



# **Web Based Course for G.C.E Advanced Level Electronics under Physics**

**A dissertation submitted for the Degree of Master of  
Information Technology**

**V. LIYANAGAMA**

**University of Colombo School of Computing**

**2019**



**Web Based Course for G.C.E  
Advanced Level Electronics under  
Physics**

**V. LIYANAGAMA  
2019**

## Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

Student Name : Venura Liyanagama

Registration Number : 2013/MIT/099

Index Number : 13550996

---

Signature:

Date: 2019/09/24

This is to certify that this thesis is based on the work of Mr. Venura Liyanagama Under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name:

---

Signature:

Date:

## **Abstract**

The Web-based Learning Management System or widely known as (LMS) lets Centralized Learning, Tracking and Reporting for Enhanced Performance, Instructors/Lecturer and students to share subject related course materials, make class notifications, submit course assignments and online forums. Current This type of LMS related website has focused on how these systems deliver and manage instructional content with little concern for how students' constructivist learning can be encouraged and facilitated. This research investigated how students apply LMS to interact, collaborate, and construct knowledge within the context. The background for this project was students' use in G.C.E advanced level electronics course under the physics of the LMS within the context. Ten students and seven graduates willingly elected to use the LMS, representing exemplary users of the course. Users' peer to peer messages within the LMS, online surveys, focus group interviews and instructor interviews were used to answer the study's overarching research question. The results indicate that students successfully used the LMS to interact and, to a considerable level, collaborate, but there was very little indication of knowledge construction using LMS technology. It is possible that the ease and accessibility of face to face meetings as well as tribulations and limits with the tools were factors that influenced whether students' online basic interaction could be further distinguished as collaboration or knowledge construction. Even though these limitations, students found several tools and functions of the LMS useful for their online peer interaction and completion of this course.

## **Acknowledgement**

I would like to express my special appreciation and thanks to my supervisor Ms. K.M.G.B. Nishakumari for her continuing guidance, advice, and encouragement in my way to prepare this project. Her patience and tolerance towards me helped to finish this project. Also, I would like to remind late Senior Prof. Gihan Wikramanayake. You were an incredible educator, an honorable mentor that only comes along once in a lifetime. And I would also like to thank Dr. Thushani Weerasinghe and all lecturers at the University Of Colombo School Of Computing for their support. So many regards and thanks to my family for their belief, continuing understanding, and sacrifice in support of my project related works. I am very grateful for Mr. A.M.K Amarasinghe ,the principle of Hakmana Hendri Ariyaratna College , Mr. Nalin Wickramasinghe , the coordinator and teacher of Hakmana Hendri Ariyaratna National College and Mr. Sanath Pushpakumara (Government Teacher of lunuwatta National college - Walimada) , Mr. Roshan Fernando (Teaching Assistant - University of Kelaniya) , and all the Students of Hakmana Hendri Ariyaratna College for their ongoing expert advice, guidance and help for gathering information. Last not least, appreciation to all my friends and classmates for their kindness and support and I would like to thank all those who helped me in various ways to make this project a success.

Venura Liyanagama.

## **List of Abbreviations**

- G.C. E - The General Certificate of Education
- A/L - Advanced Level
- O/L - Ordinary Level
- LMS - Learning management system
- MCQ - Multiple-choice question
- MIT - Master in Information Technology
- AI - Artificial intelligence
- IT - Information Technology
- ADDIE - Analysis, Design, Development, Implementation, and Evaluation E-Learning
- ICT - Information and Communication Technology

## **List of Tables**

Table 1: List of topics and allocated number of periods

Table 2: The benefits and drawbacks of online learning

Table 3: Articles and relevant comments

Table 4: Hardware and software requirements of the system

Table 5: Results of the evaluation process, is presented in the following chart.

