

LINUX BASED GENERALIZED AUTOMATED ENROLLMENT IN MOODLE
AND A FRAMEWORK TO OVERCOME CHALLENGES FACED BY
UNIVERSITIES IN ADOPTING ONLINE TOOLS

H.B.Rajitha Sandaruwan

189471M

Faculty of Information Technology

University of Moratuwa

August 2021

LINUX BASED GENERALIZED AUTOMATED ENROLLMENT IN MOODLE
AND A FRAMEWORK TO OVERCOME CHALLENGES FACED BY
UNIVERSITIES IN ADOPTING ONLINE TOOLS

H.B.Rajitha Sandaruwan

189471M

Dissertation submitted to the Faculty of Information Technology,

University of Moratuwa, Sri Lanka

for the partial fulfillment of the requirements of the

MSc/PG Diploma Degree of

Master of Science in Information Technology.

August 2021

Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

HBR Sandaruwan

Name of Student

Signature of Student

Date:

Supervised by

Chaman Wijesiriwardena

Name of Supervisor

Signature of Supervisor

Date:

Devotion

Number of people are around me and without whom this MSc program and thesis could have not been accomplished, and to whom I am ever grateful. It's none other personals than my mother and father, who continues to be source of encouragement and inspiration to me throughout my life. And to my beloved siblings, brother and sister and their family members.

Acknowledgements

Foremost, sincere gratitude to my thesis supervisor Mr. Chaman Wijesiriwardena for all the guidance and support rendered, not only to complete the thesis but to successfully complete the MSc program despite many challenges during a striving time frame. Would like to thank the management of the selected private higher education institute for providing me permission to conduct data collections in the university premise. I also would like to thank all lecturing panel and students in the university who supported me to collect data for my research.

My heartfelt gratitude goes to all the lecturers of MSc program of IT faculty, lab technicians and non-academic staff of University of Moratuwa, and last but not least my batch mates for all the academic support rendered during the pandemic period.

I thank Mr. Dinesh Madhusanka, for providing me necessary devices, Mr. Rajiv Weerasinghe for releasing me a copy of the Student Management System backup for my project work and Ms.Lasika Liyanage for proof reading of my dissertation..

Lastly, my sincere gratefulness to relations and friends who assisted and encouraged me to successfully complete my goal.

Abstract

The mechanism of adding students to a Moodle courses is called Enrolment. There are various Moodle auto enrolment plugins are available and Moodle administrator yet has to install and configure the plugin accordingly to allow students to enroll for modules. Available auto enrolment plugins only work for student's role and furthermore there is no restriction/authorization mechanism to allow students that they can only enroll for defined set of modules. Further, some plugins are only working with a particular Moodle version only.

This Proposed solution is to fulfill a burning question of educational institutes and its Moodle administrators', to enroll students only to their registered modules automatically without extra effort and time waste.

The research component of this document includes a qualitative study to a research problem emerged as; "while Sri Lankan universities use some online tools; they do not seem to get the maximum gain out of these tools due to numerous challenges. Moreover, there is no model developed with respect to Sri Lankan university context to provide necessary guidelines to overcome these challenges."

Based on the above research problem, the research was conducted with the objective of exploring challenges faced by universities in adopting online tools. Research uses the case study methodology by Yin^[54], with a single case. The university which is described as "XYZ university" is selected as the case and which offers Computing, Business and Law degrees affiliated with a university in United Kingdom. The research included an academic population of 32 academic staff members and a student sample of 260.

Research recommends numerous strategies in terms of a framework for the XYZ university as to overcome these challenges. Use of interactive presentations/slides, implementing specific tools for challenging modules, implementing an interactive portal to unite academics and students, conducting well-structured training and IT infrastructure perfections are the main recommendations.

The framework also promotes general recommendations for the XYZ university to further grasp of the advantages of online tools. Implementing measures to ensure social-interaction of students and academics, implementing a suitable strategy to select online tools for the university and ensuring mental wellbeing of students and academics are as the general recommendations.

Table of Contents

Declaration	iii
Dedication	iv
Acknowledgement	v
Abstract	vi
1.0 Chapter 01 - Introduction	1
1.1 Moodle enrolment problem statement	3
1.2 Resource requirements	4
1.2.1 Server requirements	4
1.2.2 Client requirements	5
1.3 Research problem	5
1.4 Research questions	5
1.5 Aim and Objectives	6
1.5.1 Aim	6
1.5.2 Objectives	6
1.5.3 Secondary Objectives of the research	6
1.6 Sampling and Data Collection	8
1.7 Case study methodology	8
1.8 Research scope	9
1.9 Limitations	9
2.0 Chapter 02 - Literature Review	10
2.1 Introduction	10
2.2 Moodle	11
2.3 Moodle Enrolment methods	12
2.4 Course Enrollment	12
2.5 SMS	13
2.6 SMS Data	13
2.7 Technology aided education methods in higher education	14
2.8 Restrictions of using online tools in higher education	14
2.9 Usage of online tools in different universities	15
2.9.1 Use of online tools in global universities	15
2.9.2 Use of online tools in state universities within Sri Lanka	16
2.9.3 Online tools practice in local private higher education sector	16

2.9.4 e-learning tools to support student engagements in universities	17
2.10 Substantial high use of online tools during pandemic	18
2.11 Success stories of using online tools in different universities	18
2.12 Technology acceptance model (TAM)	19
2.13 Challenges in adopting online tools in universities	20
2.13.1 Challenges - IT literacy	20
2.13.2 Challenges - Module specific	20
2.13.3 Challenges - Quality IT infrastructure	20
2.13.4 Challenges - User's IT Literacy	21
2.14 Conceptual model	22
3.0 Chapter 03 – Methodology	24
3.1 Introduction	24
3.2 Methodology in Moodle enrolment	24
3.2.1 Moodle	26
3.2.2 Connection string between LMS – cPanel	27
3.2.3 cPanel	27
3.2.4 SMS	28
3.2.5 Log in to SMS	29
3.2.6 LMS Sync- Sync Categories and Modules	33
3.2.7 LMS Sync (Sync by Batch code)	33
3.2.8 Connection string between cPanel-Oracle	35
3.2.9 Risk Benefit Analysis of the enrolment method	35
3.3 Methodology in research work	35
3.3.1 Selection and justification of case study	35
3.3.2 Design - Case study	36
3.4 Ensuring validity of the case study	37
3.4.1 Collection of case study evidence and e-learning tools	38
3.5 Data collection methods in the Case study and tools	39
3.6 Sampling strategy	41
3.7 Sampling techniques for quantitative analysis	41
3.8 Sampling techniques for qualitative analysis	41
3.9 Analytical techniques	42
4.0 Chapter 04 – Analysis	44

4.1 Academics data analysis	44
4.2 Descriptive analytics of academics	45
4.3 Qualitative analysis of academics	50
4.4 Qualitative analysis	51
4.4.1 Qualitative analysis - how adopting online tools depends on type of modules	51
4.4.2 Qualitative analysis - how adopting online tools depends on Quality IT Infrastructure	52
4.4.3 Qualitative analysis - how adopting online tools be subject to IT literacy	53
4.4.4 Qualitative analysis - how adopting online tools depends on user training	54
4.5 Students data analysis	57
4.5.1 Reliability and validity of data	57
4.5.2 Descriptive analytics – Students	58
4.6 Open ended question analysis	62
4.7 Hypothesis testing – students	63
4.8 Students qualitative analysis	64
4.9 Qualitative analysis	65
4.9.1 Qualitative analysis - how adopting online tools depends on type of subject	65
4.9.2 Qualitative analysis - adopting online tools depends on Quality of IT Infrastructure	67
4.10 Common difficulties faced by lecturers and students	68
4.11 Summary of findings	69
4.11.1 Summary of findings for academics	69
4.11.2 Summary of findings of students	71
4.12 Discussion	72
4.13 Recommendations - overcome module-based difficulties	74
4.13.1 Using interactive multimedia slides to rebuild the liveliness (real-time feedback, interactions and engagement) in lessons	74
4.13.2 Use specific tools for problem solving and practical modules	74
4.13.3 Interactive portals to bring stronger engagements and interactions	74
4.14 Recommendations - Train Users	75

4.14.1 Organize well planned, structured training sessions for both academics and students	75
4.14.2 Add a “Frequently asked questions” (FAQ) link in to LMS	75
4.15 Recommendations to improve IT Infrastructure for lessons	75
4.15.1 Learn from home	76
4.15.2 Learn on-premise	76
4.16 Overall recommendations	76
4.16.1 Enhancement of social media integrations	76
4.16.2 Implement an appropriate strategy in selecting online tools	77
4.16.3 Ensure psychological wellbeing of students and academics	77
5.0 Chapter 05 – Conclusion	79
Appendices	80
APPENDIX A	80
APPENDIX B	84
References	86

List of tables

Table 3.1 Case study tactics for Four Designs Tests by Yin to ensure validity in case studies	37
Table 3.2 Research hypothesis	38
Table 3.3 Sources of evidences in a case study and their strengths and weaknesses	40
Table 4.1 School-based cross formulation experience levels of using online tools	49
Table 4.2 Codes recognized from academic qualitative responses	50
Table 4.3 Difficulties students are finding when assuming online tools	61
Table 4.4 Codes identified from student qualitative responses	65
Table 4.5 Summary of hypothesis tests-students	72

List of figures

Figure 2.1 Original Technology Acceptance Model	19
Figure 2.2 showcases Rasheed’s classification of challenges	21
Figure 2.3 Three main areas of challenges in online learning	22
Figure 2.4 Conceptual Model/Framework	22
Figure 3.1 LMS, SMS and its users	24
Figure 3.2 System diagram of project work	25

Figure 3.3 Moodle login page	26
Figure 3.4 Moodle admin login	27
Figure 3.5 Connection string between LMS – cPanel	27
Figure 3.6 Login to cPanel	28
Figure 3.7 Environmental variable setting of SMS	28
Figure 3.8 Shortcut icon settings of SMS	29
Figure 3.9 Login of SMS	29
Figure 3.10 SMS home window	29
Figure 3.11 Setting up of class setup in SMS	30
Figure 3.12 Sample of class setup in SMS	30
Figure 3.13 cPanel Admin login	31
Figure 3.14 cPanel Home page	32
Figure 3.15 cPanel Lecturer Sync	32
Figure 3.16 cPanel Batch Sync	32
Figure 3.17 cPanel Batch Sync successfully completed	32
Figure 3.18 cPanel Program code Sync	33
Figure 3.19 SMS course start and end date selection	33
Figure 3.20 LMS Edit course setting view	34
Figure 3.21 LMS user's enrolment view	34
Figure 3.22 Connection string between cPanel and Oracle	35
Figure 3.23 Conceptual model/framework	37
Figure 3.24 Convergence of evidence for a single case study as per Yin	40
Figure 3.25 Steps of qualitative data analysis	43
Figure 4.1 Years of lecturing experience	45
Figure 4.2 Use of online tools for lecturing	45
Figure 4.3 Experience in online tools – academic staff	46
Figure 4.4 Adopting to online tools - Academic staff	46
Figure 4.5 Time taken by to learn a new tool – lecturers	47
Figure 4.6 Compelled to use online tools during pandemic lockdown – lecturers	47
Figure 4.7 Preference to use online tools – lecturers	48
Figure 4.8 Facing difficulties using online tools – lecturers	49
Figure 4.9 Model of challenges designed from academic's qualitative analysis	56
Figure 4.10 Classification of schools	58
Figure 4.11 Year/level of study	58

Figure 4.12 Use of online tools of students	58
Figure 4.13 Online learning tools used by students	59
Figure 4.14 Students adopting online tools	59
Figure 4.15 Time taken to learn a new online tool – students	60
Figure 4.16 Compelled to use online tools during pandemic – students	60
Figure 4.17 Preferences to use online tools – students	60
Figure 4.18 Facing difficulties using online tools – students	61
Figure 4.19 Word Cloud of Student challenges	62
Figure 4.20 Word cloud of challenging modules	63
Figure 4.21 Model of challenges - student's qualitative analysis	68
Figure 4.22 Challenges faced - lecturers and students	69
Figure 4.23 Challenges faced by the XYZ university in adopting online tools	73
Figure 4.24 Framework with commendations for the XYZ university to overcome the identified challenges in adopting online tools	78

List of Abbreviations

APIIT - Asia Pacific Institute of Information Technology

AI – Artificial Intelligence

BI - Behavioral Intention

BBB – Big Blue Button

CALL - Computer Assisted Language Learning

CeL - Collaborative e-Learning

CoPs - Community of Practice

Covid-19 - 2019 novel coronavirus

EFL - English as a Foreign Language

E-learning - Electronic learning

GPA - Grade Point Average

HND - Higher National Diploma

HCI - Human Computer Interaction

IDE - Integrated Development Environment

IT - Information Technology

LAN - Local Area Network

LMS - Learning Management System

MOODLE - Modular object-oriented dynamic learning environment

MS Teams - Microsoft Teams

NIBM - National Institute of Business Management

NLP – Natural Language Processing

OER - Open Educational Resources

PG – Post Graduate

PDF - Portable Document Format

SLIIT - Sri Lanka Institute of Information Technology

SPSS - Statistical Package for the Social Sciences

TAM - Technology Acceptance Model

UG – Under Graduate

UGC - University Grants Commission

UK – United Kingdom

UOM – University of Moratuwa

VM – Virtual Machine

Chapter 1

1.0 Introduction

This chapter is about the Moodle platform, how it is being used for online teaching and learning in various countries, Present Moodle enrolment mechanisms, Moodle enrolment problem, Resource requirements, Research problem, Research questions, Aim and Objectives, Sampling and Data Collection, Case study methodology, Research scope, Limitations.

Moodle is the world's widely used open source learning platform that allows educators to create courses and activities with flexible software tools for collaborative e-learning. Moodle can be effectively used in the educational systems in private or public higher education institutions. Moodle can be used in universities in different methods, both in full-time, part-time learning, e-learning or hybrid learning, or both in the initial and continuous development.

Although initially created for distance teaching and learning, Virtual Learning Environments are at present used as courtesy for the traditional educational activities, known as hybrid Learning. The Moodle platform has proved to be an effective learning tool as it is interactive, integration of multi-media content, and provides wide opportunities to collaborate, follow guidance, give and receive feedback, as well as reinforce prior learning material. Its core principle is storing, tracking, and measuring learning and providing an environment for learnings.

Moodle was first published as an open-source platform in 2001. Today it is allowing millions of teachers and learners in every nation to change the world and make it a better platform for education. Nowadays, with Moodle, being the most effective learning management systems, this problem is no longer urgent, although the issue of motivating active involvement is still on the sketch. Since the LMS platform is a upgradeable education environment, countless changes can be made to encourage both teachers' and learners' motivation.

In Sri Lanka, there are 398 Moodle sites have been registered with moodle.org [16] and in world context there are 150,194 registered sites in 242 countries [17].

The whole paradigm of teaching and learning has shifted with online tools and technologies. All most all the universities have come up with various methodologies incorporating online tools in to their curriculums. Learning management systems, social media applications, video portals and blogs are popular online tools amongst

universities (Nachimuthu)^[33]. Both the education providers and students benefit from these tools. Increased availability of course materials, accessibility to wide variety of content databases and diverse educational process efficiencies are few of the many benefits of all these online tools (Premawardhena)^[35]. Tertiary education seems to give the highest economical return in many nations in recent past. According to a World Bank report in 2017 whilst primary sector has 10% and secondary has 7%; higher education has shown an estimation of 17% earnings increase. Private education domain has become a good investment for entrepreneurs. Countries around the world have identified higher education sector means to be an income generator for their economy and as well as to provide opportunities for the young generation to pursue their higher education.

Higher education is which one can embrace after his/her secondary education at teenage. Training and vocational education can also be considered as higher education. Colleges, technical training institutes, state and non-state universities and vocational schools are the main higher educational providers around the world. It's the same in Sri Lankan context too. The universities in Sri Lanka which are publicly financed and previewed by the University Grants Commission (UGC) are known as state universities. According to the amendments to the University Act of Sri Lanka (University Grants Commission, 2020), non-state companies and institutes were also granted permission to award their own degrees. Sri Lanka Institute of Information Technology (SLIIT) was under the government regulatory for some time and private ones such as Asia Pacific Institute of Information technology (APIIT) (University Grants Commission, 2020) are two examples of higher education institutes in Sri Lanka. They use online tools to a greater extent yet it has been identified that not up to a greater height.

This research is based on a selected non-state university which is affiliated with a renowned university in UK. The selected non-state university is denoted as XYZ university hereafter.

It has both UG and PG programs offered by the affiliated university in the streams of Computing, Business and Law. The partnered university has made available its structures of the courses, assessments and course material guidelines to the Sri Lankan academics via an online teaching and learning platform called the Blackboard. The XYZ university delivers on premise teaching and learning mainly in classrooms and through its computer laboratories. These sessions are facilitated by some online tools like Moodle based LMS, online tutorials and social media groups. The XYZ university

has a current student population of approximately 800. It has further developed the use of online tools with Covid-19 pandemic as they have stepped in to online and hybrid education systems. As all-island lockdown imposed in Sri Lanka in mid of March 2020 due to the pandemic breakout, the XYZ university opted to Microsoft Teams (MS Teams) platform to deliver online lectures. The university premise was limited for students subsequently. The university is operating in either fully online or hybrid as it was subjected to the Covid-19 regulations of the country.

1.1 Moodle enrolment problem statement

Presently, I am working in the selected XYZ university in Sri Lanka as the Moodle administrator since 2011. Institute has shifted its teaching and learning platform to Moodle 09 years back and since then Moodle has lifted its teaching and learning scope to a greater height. Moodle has gradually not only become its students' virtual class room but it has been geared up with modern teaching, learning, assessments, marking, moderation and various other student-oriented plugins as well.

Enrollment to the modules is being fulfilled by the self-enrollment methods by students themselves and it has become a hectic task for the administrator with the increase of student population in recent times. Every time a new intake registers for a new semester, Moodle administrator has to create/ update modules, assign lectures to the relevant modules and provide enrolment keys through their relevant lecturer to allow students access to their modules.

Even though there are many auto enrolment plugins^[18] are available; none of the existing Moodle plugins are capable of authorizing students to access only to the modules they are entitled to access. Furthermore, integrating to an internal student management system (SMS) and manage students' enrollment in timely manner and carry out module sync/lecturer/batch sync as it being updated in its internal SMS is also not available with any plugin.

Further, since the introduction of the Moodle platform to XYZ university's students in 2008, students were expected to enroll for the modules by providing an enrolment key to enroll for their respective modules. As the Moodle administrator this was a hectic task, as all the modules have to be created under their respective main categories (ex; Applied IT, Computer Network and Security, International Business Management, etc.) and assign lecturers as well. And it was reported that providing an enrolment key is not a good way of providing access to students to modules as students could easily find the

enrolment key of other batches and could get access to irrelevant modules unnecessarily. Even it was suggested to change the enrolment key after a pre-defined time frame, it created again an additional works on the Moodle administrator to follow. Later after many discussions, it was decided to get the students email addresses from the cPanel by providing their batch codes and enrolling them to their respective modules by assigning student role and the module end date at once. This method also became an arduous administrative task as student population gradually increased with the time. Proposed solution could be able to find potential buyers on its completion from educational institutes in Sri Lanka which uses Moodle platform for its teaching and learning, as it addresses an ongoing Moodle module enrollment drawback.

1.2 Resource requirements

Following are the resources requirements for the implementation of the proposed solution.

1.2.1 Server requirements [19]

Least supported versions.

- Moodle version: Moodle 3.2 or later
- PHP version: minimum PHP 5.5.0 (cPanel) PHP 7.2.x, 7.3.x and 7.4.x (Moodle)
- Oracle Oci8 driver is required^[20]
- cPanel web control ^[22]
- Dream viewer CS4 for coding
- FileZilla for ftp file transfer
- SSH access to virtual machines

a. Hardware

- Disk space: 1GB for the Moodle files, plus as many spaces as you need to store content. Minimal 5GB.
- Processor: 2GHz dual core or more.
- Memory: 4GB or more is recommended. 8GB plus is for a large production server

b. Database^[23]

Recommended MySQL least version

c. Database drivers

Required database drivers to connect with Moodle database

1.2.2 Client requirements

Moodle supports any standard compliant web browser.

Desktop:

- Google Chrome
- Mozilla Firefox
- Apple Safari
- MS Edge
- Internet Explorer

Mobile:

- Mobile-Safari
- Google Chrome

Further, while Sri Lankan universities use online tools for their teaching and learning; they do not seem to get the maximum advantage out of these tools. There seems to be challenges faced by universities in adopting these online tools. Furthermore, there is no proper framework developed to provide appropriate recommendations for the universities to overcome these challenges and adopt online tools to obtain the maximum out of it and benefits to its students.

This research explores the challenges faced by the XYZ university in adopting online tools in three curricula. Furthermore, the research recommends a framework to overcome the identified challenges.

1.3 Research problem

While Sri Lankan universities use some online tools; they do not seem to get the maximum value out of these tools due to numerous challenges. Moreover, there is no framework developed with respect to Sri Lankan universities context to provide necessary guidelines to overcome these challenges.

1.4 Research questions

RQ1: How online tools currently are being used in XYZ university in Sri Lanka?

RQ2: How challenging is it for the XYZ university in Sri Lanka to accept online tools?

RQ3: How to formulate a framework with strategies to overcome the challenges faced by the XYZ university in adopting online tools?

1.5 Aim and Objectives

1.5.1 Aim

To develop a web-based system integrate with any type of Student Management System and automate the module sync, lecturer sync and batch sync to Moodle. Consequently, lecturers and students will be assigned only to access their respective modules only for a defined time period.

1.5.2 Objectives

1. Successfully integrate any Student Management System (SMS) with the Moodle irrespective of its database and the operating system being used.
2. Successfully complete the web interface to implement the module sync, lecturer sync and batch sync with cPanel - web hosting control panel.
3. Identify challenges in adopting online tools in the XYZ university and recommend strategies to overcome them via a framework.

1.5.3 Secondary Objectives of the research

SO1: To gather data of current utilization of e-learning tools in the XYZ university.

SO2: To classify challenges in adopting e-learning tools in the XYZ university.

SO3: To formulate/develop a framework with strategies to overcome disputes in adopting e-learning tools for the XYZ university.

Universities consist of academics and students that collaborate in order to achieve the main goal of a quality higher education. Wenger^[52] states that a Community of Practice(CoPs) is equipped with three main fundamentals: domain of knowledge, community of people and practice. When online mechanisms used for practices, it produces a Virtual CoP^[53].

In a university many online tools are being used for everyday teaching and learning. Sherer and Shea(2011) discuss that social media, Google Docs, chat rooms and video conferencing are some of the popular online tools used in worldwide universities. Sancristobal^[43] discuss four main types of online tools utilized in distance learning courses; learning management systems (LMS) , courseware, virtual labs. Courseware is a collection of ordered resources to be used for e-learning purposes (Massachusetts Institute of Technology, 2020). Online tools may be used for any type of student engagements: asynchronous and synchronous as per Hrastinski, 2008^[15]. Asynchronous e-learning enables students to engage using several media such as discussion boards

and email (Hrastinski^[15]). This flexibility allows the community to engage from anywhere in the world and any given time. Shahabadia and Uplane^[47] states that synchronous engagement is usually scheduled, real-time and more lively compared to asynchronous; where online tools such as live chats could be used.

The Technology acceptance model(TAM) introduced by Davis and Venkatesh^[4] as one of the popular information systems theories which prototypes how users accept a certain use of a technology. According to TAM a user's choice to admit a technology is based on perceived usefulness (whether the user believes that the technology is useful for what they do) and perceived comfort of use. This model is used to construct the conceptual framework in the research.

All the universities seem to be facing plentiful challenges in online tools which seems to limit them using their optimum benefits. Harvard University identifies copyright violations and privacy issues adopting online tools for legal studies. Agreeing with Harvard, Selvaras^[46] indicates that in general law students do not accept technology as a substitute for their physical classes but as a complement.

Technical barriers such as poor internet connectivity and slow internet speed are the main complications that undergraduates of Universities are undergoing whilst accessing online library resources. Further, it seems that quality IT infrastructure is a challenge in adopting online tools. Atmojo and Nugroho^[2] has come up with challenges faced by students and teachers when it comes to Indonesian context when they adopt online tools for skill development modules. It seems that based on the natures of modules it is challenging to adopt to e-learning tools.

Hampel^[12] emphasize the need for training for online courses as it is completely dissimilar from face-to-face teaching experiences. Fedock ^[7] have conducted a study amongst teachers at universities in North-east America with the purpose of exploring how online higher education academics take the role of using social media. Most of the faculty members have agreed that lack of training as a main obstruction to use social-media for delivery purposes. User Training seems to be a challenge in adopting online tools.

