Hypothesis Analysis on E-Learning Satisfaction among Undergraduates under Pandemic Situation in Sri Lanka

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https://github.com/KiruthigaBalendran/Hypothesis-Analysis-on-E-learning-Satisfaction

***Abstract*—COVID-19 is a contagious disease that is one of the major challenges faced by the whole world. This has changed the learning mode among students and undergraduates in Sri Lanka. In this study, the e-learning satisfaction among undergraduates is analyzed using statistical hypothesis methodologies as many students face various challenges in this e-learning system. Different factors like gender, current district, university and course details are examined and various hypothesis statements are generated. Test results indicate that there is strong evidence for an association between the students' current district and the satisfaction level on accessing reliable software materials.**

***Index Terms*—e-learning, hypothesis, proportion, association, chi-square distribution**

I. Introduction

Coronavirus disease (COVID-19) is a global pandemic that got diagnosed in Wuhan, China in December 2019. It has started spreading worldwide and currently, it is an ongoing pandemic which is one of the main challenges in the world. The virus can be transmitted from an infected person's nose or mouth via droplets when they speak, cough or sneeze.

As of now, there is no approved medicine to recover fully from this disease. However, there are some approved vaccines to build the immune system to fight against the virus for a short period. Many countries have imposed travel restrictions to avoid the spread and people are asked to stay indoors as much as they can. Due to this pandemic situation, most of the countries have started online-based learning at schools and universities.

Sri Lanka is a developing country, and all the districts are not highly facilitated to provide a better learning environment for students. E-learning education has been an opportunity for some students while for most of them it has been a challenge. Some of the following reasons are faced by both students and undergraduates in e-learning.

- Difficulties in acquiring a personal computer, laptop, or smartphone
- Poor internet connection and electricity supply
- Unawareness in accessing the software/tools needed for e-learning
- No proper physical environment
- Theory-based learning without laboratory sessions
- Unavailability of instructors or moderators when needed
- Unable to adapt to online-based learning
- Dissatisfaction with the e-learning method

A. Problem Statement

The objective of this study is to analyze the e-learning satisfaction among undergraduates during the pandemic situation in Sri Lanka. The study is focused on answering the following questions using statistical inference methodologies.

- Do engineering students prefer the face-to-face learning mode?
- Is there an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning?
- Do male students find more time to participate in synchronous classes than female students?

II. Related Work

Samir et al [1] have studied the features of e-learning that help undergraduates to increase the motivation of learning. For this study, they have examined the following five hypotheses and found the conclusion.

- H1: Students prefer online activities rather than the traditional method of learning
- H2: Students' attitudes towards e-learning differ based on the degree year
- H3: Students' attitudes towards e-learning differ based on the faculty
- H4: Students' grades on the exams will influence online learning
- H5: Teachers' impact plays an important role in students' willingness to use online exercises.

The significance level for the above hypotheses is 5% and they have used three studies to examine the results. The first study investigated H1, H2 and H3 and the second study is tested for H4 and H5. The participants for this questionnaire

were students from British University [2] and Helwan University in Egypt [3]. The test results indicate that H1, H2, H3 and H5 were accepted and H4 was rejected.

The main objective of the research presented by Said et. al [4] is to study the factors that cause undergraduates' acceptance in online-based learning. The authors have proposed a model to investigate trust, quality, innovativeness and knowledge sharing on e-learning acceptance. The questionnaire was distributed at the British University in Dubai and the University of Fujairah. 251 undergraduates took part in this study. To study further on the research, they have defined the below hypotheses.

- H1: Innovativeness has a positive impact on E-learning acceptance
- H2: Knowledge sharing has a positive impact on E-learning acceptance
- H3: Quality has a positive impact on E-learning acceptance
- H4: Trust has a positive impact on E-learning acceptance

The collected data was analyzed using SmartPLS and SPSS tools and they have used Structural Equation Modelling (SEM) to validate the proposed model. Their findings conclude that knowledge sharing and quality have got a positive impact on e-learning acceptance among students while innovativeness and trust did not have any significant effect on e-learning acceptance.

