<---	IDIR	0.802
IDIR410	**<---**	**IDIR**	**0.841**
IDIR411	<---	IDIR	0.785
IDIR412	<---	IDIR	0.758
IDIR413	<---	IDIR	0.809
IDIR414	<---	IDIR	0.748
IDIR415	<---	IDIR	0.774
EL51	<---	EL	0.721
EL52	<---	**EL**	**0.856**
EL53	<---	EL	0.827

Source: Primary Data Processing, 2023

Based on table 7, the estimated values were all more than 0.5, this meant that all indicators on the exogenous variables were valid.

Table 8. Goodness of Fit Index for exogenous

Goodness of Fit Index	***Cut of Value***	***Analysis Results***	***Evaluation Model***
Chi-Square	<124.3	1314.039	Not Good
Probability	≥ 0.05	0.00	Not Good
AGFI	≥ 0.90	0.713	Good Enough
GFI	≥ 0.90	0.675	Not Good
TLI	≥ 0.95	0.886	Good Enough
CFI	≥ 0.95	0.893	Good Enough
CMIN/DF	≤ 2.00	0.588	Not Good
RMSEA	≤ 0.08	0.085	Good Enough

Source: Primary Data Processing, 2023

The model did not fit the data well based on the chi-square, probability, GFI, and CMIN/DF indices. However, the AGFI, TLI, CFI, and RMSEA indices suggested that the model was

good enough. Therefore, the value of the highest analysis results of evaluation model was considered good enough.

SEM Analysis of Endogenous Variables

In this section explained about the calculation of correlation between each endogenous variable. Endogenous variables were contained in this research is E-Learning. In this case E-Learning is the dependent variable. The relationship between E-Learning indicators as shown in Diagram Flow Chart 2

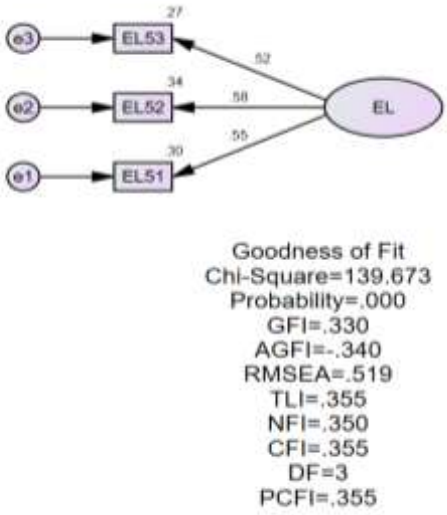

Diagram Flow Chart 2. SEM Analysis of Endogenous Variables

Table 9. Recapitulation of Endogenous SEM Analysis

			Estimated
EL51	<-->	E-Learning	.545
EL52	<-->	E-Learning	.583
EL53	<-->	E-Learning	.516

Data Source: Primary Data Processing, 2023

The Table 9 above showed a recapitulation of the estimated coefficients (path coefficients) in an endogenous Structural equation modeling (SEM) analysis. Hence, the estimated values are all more than 0.5, this indicates that all indicators on the endogenous variables are valid and E-Learning variables have the strongest correlation towards EL52 compared to the relationship between other endogenous variables.

Table 10. Goodness of Fit Index for Endogenous

Goodness of Fit Index	***Cut of Value***	***Analysis Results***	***Evaluation Model***
Chi-Square	<124.3	139.673	Good Enough
Probability	≥ 0.05	0.00	Good Enough
AGFI	≥ 0.90	0.330	Not Good
GFI	≥ 0.90	0.340	Not Good
TLI	≥ 0.95	0.355	Not Good
CFI	≥ 0.95	0.355	Not Good
CMIN/DF	≤ 2.00	3	Not Good
RMSEA	≤ 0.08	0.519	Not Good

Source: Primary Data Processing, 2023

Based on the provided table 10, here is the interpretation of the goodness of fit indices for the endogenous model, the provided goodness of fit indices, the endogenous model did not fit the data well. The chi-square, AGFI, GFI, TLI, CFI, CMIN/DF, and RMSEA indices all indicated a poor fit.