Rashid^[38] in his classification of challenges highlights technological literacy as a main students' challenge. Rashid conducted a study among 300 university students in order to identify challenges in web-based learning. The results indicated that there are positive relations between student's prior experience and online learning. Rashid^[38] has conducted a methodical evaluation of difficulties in the e-learning component of

hybrid learning. Their findings showcase technological literacy as a main challenge for students and academics when adopting online tools. It seems that IT literacy is a challenge in adopting online tools as well.

1.6 Sampling and Data Collection

205 of existing students from first year, second year and third/final year doing under graduate degrees in Business, Computing and LAW were involved with the survey organized. The prime objective of the study was to study the factors of adopting to the university online learning environment by lecturers and students.

The surveys consisted of two questionnaires (student and academics), each consisted of both MCQ type and open-ended questions (see Appendix A). The participants replied their answers based on their internal and external experience of learning and teaching through the use of the university learning management system (LMS), Moodle. The findings reveal the respondents' perception on virtual learning together with the obstacles they experienced during the exercise.

1.7 Case study methodology

This research uses Yin^[54] case study methodology. The case study methodology is much suited for the research as the current teaching activities of the universities using online teaching tools are examined and cannot manipulate the teaching and learning activities. The purpose is to that the generalizations the lessons learned from the research and it may help other universities to apply those lessons learned.

The research focusses on obtaining positive organizational transformation by overcoming any challenges in adopting online tools. The prime objective was to identify challenges faced in conditions of day to day teaching in universities using online teaching tools. Within the methodology, I have come up with a conceptual framework based on the literature reviewed.

While sticking to Yin^[54] case study method and I have taken suitable mechanisms to strengthen the evidence and overcome biasness and mixed data collections in terms of quantitative and qualitative data(online surveys and interviews). The XYZ university consists a population of 32 academics and over 800 students in the streams of Computing, Business and Law. A student sample of 260 is selected using probability sampling^[26]. Total academic population is used for the research as well.

Based on the previous literature a conceptual framework is established and hypothesis have been derived. The collected quantitative data is investigated using statistical application SPSS version 16.0. Nvivo software is used to analyze open ended questions and to come up with themes/codes in interview transcripts. As per the student sample descriptive statistics is found to explain the demographics and correlation techniques used to identify associations between independent variables and dependent variable identified in the conceptual framework. Additionally, interviews were carried out to strengthen the quantitative findings obtained of the students. As per the academics, the population was described and qualitative analysis of interview responses used to find the challenges they face. Research results is used to create a framework from which recommendations given to the XYZ university to overcome challenges and adopt to online tools.

1.8 Research scope

The research focus on a selected private university (depicted as XYZ University in this thesis) in Sri Lanka and all the other state and non-state universities are out of scope of due to the prevailing pandemic circumstances. The study only focusses on 2 branches of the XYZ University situated in Colombo. The research focusses on the undergraduate programs in the streams of Computing, Business and Law of the XYZ University. Postgraduate programs in the XYZ University are out of the scope for the research.

1.9 Limitations

The research is limited to undergraduate programs in the streams of Computing, Business and Law of the XYZ University. The post graduate program is excluded from the research work due to foreseeing the inability of rich participation. Research focus the two branches of the XYZ University situated in Colombo. This might become a limitation when the study results are been generalized to cater to the universities in Sri Lanka. Visiting academics of the XYZ University are not considered for the research considering the fact that, the visiting academics are often get changed according to the needs of a particular modules, semester or a school. Therefore, only full-time and part-time academics were considered. The research will be limited in terms of recommendations for only the streams of Computing, Business and Law since the XYZ University.

Chapter 2

2.0 Literature Review

2.1 Introduction to Literature Review

In this chapter it discusses about the literature review carried out to identify research gaps and grasp the theoretical and contextual experiences of the research. The conclusions of the literature review are used to study research questions and to propose a conceptual framework. Literature review discovers the use of e-learning tools in societies of practices in campuses and the difficulties faced by academics and students while using these e-learning tools. The Technology Acceptance Model, (TAM) [4] is used as the theoretical groundwork and behavioral intention is a factor that leads people to use the TAM technology.

Further, this chapter develops the research context through discussions of the relevant literature concerning the practices of using LMS within institutes/universities and matters that are important in the development of sustainable resolution for student enrolment in Moodle.

The open-source learning management system-Moodle is already widely used in all segments of education starting from primary schools to universities all over the world. It is freely available, flexible, customizable and basically contains many standard features which has made it to become famous. Moodle is available in more than 100 languages. Today, more than 54,000 active sites are registered over 225 countries, with millions of users compared to some open-source e-learning systems and found that Moodle is one of the most adaptable. From its origin, Moodle has been designed to be interactive web based LMS platform, which simplifies interactions among learners themselves, learners and instructors, learners and contents and between learners and software (interfaces). The learner-learner, learner-instructor and learner-content interactions can be found in both traditional classrooms and web-based courses.

The interactive learning / active learning is done through LMS and is considered to be in the field of Human Computer Interaction-HCI. Moodle is user friendly, easy to use application and possesses distinctive features for the execution of HCI and comprises of all typical LMS components as mentioned. Despite the fact that ease of use is one of the conditions which facilitate user adapted interaction in Moodle as argued, however, there are several other features signifying future of HCI as pointed out. These characteristics contain high-functionality systems, mixed media (images, voice, sounds,

video, text, and formatted data), mass availability of computer graphics, high-bandwidth interaction, large and thin displays and information utilities.

Moodle is one of the mostly used open-source e-learning platforms, that enables the creation of a course, ensuring courses can only be accessed by its enrolled students. Moodle allows the exchange of information among its users irrespective of been geographically detached, through mechanisms of synchronous (chats) and asynchronous communication (discussion forums). In functional viewpoint, it has easily configurable features, allowing the formation of student assessment processes (quizzes, online tests and surveys), as well as offering a wide variety of complementary tools to support the teaching and learning process.

Moodle uses a role-based access mechanism, and executes three major roles; administrator, teacher, and student. A user can be granted any of these roles. A user can be a student in one course, and a teacher for another. A teacher can also be the system administrator. Only those with an administrator role can control and create courses or assign teacher role to others or assign administrator role to anyone else. When a user enrolls to a particular course that role becomes a student role.

Moodle provides four types of access mechanism for students to join a course. The simplest method requires no authentication and allows any user to join the course. The second is a guest user mode where the user can go through the course, but cannot participate in any activity. The third mode requires the teacher to enroll each student directly one by one, manual enrolment. In this mode the teacher has full control in adding or removing students. Both enrolment and removal are done through a simple interface that can be accessed through the participant link on the course page. It shows a list of all valid users on the system and the list of current students. The fourth option uses an enrolment key set by the teacher/administrator. The teacher is supposed to share this key with all its students. Students must provide this key on their first entry to enroll them in the course. If the key is valid, the enrolment will be successful, and thereafter access does not require the key. Once all students are enrolled, it is better to alter the enrolment key to prevent misuse. If any 'unwanted' student enters the course, the teacher has full privileges to expel that user from the course as mentioned earlier.

2.2 Moodle

Moodle is web (PHP) based application. Its global developer teams' aim is to support its framework of education. Moodle has been designed as a result of a project.

Moodle is Open Source software and is available under the GNU Public License and it is copyrighted. Copying, usage and modifying is allowed fully provided that original license and copyrights be detached or modified, provide the source public, apply license to any derivatives.

Moodle can be installed^[21] on any computer that can run php and support an SQL type database. It is not recommended to use the same server for both applications and database. Most recommended method is that to execute application and database in separate servers. Most common database to use is MySQL, because it is Open Source database management system. It can be run on even Mac, Windows and many derivatives of Linux, operating systems.

2.3 Moodle Enrolment methods

In general, Moodle enrollment plugins have been provided. Enrollment plugins are the way of managing course enrollment. A number of ways of course enrollment is listed below:

- Self-enrolment
- Manual enrolment
- Flat file
- IMS Enterprise (from v1.6 onwards)
- Internal enrolment (default method)
- LDAP
- Payment Gateways- eg: Paypal
- Moodle Network (from v1.8 onwards).

2.4 Course Enrollment

Administrator sets up user authentication. Process starts creating semester courses. Next step is course enrollment for teachers and students.

On the SMS, which serve UG and PG of degree programs and since student numbers getting high, consist of nearly two hundred course enrollment number for each semester. Manual enrollment is impossible because of high overload. Need of performing this job effectively and efficiently, instead of manual mechanism is very important.

Also, after add-drop steps, there is a requirement to update course enrollments. Some students drop some courses and add some courses in place of dropped modules. Some students just enroll for all the courses without any intention. Therefore, these types of actions make another overhead for enrollment task. For some universities and institutions, LMS and Student Management System (SMS) are available on the same or they are just integrated, but it's a very occasional instance. The separated applications are successful on their parts. Therefore, the problem which has been tried to provide a solution is integration of SMS with LMS. Each of them is two different systems, and has to be made synced with each other automatically. The total solution for an enrollment mechanism on Moodle with a SMS is in huge demand nowadays.

2.5 SMS

Student Management System (SMS) is software to manage student personal data for educational institutions. SMSs include all the information of students such as personal data, curriculum information, class information, grades etc. SMSs provide capabilities for recording of all the mentioned information. The main aim of using the SMSs is to improve the use of student information. A functional SMS must have some major features like system maintenance, user management, personal information management and reporting. Course registration consists of two steps. In the first step, student selects the course(s) that he/she wants to take. In the second stage, academic administrator administers course/courses taken by a student and verifies if all the selections are valid.

2.6 SMS Data

As stated above, if your remote education infrastructures have been built separately, you would find a way to enroll users synchronously with SMS on LMS.

Each SMS can offer you a csv file to type which includes data like below,

- 2009010207002;D.E. - Computer Engineering;CME209
- 2009010207002;D.E. - Computer Engineering;CME211
- 2010528130005;Master of Science - Computer Engineering (Distance Education – Without Thesis);CMM719
- 2010528130005;Master of Science - Computer Engineering (Distance Education – Without Thesis);CMM741
- 2010010113046;D.E. - English Literature And Language;ELIT107
- 2010010113046;D.E. - English Literature And Language;ELIT211

Flat file are used to make enrollments. But there is a requirement to map SMS users with LMS users.

2.7 Technology aided education methods in higher education

Teaching includes imparting and disseminating the relevant knowledge, assisting students in learning and applying the knowledge. With the expertise knowledge in the subject area, a teacher is expected to be updated on recent developments of their relevant study areas. Creating content, delivering lectures, grading assessments are responsibilities of a teacher and contribute to students' extra learning. In a university lecturing practices should also lead to skill development, career aspirations and behavior building. These characteristics definitely strengthen a student's profile to fit to achieve career aspirations.

Zuhairi[55] states that technology aided teaching can be categorized in to so many modes according to the nature. On-campus, distance education, e-learning and blended/hybrid learning are some of those. On-campus is the traditional face-to-face course delivery where students and academics are on campus premise. Distance education is where the student and academics are remotely connected through internet. E-learning is where students engaged in web-based learning. Zuhairi[55] adds that online learning is a means of lifelong learning which enables growth of access and flexibility for students. Blended learning allows students to choose from both on premise and off premise as per their ease. Businesswire.Inc, a leading publication releases, global companies report that; the online education market by the year 2025 will reach a market value of US\$350 Billion. Meaning, there is a significant demand for online tools in the field of education.

2.8 Restrictions of using online tools in higher education

It is general rule any technology comprises of both its own pros and cons. Every online tool comes with certain boundaries. Using online tools will lessen the richness of face-to-face education. Nevertheless, in a study conducted by Kumar and Bowers_[30] they have found out that students showcased stronger social presence and teacher interactions in online learning compared to face-to-face learning. It is understood that mixed reviews exist in terms of liveliness of lessons while using online tools.

University instructors' inconsistency in their non-verbal communication in online delivery has impacted on undergraduate learning because communications that takes

place in online, does not meet the quality communication as it happens during a face-to-face discussion. However as per Smith and Northcote^[49] has suggested, if the universities have the ability to deliver online tools which facilitates video conferencing, above limitations can be eliminated. The followings reveal the international and local use of online tools in universities.

2.9 Usage of online tools in different universities

2.9.1 Use of online tools in global universities

The most generally used web-based tools in Indian universities are LiveBinders, Skype, Voice Thread and Wetoku. LiveBinders is a free online bookmarking website that offers an exclusive technique of storing online resources and sharing those resources with others (livebinders.com). Skype is another communication platform empowering students to work together with their lecturers and peers. A VoiceThread is a collaborative, multimedia slide show app that embraces images, documents, and videos and allows people to navigate slides and leave comments in 5 ways, using voice (with a mic or telephone), text, audio file, or video (via a webcam). The platform enables students to interact, collaborate and share contents that enables students to build online presentations by adding images, documents, and videos, and other media to which other users can add comments for discussion. This increased interactivity will surely be received positively amongst the community. Wetoku is a web site or web tool from Korea that delivers a simple platform for interviewing someone on internet. Once the recording is completed, the interviewer can embed the copy of the URL into a blog or a website(www.wetoku.com).

Martin and Tapp^[32] discuss the use of MS Teams in teaching undergraduate law modules at Staffordshire University in United Kingdom. Martin and Tapp^[32] also states that MS Teams comes with functionalities such as sharing desktop, slides and the live chat option which improves the interactivity of the lesson.

Sancristobal^[43] has classified four main types of online tools utilized in distance learning courses: courseware, LMS, virtual labs and remote labs. Courseware refers to a software especially designed for educational purposes. It is now widely accessible online with numerous resources and supporting materials such as reference books, research papers and journals. Courseware is known its used for online courses and certifications such as Microsoft Certified Professional courses.

Zuhairi^[55] clarifies about Massive Open Online Course(MOOC) as a fast-growing trend in higher education especially in Open Universities. Open Educational Resources (OER) and MOOCs together plays a significant role in global education context. Foreign students obtain access to various learning resources through OER/MOOCs channels/platforms and in more remote virtual labs allow students to hands on instruments via web interfaces.

2.9.2 Use of online tools in state universities within Sri Lanka

In a study conducted by Sandanayake, Madurapperuma and Dias^[44] in faculty of Information Technology, University of Moratuwa (UOM) utilize Moodle in their blended e-learning. University of Colombo holds distance learning using online tools. A study conducted in national universities in Sri Lanka by Fernando and Kanaganayagam^[8] shows that majority of the courses in Sri Lankan in Open University are held as online courses. University of Kelaniya has enabled a list of online tools for their undergraduates via their web site (Research council University of Kelaniya, 2020). Distance and continuing education unit at University of Ruhuna provides access to their LMS for their undergraduates (DCEU-University of Ruhuna, 2020). Furthermore, Grammarly and the Ginger grammar checker are tools which can be enabled via the web site. Those tools support students to incorporate of NLP and AI in their academic writing. Majority of state universities have their own Moodle site nowadays.

2.9.3 Online tools practice in local private higher education sector

Sri Lanka Institute of Information Technology (SLIIT), use repl.it tool^[28]. It is to conduct self-guided programming lab sessions. Programming is a tough module for undergraduates as they are not provided with prior experience in the subject matters from their schools. Therefore, the repl.it tool supports them to test their programming capability online prior to submissions during their practical examinations. Autonomous grading selection of Repl.it software to reduce manual grading^[39] is utmost a better facility as well.

Turnitin^[51] is a propriety online tool to spot academic plagiarism of students' submissions. Integrity of student's work is measured with this tool. If the academics are to perform this manually, it would have been impractical to detect such an accurate level of plagiarism and it provides a comprehensive report of each student's submission which consist of the originals referred by the student, sections of the source accessed

and also provides a clear percentage of plagiarism. Private higher education institutes like of Asia Pacific Institute of Information Technology (APIIT) and SLIIT are utilize Turnitin application.

BigBlueButton(BBB) is a paid app to have web conferencing for Linux based servers to facilitate virtual teaching and learning. The tool's ability to integrate with learning management systems and student attendance system also finds it beneficial. NIBM higher education institute uses BBB for sharing course materials and to conduct online teaching. Recording feature comes with this tool is ideal for the students who cannot participate for real-time lectures.

It is obvious that both government and private high education institutes in Sri Lanka, use online tools for academic activities nowadays. These tools contribute vastly for students to achieve their academic excellence. Student engagement is also a close indicator of student academic achievements. Student engagement contributes to student academic achievements in universities. Therefore, it is understood that to provide required online tools to ensure enhanced student engagement is universities' responsibility. Further, Huei^[25] states that cognitive engagement is effort and motivation towards learning, emotional engagement is student attitude to instructors and behavioral engagement is involvements of academic tasks. Students' logical behaviors are strongly attached with their emotions as they experience a community of different personalities and cultures via many extracurricular actions. Therefore, it is important to encourage students' engagements via group discussions, reading, assessments and research based in higher education institutes.

2.9.4 e-learning tools to assist students' engagement in universities

A study evidence shows that, student learning is connected to their participation and it was found that the student GPA (Grade Point Average) strength relied not on their intellectual ability but on their study skills and/or motivation factor.

Sherblom, Withers and Leonard^[31,48] discuss that skill, knowledge, motivation and grasp as main influencers of student engagement adopting to online tools. Students will increase their contribution if they have the knowledge as how to interact and share their ideas in an online learning platform. They also need to be well skilled as how to use these online tools which is used to facilitate these online discussions. Universities should enable and support to strengthen these influential factors and it is clear that using online tools in universities could enhance student engagements.

2.10 Substantial high use of online tools during pandemic

During the lockdown due to Covid-19, universities around the world rapidly shifted to online tools seamlessly to continue of their academic delivery. Hayashi^[14] presents that by 1st of June 2020, approximately 90.3% of Japanese universities switched to distance learning. 88% of youth succeeded to continue their higher education via 40% of online assessments and 54% lectures conducted using video. It is very inspirational to observe such a high percentage of universities in the country having the ability to switch in to online teaching and in return continuing educating their young generation.

Sri Lankan universities have started use of various modes of education such as collaborative learning and project-based learning using online tools. Hayashi^[14] agrees that lower the negative impact on the higher education sector during the pandemic, many Sri Lankan universities switched to online teaching means. Furthermore, as of 23rd August 2020, more than 13 million learning activities such as attending online quizzes and accessing reading material has been recorded in Sri Lanka using online tools such as LMS.

2.11 Success stories of using online tools in different universities

It can also be seen that a substantial amount of commitments from the academics, students and the universities is required to achieve this level of success from the online tools. Success stories of using online tools in universities has been reported. In many of these success stories we could see that the students and academics have greatly benefited from the e-learning tools.

In India there is a success story by utilizing social media as an tactic of online learning during the Covid-19 epidemic according to Dutta^[6]. In a study carried out between three Indian universities; it has received an 80% positive response rates from the students for using social media and students have paid their gratitude for university for paying attention for that initiate.

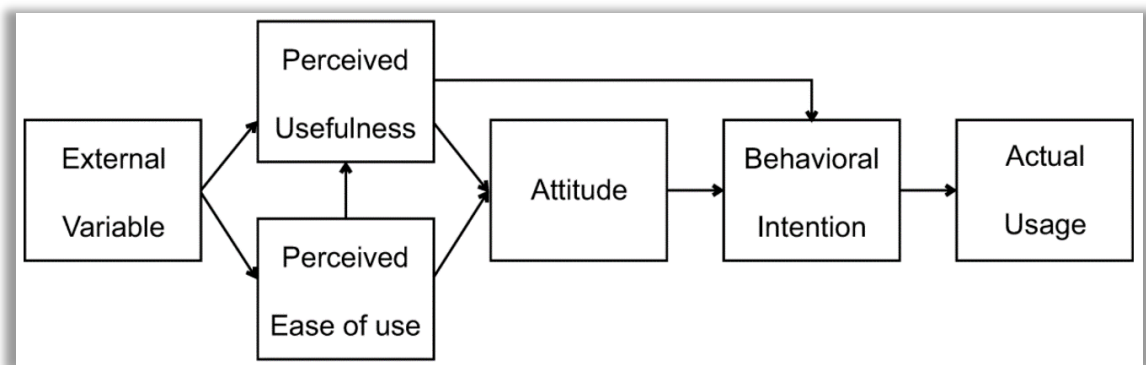
To analyze success of using Collaborative e-learning (CeL), a framework has been developed by Fernando and Kanaganayagam^[8]. Collaborative e-learning is a teaching method that focus on improving student skills such as communication, reasoning, and processing. There was a study conducted in the context of 15 Sri Lankan state universities where the study sample comprised of academics, undergraduates and post graduates. Study findings recognized that the most effective tools to use in CeL to improve interaction between students and lecturers as: Moodle, online conferencing

tools and online sources. Further, it was also found that the most effective tools to improve interaction amongst students are: online conferencing tools (Zoom, Moodle, MS Teams, online sources and virtual class rooms).

2.12 Technology acceptance model (TAM)

Davis and Venkatesh_[4] invented the Technology acceptance model (TAM) is one of the widespread information systems theory which models how users acknowledge a certain use of a technology. According to TAM, a user's capability to acknowledge a technology is defined as actual system use. Actual system use is accomplished by Behavioral Intention (BI) which is influenced by user's attitude. Attitude means a user's opinion/ impression towards a technology. The decision of the user acknowledging a technology is constructed on two aspects: perceived usefulness (whether the user believes that the technology is useful for what they do) and perceived ease of use (whether the technology is usable). Further, this decision is also very much depending on certain external variables likes of age and social influences.

Figure 2.1: Original Technology Acceptance Model



The TAM is most suitable to be used as a theoretic framework for this study work as it is clear that the user's perceptions, impression, technology consciousness and attitude impact the way how they accept a technology. Accordingly, these features will have a very straight forward impression on how students and lecturers of the XYZ University adopt online tools.

2.13 Challenges in adopting online tools in universities

In below section I have discussed about studies and other works on challenges in adopting online tools in universities.

2.13.1 Challenges - IT literacy

Fransson^[11] has carried out a study for an online mentor course for newly qualified teachers. The study has found out that technical challenges arise mainly due to lack of experience of mentors and with computers/devices.

2.13.2 Challenges - Module specific

Computing faculties in universities also seems to be facing enormous challenges in their transmission from on-premise to online teaching and learning. Many studies have showcased an alarming high percentage of respondents having faced difficulties in virtual learning when it comes to practical modules. Hence, it is clear that especially the transition from on-premise to online has been ‘stressful’ for many students.

A research has conducted in the department of legal studies of Open University, Sri Lanka to find out the use of technology to teach law through distance and open learning. Research stresses in favor of using online tools and software such as video conferencing, e-journals of law, electronic legal databases. In general, law students do not accept technology as a substitute for their face-to-face classes but as a complement and law degree programs seems to have slow adoption rate and adverse perspective on online tools.

Law faculties of higher education institutions around the world seems to be facing challenges related to the online delivery of certain law modules. For example, in Harvard University^[13], have identified copyright violations and privacy issues in adopting online tools for legal studies.

2.13.3 Challenges - Quality IT infrastructure

Infrastructure restrictions are the most common challenges faced everywhere. From the educational institutes’ point of view inaccessibility of servers, servers without being updated/upgraded, outdated software and poor testing conducted on the virtual lab tools have been identified as challenges. Requirement of 24 x 7 IT service is a challenge for a strong IT infrastructure is mandatory. Online higher education in China with the student’s poor/low broadband connection has been found as a main challenge. A study

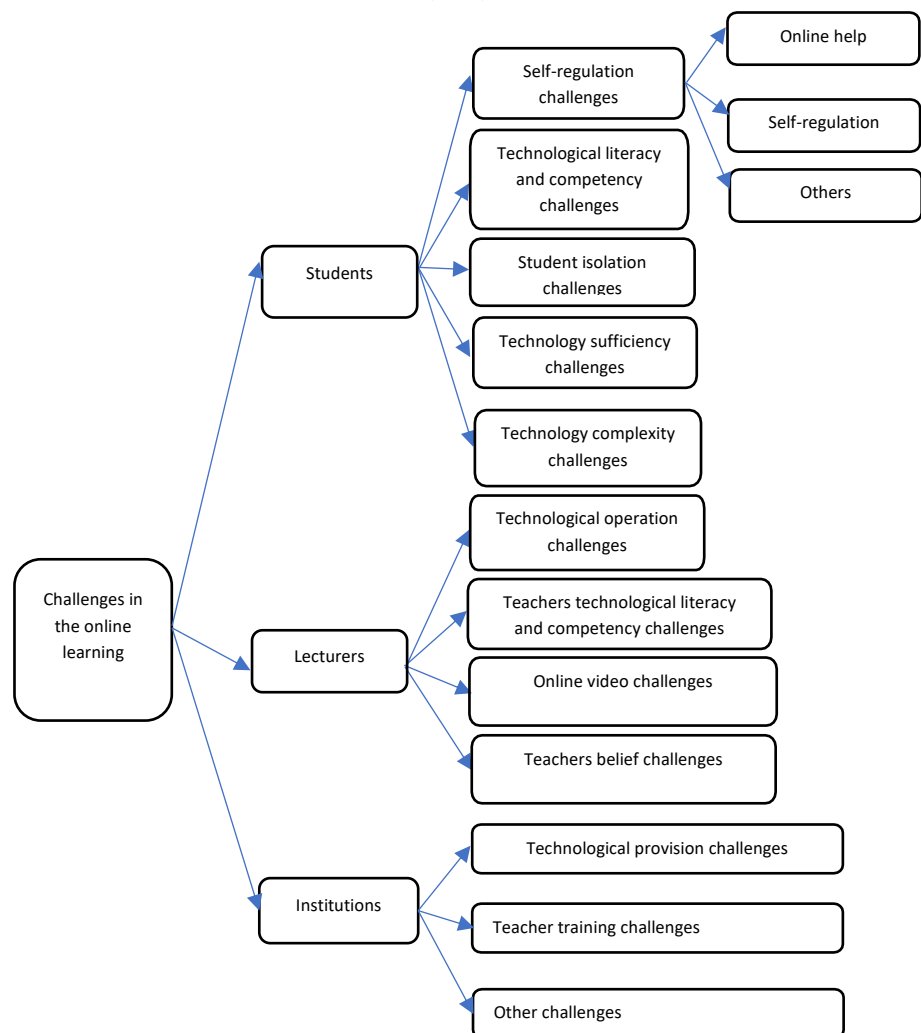
carried out in America, indicated that undergraduates faced technical obstructions is a main challenge. Furthermore, slow internet connectivity, blocked resources/sites and slow internet speed are among the technical challenges that undergraduates are facing in accessing library resources online.