Shu-Sheng Liaw and Hsiu-Mei Huang [5] presented research to investigate learner self-regulation in e-learning environments. They have taken 196 university students for the survey and defined the below hypotheses.

- H1: Perceived satisfaction in e-learning will be impacted by perceived self-efficacy.
- H2: Perceived satisfaction in e-learning will be impacted by the perceived anxiety.
- H3: Perceived satisfaction in e-learning will be impacted by the interactive learning environments.
- H4: Perceived usefulness of e-learning will be impacted by perceived self-efficacy.
- H5: Perceived usefulness of e-learning will be impacted by perceived anxiety.
- H6: Perceived usefulness of e-learning will be impacted by the interactive learning environments
- H7: Perceived usefulness of e-learning will be impacted by perceived satisfaction.
- H8: Perceived self-regulation in e-learning will be impacted by perceived satisfaction.
- H9: Perceived self-regulation e-learning will be impacted by perceived usability.
- H10: Perceived self-regulation e-learning will be impacted by interactive e-learning environments.

Their hypothesis tests conclude that except H5, all other factors have a positive impact on perceived satisfaction, usefulness and self-regulation.

III. Methodology

This section elaborates on the steps used to build the hypothesis to the problem. Common steps in a survey-based study are followed. At first, a questionnaire is designed to capture the necessary responses for the hypothesis. Once it is built, it is shared, and data is collected. To clean up the data, preprocessing techniques are used. Further descriptive analysis is conducted to study the data in depth. Then, based on the responses, hypothesis statements are created, and conclusions are derived. The Fig 1. describes the methodology steps.

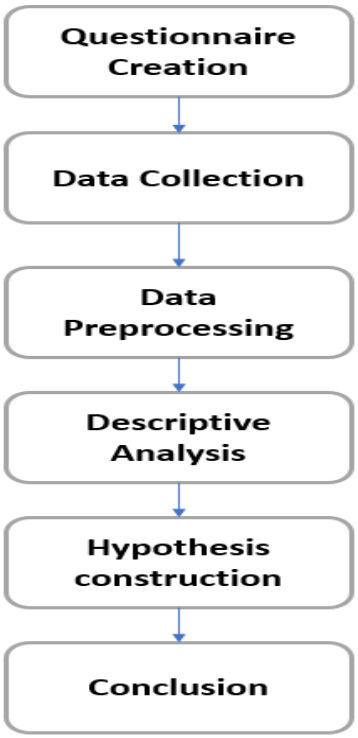

Fig. 1. Steps for Hypothesis Analysis

A. Preparing the questionnaire

A questionnaire with eleven questions is added. It consists of both categorical nominal and categorical ordinal variables. It has also covered the following demographic variables as well as user satisfaction levels through the Likert scale [6].

- Gender
- Age
- Current district
- University
- Domain of study

To understand the satisfaction levels of the undergraduates, the following statements have been given to mark the response on the Likert scale. This scale has five different choices; Very dissatisfied, dissatisfied, neither satisfied nor dissatisfied, satisfied, and very satisfied

- I have no difficulty accessing reliable communication software/tools (e.g., MS Teams, Zoom, Google Hangout)

- I can always find time to participate in synchronous classes (e.g., live-streaming lectures or video conferencing at a set time)
- In general, my instructors are available or responsive
- The adjusted/modified assessment is effective in helping me learn
- I feel that my course lessons or activities have been well delivered in the online environment

At the end of the questionnaire, respondents are asked to choose their preferred learning environment. They were asked to mark out of three options: Face-to-face, Online and Hybrid. Table I defines all the attributes and descriptions.

TABLE I
ATTRIBUTE DESCRIPTION

Attribute Name	Description	Type
Gender	Gender of the person	Categorical nominal
Age	Age of the person	Categorical ordinal
Current district	Name of the district	Categorical nominal
University	Enrolled university	Categorical nominal
Domain of study	Enrolled field	Categorical nominal
Satisfaction level on communication tools	Accessing reliable communication software (e.g., MS Teams, Zoom, Google Hangout)	Categorical ordinal
Satisfaction level on participation	Finding time to participate in synchronous classes	Categorical ordinal
Satisfaction level on availability of instructors	Instructors are available and responsive	Categorical ordinal
Satisfaction level on the effectiveness of the assignment	Adjusted/modified assessment is effective	Categorical ordinal
Satisfaction level on course lessons	Course lessons or activities have been well delivered in the online environment	Categorical ordinal
Learning environment mode	Preferred Learning environment	Categorical ordinal

B. Data collection

The questionnaire was created through Google Form [7]. It was shared through social media like Facebook, LinkedIn and Whatsapp. The link of the survey is also passed through mails to undergraduates. Within two months, 103 responses were collected. Finally, the responses are converted to CSV format to do clean up.