Full Model Analysis

The next analysis model is a Full Structural Equation Model (SEM), after analyzing the level of uni-dimensionality of the indicators forming the latent variables which were tested using confirmatory factor analysis; they were good exogenous variables and endogenous variables. Analysis of data processing results at stage full model SEM was done by conducting suitability tests and statistical tests. The Results of Data processing for full model SEM analysis is shown in Diagram Flow Chart 3 Which presented that between the Institutional Policy variables on E-Learning has a correlation value of .107, the human resources variable on E-Learning has a correlation value of .143, Pedagogical Skills Related to ICT variable on E-Learning has a correlation value of .100, and the Infrastructure (Devices; Internet Accessing, Resources/Services/Spaces) variable towards E-Learning has a correlation value of .032.

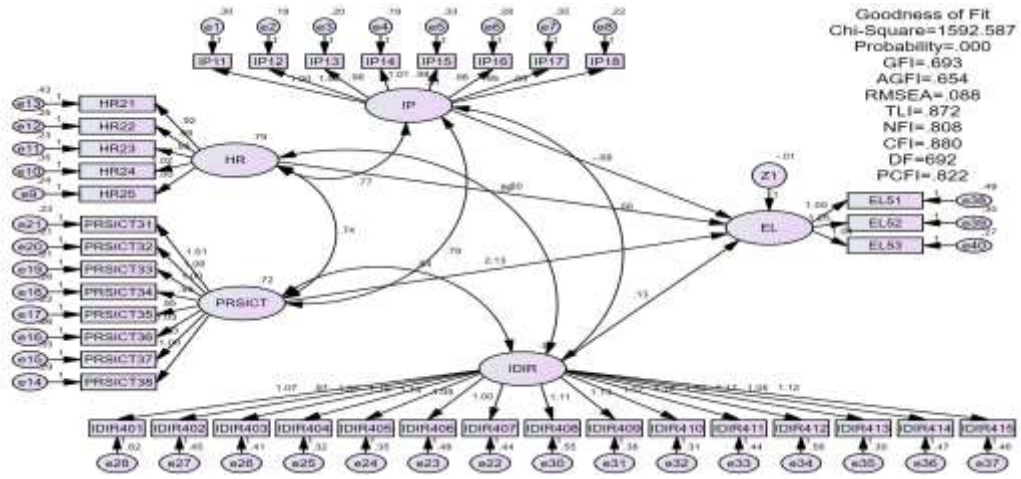

Diagram Flow Chart 3. Full Model Analysis

Table 11. The Greatest Indicator Recapitulation per Variable

No	Variable	Indicator	Value
1	Institutional Policy	IP12	**0.917**
2	Human Resources	HR25	**0.876**
3	Pedagogical Skills Related to ICT	PRSICT32	**0.893**
4	Infrastructure (Devices) Internet Accessing, Resources/Services/Spaces	IDIR410	**0.841**
5	E-Learning	EL52	**0.856**

Source: Primary Data Processing, 2023

Based on table 11, it showed that indicator value for Institutional Policy (IP) variables were dominantly influenced by IP12 indicators. The dominant Human Resources (HR) variable was influenced by the HR25 indicator. The Pedagogical Skills Related to ICT (PRSICT) variable was dominantly influenced by the PRSICT32 indicator. Additionally, Infrastructure (Devices) Internet Accessing, Resources/Services/Spaces (IDIR) variables were mainly influenced by the IDIR410 indicator. The dominant E-Learning (EL) variable was influenced by the EL52 indicator.