2.13.4 Challenges - User's IT Literacy

Many researchers have found out of list of challenges and it highlights main student challenges as self-regulation, literacy in technology, student detachment, technology sufficiency and technological complications. Main challenging areas for teachers are been identified as technological illiteracy and operational drawbacks. Educational institutional challenges have been categorized as technology provisional and teacher training.

Figure 2.2 showcases Rasheed's classification of challenges

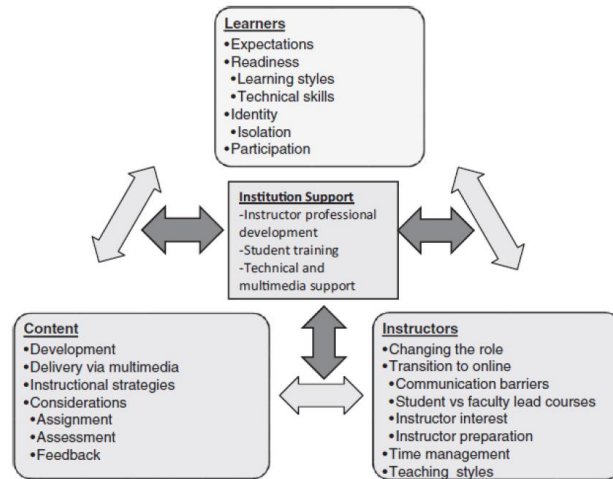
Source: Rasheed (2020)



Kebritchi^[27] has conducted a literature review on experimental studies to identify challenges in online education based on published articles and they have referred to 104 articles and has come up with the model as in Figure 2.3 showcase a categorization of three main areas of challenges: learners, content and instructors.

Figure 2.3: Three main areas of challenges in online learning

Source: Kebritchi et al.(2017)

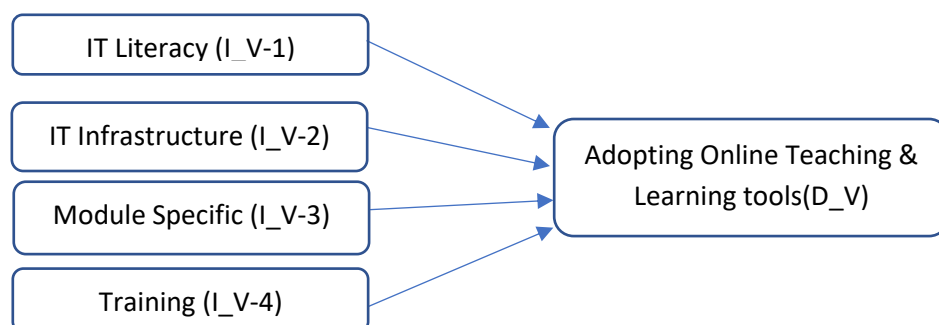


It is very much clear that many universities in global and local seem to be going through diverse challenges in adopting online tools in learning and teaching and it can be list out as IT literacy of users, challenging modules, obtaining a high-quality IT infrastructure facilities and inadequate user training found to be the four (04) major challenges. A gap in the literature review has been identified where there is no clear indication as to what exact challenges faced by universities in terms of online tool adoption. Another gap identified is that there are no proper recommendations provided to overcome these challenges. This research aim is to develops a conceptual framework with the above research studies and literature review.

2.14 Conceptual model

The following conceptual framework is designed on the findings of the literature review and pragmatic studies:

Figure 2.4 - Conceptual Model/Framework



Conceptual framework recognizes 4 different independent variables. IT literacy (IV_1) represents the challenges due to the IT literacy of academics and students. IT infrastructure (IV_2) represented the challenges due to IT infrastructure. Module specific (IV_3) is representing challenges based on types of modules. Training (IV-4) represents challenges due to training provided for academics and students. The diagram also identifies a dependent variable (D_V) called adopting online tools.

Chapter 3

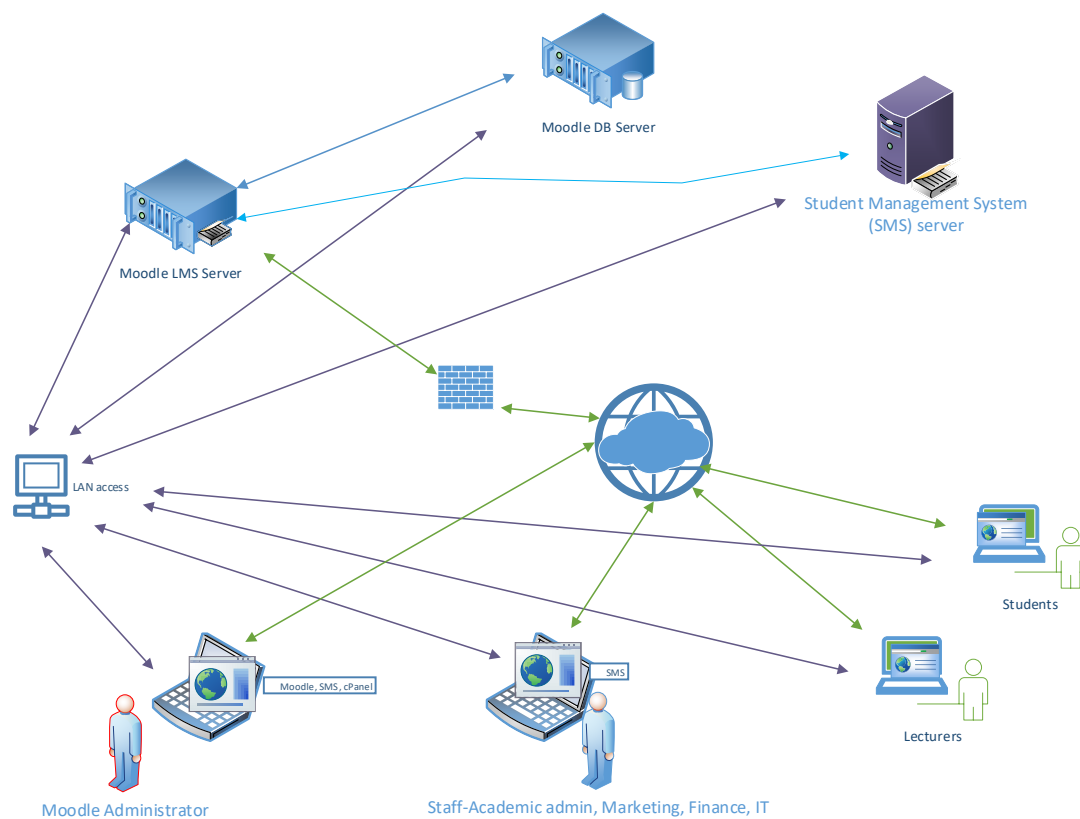
3.0 Methodology

3.1 Introduction

This chapter describes about methodology used in the Moodle enrolment project work and methodology used in research work. It is important to have a well-defined research methodology to obtain a clear structure for the research. The structure may include the approach, strategy and components of the methodology. I have followed the Robert K.Yin^[54] case study methodology with quantitative and qualitative data collection.

3.2 Methodology in Moodle enrolment

Figure 3.1 – LMS, SMS and its users



As per above Figure 3.1, in the live environment, Moodle server is running on a virtual machine having Moodle v3.8 and php v7.2 and apache tomcat web service. Moodle database is on MySQL and running on a separate server in view of minimizing the traffic on having same Moodle and database on the same server.

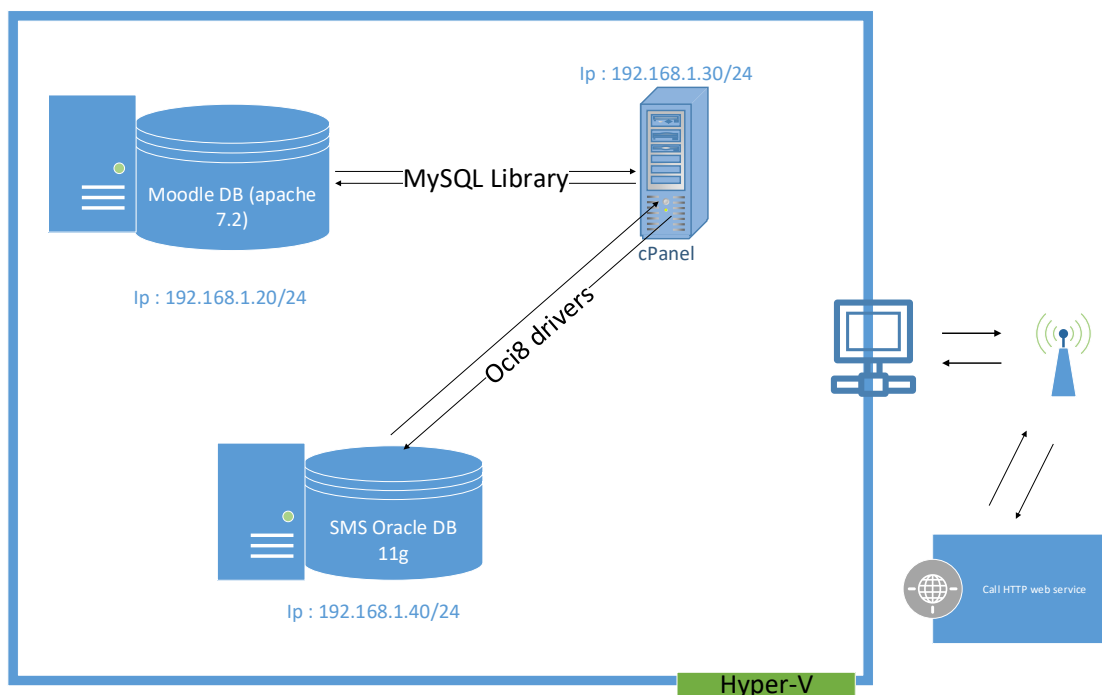
Student's registration process is carried out by the marketing staff. Finance staff carries out of all the payment recording on the Student Management System (SMS).

Thereafter, all the academic activities related to each and every student and against each and every module a student takes, are implemented by the academic staff until a student is passed out. Library staff take care of the reservation, renewal and late payment of book return through SMS. IT staff providing all the necessary accessibility to the GIMS system and help for IT related inquiries on SMS and report generation from the SMS. Both students and academic staff are not given access to SMS at any point of time and it is only made accessible to non-academic staff as mentioned above.

Moodle administrator is solely responsible for up and running of the Moodle teaching and learning, plugins integrations, backup/restore, providing necessary training for lecturers on Moodle, marking and moderation process, OS upgrade and security enhancements of both Moodle and Database.

SMS administrator is solely responsible for providing support to IT related inquiries from staff members on SMS, report generation, backup/restore, and security upgrades of SMS.

Figure 3.2 – System diagram of project work



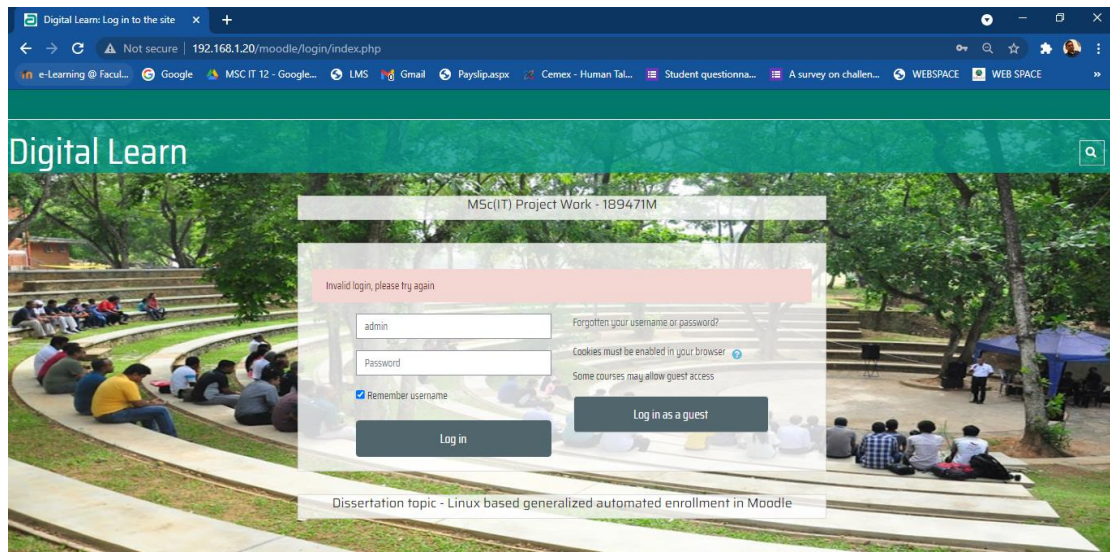
1. As mentioned in the resource requirements, LMS server and LMS database server is installed in the same virtual machine in the test environment. (ip address – 192.168.1.20)

2. Student Management System's (SMS) is run on a separate virtual machine (ip address – 192.168.1.40). Its SMS Oracle database is connected with the cpanel server by the Linux based Oracle Call Interface (OCI8) drivers.
3. Module sync, lecture sync and batch sync will be done with cPanel. And cPanel is installed on a separate VM (ip address – 192.168.1.30) and run on CentOS platform and with php 5.4. Further it is connected to Moodle server with MySQL libraries.
4. All the virtual machines are run on Hyper-V windows virtual environment.

3.2.1 Moodle

- | | | |
|---------------|---|--------------|
| 1. Moodle | - | v3.11 |
| 2. php | - | v7.3 |
| 3. http | - | v2.4.6 |
| 4. ip address | - | 192.168.1.20 |

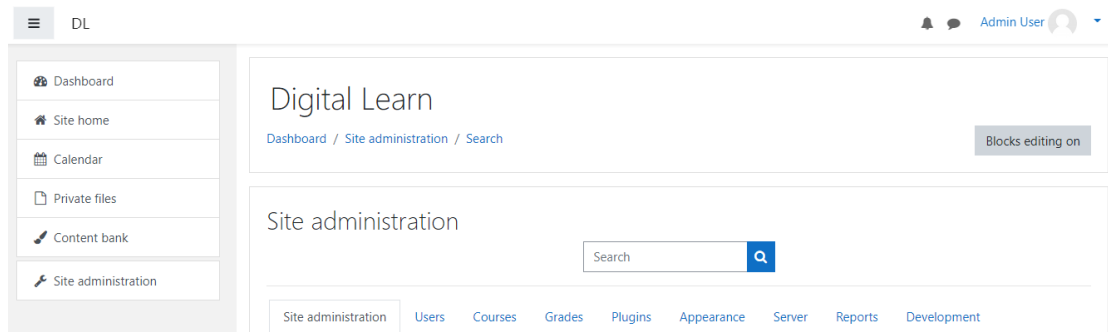
Figure 3.3 Moodle login page



- | | | |
|-------------------|---|--|
| Login to LMS site | - | <u>http://192.168.1.20/moodle/login/index.php</u> |
| UN | - | admin |
| PW | - | aaAA12!@ |

Admin user account has all the admin rights to carry out administrative tasks.

Figure 3.4 Moodle admin login



3.2.2 Connection string between LMS – cPanel

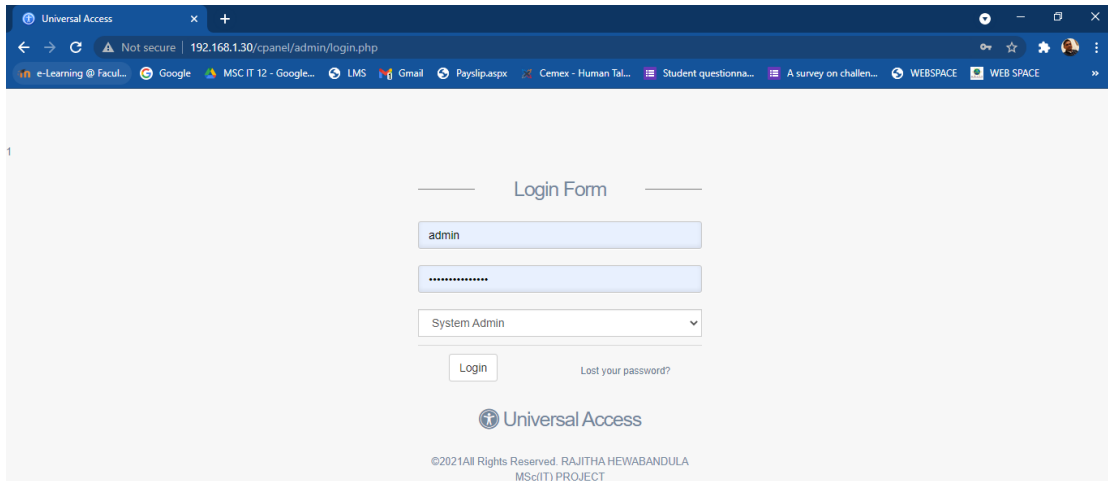
Figure 3.5 Connection string between LMS - cPanel

```
////////////////////////////////////  
  
//cPanel and lms conection  
function lms_conn(){  
    $conn = mysqli_connect("192.168.1.20","moodleuser","mmMM12!@", "moodle");  
    return $conn;  
}  
  
//get data from lms  
function query_data_lms($query){  
    global $apiitCore;  
  
    $row=mysqli_query($apiitCore->lms_conn(), $query);  
    return $row;  
}  
  
//fetch data from lms  
function fetch_data_lms($data){  
    $row=mysqli_fetch_assoc($data);  
    return $row;  
}  
  
//fetch array from lms  
function fetch_array_lms($data){  
    $row=mysqli_fetch_array($data);  
    return $row;  
}
```

3.2.3 cPanel

Site	-	http://192.168.1.30/cpanel/admin/login.php
php	-	v5.5
http	-	v2.4.6
ip address	-	192.168.1.30

Figure 3.6 Login to cPanel



Site - <http://192.168.1.30/cpanel/admin/login.php>
UN - admin
PW - 1(+@webspacesA?1

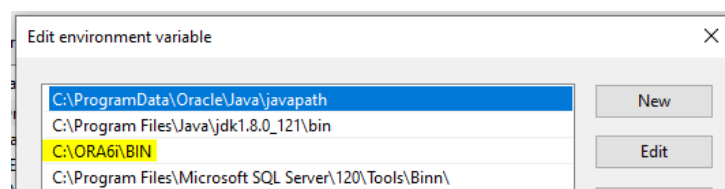
Admin account carries all the privileges to program code sync, module sync, batch sync.

3.2.4 SMS (Student Management System)

Server ip - 192.168.1.40
Oracle - 11g
OS - Windows 2008 R2

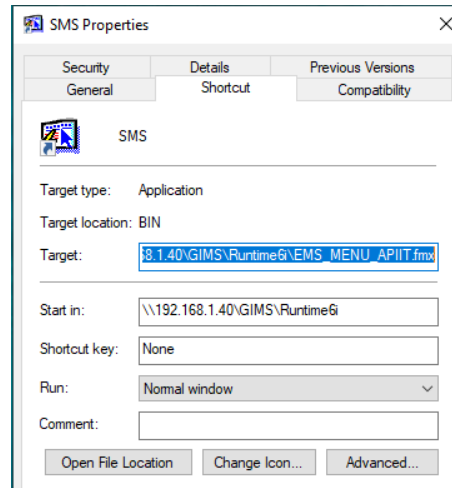
SMS application is installed on the client machine by copying the necessary folder on client's machine C drive. Then set the environmental variable path set as C:\ORA6i\BIN below.

Figure 3.7 Environmental variable setting of SMS



Thereafter, set the icon start in as [\\192.168.1.40\Runtime6i](http://192.168.1.40/Runtime6i) in the desktop icon properties.

Figure 3.8 Shortcut icon settings of SMS



3.2.5 Log in to SMS

UN - pradeep

PW - rajitha

This account is comprised of all the necessary admin privileges to carry out creating class setups, creating lecturer accounts and all the necessary academic administrative tasks and responsibilities.

Figure 3.9 Login of SMS

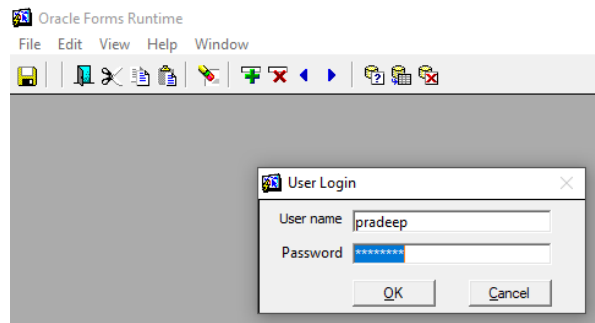
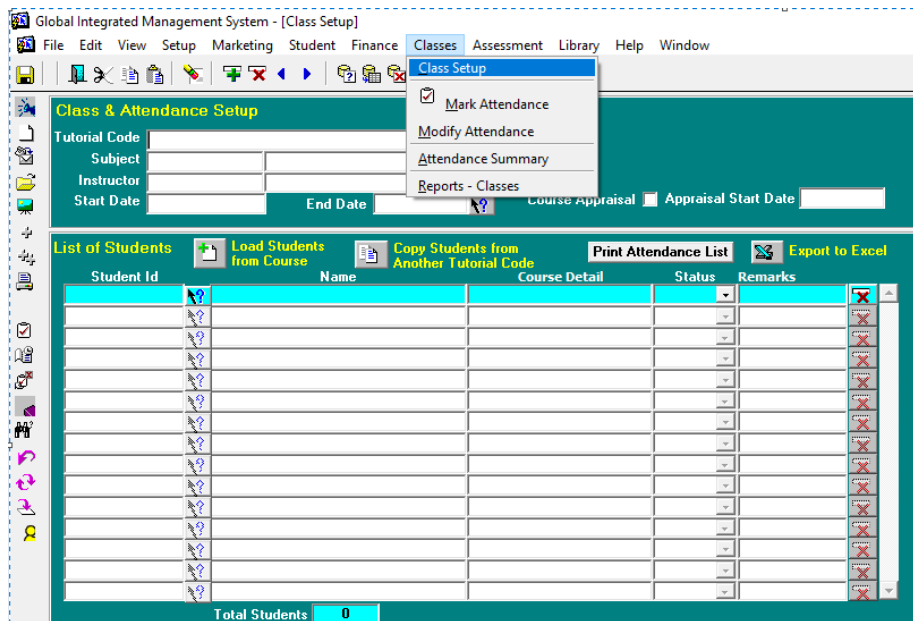


Figure 3.10 SMS home window



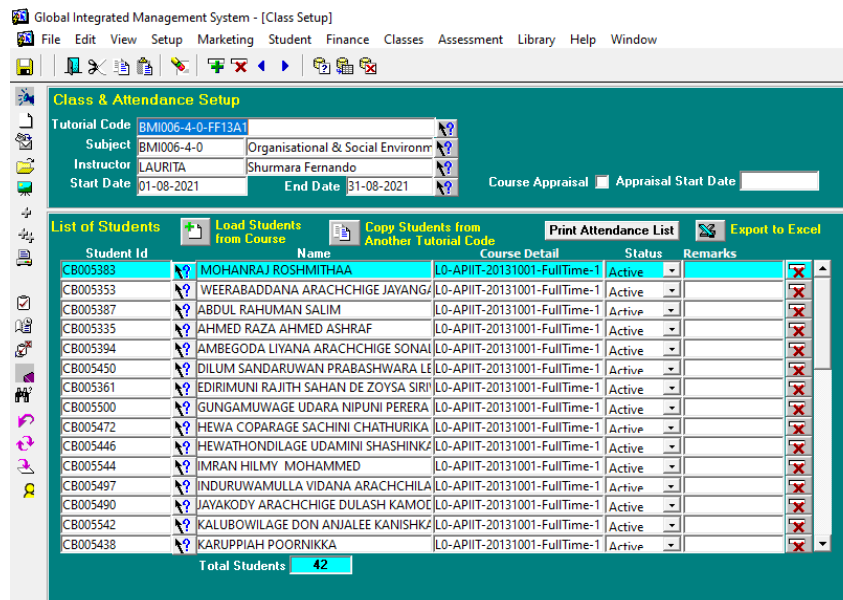
In order to sync the module, lecturer and the batch; academic administrator has to create the class setup under Classes-> Class Setup in the menu.