C. Data Preprocessing

In the collected data, there were certain data errors. When respondents were asked to type their answers, there were different answers with the same meaning. For example, the age field was supposed to be typed as a short answer. However, there were answers like 21, 21 years which were finally replaced as 21. Also, for the University, respondents were asked to type the answer. There were some values like Moratuwa, UOM, Moratuwa University which were finally being replaced as the University of Moratuwa.

D. Descriptive Analysis

The collected data was analyzed to understand the variables of the data. Fig. 2 shows the percentage of the respondents' gender and most of them are male. The bar chart in fig. 3 indicates that most of the undergraduates are from the Jaffna district and the least are from Puttalam. Fig. 4 and fig.5 describe the domain of the study and the university they are enrolled. Most of the students are from the University of Peradeniya and studying Engineering. 53.4% of the undergraduates prefer a face-to-face learning environment rather than an online and hybrid mode(fig.6).

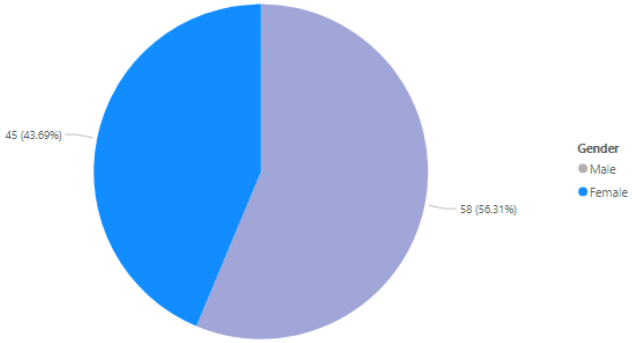

Fig. 2. Percentage of Responses by Gender

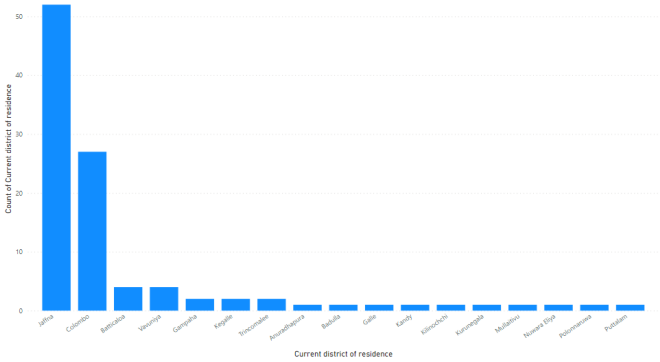

Fig. 3. Distribution of Districts

E. Hypothesis creation

Hypothesis statements are constructed based on the collected data to analyze the problem. A null hypothesis and an alternative hypothesis statements are generated. Most of them are studied through the difference in proportion test [8] and some of them are from the Chi-Square test [9]. These tests are used in finding proportions of the data and association between variables. A test statistic is calculated to find the conclusion.