Table 12. Goodness of Fit Index for the Full Model

Goodness of Fit Index	*Cut of Value*	*Analysis Results*	*Evaluation Model*
Chi-Square	<124.3	1592.587	Not Good
Probability	≥ 0.05	0.00	Not Good
AGFI	≥ 0.90	0.693	Not Good
GFI	≥ 0.90	0.654	Not Good
TLI	≥ 0.95	0.872	Good Enough
CFI	≥ 0.95	0.880	Good Enough
CMIN/DF	≤ 2.00	0.692	Not Good
RMSEA	≤ 0.08	0.088	Good Enough

Source: Primary Data Processing, 2023

Based on the provided goodness of fit indices, the full model has mixed results. The chi-square, AGFI, GFI, and CMIN/DF indices suggested a poor fit, while the TLI, CFI, and RMSEA indices indicated a good enough fit.

Research Output Results

Table 13. Research Hypothesis Output Results

			Estimate	**S.E.**	**C.R.**	**P**
E-Learning	<---	Institutional Policy	.11	.029	3.667	***
E-Learning	<---	Human Resources	.14	.046	3.095	.002
E-Learning	<---	Pedagogical Skills Related to ICT	.10	.041	2.434	.015
E-Learning	<---	Infrastructure (Devices) Internet Accessing, Resources/Services/Spaces	.03	.012	2.731	.006

Data Source: Primary Data Processing, 2023

Based on Diagram Flow Chart 3, and table 11, it could be seen that to improve E-Learning in the accredited higher education institutions (HIE) in Timor-Leste, the prerequisite thing that must be considered for each variable that influenced the 8 accredited higher education's institutions to incorporate web application tools as E-Learning culture is:

1. Human Resources on Technological Skills variable with the influence of 14% on E-Learning for 8 accredited higher education institutions (HEI) in Timor-Leste with the most dominant and influential indicator was on the fifth indicator that was about "the institution had a major training program in technology for academic staff or students in the last 5 years"
2. Institutional Policy on policy issues for technological use as E-Learning variable with the influence of 11% on E-Learning for 8 accredited higher education institutions with greater and influential indicator was on the second indicator namely "there is a policy for financial investment in ICT infrastructure provided by your university or institution".
3. In the Pedagogical Skills Related to ICT variable, with the indicator that was dominant and had the influential on E-Learning itself was on the second indicator that was about "The institution provides formal requirements (SOP) on mentoring teachers for incorporating technology during class practices effectively carried out".
4. The infrastructure; Devices, Internet and Resources/Services/Spaces with the influence of 10% on E-Learning for 8 accredited higher education institutions in Timor-Leste with the great and influential indicator was on the tenth indicator which was about "You get good Wi-Fi/wireless Internet connectivity on your campus".
5. Hence, E-Learning as a dependent variable was moderated by Human Resources on Technological Skills, Institutional Policy on policy issues for technological use as E-

Learning, The Infrastructure; Devices, Internet and Resources/Services/Spaces, and Pedagogical Skills Related to ICT variables, this can be enhanced by designing annual training for lecturers to integrate and master the ICT with updated web application tools and designing curriculum through inserting ICT on topics and applying on one or two lessons to assist students better understanding the e-learning concept. This indicated that the presence of the variable indicators can strengthen the E-Learning variable.

Hereby, there was numerous of research findings had revealed the importance of technological integration in pedagogical practices and suggest that it facilitates not only the students but also the teacher in the learning process (Salam et al., 2019). Following that, Islam et al. (2019) cited by (Akram et al., 2021) showed that the use of technology in teaching makes teachers competent in pedagogical and content areas in classrooms and helps students learn effectively with the help of technological tools.

As the evidence showed on ICT & Innovation Survey revealed that students were unable to access online classes due to limited access to the internet. The socio-economic background of parents also limits students' access to online learning opportunities, (Afonso de Almeida, 2020). The lack of training for teachers/lecturers on ICT, infrastructures, resources to access the internet, and digital platforms which are the main challenges to the teaching and learning process, (UNICEF, 2020).