Figure 3.11 Setting up of class setup in SMS



Below Figure 3.10 indicates a precisely created class setup of Organizational & Social Environments module in SMS. It consists of 42 students.

Figure 3.12 Sample of class setup in SMS



Each and every module belongs to their respective category according to the level it belongs to;

Table 2.1 Course structure

Program code in SMS	Category in LMS	Sub categories	Code Ex;
Foundation	Foundation Program	Level 0	FF13A1
CNS	Computer Network & Security	Level 1 Level 2 Level 3	CF13A1CNS/CNSENG IF13A1CNS/CNSENG HF13A1CNS/CNSENG
IBM	International Business Management	Level 1 Level 2 Level 3	CF13A1IBM IF13A1IBM HF13A1IBM
SE	Software Engineering programme	Level 1 Level 2 Level 3	CF13A1SE/ SEENG IF13A1CNS/ SEENG HF13A1CNS/ SEENG
LLB	LLB(Hons) Law	Level 1 Level 2 Level 3	CF13A1LLB IF13A1LLB HF13A1LLB

above categories are further divided in to sub categories according to levels;

- level 0 - Foundation
- level 1 - First year
- level 2 - Second year
- level 3 - Third year

Figure 3.13 cPanel Admin login

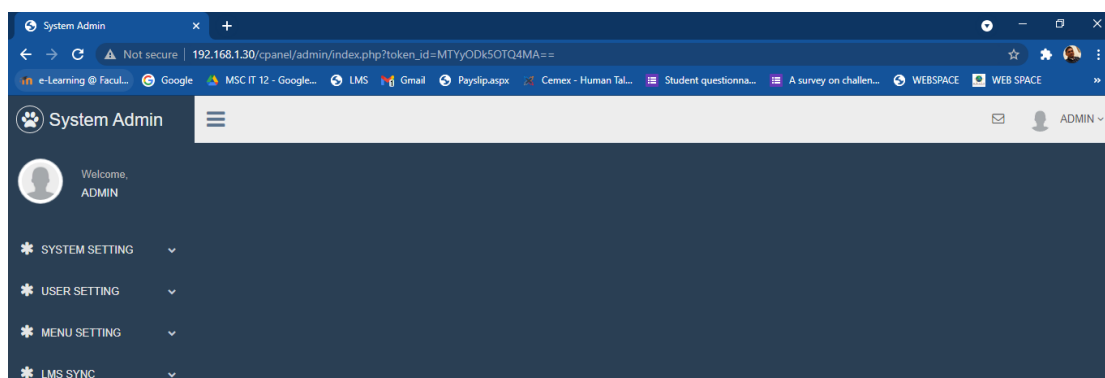
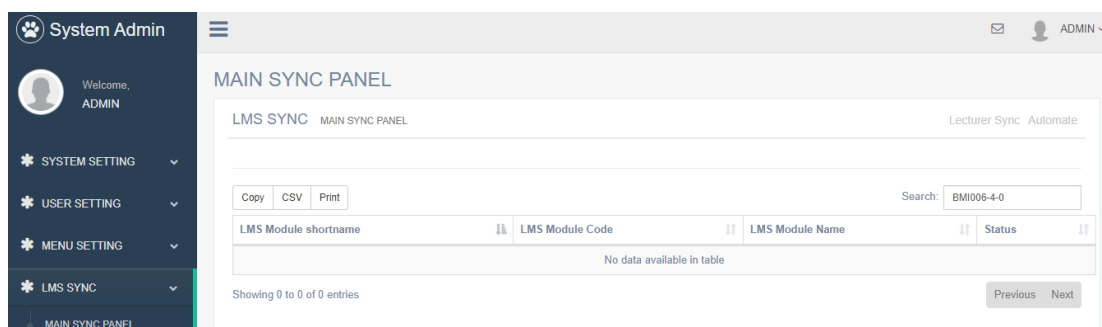
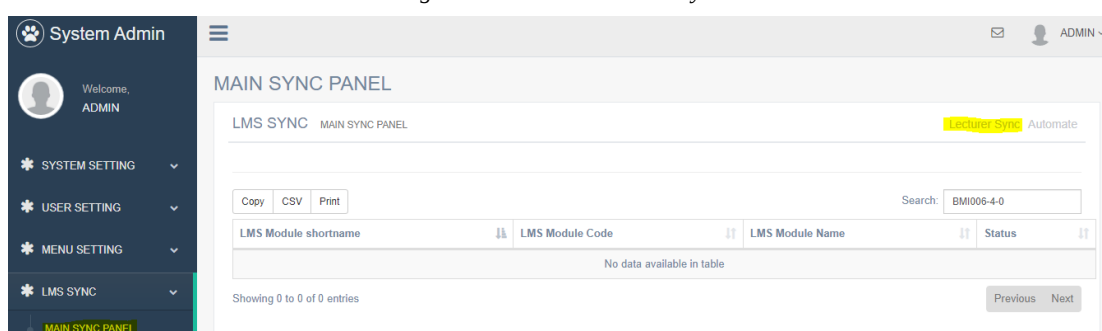


Figure 3.14 cPanel Home page



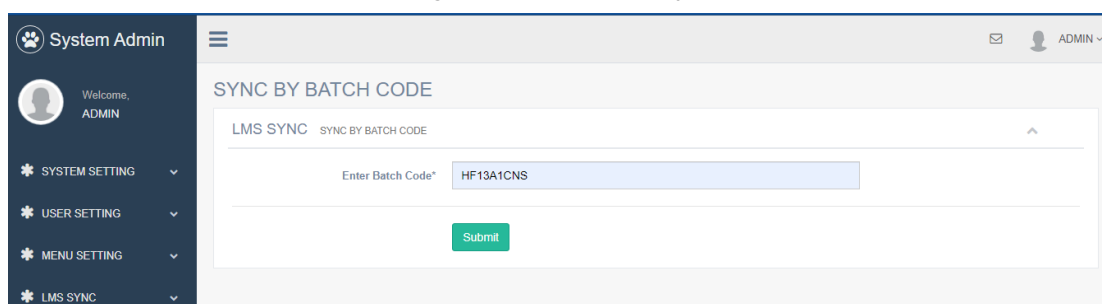
Lecturer sync is created under MAIN SYNC PANEL, but the same function is written in to sync batch code.

Figure 3.15 cPanel Lecturer Sync



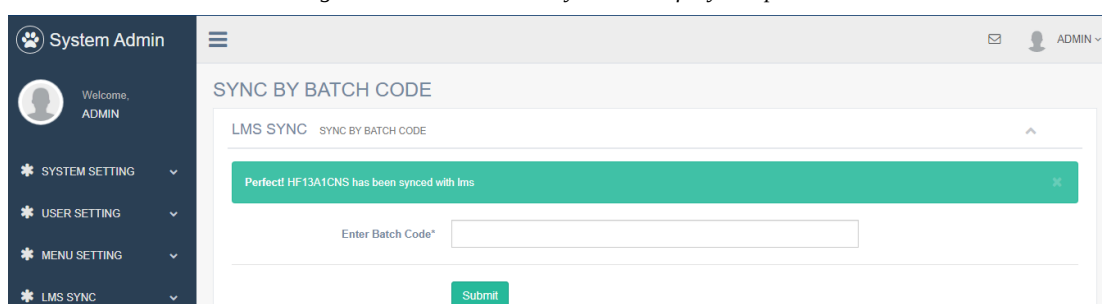
Batch sync is run with LMS Sync -> Sync by batch code.

Figure 3.16 cPanel Batch Sync



When you enter the batch code; eg – HF13A1CNS (HF - final year batch/Level 3, 13 - 2013, Intake – October, 1- group 1, CNS – Computer & Network). When the sync runs successfully, after a few seconds it indicates as below figure.

Figure 3.17 cPanel Batch Sync successfully completed



3.2.6 LMS Sync- Sync Categories and Modules

Before run the module sync, it is compulsory to run category sync as that function is written to create all the categories on the tables of LMS database.

Figure 3.18 cPanel Program code Sync

System Admin

Welcome, ADMIN

SYSTEM SETTING

USER SETTING

MENU SETTING

LMS SYNC

SYNC CATEGORIZES AND MODULES

LMS SYNC SYNC CATEGORIZES AND MODULES

Enter Program Code*

Submit

Remember to run modules sort option in lms after sync a program code.

3.2.7 LMS Sync - Sync by Batch code

During the synchronization process, Subject sync with Course full name and batch code sync with the Course short name/Course ID number in LMS. Course category is taken from the program code at SMS. Teacher role is defined as per the instructor parameter and the name provided in SMS. Course start date is fetched from the SMS start date. Students who have been enrolled to a specific module can be fetched from List of students as per below Figure 3.16.

Figure 3.19 SMS course start and end date selection

Select Course

Find FF1%

Course Alias	Course Code	Intake Number	Study Mode	Semester	Period From	Period To
FF12A1	L0-APIIT	20121001	FullTime	1	22-OCT-12	31-OCT-12
FF1321	L0-APIIT	20130201	FullTime	1	26-FEB-13	26-FEB-13
FF13A1	L0-APIIT	20131001	FullTime	1	28-OCT-13	13-OCT-13
FF1431	L0-APIIT	20140301	FullTime	1	24-FEB-14	17-FEB-14
FF1432	L0-APIIT	20140302	FullTime	1	24-FEB-14	17-FEB-14
FF1471	L0-APIIT	20140701	FullTime	1	30-JUN-14	15-JUN-14
FF14A1	L0-APIIT	20141001	FullTime	1	20-OCT-14	23-OCT-14
FF1531	L0-APIIT	20150301	FullTime	1	23-FEB-15	10-FEB-15
FF1571	L0-APIIT	20150701	FullTime	1	29-JUN-15	05-JUN-15
FF15A1	L0-APIIT	20151001	FullTime	1	01-AUG-21	31-AUG-21
FF1631	L0-APIIT	20160301	FullTime	1	01-MAR-16	05-MAR-16
FF1671	L0-APIIT	20160701	FullTime	1	27-JUN-16	05-JUN-16
FF16A1	L0-APIIT	20161001	FullTime	1	17-OCT-16	05-OCT-16

Find OK Cancel

When the module sync is successfully executed, it appears on LMS on edit setting in the respective module with correct parameters applied according to SMS.

Figure 3.20 LMS Edit course setting view

At the same time, lecturers and students are also enrolled to the respective module precisely according to the time defined in SMS on respective user table on LMS with correct role. But it does not reflect on the LMS list of users until the respective user is registered on LMS. Students and lecturers' logins must be created (create their logins) on LMS prior to run the module sync on cPanel.

In order to make sure that both lecturers and students have been correctly enrolled to the modules, Moodle administrator could search for the respective module and check on participants or enrolled user settings and if it is correctly applied, should appear like below Figure 3.18.

Figure 3.21 LMS users enrolment view

First name / Surname	Email address	Roles	Groups	Last access to course	Status
cb005500 cb005500	cb005500@apiit.lk	Student	No groups	Never	Active
Ms.Shurmara Fernando	laurita@apiit.lk	Teacher	No groups	Never	Active

3.2.8 Connection string between cPanel-Oracle

Figure 3.22 Connection string between cPanel and Oracle

```
<?php
$apiitCore = new apiitCore;

class apiitCore{
    /*-----||| Oracle DB setting -----*/

    function oracle_conn(){
        $ora_conn = oci_connect("ems3","ems3(&%#!","//192.168.1.40/orcl");
        if (!$ora_conn) {
            $m = oci_error();
            echo $m['message'], "\n";
            exit;
        }
        else
        {
            return $ora_conn;
        }
    }

    function oracle_conn2(){
        $ora_conn2 = oci_connect("webapp","rajitha","//192.168.1.40/orcl");
        if (!$ora_conn2) {
            $m = oci_error();
            echo $m['message'], "\n";
            exit;
        }
        else
        {
            return $ora_conn2;
            oci_close($ora_conn2);
        }
    }
}
```

3.2.9 Risk Benefit Analysis of the enrolment method

Successful implementation of this project will benefit the educational institutes who are heavily rely on the Moodle platform to reduce the hassle in students/lectures enrolment. Further, significant benefit of this project will be that the proposed solution provides platform to integrate and student management system database system to with any type of Moodle database system. In addition, proposed solution works with any Moodle platform irrespective of the version.

Risk involved with this proposed solution is that initially it will be designed to only work with Moodle on Linux base operating systems.

3.3 Methodology in research work

3.3.1 Selection and justification of case study

The selection of the research methodology was constructed on three parts: the type of research questions, the distinct of ability a researcher has over its real behavior events and the degree of focus on current or past events (Robert K.Yin^[54]). In terms of the research questions, this research emerges as an empirical case study as it tests for challenges in adopting online tools. Yin^[54] states that a research is in favor of a case study method when it includes mainly “How” research questions. Punch^[36] also agrees

that in case studies the research questions needs to be “How” questions. The research in agreement, poses the following “How” questions.

RQ1: How are online tools currently used in the XYZ university in Sri Lanka?

RQ2: How challenging is it for the XYZ university in Sri Lanka to adopt to online tools?

RQ3: How to formulate a framework with strategies to disregard the difficulties faced by the XYZ university in adopting online tools?

The research also is supported by variety of evidence: online survey conducted targeting students of the XYZ university and interviews of the academics and students engaged in online teaching and learning. This significantly differs from experiments as unlike in case studies, in experiments the researcher can manipulate the behaviors.

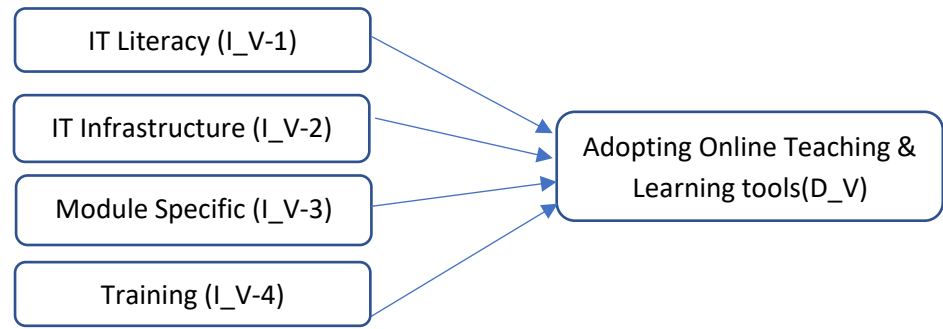
3.3.2 Design - Case study

Case study approach poses a unique method and its own research designs. Robert K. Yin^[54] explains that a case study research design is based on 4 criteria as below,

- 1st criteria- is that the case study includes mostly “How” questions to best suit the case study.
- 2nd criteria - study intention. Which means as to what the study aims at investigating within its scope. The research studies how challenging is for the XYZ university to adopt online tools.
- 3rd criteria - the unit of analysis which is the scope of the case study. For this research the unit of analysis is the XYZ university and its academic and student community. The research focusses on obtaining positive organizational change by overcoming any challenges in adopting online tools. As a result, enhanced teaching and learning experiences are expected.
- 4th criteria - the case study needs to have a theory prior to the data collection. The research is to identify challenges faced by the XYZ university in adopting online tools.

The conceptual framework integrates independent variables and a dependent variable as adopting online teaching tools. Literature review findings in Chapter 2 were the base for the independent variables of quality of IT infrastructure, type of modules, IT literacy of users and training for users. The dependent variable adopting online tools was formed based on the Technology Acceptance Model as per Davis and Venkatesh^[4].

Figure 3.23 Conceptual model



Each of those variables in the conceptual model is tested using a hypothesis described later in this chapter.

- The fifth element - a criterion for interpreting the findings. The criteria suggest what it requires after the data has been collected.

3.4 Ensuring validity of the case study

Robert K. Yin^[54] identifies four tests from which the validity of the case study could be ensured. The validity of the case study needs to be based on construct, internal and reliability factors. External validity is omitted as it caters only for exploratory studies.

Table 3.1: Case study tactics for Four Designs Tests by Yin to ensure validity in case studies

Tests	Case Study Tactic	Phase of research in which tactic occurs
Construct validity	● Use multiple sources of evidence	data collection
	● Establish chain of evidence	data collection
	● Have key informants review draft case study report	composition
Internal validity	● Do pattern-matching	data analysis
	● Do explanation-building	data analysis
	● Address rival explanations	data analysis
	● Use logic models	data analysis
External validity	● Use theory in single-case studies	research design
	● Use replication logic in multiple-case studies	research design
Reliability	● Use case study protocol	data collection
	● Develop case study database	data collection

Quantitative data collected from students of three streams (Computing, business and Law) in the XYZ university. Interviews were conducted with academic population. Interviews were also conducted for the students to support and strengthen the primary

data collected via an online survey. Secondary data was collected through literature review.

The research findings present a model to overcome challenges in adopting online tools. These findings could be generalized for the domain of Sri Lankan universities.

The research confirms reliability in order to minimize errors and biasness. I have ensured that all the steps and processes followed in the research is well documented, so that another researcher may follow the same and repeat the case study if wants to in future and have broken down the research process into many sub phases as it operationally convenient for the documentation.

3.4.1 Collection of case study evidence and e-learning tools

As suggested by Randolph & Eronen^[37] the case study protocol consists of four sections,

- **Section 1:** Case study outline its objectives, issues being addressed and reading material. The selected material for the case study focused on the hypothesis, case study rationale, and the theories involved. Davis and Vankatesh^[4] Technology Acceptance Model(TAM) is the theory used. As stated above the study has a common rational. Research focus on the following hypothesis which will be tested using study data. The following questions were designed based on the identified conceptual framework; hoping to find answers for the research question on “How challenging is it for the XYZ university in Sri Lanka to adopt online tools”:

Table 3.2: Research hypothesis

Questions	Alternate Hypothesis (H1)	Null hypothesis (H0)
Does adoption of e-learning tool have a relationship with IT infrastructure?	Adoption of e-learning tools has a relationship with having a strong IT infrastructure.	Having a strong IT infrastructure has no relationship in adopting e-learning tools.
Does adoption of e-learning tools have a relationship with types of modules?	Adoption of e-learning tools has a relationship with type of module.	Adoption of e-learning tools has no relationship with the type of modules

Does user training have a relationship with adopting e-learning tools?	Adoption of e-learning tools has a relationship with user training.	Adoption of e-learning tools has no relationship with user training.
Does IT literacy of users have a relationship with adopting e-learning tools?	There is a relationship between a user's IT literacy and adopting e-learning tools	There is no relationship between a user's IT literacy and adopting e-learning tools

- Section 2:** data collection procedures which specifies that the researcher should adhere to research ethics and have a good understanding about the physical constraints of the study. I have obtained the permission from the XYZ university's top management prior to conducting the research in its premises. Have taken all necessary measures to ensure ethical data collection for the study. Consent was obtained from all academics and students prior to data collection. Study has ensured privacy and confidentiality of the XYZ university and its respondents. The responses in terms of interview evidences, survey results and statistics are only used for the purpose of this study and not misused/shared with any other party.
- Section 3:** Indicates that the researcher should keep the research questions in mind whilst preparing the data collection questions. The questions should cater to the unit of analysis of the case study. This research focusses on collecting data from an organization.

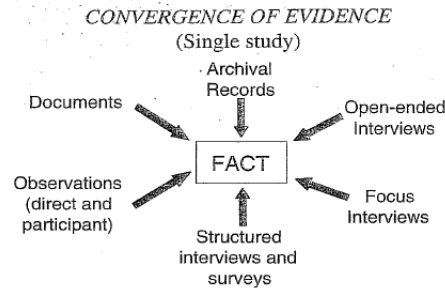
3.5 Data collection methods in the Case study and tools

Robert K. Yin [54] express that case study evidence in a single case study is ruled by four main principles: case study database, practicing care, multiple evidences and maintaining a chain of evidence when using electronic evidences.

This case study used multiple evidences such as field observations, interviews and public files of the institute. The case study had an institute as the unit of analysis and was supported by mixed evidence of structured survey, interviews and review of school documents.

The Figure 3.21 showcases how numerous sources of evidence could utilize to strengthen a single case study's outcome. Multiple sources strengthen the construct validity of the case study.

Figure 3.24 Convergence of evidence for a single case study as per Yin



Rashid^[38] identifies the importance of using both quantitative and qualitative inquiry mechanisms in researches. Furthermore, it recommends that qualitative data should be used to interpret quantitative data in a better way. Flick^[10] encourage the use of multiple sources to ensure richness of a case study.

Mixed methods have been used to strengthen the findings of single case studies. I have used multiple evidence to strengthen study results. Primary source of evidence was online surveys to obtain quantitative data from the students. I have used a Google forms to collect data via online survey. The student quantitative findings were strengthened by qualitative data obtained via interviews afterwards. Academics data was attained by interviews too. The table 3.3 represents six sources of evidence identified by Robert K. Yin^[54] that could be used in a case study, their benefits and weaknesses.

Table 3.3: Sources of evidences in a case study and their strengths and weaknesses

Source of Evidence	Strengths	Weaknesses
Documentation	- stable—can be reviewed repeatedly - unobtrusive—not created as a result of the case study - exact—contains exact names, references, and details of an event - broad coverage—long span of time, many events, and many settings	- retrievability—can be low - biased selectivity, if collection is incomplete - reporting bias—reflects (unknown) bias of author - access—may be deliberately blocked
Archival Records	[Same as above for documentation] - precise and quantitative	[Same as above for documentation] - accessibility due to privacy reasons
Interviews	- targeted—focuses directly on case study topic - insightful—provides perceived causal inferences	- bias due to poorly constructed questions - response bias - inaccuracies due to poor recall - reflexivity—interviewee gives what interviewer wants to hear
Direct Observations	- reality—covers events in real time - contextual—covers context of event	- time-consuming - selectivity—unless broad coverage - reflexivity—event may proceed differently because it is being observed - cost—hours needed by human observers
Participant-Observation	[Same as above for direct observations] - insightful into interpersonal behavior and motives	[Same as above for direct observations] - bias due to investigator's manipulation of events
Physical Artifacts	- insightful into cultural features - insightful into technical operations	- selectivity - availability

In my research, I have used interviews and online surveys as main sources of primary data evidence. Yin^[54] states that there are three types of interviews to be used in case studies: lengthy, shorter and survey interviews. Shorter interviews took place for an hour. Both these interviews are conversations with the participants and was open-ended questions. Though, the research incorporated survey interviews was facilitated by a structured questionnaire. For academics, I had interviews inside the XYZ university. Interviews were conducted via Microsoft Teams. Student interviews were conducted for the objective of obtaining supporting evidence for the online survey responses and to explain any outliers if any. Academic interviews were conducted as the mechanism to get their responses on using online tools.

3.6 Sampling strategy

The research population comprises of academics and students who belongs to the 03 streams of Computing, Business and Law of the XYZ university. The number of academic staffs as of June 2021 of the three streams was thirty-two (32).

3.7 Sampling techniques for quantitative analysis

The student population of the 03 schools as of June 2021 is 806. The sampling technique defined by Krejci and Morgan ^[53] is used to decide on sample size. For a population of 806 students, a sample size of 260 is considered appropriate at a 95% confidence level with a 5% margin of error since this is a sociology research ^[29]. The student sample comprised of 47 Computing students, 74 Business students and 84 Law students. Simple random sampling technique (random draws) was used to provide each respondent an equal chance of getting selected ^[29]. An online survey (through Google form) was shared with students, in which provided a field for them to specify which school (Computing, Business and Law) they belong to.

3.8 Sampling techniques for qualitative analysis

The students selected for interview belonged to one of the three streams and are knowledgeable and experienced to use online tools in the XYZ University.

Seidler^[45] states that the sample size to conduct purposeful sampling should be at least five minimum. I interviewed a sample of 20 undergraduates. Interview carried for 30-60 minutes using Microsoft Teams app. Students participated for the interviews online as during the interviews as the students were restricted to come to the university

premises due to Covid-19 rules and regulations. Students were informed beforehand that interview is documented for future references. It was ensured that the respondents and the XYZ University identity is not revealed during the interviews.