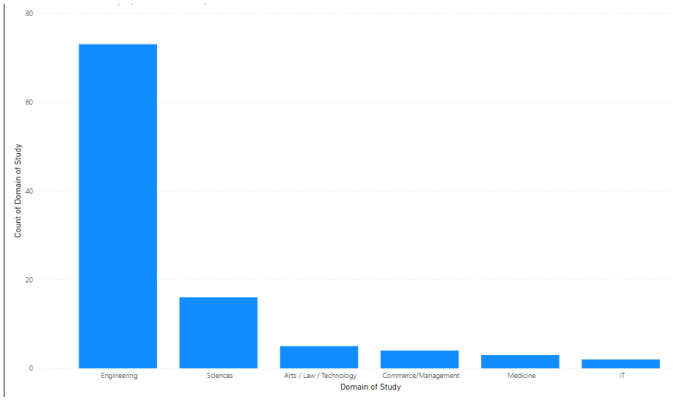

Fig. 4. Domain of Study

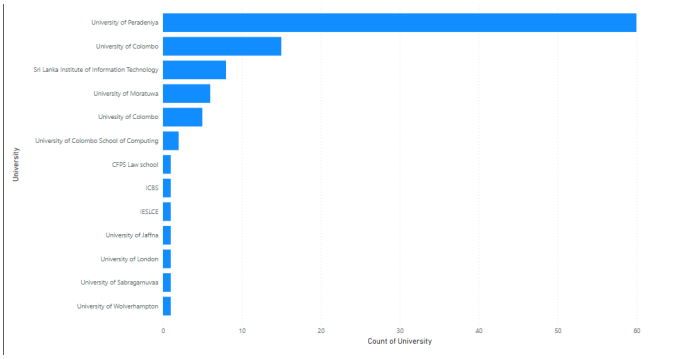

Fig. 5. Percentage of enrolled university

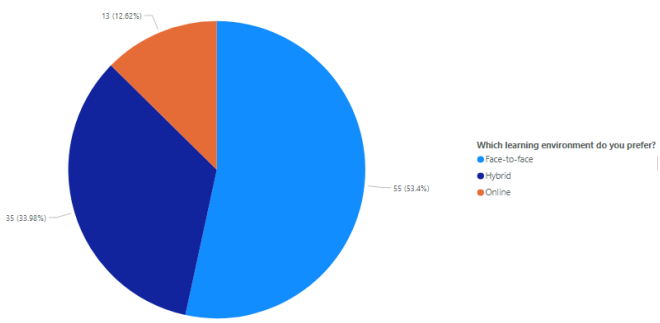

Fig. 6. Distribution of preferred learning environment

F. Deriving conclusion

After creating hypothesis statements and calculating the test statistic, p values are calculated in Microsoft Excel [10]. Then the value is compared with the 5% of the significance level. If the significant level is higher than the p-value, then the null hypothesis is rejected. Otherwise, we do not reject the null hypothesis.

IV. Statistical Inferences

This section focuses on hypothesis testing to obtain informative insights from the collected responses in the survey. Each of this section describes the hypothesis statements, test statistics and conclusion.

A. Engineering students Vs. face-to-face learning mode

Fig. 4 and fig. 6 depict that most of the undergraduates are studying Engineering and the respondents prefer face-to-face learning mode. It would be interesting to ask, "Do engineering students prefer face-to-face learning mode?". So, the hypothesis for this question is formulated in two statements.

- H_0: Proportion of engineering $P_{(e)}$ and other students $P_{(o)}$ who prefer face-to-face learning mode are equal
- H_a: Proportion of engineering who prefer face-to-face learning mode is greater than other students

Based on the above statements, a difference in proportion test [11] is carried out. Table II provides the counts on Engineering undergraduates and their preferred learning environment modes. It also states the count on other undergraduates' choices.

TABLE II
Domain of Study and Preferred Learning Mode

	Engineering	Other undergraduates	Total
Face-to-Face	37	18	55
Online	11	2	13
Hybrid	25	10	35
Total	73	30	103

- The proportion of engineering students who prefer face-to-face learning mode $P_{(e)} = 0.51$
- The proportion of other students who prefer face-to-face learning mode $P_{(o)} = 0.6$
- $P_{(e)} - P_{(o)} = -0.09$
- Pooled sample proportion = 0.536
- Standard error = 0.108
- Test statistic = -0.832
- P-value = 0.203

Since the p-value is higher than the 5% significance level, we do not reject the null hypothesis. Hence, we do not have much evidence that the proportion of engineering P(e) and other students P(o) who prefer face-to-face learning mode are equal.

B. Association between current district and satisfaction level on accessing reliable software

This was another interesting hypothesis to analyze. The question is "Is there an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning?". The following hypothesis statements are defined.

- H_0: There is no association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning
- H_a: There is an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning

Since this is a test of association between two categorical variables, the Chi-Square Test of Association was performed.