The findings indicated that overall of these studies were based on incorporating technology or ICT for teaching and learning performance presented the four (4) variables; Institutional Policy, Human Resources, Pedagogical skills Related to ICT and Infrastructure.

So, the findings mentioned above targeted of discovery was primary about technological integration in pedagogical practices, challenges of internet accessing, socio-economic background, and followed by teacher/lecturer training to enhance and facilitate students' learning.

In this finding however, the most influential factor of incorporating technology using web application tools for e-learning culture was firstly on human resources with technological skills, particularly the presence of a major training program in technology for academic staff or students are the primary goal as the facilitator to deliver the teaching content knowledgably. This indicated the importance of providing regular training to improve technological skills among faculty members and students. Institutional policy issues for technological use also play a significant role in promoting E-Learning. A specific policy for financial investment in ICT infrastructure provided by the university or institution is particularly influential in this regard. Then, Pedagogical skills related to ICT, specifically the provision of formal requirements for mentoring teachers in incorporating technology during class practices, also contribute to the effectiveness of E-Learning. Lastly, The availability of infrastructure, including devices, internet access, and resources/services/spaces, is another crucial factor. Good Wi-Fi/wireless internet connectivity on the campus is identified as the most influential indicator in this category.

The Statistical Results on Web Application Tools on 1.0, 2.0, 3.0 and 4.0

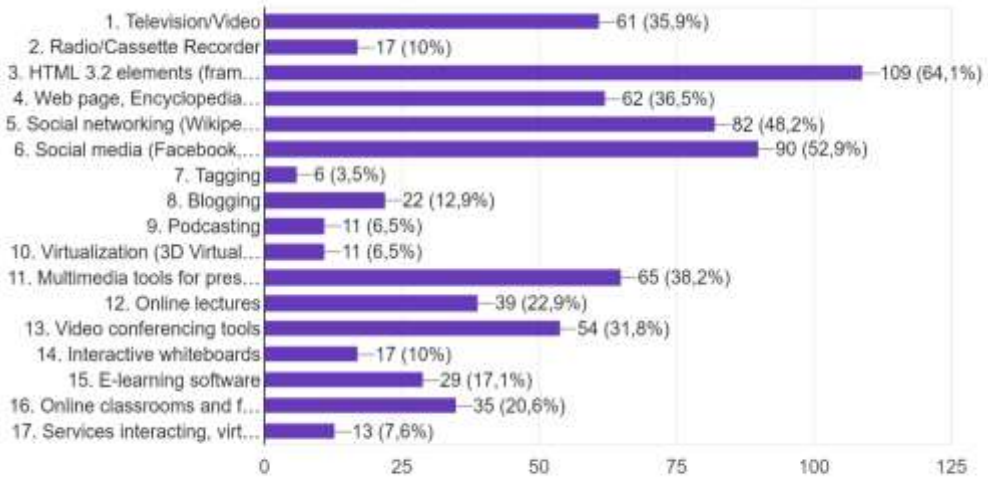

Figure 6. The Statistical Results on Web Application

On figure 6, showed that the highest respondents of 170 people were on HTML 3.2 elements (frames, database, graphic, and tables) with the frequency of 109 and the percentage was 64.1%, it revealed the common usability of lecturers and students were with web 1.0. Followed by social media (Facebook, YouTube, Tik-Tok, Twitter, and Google) with higher frequency of respondents were 90 people and its percentage was 52.9%. Then, Social networking (Wikipedia, E-mail) were 82 respondents and the percentage was 48.2%. the lowest was on tagging with the frequency of 6 and the percentage was 3,5%.

It could be stated that the familiarity of web application tools used in higher education institutions was mostly still on web 1.0 and 2.0 as e-learning culture indicated on the respondents of total 170 people who were faculty members; lecturers and students in 8 accredited HEI in Timor-Leste.