3.9 Analytical techniques

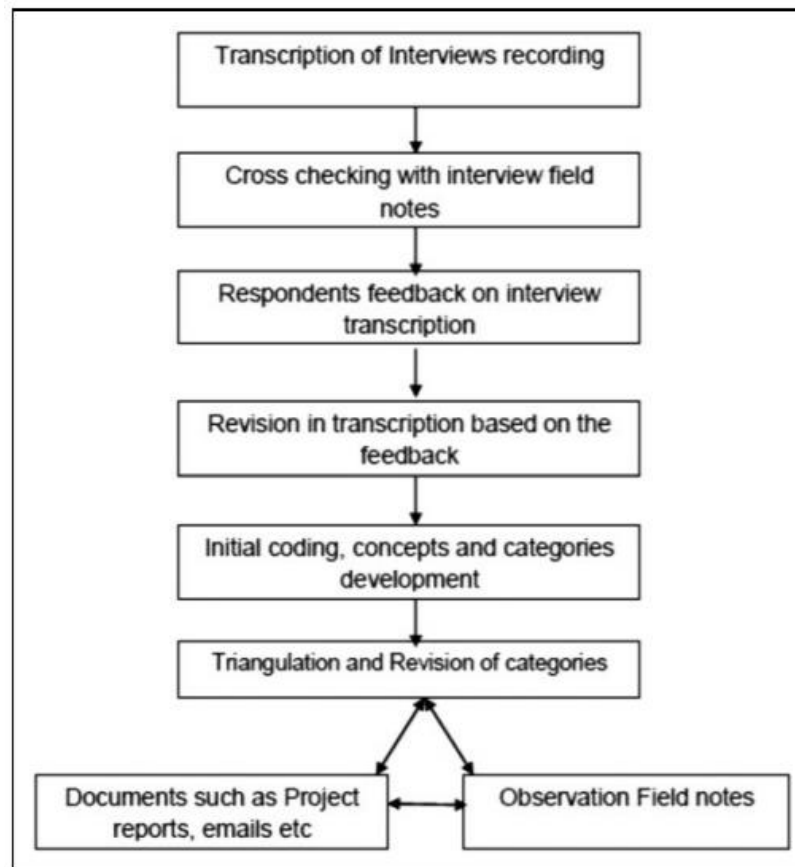
Student survey data was analyzed quantitatively and the results strengthened with qualitative findings. Descriptive and statistical are the two main analysis techniques available. Only descriptive analysis is used for studies where only one variable is concerned. A descriptive analysis using the demographic data (school, level) was done to describe the academics and student responses. Normality test was carried out for students' data. It was indicated that most of the data are deviated from normal distribution. Subsequently, the significance of the relationships was identified using Spearman correlation technique.

Qualitative data analysis is completed in two main methods: inductive and deductive. In order to select deductive approach, it was needed to be sensible of possible responses of participants. This approach is considered favoritism as the coding framework was decided prior. Had very little information of most likely responses of the respondents consisting of students and academics and cannot prior design a coding framework. Therefore, deductive method cannot be utilized here. Burnard (2008) also agrees that the inductive approach can be used for analyzing qualitative data without any predetermined theory or a framework which is an intended outcome of this study.

Thematic content analysis qualitative method is also used for this research. Thematic content analysis allows to analyze records, identify themes within the records and collecting examples of the themes from the records. NVivo research application is used to create word clouds out of the interview transcripts of both students and academics. These word clouds were useful to find the codes for the analysis. These codes were then used to investigate interview responses. Rashid^[38] also suggests that themes generation and coding is the most recognized method to analyze qualitative empirical material.

Figure 3.25 Steps of qualitative data analysis

Source: Rashid



I have identified codes and categories which appeared from the collected primary data. Afterwards open coding mechanism is used where I read interview transcripts, made notes and created short codes to finalize what was expressed by the respondents. All the interview transcripts were read and decoded.

According to the above mechanism; quantitative analysis of student data is integrated and strengthened with the analysis of qualitative data gathered via student interviews. Academic's facts are only analyzed using qualitative analysis.

Through the quantitative and qualitative analysis, finds challenges faced by academics and students in adopting online tools in the XYZ University. While obliging to the research objectives, came up with a model with suitable recommendations to overcome the identified challenges.

Chapter 04

4.0 Analysis

Chapter four presents descriptive and inferential statistics. Descriptive statistics is used to elaborate the selected populations and samples of the research component. Next, the chapter will show about the inferential statistics which used to recognize associations and generalize about the populations within the research variables. At the end, the chapter signifies a summary of conclusions in relate to answer the research questions.

The entire academic population and a sample set of students of XYZ university were taken for this research. The academic population comprised of 32 academics from the streams of Computing, Business and Law. The student sample consisted of 260(Krejci and Morgan) students from again from the same three different streams.

For the academics an online survey was given to obtain demographic data. They were then interviewed to obtain their responses and ideas of adopting online tools. Thematic qualitative data analysis approach suggested by Burnard(2008) is used to analyze the interview responses.

The student sample was also given an online survey to obtain data. Fincham^[9] recommends that a researcher's goal should be to attain a response rate of at least 60% for surveys. Nulty^[34] also recommends that research using online surveys should obtain a response rate no lower than 60%. The student survey attained a response rate of 78.84% with 205 responses. The student data is primarily presented as demographic data.

A normality check was conducted for student data using Kolmogorov & Smirnov test^[41]. The Kolmogorov & Smirnov test results indicated that most of the student data are deviated from a normal distribution. Therefore, in order to check the significance of the relationships between variables Spearman correlation technique was used ^[24]. Correlation is checked to identify relationships between the data. According to Yin^[54] case study methodology, to strengthen these quantitative findings, qualitative data is also collected from the students via online interviews.

4.1 Academics data analysis

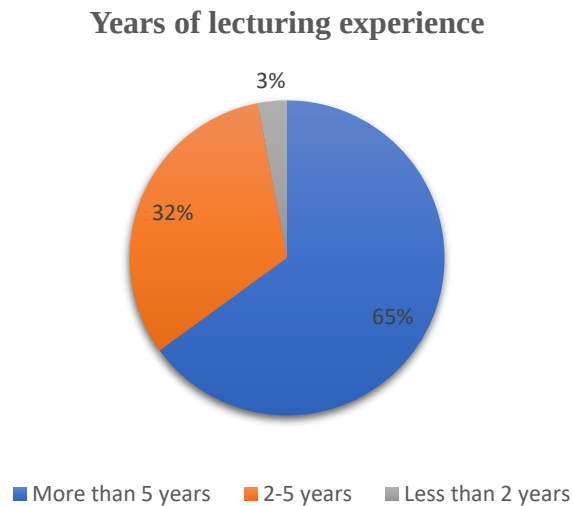
The entire academic population in the XYZ university consists of both full-time and part-time. There are 9 academics from Computing, 8 in Business and 15 in Law schools.

4.2 Descriptive analytics of academics

The following descriptive analysis is conducted to describe the academic staff population of the XYZ university.

Figure 4.1: Years of lecturing experience

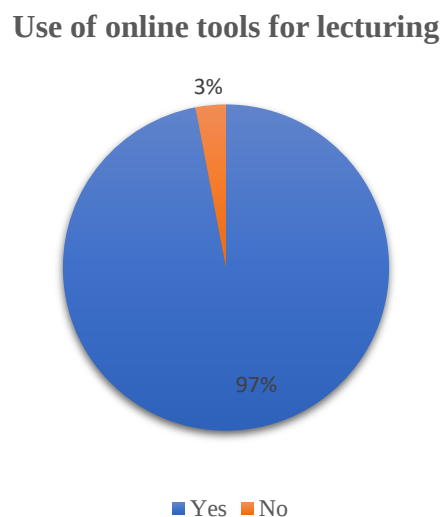
Source: Survey data



According to the Figure 4.1, almost 65% of academic staff has > 5 years of teaching experience. Nearly 1/3 or 33% of the staff has from 2-5 years of previous lecturing experiences. Only a 3% of the lecture staff have < 2 years of experience.

Figure 4.2: Use of online tools for lecturing

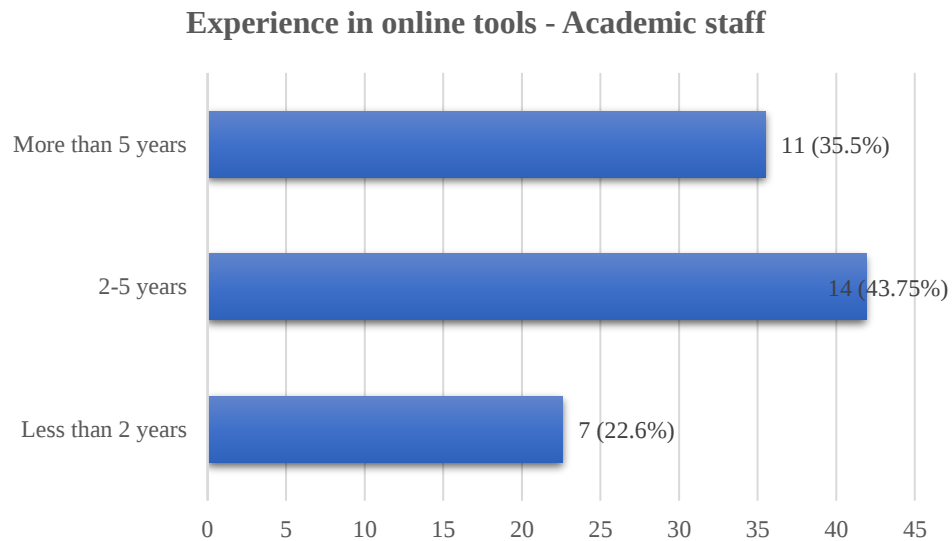
Source: Survey data



Based on the Figure 4.2, almost all the lectures (97%) have stated that they use virtual tools for lecture delivery in the XYZ university. Only one staff member had replied with does not use online tools for lecturing.

Figure 4.3: Experience in online tools – academic staff

Source: Survey data



According to the Figure 4.4, (43.75%) of staff have expressed that they have been using online teaching tools for last 2-5 years. It is followed up by the academics who has > 5 years of experience in online teaching tools as 35.5% and there are about 22.6% of academics having < 2 years of experience.

Figure 4.4 Adopting to online tools - Academic staff

Source: Survey data

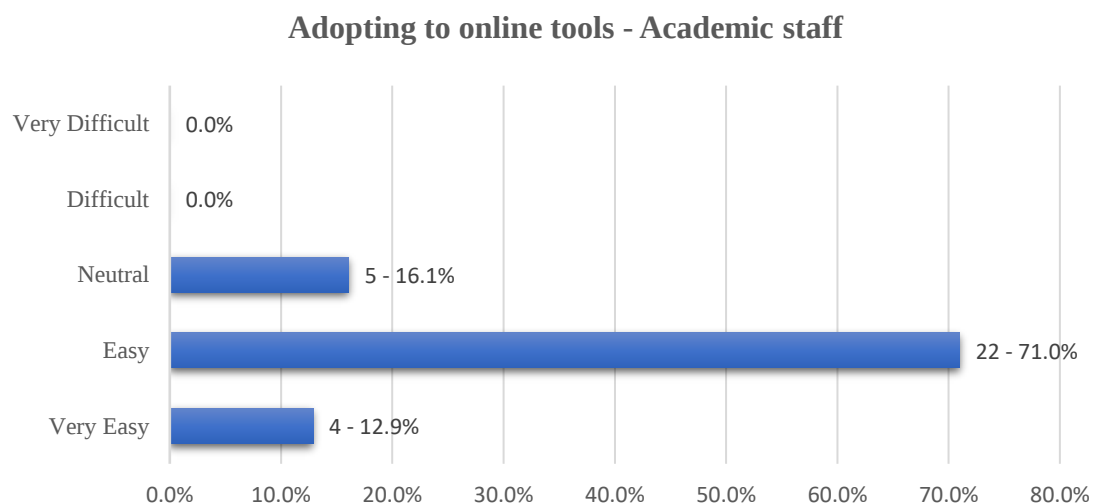


Figure 4.4 shows that 71% of academics have largely expressed that it is easy to adopt to online tools, 16.1% has replied neutral and 12.9% have replied with saying it is very

easy to adopt. There is no staff member who has stated that it is either difficult/very difficult to fix with online tools for their teaching.

Figure 4.5 Time taken by to learn a new tool - lecturers

Source: Survey data

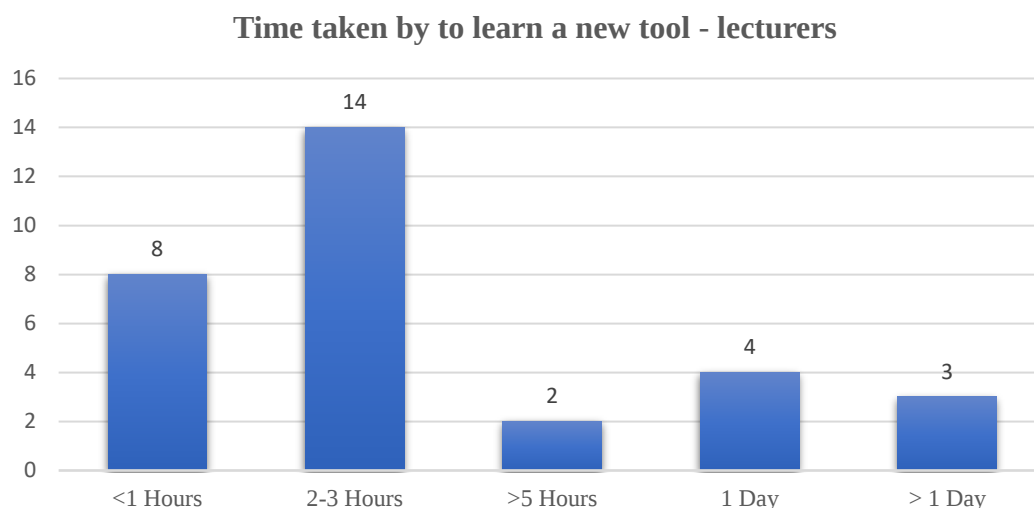
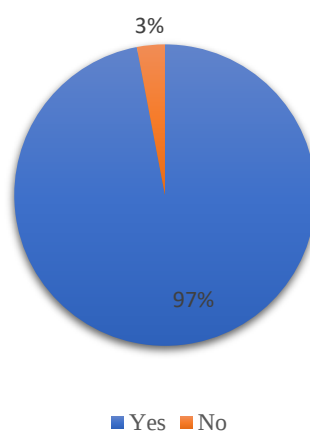


Figure 4.6 indicates that majority as fourteen (14) have stated that they need 2-3 hours to learn an online new tool. Eight (8) academics says that they need less than an hour (<1 hr.). Four (4) academics mention that they need 1 day to learn a new tool. Three (3) academics states they need more than 1 day (>1) and two says they need more than 5 hours to (>5 hrs.) to learn a new tool.

Figure 4.6 Compelled to use online tools during pandemic lockdown - lecturers

Source: Survey data

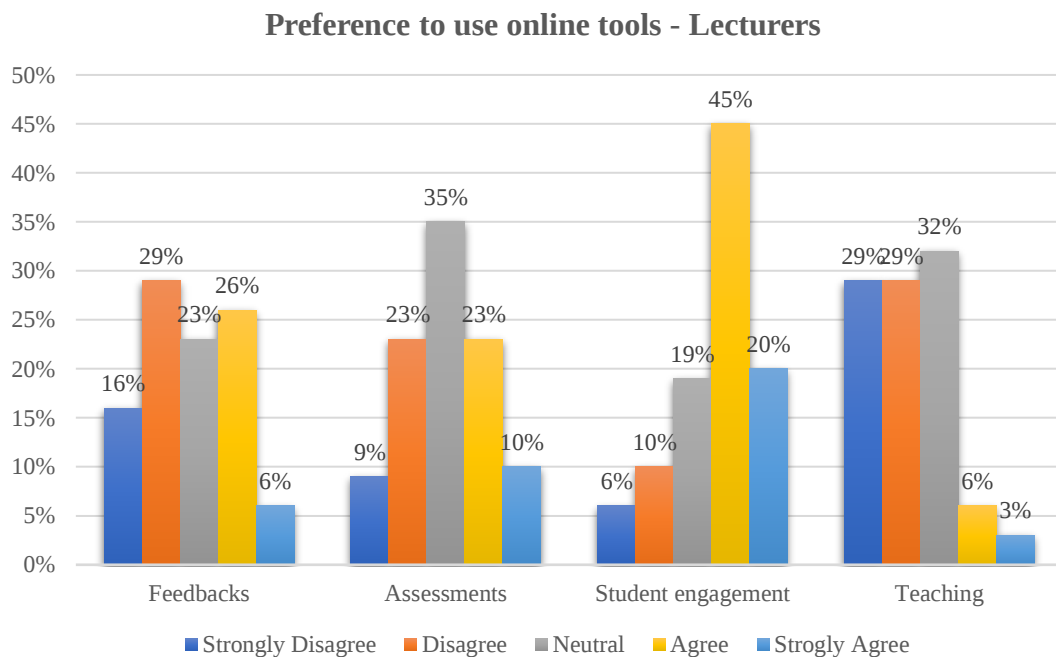
Compelled to use online tools during pandemic lockdown - lecturers



According to Figure 4.6, 97% shows that they were forced to use e-learning tools for their lecturing during the pandemic lockdown. Only 3% of academics says that they were NOT.

Figure 4.7 Preference to use online tools - lecturers

Source: Survey data



According to the above bar chart in Figure 4.7, we can see that 29% strongly disagrees to use online tools. It is interesting to see that exact the same 29% of academic staff disagrees with the use of online tools for their lecturing. Out of 32 academic staff 32% is neutral on online tools. Percentages of agree and strongly agree are respectively 6% and 3%.

Nevertheless, academics appears to have a different insight on using online apps in their modules. 6% and 10% of academics have respectively replied as strongly disagree and disagree to use online tools. The percentage of neutral response is 19%. The percentage as 45% agrees to use online tools for student engagement and 20% strongly agrees with the same.

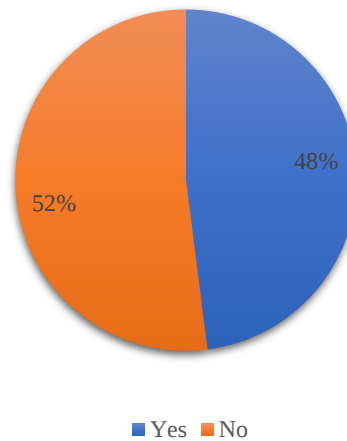
Figure 4.8 shows that only 9% of lecturers strongly disagree to use online tools to conduct their assessments/feedbacks. 23% of academics have disagreed. Much of the academics as 35% seems to be on a neutral ground. 23% and 10% of staff agrees and strongly agrees to use online tools to conduct their assessments respectively.

Accordingly, preference of using online tools to provide feedback to their students are as follows; 16% - strongly disagrees and 29% - disagrees. 23% of academics are in neutral stance on providing feedback online. Respectively 26% and 6% of percentages are of academics who agrees and strongly agrees to provide feedback.

Figure 4.8 Facing difficulties using online tools - lecturers

Source: Survey data

Facing difficulties using online tools - lecturers



As per the Figure 4.8, mixed responses can be seen as 52% of academics have stated that they faced difficulties using e-learning tools while 48% declared that they have not faced difficulties.

Table 4.1: School-based cross formulation experience levels of using online tools

Source: Survey data

	Experience in using ONLINE TOOLS			Total
	Total 2-5 years	Less than 2 years	More than 5 years	
Business	5	2	1	8
Computing	4	0	5	9
Law	5	10	0	15
Total	14	12	6	32

According to the table 4.1, majority of Business academics has 2-5 years of experience in utilizing e-learning tools. Computing academics either possess 2-5 years or > 5 years of experience with online tools. Majority of Law academics pose < 2 years of

experience, whereas Business school shows 2 academics with < 2 years of experience with online tools. Computing school doesn't have any academic with < 2 years of online tool experience.

4.3 Qualitative analysis of academics

Total academics staff population of the XYZ university were interviewed and transcripts are created out of interview sources. The qualitative response analysis by Rashid_[38] is used to analyze the responses.

Table 4.2: Codes recognized from academic qualitative responses

Source: Interview data

Inductive categories (Codes)	Sub categories
E learning Tools	• Lectures • Assessments and marking • Feedback and comments
Challenges in lecturing	• Experience and transmission • Achieving learning outcomes • Extra workload • Challenging modules • Changing teaching methods • Self-learning • Student engagement challenges • Size of the batch • Difficulty of measuring student understanding
Challenges in academics training	• Volume of training • Types of training + module specific/related training • Perceptions on training • Post training assistance
IT Infrastructure and Resources	• Present IT infrastructure • Lecture delivery depend on IT Infrastructure • Availability of online teaching tools
Assessment based challenges	• Monitoring and invigilation • Customizing assessment structures

	• Integrity/Turnitin/Plagiarism issues
Suggestions for improvement	• Student Interaction/engagement • IT Infrastructure • Lesson delivery and practical

The codes identified in the table 4.2 was used to analyze the interview responses. Following are some of the prominent replies extracted from the academic's interview transcripts/responses. It is surprise to see that some of the responses opposes among the schools.

When presenting the responses, have used the following notations,

E.g. **CSReply1**

The above short code indicates that the reply is from the Computing school. Also, the short code indicates that the sequence of reply (**Reply1**). The school is represented by the first letter of the school.

4.4 Qualitative analysis

4.4.1 Qualitative analysis - how adopting online tools depends on type of modules

In order to analyze responses which indicated the challenging modules, the sub categories in codes “challenges in lecturing” and “Assessment based challenges” was used and as per Computing and Business academics they have specific modules that does not fit well with online delivery.

BSReply3: EAP module is totally pre-designed with variety of hands-on workshops. It is very difficult to deliver with it during and beyond pandemic. Expet to have better interactive tools to improve student interaction (English for Academic Purpose, June 23,2021).

BSReply4: students find it difficult in group activities. Further It was tough to teach economics online. The module depends on student responses. Student interaction is missing in lectures. Case study discussions also experienced very challenging (Management Accounting, June 25,2021).

CSReply5: during a one-hour lesson when the batch has 30-40 students, it is very difficult to grant individual attention to students. It is very difficult to teach practical programming modules online platform. (Network Security, June 23,2021).

CSReply6: some students keep their webcams off/some does not have cams are causing few problems. Cannot figure out with their expressions of easy/difficult ability of

understanding the lesson and does not help me at all. Inability to use the whiteboard also limits my teaching a lot (Quantitative Mathematics, June 23,2021).

CSReply10: skill development and programming modules at times become boring for students. need more suitable collaborative tools (Commercial Computing, June 23,2021).

CSReply11: had to change my delivering methods entirely in short time span. Majority of students do not upload their programming submissions on time (Object Oriented Programming, June 23,2021).

However, Law lecturers think theoretical modules suit well to online delivery. Yet some law academics have faced issues in teaching of modules without the usual practice of having resources like white boards. Somehow, they were able to manage with alternate resources such as Microsoft whiteboards without major problems.

LSReply2: *all my modules are theoretical basis and I able to deliver without many issues* (Property and Administrative Law, June 23,2021).

LSReply13: Criminal law module is a more material-based module, have lots of theory in it and needed extra reading and it made extra work loaded (Criminal law, June 23,2021).

LSReply14 -LOE is more theoretical so did not find anything difficult (Law of Evidence, June 23,2021).

LSReply15 –Not like in physical class and using the physical white board, found teaching stressful. I used MS whiteboard but it was not too much effective (Trust and Equity law, June 23,2021).

4.4.2 Qualitative analysis - how adopting online tools depends on Quality IT Infrastructure

With respect to analyze of responses which indicated the IT infrastructure-based challenges, the subcategories under the code “IT Infrastructure and Resources” was extracted from the Table 4.2. After the lockdown imposed in the country in March 2020, the university was opened only for academics before the start of the second wave. Academics held their lectures having come to university premises. Lecturers expressed the technical glitches encountered during delivery and issues were related to network laggings, bandwidth and low speed.

CSReply17: experienced network traffics while doing lectures through MS Teams. At times marking got delayed due to lags in LMS and resulted in marks going missing. (Network and Cyber Security, June 24,2021).

CSReply18: Even though we as academics come to the university and conducted the sessions but students connected remotely. Go through network delays sometimes specially when connected through wifi. Students face some network failures, data package issues, sudden power cuts and bad weather conditions. (Professional Skills for Networking, June 24,2021).

BSReply20: during Turnitin submissions network got slower due to high traffic to LMS (Professional Toolkit, June 24,2021).