To discover this test, the following assumptions should be satisfied. [12]

- Both the variables should be categorical
- Each variable should have two or more categorical and independent groups.

Chi-Square test is done between the respondents' current districts and the satisfaction level they have on accessing the reliable software for e-learning. Table III is created based on the users' responses. The following abbreviations are used in Table III

- Very dissatisfied - 1
- Dissatisfied - 2
- Neither satisfied nor dissatisfied - 3
- Satisfied - 4
- Very satisfied - 5

TABLE III
CURRENT DISTRICT AND SATISFACTION LEVEL ON ACCESSING RELIABLE SOFTWARE

	1	**2**	**3**	**4**	**5**	**Total**
Anuradhapura	0	0	0	1	0	1
Badulla	0	0	0	1	0	1
Batticaloa	0	0	1	2	1	4
Colombo	0	1	1	14	11	27
Galle	0	0	1	0	0	1
Gampaha	0	0	0	1	1	2
Jaffna	1	2	8	34	7	52
Kandy	0	0	1	0	0	1
Kegalle	0	0	0	2	0	2
Kilinochchi	0	0	0	1	0	1
Kurunegala	0	0	0	1	0	1
Mullaitivu	0	0	1	0	0	1
Nuwaraeliya	0	0	0	0	1	1
Polannaruva	1	0	0	0	0	1
Puttalam	0	0	1	0	0	1
Vavuniya	0	1	1	1	1	4
Trincomalee	0	0	2	0	0	2
Total	2	4	17	58	22	103

TABLE III contains the observed data from the survey. Observed data have passed the required condition to apply the Chi-Squared test and assume the distribution. Each cell is calculated with the expected value using Eq.1. Hence the test statistic was calculated according to Eq.2.

$$ExpectedValue = \frac{(Rowtotal * Columntotal)}{Grandtotal} \quad (1)$$

$$X^2 = \sum \frac{(Observed - Expected)^2}{Expected} \quad (2)$$

After the calculation, the following values are obtained.

- Test statistic = 106.816
- Degrees of freedom = 64
- P-value = -0.0006

Since the 5% significance level is higher than the p-value, we reject the null hypothesis. Hence, We have very strong evidence that there is an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning

C. Gender and online classes

Most of the respondents are male. This section analyzes "Do male students find more time to participate in synchronous classes than female students?". The hypothesis for this problem is defined as below.

- H_0: The Proportion of male $P_{(m)}$ and female students $P_{(f)}$ who participate in synchronous classes are equal
- H_a: The proportion of male students who participate in synchronous classes is greater than female students

This hypothesis is conducted through a difference in proportion test. Table IV summarizes the gender proportion and the satisfaction level on the participation in online classes.

TABLE IV
GENDER AND SATISFACTION LEVEL IN PARTICIPATION OF ONLINE CLASSES

	Male	**Female**	**Total**
Satisfied/Very satisfied	40	27	67
Not satisfied	18	18	36
Total	58	45	103

- The proportion of male undergraduates who participate in synchronous classes $P_{(m)}$ = 0.69
- The proportion of female undergraduates who participate in synchronous classes $P_{(f)}$ = 0.6
- $P_{(m)}$ - $P_{(f)}$ = 0.089
- Pooled sample proportion = 0.650
- Standard error = 0.095
- Test statistic = 0.947
- P-value = 0.828

Since the p-value is higher than the 5% significance level, we do not reject the null hypothesis. Hence, we do not have much evidence that the proportion of male and female students who participate in synchronous classes are equal

V. CONCLUSION

This study investigated three hypotheses on e-learning satisfaction among undergraduates under the pandemic situation in Sri Lanka. The following conclusions are obtained from the study.

A. Do engineering students prefer the face-to-face learning mode?

There is not much evidence that the proportion of engineering and other students who prefer face-to-face learning mode are equal

B. Is there an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning?

There is very strong evidence that there is an association between the students' current district and satisfaction level on accessing the reliable software/tools for e-learning

C. Do male students find more time to participate in synchronous classes than female students?

There is not much evidence that the proportion of male and female students who participate in synchronous classes are equal

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