On the other hand, web 3.0 application tools were still not accustomed to yet by faculty members because the study showed that among 170 respondents with the frequencies and percentages of web 3.0 was on average. It could be discovered on statements of indicators of Multimedia tools for presentations & content was just 65 respondents and its percentage was 38.2%. Followed by Online lectures was merely 39 respondents and the percentage was 22.9%, Video conferencing tools was 54 respondents with percentage was 31.8%, Online classrooms and feedback forms was merely 35 respondents with percentage was 20.6%, E-learning software was 29 respondents and its percentage was 17.1%, then, Interactive whiteboards was just 17 respondents with percentage was 10%, and Virtualization (3D Virtual Environments/Avatar; Steam, and Camtasia, etc) was only 11 respondents with percentage of 6.5%. This web 3.0 is very crucial to be integrated and mastered by faculty members among HEI in Timor-Leste.

Lastly, it is about web 4.0 application tools, based on study results indicated that Services interaction, virtual reality services, and natural-language services. For example, Metaverse, and XiaoMi smart home kit allows you to control your home appliances or office using your mobile devices with the frequency was only 13 and its percentage was 7, 6%.

It means that if the 8 accredited higher education institutions (HEI) in Timor-Leste optimally or regularly enhance human resources capacity buildings, incorporating and supporting the activities of teaching and learning using web application tools well in this digital era, it will improve and enable the effectiveness of E-Learning culture in 8 accredited HEIs in Timor-Leste.

Conclusion

Based on the research findings, it can be concluded that several factors significantly influence the implementation and effectiveness of E-Learning in accredited higher education institutions in Timor-Leste. The four independent variables, namely institutional policy variables, human resources, pedagogical skills related to ICT, and infrastructure, have different levels of influence on E-Learning.

The most influential factor is human resources with technological skills, particularly the presence of a major training program in technology for academic staff or students in the last 5 years. This indicates the importance of providing regular training to improve technological skills among faculty members and students. Institutional policy on policy issues for technological use also plays a significant role in promoting E-Learning. A specific policy for financial investment in ICT infrastructure provided by the university or institution is particularly influential in this regard. The availability of infrastructure, including devices, internet access, and resources/services/spaces, is another crucial factor. Good Wi-Fi/wireless internet connectivity on the campus is identified as the most influential indicator in this category. Pedagogical skills related to ICT, specifically the provision of formal requirements for mentoring teachers in incorporating technology during class practices, also contribute to the effectiveness of E-Learning.

Overall, the research suggests that incorporating and supporting the use of web application tools, particularly those related to web 1.0 and 2.0, can improve the effectiveness of E-Learning in accredited higher education institutions in Timor-Leste. However, there is still a need to familiarize faculty members with web 3.0 and web 4.0 application tools to further enhance the E-Learning experience.

Recommendations

Based on the main findings, the following recommendations can be made:

1. Provide regular training programs for faculty members and students to improve their technological skills. This will enable them to effectively incorporate web application tools into their teaching and learning practices.
2. Develop and implement institutional policies that support the use of technology for E-Learning. This should include financial investment in ICT infrastructure to ensure the availability of necessary resources.
3. Improve the infrastructure, including devices, internet access, and resources/services/spaces, to enhance the E-Learning experience. Pay particular attention to providing good Wi-Fi/wireless internet connectivity on campus. Government of Timor-Leste should play also a vital role to establish the fiber optic network.
4. Establish formal requirements and guidelines for mentoring teachers in incorporating technology during class practices.
5. Encourage the use of web 3.0 and web 4.0 application tools in E-Learning. Provide training and support to familiarize faculty members with these tools and their potential benefits.
6. Continuously evaluate and update the curriculum to include ICT topics and integrate web application tools into specific lessons. This will help students better understand the E-Learning concept and improve their learning outcomes.
7. For further study, it is necessary to identify other variables such as government support, related to the ICT and Web application tools on 4.0 and 5.0 especially in Timor-Leste.
8. For further research, it is necessary to design a comparative study among neighbor countries which integrate ICT for teaching and learning culture.

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