BSReply22 –WIFI with strong signal strength should be provided. Keeping Video switched ON is a must for exams and requires lots of bandwidth. (Numerical Skills, June 24,2021).

LSReply21: sufficient infrastructure mostly with ad-hoc connectivity issues. (Contract and Problem Solving, July 17,2021).

LSReply23- recorded lecture videos are considerably large and take substantial amount of time while uploading. (Contract & Problem Solving, June 25,2021).

4.4.3 Qualitative analysis - how adopting online tools be subject to IT literacy

In order to analyze replies which indicated IT literacy of academic, the sub categories in codes “Online tools” and “Suggestions to improve” was extracted from the Table 4.2. Academics qualitative replies indicated that they were convenient and knowledgeable to use LMS on sharing materials, conducting exams and giving feedback. They started using MS Teams for collaboration with students since the country’s lockdown in March 2020. Since everyone nowadays in social media groups, they are able to communicate with their batch mates, express their views and find it easier to communicate using social media channels. However, it was an optional activity of sharing their contact numbers with students.

CSReply19 – I am comfortable with LMS platform and due to pandemic usage of the LMS increased to greater level. And as already been using MS Teams, previous experience on MS Teams was useful for me. (Enterprise Cloud Computing in the AWS Environment, June 24,2021).

CSReply28 – using LMS, Teams and its whiteboard was not a big hassle (Database and Data Storage, June 25,2021).

BSReply29: In addition to MS Teams, LMS and video tutorials, I started using Zoom app also to collaborate with students more. (Information Systems in Organizations, June 25,2021).

BSReply31: providing quick feedbacks through social media app like WhatsApp is convenient and faster (Information Systems in Organizations, June 25,2021).

LSReply30 – I use online tutorials, video tutorials, workshops, group works/assignments via online too as addition to academic activities (*Introduction to Business*, June 25,2021).

4.4.4 Qualitative analysis - how adopting online tools depends on user training

In order to analyze responses which indicated Training, the sub categories in codes “Teacher Training” was used from the Table 4.2. Computing and Business academics posed a negative impression on the training provided for them. They also indicated that immediate transformation to e-learning teaching at the start of the pandemic reduced the time of any university that could have been allocated for proper training. They also indicated that even though they can use the current online tools in the university, they are unaware of the teaching specific features of the tools. However, many Computing and Business academics stated that whenever they faced an issue with the online tools they could contact their IT Team for help.

CSReply12: did not receive either proper training or training materials. Therefore, at initial stages, not knew how effectively use Microsoft Teams & its features in to our lectures (Advanced Database Systems, June 14, 2020).

CSRes32: specifically, designed training on how to handle online session/delivery was not received. (Mobile app development-2, June 25, 2021).

CSReply10 –proper training was needed immediately after the pandemic breakout for all the lecture staff. Guidelines through emails were received. Had to contact IT team as and when required for help. (Engineering and Integrating Robust Large-Scale Systems, June 26, 2021).

BSReply33: Training should have been arranged by a third-party vendors/suppliers and not internal training. Would have received proper insights to teaching. (Task Based Software Engineering, June 14, 2021).

BSReply31: We had to do a lot of self-study to competent on online tools (Global Business, June 14, 2021).

BSReply29: if proper training had been prearranged, we could have learned the online tools much faster in March 2020 (Authentic Leadership, June 25,2021).

BSReply26: there were few webinars arranged by external experts. As an academic I did not gain enough insights to use tools out of them (Entrepreneurial Marketing, June 25,2021).

However, law academics seemed to have a different understanding. They seem to be happy with the brief training received from the IT team in terms of instructions. It is also notable that many law academics stated during the interviews that they are not IT savvy enough to identify best online tools to deliver law modules. Law academics also indicated that they could contact their IT dept. for any IT help they needed to resolve online tool related issues.

LSReply30 - sufficient training and needed support was received on the move by the IT team (Tort Law, June 25,2021).

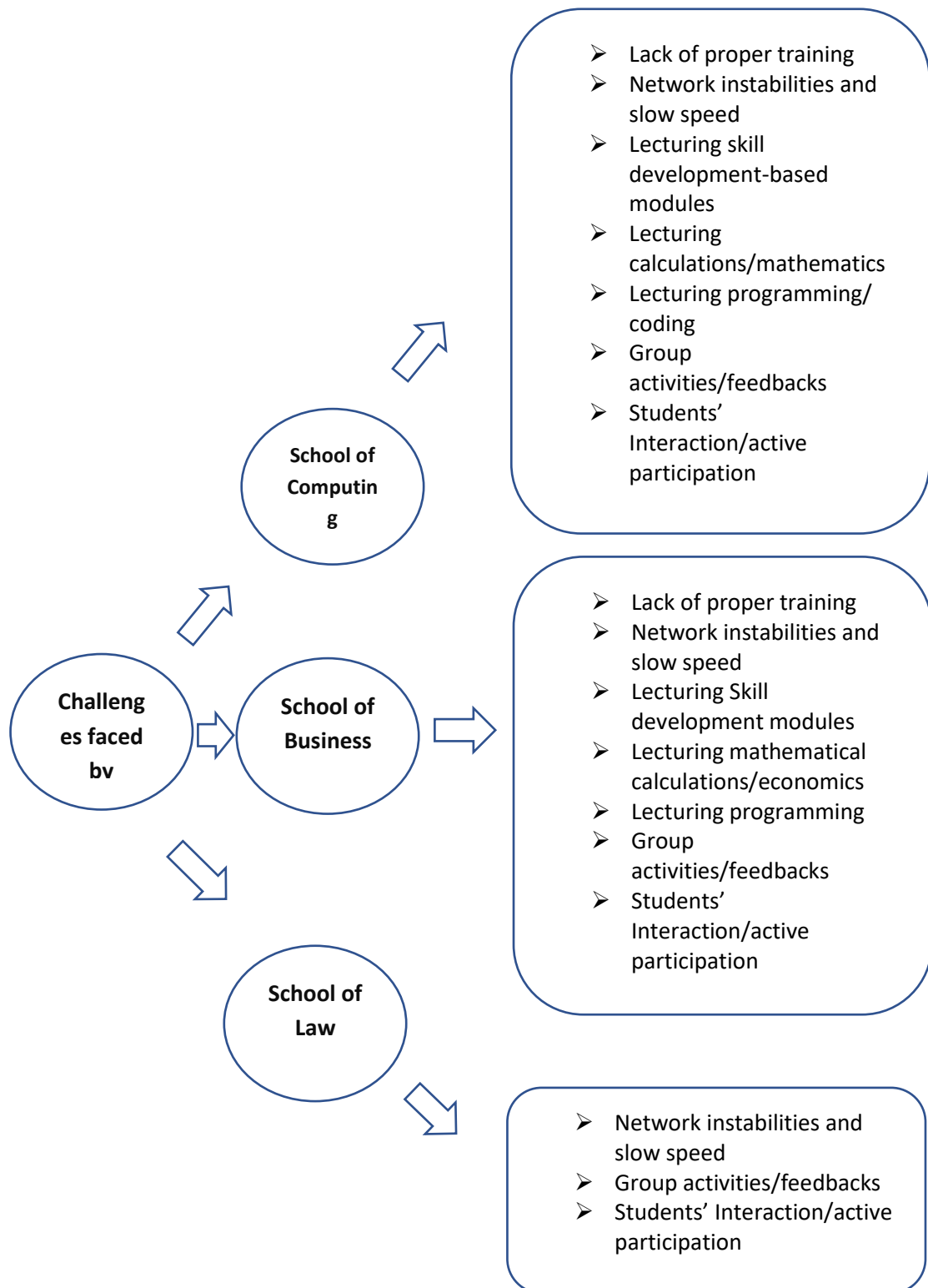
LSReply27 – feel MS Teams is comfortable to use with its available features as an online delivery platform. (Company law, June 25,2020).

LSReply24: had no much awareness of best online tools. Received few instructions emails and followed the steps accordingly. (English Legal Systems, June 25,2020).

Based on the above qualitative analysis; All three schools face many challenges in adopting online tools. The following is a model in Figure 4.10 was developed based on the challenges faced by academics.

Figure 4.9 Model of challenges designed from academic's qualitative analysis

Source: Academic interview data analysis



Based on Figure 4.9 it is clear that academics encounters difficulties in terms of network traffics, slow speed and low bandwidth which could all be categorized as IT

infrastructure challenges. Achieving student interactions, engagement, conducting group activities and carrying out assessments tasks for their batches are found to be challenging with these online tools.

However, it is clear to see that Computing and Business academics have mentioned that it is challenging to teach their practical modules with online tools. Skill-development and programming language modules also expressed as challenging to adopt online tools. However, law lecturers have not specifically mentioned of any challenging modules as such.

Additionally, Computing and Business staff have indicated that they are not happy with the training they received on using online tools; although law academics have not voiced any bad expressions on the amount and type of training they received.

4.5 Students data analysis

Data collected by the student sample is analyzed below in terms of inferential statistics.

4.5.1 Reliability & validity of data

Cronbach alpha(α) calculation is used to check validity of student questionnaire. According to behavioral science, in order to be vastly reliable, the Cronbach alpha value needs to be more than 0.7. If the Cronbach alpha is > 0.6 and < 0.7 , then the questionnaire can be considered as moderately reliable. The questionnaire used for the student data collection showed a value of 0.682 which means that the student questionnaire is moderately reliable.

Case Processing Summary

		N	%
Cases	Valid	205	100.0
	Excluded ^a	0	0
	Total	205	100.0

Reliability Statistics

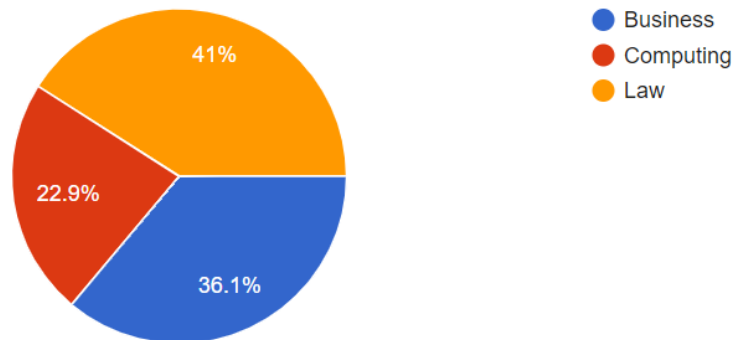
Cronbach's Alpha	N of Items
0.682	15

4.5.2 Descriptive analytics - Students

The following describe the student sample.

Figure 4.10 Classification of schools

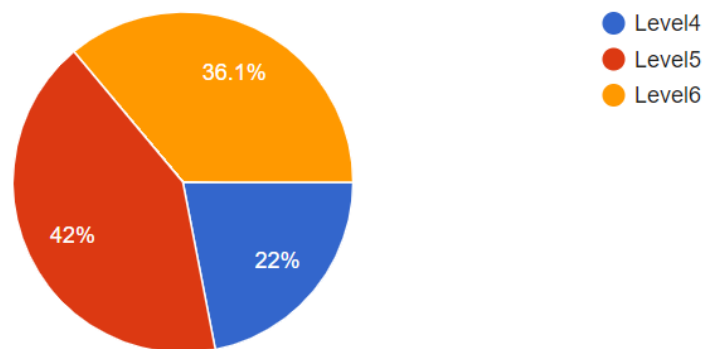
Source: Survey data



According to the Figure 4.10, much student respondents (41%) are from law school. 36% students are from the Computing and 23% are from the Business school.

Figure 4.11 Year/level of study

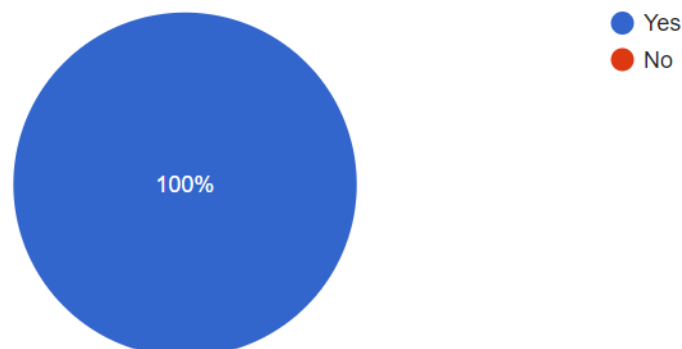
Source: Survey data



As shown in the above Figure 4.11, much of the students (42%) are in their second year (Level 5), followed by 36% from final year (Level 6) and first year/Level 4 student input is 22%.

Figure 4.12 Use of online tools of students

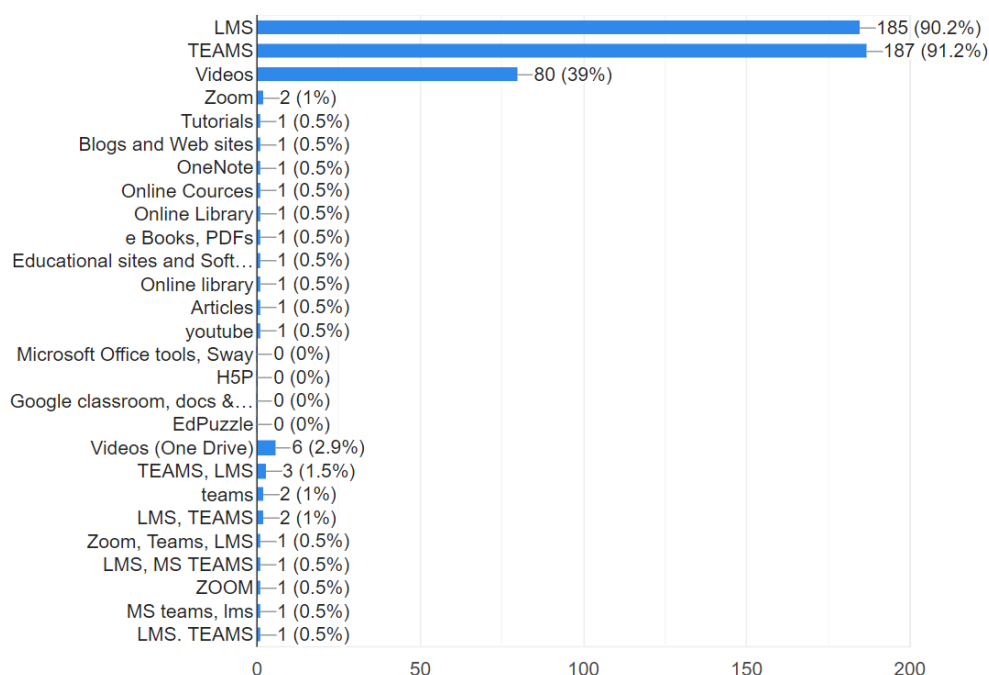
Source: Survey data



According the Figure 4.12, it is clear indication of that 100% of the all students are in 3 streams (Computing, Business and Law) use online tools for their day to day learning.

Figure 4.13 Online learning tools used by students

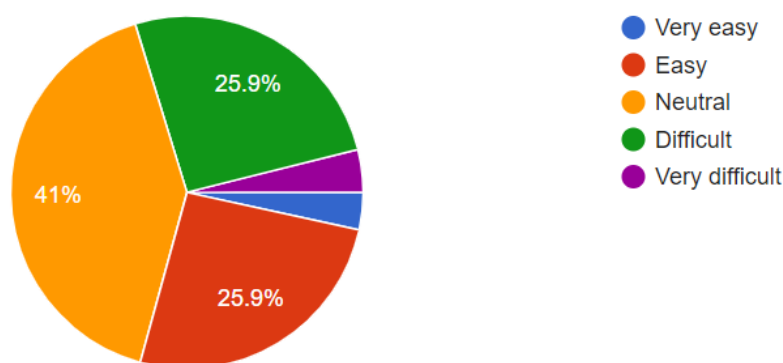
Source: Survey data



As shown in Figure 4.13, students have replied with that both the LMS and Microsoft Teams are the most commonly used tool for their learning with 96% and 96.6% respectively and followed by online videos with a 48% of responses. Online tutorials, blogs and websites, OneNote, online courses, e-books, educational web sites, online library articles and YouTube are the other online resources use for their learning.

Figure 4.14 Students adopting online tools

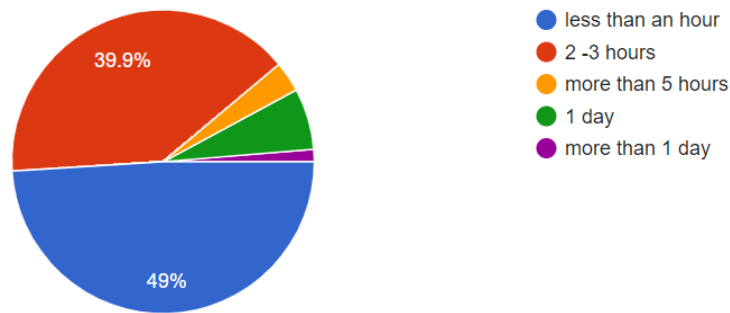
Source: Survey data



In Figure 4.14, we can realize that the students show mix responses for adopting online tools. Majority of students (41%) having neutral stance. 26% of students expressed that it is tough to adopt with the online tools. Interestingly another 26% of students have stated they find it comfortable to cope up with adopting to online tools. There is a 3% of students who says that it is very challenging and 4% says it is very easy to adopt online tools.

Figure 4.15 Time taken to learn a new online tool - students

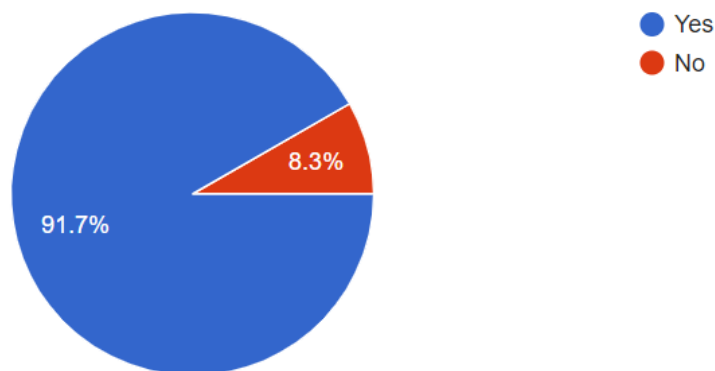
Source: Survey data



As per the Figure 4.15, almost half of (49%) says that it takes about less than 1 hour to learn a new tool. 40% say they need 2-3 hrs. 7% of students spend approx. 1 day to learn a new tool. 3% of the students takes > 5 hours to learn while more than 1 day is utilized to learn a new tool out of 1% of the 205 of sample students.

Figure 4.16 Compelled to use online tools during pandemic - students

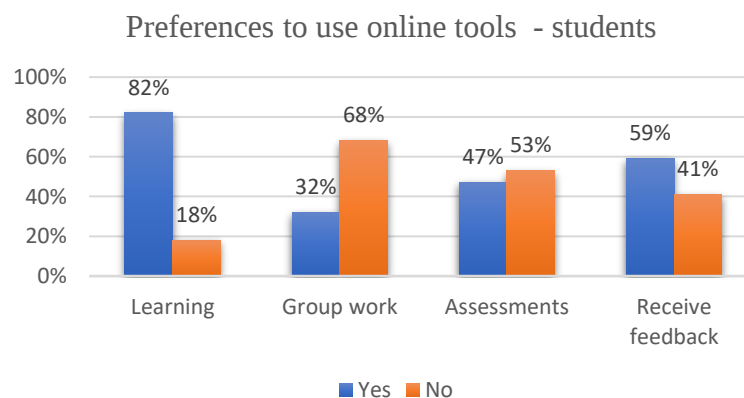
Source: Survey data



According to Figure 4.16, nearly 92% out of the sample population, have replied as they were forced to use online learning tools during the pandemic.

Figure 4.17 Preferences to use online tools - students

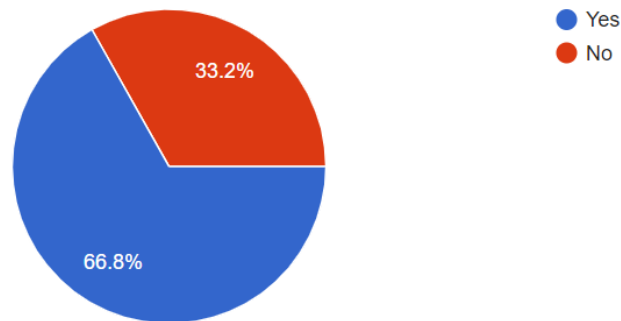
Source: Survey data



According to the above bar chart in Figure 4.17, majority of students (82%) prefer online tools for learning subject matters whilst only 18% do not prefer online tools for learning. However, majority of students (68%) do not like to use online tools for group works. Contractively only 32% prefers to do group work using online tools. Preference to use online tools for assessments seems to have mixed responses. 53% of students don't like to have online tools for assessments as 47% students likes online tools for assessments. Similarly, receiving feedback is another area for which students have mix responses. 59% likes to use online tools to receive feedback whilst 41% doesn't like.

Figure 4.18 Facing difficulties using online tools - students

Source: Survey data



As shown in Figure 4.18, It is common to see that more than half of the students have encountered challenges using online tools with approx. 67% of the responses saying “yes”. However, there is a 33% of students who have replied with saying that they have not faced difficulties in using online tools.

Table 4.3 Difficulties students are finding when assuming online tools

Source: Survey data

		Difficulties to adopt online tools					
		Difficult	Easy	Neutral	Very Difficult	Very easy	Total
Comp.School	% within the school	2 4.25%	17 36.17%	25 53.19%	2 4.25%	1 2.12%	47 100%
Business School	% within the School	16 26.12%	28 37.83%	24 32.43%	1 1.35%	5 6.75%	74 100%
Law School	% within the school	35 41.66%	8 9.52%	35 41.66%	4 4.76%	2 2.38%	84 100%
Total	% within the school	53 25.85%	53 25.85%	84 40.97%	7 3.41%	8 3.9%	205 100%

Spearman Correlation - IT infrastructure Quality (I_V2) vs Adopt online tools (DV)

			IV2_QI	DV_Adopt_Online_Tools
Spearman's rho	IV2_QI	Correlation		
		Coefficient	1.000	-.124
		Sig. (2-tailed)	.	0.020
		N	205	205
ols	DV_Adopt_Online_To	Correlation	-0.124	1.000
		Coefficient		
		Sig. (2-tailed)	0.020	.
		N	205	205

Spearman Correlation - IT Literacy(I_V3) and Adopt online tools (DV)

			IV3_IT_Literacy	DV_Adopt_Online_Tools
Spearman's rho	IV3_IT_Literacy	Correlation		
		Coefficient	1.000	0.209
		Sig. (2-tailed)	.	0.000
		N	205	205
ols	DV_Adopt_Online_To	Correlation	0.209	1.000
		Coefficient		
		Sig. (2-tailed)	0.000	.
		N	205	205

Spearman Correlation - User Training (I_V4) and Adopt online tools (DV)

			IV4_IT_Literacy	DV_Adopt_Online_Tools
Spearman's rho	IV4_User_Training	Correlation		
		Coefficient	1.000	0.302
		Sig. (2-tailed)	.	0.000
		N	205	205
ols	DV_Adopt_Online_To	Correlation	0.302	1.000
		Coefficient		
		Sig. (2-tailed)	0.000	.
		N	205	205

4.8 Students qualitative analysis

A total of 20 students were interviewed to gather their replies on adopting online tools. The transcripts/codes were created out of those interview evidences. The qualitative response analysis by Rashid_[38] is used to analyze the responses as same as academics. NVivo research software is used to classify the codes in the transcripts. The Table 4.4 shows the identified codes.

Table 4.4 Codes identified from student qualitative responses

Source: Interview data

Inductive categories (Codes)	Sub categories
Online Learning	Experience and transmission Student interaction/engagement Challenging modules Receiving feedback and support
Student Training	Amount of training Type of training Perceptions on training Post-training support
IT Infrastructure and Resources	Learning dependency on IT Infrastructure Present IT infrastructure
Suggestions to Improve	IT Infrastructure Lesson delivery Student interaction/engagement

The codes identified in the table 4.16 was used to analyze the interview responses. The following are some of the notable responses extracted from the student interview transcripts. It is fascinating to see that some of the responses are opposing among the 3 schools.

While presenting the replies, I have used the following symbolization:

E.g. CSReply1

The above code indicates that the **Student reply** is from the **Computing** school. Further it indicates that the replied number as per it received (**Reply1**). The school name is denoted with the first letter of the school name.

4.9 Qualitative analysis

4.9.1 Qualitative analysis-how adopting virtual tools depends on type of subject

In order to analyze responses which indicated the challenging modules, the sub categories in codes “Online learning” was used from the Table 4.4. Computing and Business schools’ students replied by indicating that there are specific modules that do not adopt well.

BSReply2: somedays had 3 hrs of lectures endlessly. It is very hard to grab the lesson in such case. Real-time assistance and feedbacks for our subject matters were lacking.

When batchmates send their questions through emails, we only receive the responses few days later. And it results in not been able to effectively work on group assessments and achieve learning outcomes. Group works/presentations/assignments were difficult to complete online (personal communication, June 29, 2021).

BSReply6: FYP(Final year project) was the hardest when it comes to online learning (Final Year Project-Business, June 29, 2021).

CSReply7 – Practical modules were found hard to understand on online as we were unable to clarify the doubts as it emerges. We received our answers for our questions only when lecturers are free from their works. (Task Based Software Engineering, June 29, 2021).

CSReply10: When group assignments were arranged online, we felt it was more difficult and stressing everyone due to technical glitches. Some group members were made to postpone their group assignments and discussions due to technical malfunctions. Post-training on technical aspects of accessing IT services is anticipated. (Malicious Software and Security Programming, July 02, 2021).

CSReply17: software engineering/programming modules adoptability with online mode was not that effective for students. There is a requirement/application of a collaborative lab tool. Everyone feels programming subjects need a lot of lab with instructor involvement. Would have liked to have more lab sessions than normal. (Mobile application development, July 03, 2021).

Law students are in contradiction on their view on online learning and have stated that even though the online learning is difficult they try to adopt with it.

LSReply14: Theoretically law modules are very heavy and were very ineffective in adopting to online learning. Generally used to arguments with the lecturer on some points and discuss on case studies lengthy in face-to-face classes. Nowadays just keep listening to 2-3-hours of lectures. There are many days where no interaction at all. Our batch consist of 80 plus students and never had a situation where all our doubts were cleared by the lecturer during the lesson times. We expect deep discussions with lecturers and peers for case studies on law cases which didn't happen. All these things effect our studies. (Contract and problem-solving law, July 03, 2021).

LSReply22: we did not receive feedback on time for our group discussions in ELS module. (English law systems, July 03, 2021).

According to the above analysis, it is understood that the below types of modules are difficult to adopt online with online tools,

- Practical/simulation modules usually conduct in lab environments (programming modules, computer networking modules)
- Final year projects of Software Engineering and Computer Networks, which requires a lot of interaction with the supervisor.
- Soft skill-development modules (Business modules)
- Modules which includes group work/group assignments as the mode of assessments.
- Modules which contains problem-solving skills (Management Accounting, mathematical modules, Economics)
- Law modules with heavy theoretical concepts, case studies and lot of discussions with lecturers/mentors

4.9.2 Qualitative analysis - adopting online tools depends on Quality of IT Infrastructure

Sub topic in codes “IT Infrastructure and Resources” was used from the Table 4.4. As per Student’s responses, analysis indicated that they have experienced many issues in IT Infrastructure facilities. Most of the concerns were raised on network latencies, data bandwidth and data issues.

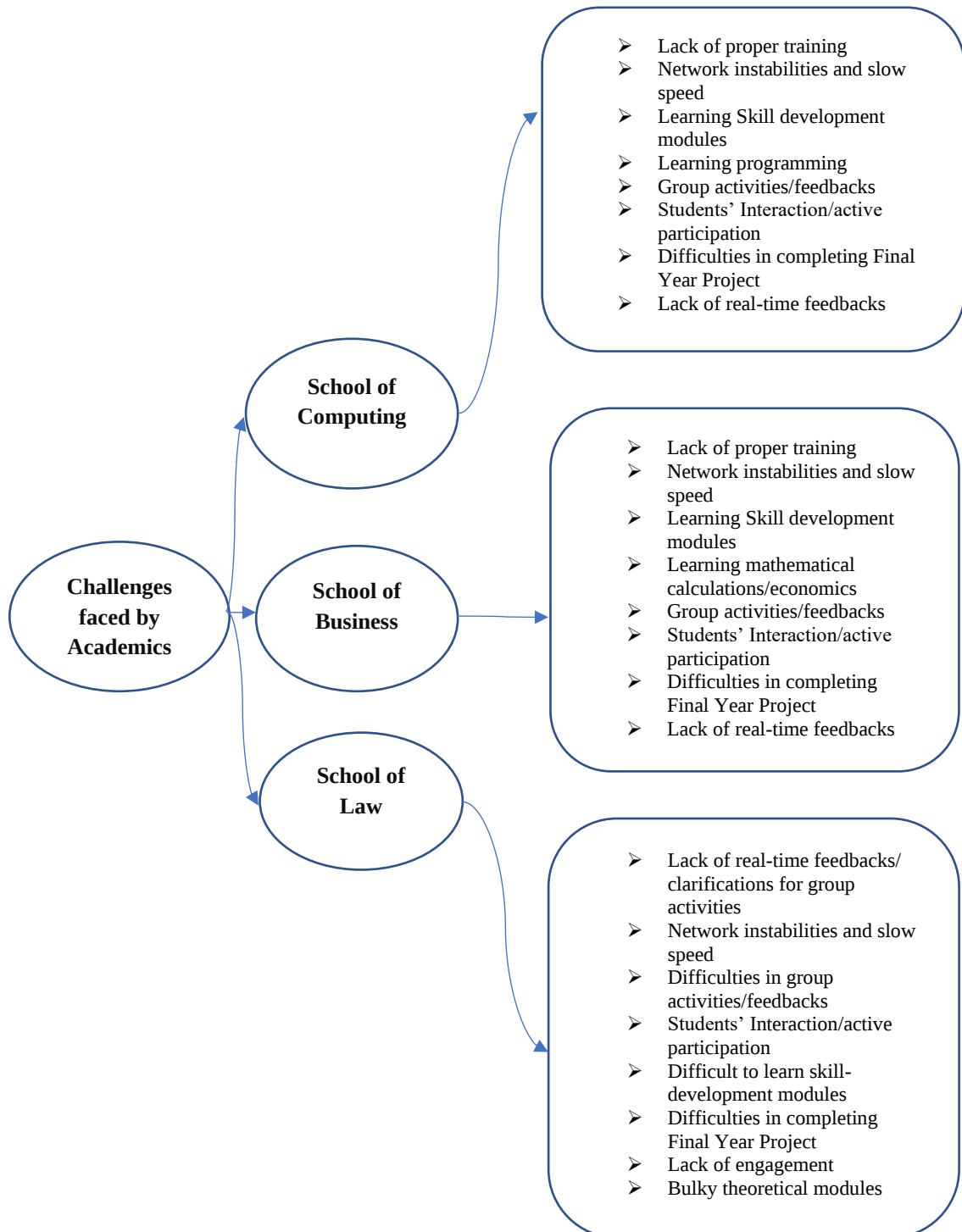
BSReply11: time to time network malfunctions. We had connectivity issues. (Personal communication, professional tool kit, June 29, 2021).

BSReply19: due to size limitation of uploads, we encountered 404 error status/pages while uploading video submissions to LMS. Lectures consulted IT Team and was able to resolved. (Big data, July 03, 2021).

Based on the above; it is obvious to see that students from all three schools face numerous challenges. The following model in the Figure 4.22 specifies the encounters that was occurred based on the qualitative findings of students.

Figure 4.21 Model of challenges - student's qualitative analysis

Source: Students Interview data



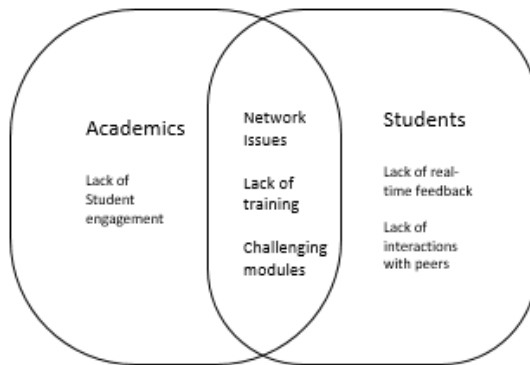
4.10 Common challenges confronted by academics and students

After investigating the responses of common difficulties confronted by both academics and students were organized by a mapping as per below.

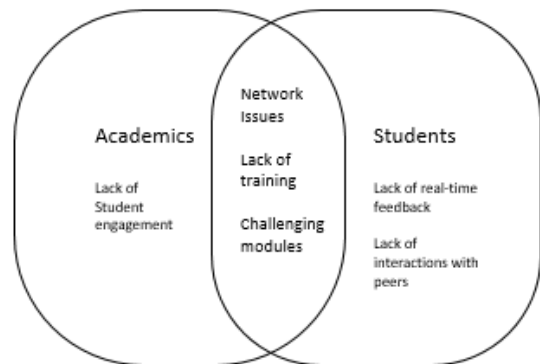
Figure 4.22 Challenges faced - lecturers and students

Source: Interview data

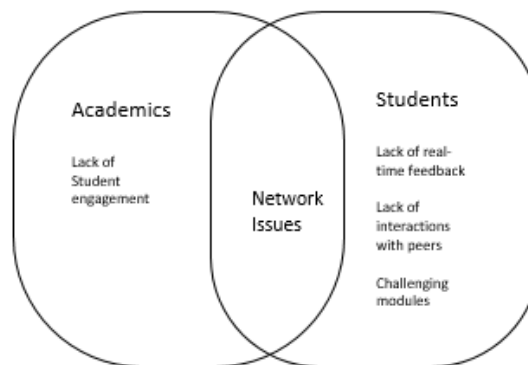
School – Computing



School - Business



School – Law



It was found that in Computing and Business school the common challenges are as challenging modules, lack of desired training, network issues. Even though, in the law school, it was identified only one common challenge as network issue. Challenging modules and lack of proper training existed only in law student responses.

4.11 Summary of findings

4.11.1 Summary of findings - Academics

According to the descriptive analysis, majority of the academics are well experienced in teaching with (65%) of having more than 5 years of lecturing experiences. 97% of the academics frequently use online tools for their teaching. Some of the common online tools used at the XYZ university are; MS Teams, LMS, videos, online video/text tutorials. Majority of the academics were experienced enough drawbacks to use online tools for their teaching previously as well and have indicated that it was not that difficult

to adopt to the online teaching in less time frame. Subsequently, majority of the academics have replied that they only need less than an hour to learn a new online tool. Academics in the XYZ university were forced to shift to online at the start of the Covid-19 break out and during the lockdown of the country since mid of March 2020; with which they all got familiarized to MS Teams as the online platform for them to collaborate with their students, provide feedback and conduct assessments. And at the same time, do not prefer online tools to teach with, as on-premise classes are the most preferred way of module delivery.

Based on the model as per Figure 4.21 and the qualitative analysis carried out it was clear to see that Computing and Business academics finds difficulties to adopting online tools depends on types of modules. Because, there are modules in both computing and business school curriculum that are difficult to adopt with online delivery. However, the law academics have specified that there are no modules found difficult to cope up with online lecture delivery. Selvaras^[46] has expressed with positive observations of law modules of been able to adopt well online.

However, as per Leonard^[31] and Sloan, they have disagreed and stated that only certain law modules adopt well with online. Eventually, we could see that there are specific modules which are challenging to adopt with online tools.

Computing and Business academics have faced many IT infrastructure-based issues while adopting to online tools as per the results of qualitative analysis. However, law academics seems to have not stated any foremost difficulties relate to the IT systems. After going through all the academic's qualitative responses, IT infrastructure matters are can be identified as a challenge in adopting online tools.

Past researches indicate that IT literate users adopted well with online teaching. Furthermore, it has been found that IT literate teachers/lectures demonstration only a smaller number of concerns in adopting to online tools. However, Computing and Business academics request more education specific tools implementation, although law school have stated they do not have enough knowledge to propose what are the better tools for law school and online teaching. Since, all the academics in XYZ university are IT literate, IT literacy is not a challenge in adopting online tools of the university.

The academic's challenges model in Figure 4.21, shows that Computing and Business academics are not in favor of the volume and sort of training received by them. Their common assessment is that more structured trainings should have been provided and

based on that they will get to know more features of the online tools which they can use to improve their online lessons. It is suggested that academic staff needs to be granted satisfactory training to ensure successful adoption of online tools for online lesson delivery. Nonetheless, law academics doesn't seem to be ill-fated of the training they received during the pandemic. This could be due to that 75% of law academics who were taken for the research are employed in the XYZ university as part-timers. Therefore, they come to the premises of the university only for few (2-3) days and resulting of not been facing the difficulties of such that the full-time academics in Computing and Business schools faced due to improper training.

4.11.2 Summary of findings - Students

As per the descriptive analysis of the students, all students in the XYZ university use online tools for their learning. Most popular online tools used by students are: LMS, MS Teams, Zoom and online video tutorials. When inquired students came with mixed responses, their ease of adoption to online tools where majority of students (41%) remained in a neutral opinion.

Most of the students (49%) has indicated that they require more than 1 day to learn a new tool. Majority of students (92%) were compelled to use online tools due to breakout of Covid-19; where they got used to use MS Teams as the tool of collaboration with lecturers. Huge portion of the students prefer to use online tools for participating for lectures and receiving feedback for their modules.

Somehow, majority of students do not prefer online tools as a means for them to conduct group work and assessments and further to the same majority of students (67%) have expressed that they face difficulties in using online tools for their learning.

In the methodology chapter hypothesis was created to be tested in order to answer queries related to the study, "How challenging is it for the universities in Sri Lanka to adopt online tools?".

Table 4.5 demonstrates a conclusion of findings of hypothesis tests conducted using Spearman correlation technique and evidence is also presented indicating similar findings.

Table 4.5 Summary of hypothesis tests-students

Source: Hypothesis test results

Questions	Results of the hypothesis test
Adoption of e-learning tools have a relationship with types of modules?	Adoption of online tools has no relationship with the type of modules
Adoption of e-learning tools have a relationship with IT infrastructure?	Adoption of online tools has a relationship with having a strong IT infrastructure.
Does IT literacy of users have a relationship with adopting online tools?	There is a relationship between a user's IT literacy and adopting online tools
Does user training have a relationship with adopting e-learning tools?	Adoption of online tools has a relationship with user training.

4.12 Discussion

According to the research findings in section 4.3, with prior experimental studies; the following is a look back to the study objectives defined at the start of the research.

The first objective, led to the first research question to find out how online tools are being used in the university. According to the findings, it is realized that before the start of the Covid-19 pandemic, academics have used online tools just to distribute course materials, for online assessments and to provide feedback. YouTube, Zoom are few of the other online teaching tools. LMS is the most popular tool being used for teaching and learning by universities. Online videos, online courses, e-Books, MS OneNote, Blogs and web sites and online libraries are also being used. However, with the Covid-19 pandemic universities started using MS Teams platform to conduct online lectures as they altered their on-premise classes in to online/blended classes.

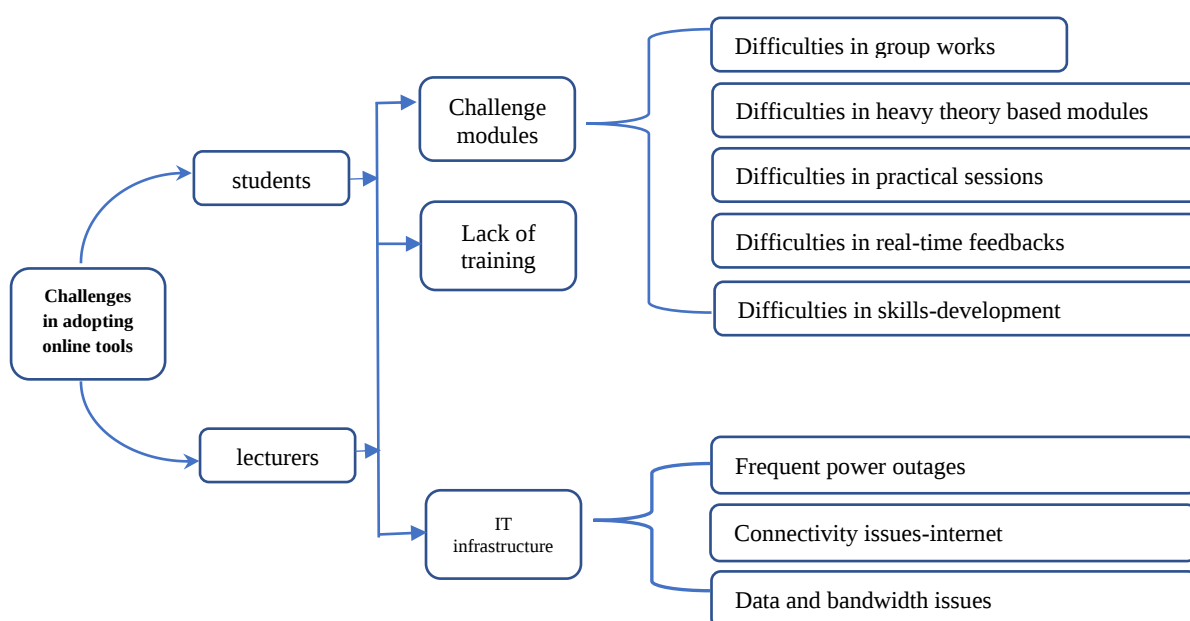
The second objective, which led to the second research question based on, how challenging it was for the university to adopt online tools. For the research, I brought up a conceptual framework which comprised of possible challenges (Independent variables) such as: type of modules, quality IT infrastructure, user training and IT literacy of both academics and students. Their inter-relationship against adopting online tools (dependent variable) was analyzed. As per the quantitative analysis strengthened

by qualitative findings for the student sample, it was found that IT Infrastructure, certain type of module and user training are been the challenges. Among the academic population, the qualitative findings revealed that all 03 schools (Computing, Business and Law) are IT well literate. Specific Computing and Business modules adopt poorly online. Lack of proper training is also identified as a challenge for all the academics. They suggested to improve IT infrastructure for better module delivery.

As a result of qualitative analysis, one model for each was created with the challenges that each school face. Accordingly, the model of academic challenges is presented in Figure 4.9 and the model of student challenges is presented in Figure 4.21. Depend on both those two models, common challenges were Figured out and with the student's quantitative findings, the following model is developed which includes all the challenges faced by both students and academics.

Figure 4.23 Challenges faced by the XYZ university in adopting online tools

Source: survey data and interview data



The third objective which directed to the third question is to formulate a framework with tactics to overcome the challenges faced by the university. After considering the research findings and researched studies the following strategies are recommended for the university.

4.13 Recommendations - overcome module-based challenges

4.13.1 Using interactive multimedia slides to rebuild the liveliness (real-time feedback, interactions and engagement) in lessons

According to the research findings, “liveliness” of the lessons has become reduced when it is delivered online. Academics and students of the XYZ university have also suggested to have better tools to deliver lectures. Absence of face-to-face interaction may be reestablished up to a great extent with the following interactive multimedia tools/mechanisms.

- Students could engage with the lecture and materials shared by the lecturer during the session time to time. (via text, audio or even by video comments)
- Lecturers could check the student’s engagements level during a lesson through the live feedback. (problem solving activities, peer markings)
- Lecturers may frequently practice this with students for the modules in which they think that students expect a lot of feedback from them. (Assessments and final year projects)

4.13.2 Use specific tools for problem solving and practical modules

Repl.it is an (IDE) Integrated Development Environment platform which enables software engineering students for their programming subjects. Its real-time collaboration interface motivates students to code by replicating the real physical lab environment. Tools such as Google Techdev guide and Repl.it are supposed to be tools to bring students the interaction and support requirements they need during programming/coding meetings. Academics may use these kinds of tools to emulate the physical labs on online scenario. The university must invest considerable amount of its time and effort to evaluate what type of tools that can be used to conduct virtual programming/coding, problem-solving and lab sessions for their students.

4.13.3 Interactive portals to bring stronger engagements and interactions

Interactive portals are a solution for both academics and students to rebuild the collaboration between them, skill development, instant feedback, assessment guides, group discussions, engagements and also create awareness on module specific learning.

Marketing Teacher.com is an online portal simplifying students and teachers in the field of marketing. This portal comprises of a YouTube channel which is dedicated for marketing videos and a repository of lesson store which includes lessons on several areas of marketing.

Further, HILT(Harvard Initiative for Learning & Teaching)[13] is an online medium by the university Harvard with the prime objective of improving innovation and excellence of teaching and learning. It offers its academic staff and students a diversity of resources on one platform which forms both technological and pedagogical needs.

4.14 Recommendations - Train Users

4.14.1 Organize well planned, structured training sessions for both academics and students

It is must that both the students and academics must be supported by providing adequate training prior to start of lessons as per research done by Dhawan[5]. Proper training should provide on the most widely tools such as LMS and MS Teams for the academics and students to understand education specific features of these applications.

As three schools have their own way of module delivery and subject matters, it is recommended to have separate training sessions for each. Training sessions could be conducted as a joint venture by in-house IT team and with the aid of software vendors/ service providers to achieve better results.

4.14.2 Add a “Frequently asked questions” (FAQ) link in to LMS

LMS is found to be the most extensively and frequently used online tool in the XYZ university as per the research findings. It is recommended that the university designs a frequently asked questions (FAQs) page to guide their students and its academics on LMS. This page (eg; www.lms.xyz.lk/learn) may provide a comprehensive list of questions and answers with best possible video demonstrations on the LMS. Both students and lectures may be benefited with this by getting quick answers for many of their required inquiries especially during an online/distance learning.

4.15 Recommendations to improve IT Infrastructure for lessons

Every university must invest considerable time, effort and capital to ensure seamless infrastructure for its students and academics[5]. Due to the pandemic, the university may happen to switch back and forth from online and hybrid teaching/learning time to time. Consequently, IT infrastructure faultlessness play a vital role. University needs to

be responsible for preparing adequate IT infrastructure for its students and academics on both on-premises as well as work/learn from home.

4.15.1 Learn from home

Many internet service providers have come up with customized data packages and data bundles for student's community to learn from home. Dialog^[3] work & Learn plus package (Dialog Axiata PLC, 2021) and SLT-MOBITEL^[50] Work and Learn online data bundle (SLTMobitel Pvt Ltd) are the two most featured customized packages introduces recently due to the Covid-19 pandemic. In a case where the university shift on to 100% online learning due to the pandemic, some percentage of the facility charges paid by the students (eg: library fee and lab facility fee) could be spend as the incentives for data packages. It is because, when teaching is 100% online delivery students are not supposed to come to the university premises to use library facilities and the lab facilities.

4.15.2 Learn on-premise

In order to deliver an uninterrupted use of online teaching and learning on-premise, the XYZ university better ensure with the following actions has been taken,

- Uplift the Local Area Network (LAN) by using industry standard hardware and with cutting edge technology with higher redundancy and high data transfer rates.
- Make sure regular maintenance cycles and upgrades are carried out for hardware and software.
- Confirmation of regular backup policies in place for all the systems servers and online tools.

4.16 Overall recommendations

4.16.1 Enhancement of social media integrations

After the pandemic break out students have come across many transition difficulties. All the students considered for the research survey are full-time and are very much used to on-premise education. The XYZ university must realize how importance the strengthening student-academics social integration between the two clusters. In order to do that XYZ university could improve peer relations, better communication of academic support to students and must develop mentoring programs Rovai^[40]. The best way of enhancing peer relations, many universities now practice study-buddy

programs. Working with their buddies will make sure that the batch mates/juniors are no more isolated in their own and is reaching social interactions with their batch mates/seniors. It is always recommended now that to train and guide academic mentors with the best practices of student-academic interrelationship in online environment.

4.16.2 Implement an appropriate strategy in selecting online tools

Universities have their own conducts of evaluating online tools. Anstey and Gavan^[1] from Western University, Canada have come up with a rubric form to measure e-learning tools in higher education.

Bloom's digital taxonomy provides a comprehensive guideline for academics as how to use digital tools and technologies to encourage student virtual learning. (E.g. Investigating could be carried out by using e-learning tools such as online surveys and mind map tools)

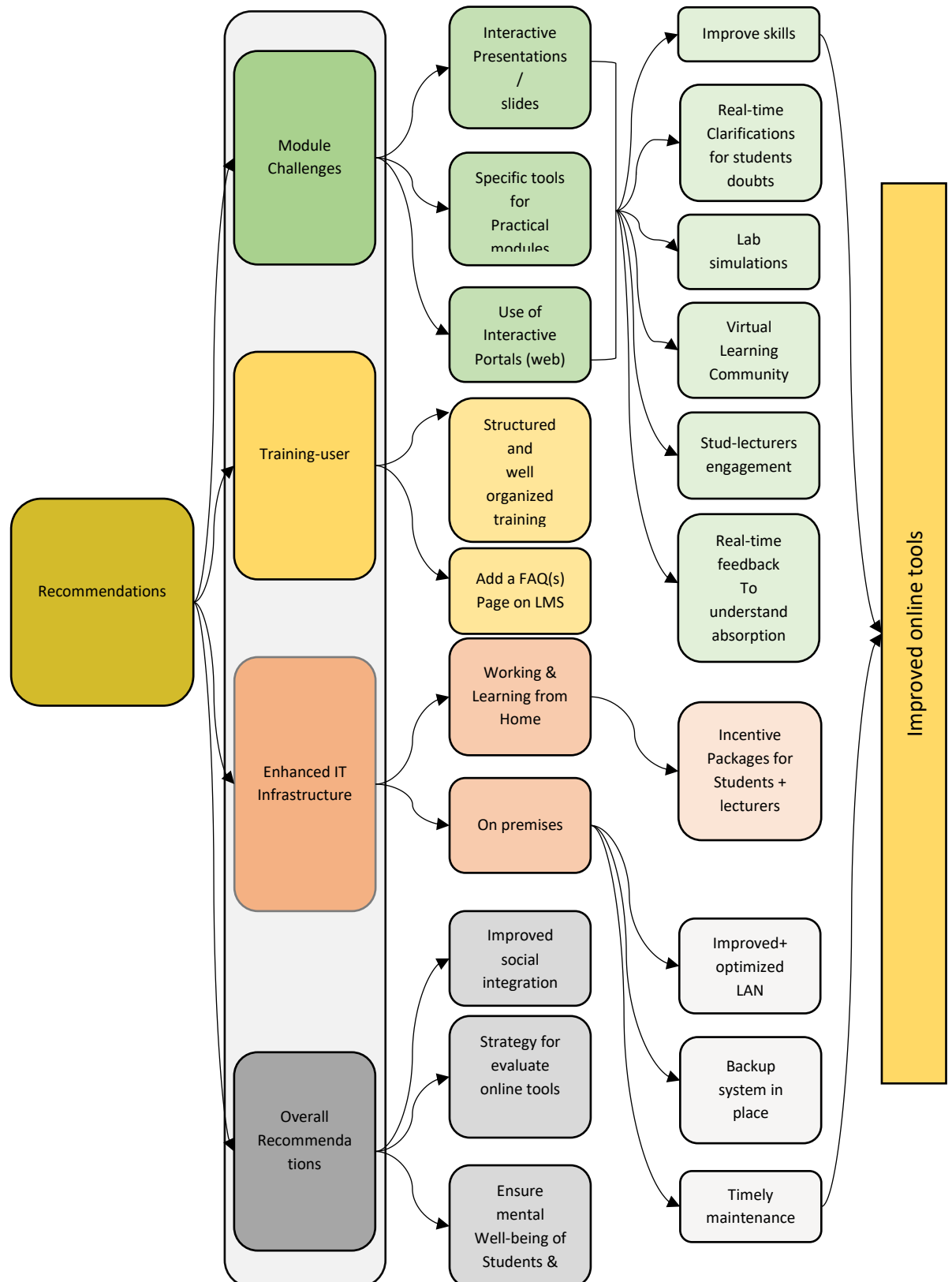
It is recommended for the XYZ university to stick to a standard guideline like mentioned previously when assessing online tools and hopefully this way university will be in a position to implement critical online tools than funding in general tools used in masses.

4.16.3 Ensure psychological wellbeing of students and academics

Transition in to both online and blended e-learning from time to time have put students and academics in to lot of physical endeavors and same time it could also have an adverse effect on their mental and physical comfort^[42]. Qualitative findings of the research also indicated that many students and academics do go through lots of awkwardness and isolation and in search for social interaction due to virtual education. It is recommended to appoint a team of counselors to be in touch with students and academics and assist them to preserve their mental healthiness. Based on all the above, as recommendations to the third objective of the research, below framework is designed for the XYZ university as strategies to eliminate the identified challenges in adopting online tools.

Figure 4.24 Framework with commendations for the XYZ university to overcome the identified challenges in adopting online tools

Source: Survey and interview results



Chapter 5

5.0 Conclusion

This research identifies difficulties in fitting with online tools faced by XYZ university and researched facts from academics and students of the university to discover the challenges faced in adopting to online tools. The findings disclose that types of modules, IT infrastructure problems and user training are the key challenges in adopting online tools. Subsequently, in order to eliminate the identified challenges, the following recommendations are suggested for the XYZ University.

- **To mitigate module related challenges,**
 - Introduce and Implement interactive platforms to make linking between students and academics as much as possible
 - Integrate interactive presentations to keep liveliness of online lessons
 - Use highly effective and specific online tools for practical and problem-solving modules
- **To eliminate the IT infrastructure anomalies**
 - Improve LAN infrastructure facilities, put proper backup policies in place and regularize and monitor the maintenance
 - Offer promotional data packages for both students and academics
- **To ensure effective user training**
 - Conduct well-structured and organized training for academics and students with the help of expertise resource persons.
 - Include a “frequently asked questions” supportive page on to LMS as “Let’s learn”
- **In General**
 - Promote arrangements to confirm social-interaction among students and academics
 - Identify, evaluate and acquisition of best online tools for the university
 - Take care of mental wellbeing of students and academics while conducting online delivery
 - Online resources are nowadays have become “pay-as-you-go” and not like earlier days that you just buy things outright.

APPENDIX A

Student questionnaire

This survey conducts to identify challenges face in adopting online tools by universities.

Target people: To be completed by students in universities in Sri Lanka.

Purpose: The data collected through this survey will be used as a part of descriptive research in to challenges in adopting online tools for universities. The research is conducted for the completion of a master's research of MSc in IT, Faculty of Information Technology, University of Moratuwa)

Confidentiality: Please note that the responses you provide are completely anonymous and confidential. Research conclusion and report will not comprise of any reference to any individuals.

Section A: Experience of the user

1. What is the school you are attached to? (check boxes for Business, Computing, Law schools)
2. Current level at the university? (check boxes with options as Level 4, Level 5, Level 6)
3. Do you use any e-learning tools for learning your subjects/modules? (yes/ no)
4. If Yes, what are those e-learning tools you are using for learning?
5. How difficult is it for you to adopt to a new tool? (check box options with Very easy, easy, neutral, difficult, very difficult)
6. How long will it take you to learn a new tool? (check box options with less than an hour, 2-3 hours, > 5 hours, 1 day, > 1 day)
7. Were you forced to use e-learning tools for learning during the Covid 19 lock down? (yes / no)
8. Have you faced any difficulties while using any of these above e-learning tools? (yes / no)
9. If Yes, what are they?

Section B: Prior Training

Please check (x) and rate your answers. (**Likert scale**- Very easy, easy, neutral, difficult, very difficult)

10. I could assume to online tools without training
11. I have gone through training for the e-learning tools I'm using during the orientation.
12. Always need training before using a new e-learning tool.
13. Having previous knowledge with e-learning tools helped me to adapt to new e-learning tools.?
14. It would be better if more training is provided to efficiently use e-learning tools

Section C: Quality of Infrastructure

15. Have adequate IT resources provided by the university for my e-learning.
16. The network availability and network speed at the university is satisfactory for uninterrupted learning.?
17. Have faced issues in learning with online tools due to poor network speed/ availability at the University.
18. If the answer for the above is Strongly Agree/Agree type the type of issues?
19. I have faced issues contributing for assessments with e-learning tools due to poor network speed/ availability at the university. (Online exams)
20. If the answer for the above is Strongly Agree/Agree the type of issues?
21. What are the technical glitches faced while connecting to lectures from home during the Covid-19 lock down?
22. What do you advise to overcome the above matters stated in question 21?

Section D: Ability of adopting to e-learning tools based on program structures (IT, Business, Law)

- 23. It is/was difficult to absorb modules using online tools?
- 24. If the answer for the question 23 then specify the modules and the nature of difficulty
- 25. It is/was difficult to interact with the lecturer(s) using e-learning tools
- 26. It is/was difficult to interact with my peers in group assignments using e-learning tools
- 27. It is/was difficult to participate in exams in my modules?
- 28. It is/was difficult to get feedback from the lecturers for my modules?

Section E: Effect of acceptance

- 29. I think it is very effective to use e-learning tools for learning.
- 30. If the answers for the above is yes, state reasons?
- 31. I do not like to adopt e-learning tools for my learning.
- 32. If the answers for the above is yes, state reasons?
- 33. I would prefer to use e-learning tools for learning?
- 34. I would prefer to use e-learning tools for Group work
- 35. I would prefer to use e-learning tools for participating in assessment and tests
- 36. I would prefer to use e-learning tools for Receiving feedback
- 37. If you have answered 35-38, state intended improvements/positive experience in the relevant areas you have achieved due to e-learning tools?

Section F: IT Literacy

- 38. I frequently use e-learning tools and online software for my learning
- 39. I feel easy to use e-learning tools and online software for learning
- 40. I need assistance from the IT department, when using e-learning tools and software
- 41. If the answer for the above is Strongly Agree/Agree select the type of assistance

Section G: Adopting to e-learning learning tools

- 42. I feel that e-learning tools are suitable to be used in the field of education
- 43. I use e-learning tools to learn my modules
- 44. I am familiar with the e-learning tools that I use
- 45. I prefer e-learning tools compared to the conventional methods of learning
- 46. I feel that e-learning tools are the future of education

Academic questionnaire

Conduct this survey on finding challenges in adopting e-learning tools for teaching in universities in Sri Lanka.

Target: To be completed by academics belonging to universities.

Purpose: The data gathered by this survey will be used as a part of descriptive research in to challenges in adopting online tools for teaching in universities. The research is conducted for the completion of a master's program (for MSc in IT, Faculty of Information Technologies, University of Moratuwa)

Confidentiality: Please note that the answers you provide are completely anonymous and confidential. Research outcome and the report will not include reference to any individuals.

1. What is the school you lecture? (check boxes with 3 schools)
2. How many years of teaching experience (check boxes with options, < 2 years, 2-5 years, > 5 years)
3. Do you use any e-learning tools for lecturing? (yes/ no type)
4. If Yes, what are the e-learning tools you are using? (options)
5. For how long you have been using e-learning tools for lecture delivery? (check boxes with options, < 2 years, 2 -5 years, > 5 years)
6. How difficult is/was it for you to adopt to a new e-learning tool? (check box options with very easy, easy, neutral, difficult, very difficult)
7. How long will you take to learn a new e-learning teaching tool? (check box options with less than an hour, 2 -3 hours, more than 5 hours, 1 day, more than 1 day)
8. Were you forced to use e-learning tools for ~~lecturing~~ during the pandemic? (yes / no type)
9. Have you faced any difficulty/difficulties of using any of these above e-learning tools? (yes / no type)
10. If Yes, what are they?

APPENDIX B: Interview schedule for students and academics

Microsoft Teams application was used as the platform to conduct the interviews to contact respondents remotely as reason of Covid-19 restrictions. The interviews persisted for 30-60 minutes.

1. Before start of the interview

a) Created a good understanding: First I presented myself to the respondents and reasoned out as to why they were selected for the interview. The basis for the research also mentioned to the respondents beforehand start of the interview.

b) Purpose: Research objective and the expected outcomes of the research were also described to the respondents. The interview structure was briefed. Finally, the aim of the interview was explained to get to know the challenges faced by them.

c) Motivation: The respondents were learnt that the findings of the research will be beneficial in adopting effective usage of e-learning tools for their university. Therefore, the respondents became highly motivated having known that everyone will be benefited as a result of this.

2. During the interview

a) The meeting starts with introductory material of the respondents (school of study, level/year of study and teaching experience of academics)

b) Next session was to getting to know the respondent's experience in adopting to e-learning tools.

c) Lastly, questions were directed to know the challenges they face while adopting e-learning tools.

3. End of the interview

a) The respondents were given time to share on any thoughts/suggestions to overcome the challenges faced.

b. At the end, appreciated the time taken for the interview despite individual commitments.

References

- [1] Anstey.L, & Gavan W. (2018). A rubric for evaluating e-learning tools in higher education. Retrieved from Educase: <https://er.educause.edu/articles/2018/9/a-rubric-for-evaluating-e-learning-tools-in-higher-education>
- [2] Atmojo.A.E.P, & Nugroho.A. (2020). EFL Classes Must Go Online! Teaching Activities and Challenges during COVID-19 Pandemic in Indonesia. Register Journal, 13(1), 49-76. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/63464185/EFL_Classes_Must_Go_Online_Teaching_Activities_and_Challenges_during_Covid-19_Pandemic_in_Indonesia20200529-47095-ktas8p.pdf?1590761238=&response-content-disposition=inline%3B+filename%3DEFL_Classes_Must_Go_O
- [3] Dialog Axiata PLC. (2021). Dialog work & learn plus pack. Retrieved from Dialog: <https://www.dialog.lk/work-and-learn-plus-pack>
- [4] Davis.F.D, & Venkatesh.V. (2000). A theoritical extension of the technology acceptance model. Management Science, 46(2), 1-17.
doi:10.1287/mnsc.46.2.186.11926
- [5] Dhawan.S. (2020). Online learning: A Panacea in the time of Covid -19 crisis. Journal of educational technology systems, 49(1), 5-22. Retrieved from <https://journals.sagepub.com/doi/pdf/10.1177/0047239520934018>
- [6] Dutta.A. (2020). Impact of Digital Social Media on Indian Higher Education: Alternative Approaches of Online Learning during COVID-19 Pandemic Crisis. International Journal of Scientific and Research Publications, 10(5), 1-8. Retrieved from https://www.researchgate.net/profile/Ankuran-Dutta-2/publication/341606651_Impact_of_Digital_Social_Media_on_Indian_Higher_Education_Alternative_Approaches_of_Online_Learning_during_COVID-19_Pandemic_Crisis/links/5eca0b69458515626cc6c888/Impact-of-Digital
- [7] Fedock.B, McCartney.M, & Neeley.D. (2019). Online adjunct higher education teacher's perceptions of using social media sites as instructional approaches. Journal of research in innovative teaching & learning, 12, 222-235. Retrieved from <https://www.emerald.com/insight/content/doi/10.1108/JRIT-02-2018-0005/full/pdf?title=online-adjunct-higher-education-teachers-perceptions-of-using-social-media-sites-as-instructional-approaches>

- [8] Fernando.I, & Kanaganayagam.S. (2013). Analysis of the awareness of collaborative e-learning (CeL) in Sri Lankan university education. *International conference on Advances in ICT for Emerging Regions(ICTer)* (pp. 253-260). Colombo: IEEE. Retrieved from <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6761187>
- [9] Fincham.J.E. (2008). Response rates and responsiveness of surveys, standards and the journal. *American journal of pharmaceutical education*, 72(2). Retrieved from <https://www.ajpe.org/content/72/2/43>
- [10] Flick.U, Kardorff.E, & Steinke.I. (2004). *A companion to qualitative research* . London: Sage.
- [11] Fransson.G. (2016). Online(Web based) education for mentors of newly qualified teachers: Challenges and opportunities. *International journal of mentoring and coaching in education*, 5(2), 111-126. Retrieved from <https://doi.org/10.1108/IJMCE-12-2015-0039>
- [12] Hampel.R. (2009). Training teachers for the multimedia age:Developing teacher expertise to enhance online learner interaction and collaboration. *Innovation in language learning and teaching*, 35-50. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/17501220802655425>
- [13] Harvard University. (2020). Copyright considerations for the Harvard Community in SHifting courses from in-person to online during the COVID-19 crisis. Retrieved from Harvard University: <https://guides.library.harvard.edu/CopyrightCOVID>
- [14] Hayashi.R, Garcia.M, Maddawin.A, & Hewagamage.K. (2020). Online learning in Sri Lanka's Higher education institutions during the Covid-19 pandemic. Colombo, Sri Lanka. Retrieved from <http://dx.doi.org/10.22617/BRF200260-2>
- [15] Hrastinski.S. (2008). Asynchronous and synchronous E-learning. Retrieved from EducaseReview: <https://er.educause.edu/-/media/files/article-downloads/eqm0848.pdf>
- [16] <https://moodle.org/>
- [17] <https://stats.moodle.org/>
- [18] https://docs.moodle.org/38/en/Course_enrolment
- [19]https://www.int-comp.com/images/moodle/ICT_Guide_Basic_Minimum_System_Requirements_for_Moodle.pdf

- [20] https://centos.pkgs.org/7/remi-x86_64/php55-php-oci8-5.5.38-11.el7.remi.x86_64.rpm.html
- [21] https://docs.moodle.org/38/en/Installing_Moodle
- [22] <https://www.hostinger.com/tutorials/what-is-cpanel>
- [23] https://docs.moodle.org/dev/Moodle_3.8_release_notes#Database_requirements
<https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/about/nvivo>
- [24] Hauke, J., & Kossowski, T. (2011). Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. *Quationes Geographicae*. doi:10.2478/v10117-011-0021-1
- [25] Huei, Y. C. (2014). Student engagement and learning using an Integrated student lecturer engagement design framework. *International conference on teaching, assessment and learning for engineering* (pp. 79-85). Wellington: IEEE. doi:10.1109/TALE.2014.7062590
- [26] Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, 30, 607-610. Retrieved from https://home.kku.ac.th/sompong/guest_speaker/KrejcieandMorgan_article.pdf
- [27] Kebritchi, M., Lipschuetz, A., & Santigau, L. (2017). Issues and challenges in for teaching successful online courses in Higher education: A literature review. *Journal of educational technology systems*. doi:10.1177/0047239516661713
- [28] Kodagoda, N. (2020). Using repl.it for conducting self-guided programming labs. Colombo, Sri Lanka. Retrieved from <https://medium.com/@nuwank/using-repl-it-for-conducting-self-guided-programming-labs-7f50d5a09e4d>
- [29] Kothari, C. R. (2002). *Research methodology: methods & Techniques* (2 ed.). New Delhi: Ner Age International.
- [30] Kumar, P., & Bowers, J. (2015). Student's perception of teaching and social presence: A comparative analysis of face-to-face and online learning environments. *International journal of web-based learning and teaching technologies*, 10(1), 27-44. Retrieved from <https://www.semanticscholar.org/paper/Students'-Perceptions-of-Teaching-and-Social-A-of-Bowers-Kumar/c45e29bf50b537b04dc28abacc6dae53b7ecb499>
- [31] Leonard, A., Hamutumwa, N., & Mchombu, C. (2020). Use of electronic resources by law academics: a case study from the university of Nabibia. *Collection and curation*, 39(3), 57-68. Retrieved from <https://doi.org/10.1108/CC-06-2019-0017>

- [32] Martin.L, & Tapp.D. (2019). *Teaching with teams: An introduction to teaching an undergraduate law module using Microsoft Teams. Innovative practice in higher education*, 3(3), 1-10. Retrieved from https://www.researchgate.net/publication/332964592_Teaching_with_Teams_An_introduction_to_teaching_an_undergraduate_law_module_using_Microsoft_Teams
- [33] Nachimuthu. (2018). *Innovative teaching learning through web tools. International journal of research in humanities, arts and literature*, 275-280. Retrieved from https://www.researchgate.net/publication/327907151_INNOVATIVE_TEACHING_LEARNING_THROUGH_WEB_TOOLS
- [34] Nulty.D.D. (2008). *The adequacy of response rates to online and paper surveys: what can be done. Assessment and evaluation in Higher education*, 33(3). Retrieved from <https://doi.org/10.1080/02602930701293231>
- [35] Premawardhena.N.C. (2011). *Enhancing student performance through web-based learning and online teaching tools at Sri Lankan universities. 4th International conference on Interactive collaborative learning (pp. 1-3). Piastany: IEEE*. Retrieved from <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6059585>
- [36] Punch.K. (2005). *Introduction to social research: Quantitative and qualitative approaches (2 ed.)*. London: Sage.
- [37] Randolph.J, & Eronen.P.J. (2007). *Developing the learning door: A case study in youth participatory program planning. Evaluation and program planning*, 30, 1-11. Retrieved from <https://reader.elsevier.com/reader/sd/pii/S014971890600111X?token=CB04120D7B1D9A1C484E3131E7073B263E78A0A7F54DAB1753E4909AA820B49AFA3566044D223E9923093ADBC3870AAF>
- [38] Rashid.Y, Rashid.A.Warraich.M.A, Sabir.S.S, & Waseem.A. (2019). *Case study method: A step by step guide for business researches. International journal of qualitative methods*, 18, 1-13. Retrieved from <https://journals.sagepub.com/doi/pdf/10.1177/1609406919862424>
- [39] Repl.it.Inc. (2020). *Code and collaborate*. Retrieved from Repl.it: www.repl.it
- [40] Rovai.A.P, Wighting.M.J, & Liu.J. (2005). *School climate- sense of classroom and school communities in online and on-campus Higher education courses. Quarterly review of distance education*, 6(4), 361-374. Retrieved from

<http://debdavis.pbworks.com/w/file/fetch/91465800/EDUC815-School%20Climate.pdf>

[41] Royston.J.P. (1982). An extension of Shapiro and Wilk;s W test for normality to large samples. *Applied statistics*, 31(2), 115-124. Retrieved from

https://www.jstor.org/stable/2347973?seq=1#metadata_info_tab_contents

[42] Sahu.P. (2020). Closure of universities due to Coronavirus desease 2019(Covid19): Impact on education and mental health of students and academic staff. *Cureus journal of medical science*, 12(4). Retrieved from

<https://www.cureus.com/articles/30110-closure-of-universities-due-to-coronavirus-disease-2019-covid-19-impact-on-education-and-mental-health-of-students-and-academic-staff>

[43] Sancristobal.E, Pesquera.A, Martin.S, Gil.R, Tawfik.M, & Carpio.J. (2012). Challenges of applying online learning tools in distance learning courses. *Global Engineering education conference (EDUCON)* (pp. 1-7). Marrakech: IEEE. Retrieved from <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6201133>

[44] Sandanayake.A.T, Madurapperuma.A.P, & Dias.D. (2011). Enhancing the learning environment by indentifying the learner behaviour in an e-learning system. *International journal of information and education technology*, 1-8. Retrieved from http://www.ineer.org/Events/ICEEiCEER2009/full_papers/full_paper_120.pdf

[45] Seidler.J. (1974). On using informants: a technique for collecting quantitative data and controlling measurement error in organization analysis. *American Sociological Review*, 39, 816-831. Retrieved from <https://www.jstor.org/stable/pdf/2094155.pdf?refreqid=excelsior%3A37c171a08b879706473f24cfdc0a42e0>

[46] Selvaras.J. (2020). Technology usage for teaching and learning law in open and distance learning: a Sri Lankan perspective. *Asian Association of Open universities journal*, 69-81. Retrieved from <https://doi.org/10.1108/AAOUJ-11-2019-0051>

[47] Shahabadia.M, & Uplane.M. (2015). Synchronous and asynchronous e-learning styles and academics. *Procedia social and behavioral sciences*, 131-132. doi:10.1016/j.sbspro.2015.01.453

[48] Sherblom.J, Withers.L, & Leonard.L. (2013). The influence of computer mediated communication(CMS) competence on Computer supported collaborative learning (CSCL) in online classroom discussions. *Human communication*, 31-39. Retrieved from

https://s3.amazonaws.com/academia.edu.documents/31112437/01_03_13_Sherblom.pdf?response-content-disposition=inline%3B%20filename%3DThe_influence_of_computer-mediated_commu.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=ASIATUSBJ6BAO7NC6VPF%2F202004

[49] Smith.L, & Northcote.M. (2017). *Community in online higher education: challenges and oppertunities. Electronic journal of e-learning*, 188-198. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1141773.pdf>

[50] SLTMobitel.Pvt.Ltd. (2021). *Learn and work online*. Retrieved from SLT: <https://www.slt.lk/en/broadband/data-addons/meet>

[51] <https://www.turnitin.com/>

[52] Wenger.E, McDermott.R.A, & Snyder.W. (2002). *Cultivating communities of practice: A guide to managing knowldge*. Boston: Harvard Business school press. Retrieved from https://books.google.lk/books?hl=en&lr=&id=m1xZuNq9RygC&oi=fnd&pg=PR9&ots=ZV9cdLcicX&sig=92jtMC8SQfp-HlwEpWbh2kLd8B8&redir_esc=y#v=snippet&q=domain%20of%20knowledge%20&f=false

[53] Yang.L.H, & Houghton.J. (2020). *Silver-lining of Covid 19: A virtual community of practice for faculty development*. *All Ireland journal of teaching and learning in higher education*. Retrieved from https://www.researchgate.net/publication/345135335_Silver-lining_of_COVID-19_A_Virtual_Community_of_Practice_for_Faculty_Development

[54] Yin.K.R. (2014). *Case study research:Design and methods*. Los Angeles: LA:SAGE publications. Retrieved from https://iwansuharyanto.files.wordpress.com/2013/04/robert_k-_yin_case_study_research_design_and_mebookfi-org.pdf

[55] Zuhairi.A, Karthikeyan.N, & Priyadarshana.T. (2019). *Supporting students to succeed in open and distance learning in the Open university of Sri Lanka and universitas Terbuka Indonesia*. *Asian Association of Open Universities journal*. doi:10.1108/AAOUJ-09-2019-0038