## List of Figures

Figure 1: Blooms Revised Taxonomy

Figure 2: Learning Management System

Figure 3: Power/Interest Grid for Stakeholder Prioritization

Figure 4: SWOT analysis

Figure 5: Computer Literacy

Figure 6: Capability of internet usage

Figure 7: Experience in online learning

Figure 8: Communicate with others

Figure 9: Requirements of e – Learning

Figure 10: Interest of online learning

Figure 11: The task to access the course

Figure 12: ADDIE model

Figure 13: Level 1 Course Map

Figure 14: Level 2 Course Map for Sub Topic “Junction Diodes”

Figure 15: Story Board (P-type semiconductor)

Figure 16: “Login” Interface

Figure 17: “Create New account” Interface

Figure 18: “Lesson 01 – Basic Electronics” Interface

Figure 19: “Video Tutorial –The P-N Junction” Interface

Figure 20: Graph - Result of the evaluation



## **APPENDICES**

Appendix A: Questionnaire to the target audience to gather information

Appendix B: The Syllabus of the Electronic course unit

Appendix C: Story Boards

Appendix D: Questionnaire for the Course Evaluation

## Table of Contents

Chapter 1 – Introduction .....	13
1.1 Mathematics Stream.....	14
Chapter – 2 Background .....	16
2.1 Motivation for the project.....	17
2.2 Objectives .....	17
2.3 List of deliverables .....	18
2.4 Scope of the project.....	18
2.4.1 Summary of the implementation available .....	19
2.5 Assumptions and theoretical foundation.....	20
2.5.1 What is e-Learning?.....	20
2.5.2 The history of e-Learning.....	20
2.5.3 Can we learn online by utilizing e-Learning tools?.....	21
2.5.4 Future of e-Learning .....	21
2.5.5 SCORM & Tin Can Api .....	22
2.5.6 LMS.....	22
2.5.7 Content authoring tools.....	22
2.5.8 Synchronous e-Learning vs. asynchronous e-Learning tools and technologies.....	23
2.5.9 e - learning tools and technologies used in online training /online courses .....	24
2.5.10 Best productivity tools for e - Learning .....	24
2.6 Bloom’s Taxonomy.....	25
2.6.1 Bloom's Revised Taxonomy .....	25
2.7 Learning Management System (LMS) .....	26
2.7.2 eduLanka.LK .....	27
2.7.3 Guru.lk .....	28
2.8 Assumptions of the project .....	29
Chapter – 3 Analysis and Design/Methodology.....	30
3.1 Domain analysis .....	30
3.2 Stakeholder Analysis .....	30
3.3 Identifying the stakeholders.....	31
3.4 e-learning readiness Analysis.....	33
3.5 Human resources .....	34
3.7 Content.....	34
3.8 Finance .....	34
3.9 SWOT analysis.....	35
3.10 Technical and Software Requirements of the System .....	36

3.11	Need Analysis.....	37
3.12	Objectives .....	37
3.13	Target Audience .....	38
3.14	Sampling Procedure .....	38
3.15	Data Collection Methods.....	38
3.15.1	Interviews .....	38
3.15.2	Questioner .....	39
3.16	Methods of data analysis .....	39
3.17	Data Analysis and decisions made .....	41
3.18	Learner-related characteristics.....	41
3.19	Current learning habits.....	41
3.20	Future learning habits .....	41
3.21	Situation-related characteristics .....	41
3.22	Learner Task Analysis .....	42
3.23	Content Analysis .....	43
3.24	Design Solution .....	44
3.24.1	Methodology.....	44
3.24.2	Analysis Phase .....	45
3.25	Design Phase.....	45
3.26	These are steps used for the design phase: .....	45
3.27	Development Phase .....	46
3.28	Implementation Phase .....	46
3.29	Evaluation Phase.....	46
3.30	Level 1 Course Map.....	47
3.31	Level 2 Course Map.....	48
3.32	Sample Storyboard.....	50
3.33	Developing Tools: Development and Implementation .....	51
3.34	Implementation of Moodle as Learning Management System .....	52
3.35	The Pros of Using Moodle to Built LMS.....	52
3.36	The Con of Using Moodle to Built LMS: .....	53
3.37	User Interfaces.....	54
Chapter – 4	Evaluation .....	56
4.1	Question Design.....	56
4.2	Methodological Approach .....	56
4.3	Sampling .....	57
4.4	Type of evaluation.....	57

4.5 Results of the evaluation process .....	57
Chapter – 5 Conclusion.....	59
<b>References</b> .....	60
Appendix A.....	61
Appendix B.....	63
Appendix C.....	65
Appendix D.....	70

## Chapter 1 – Introduction

General Certificate of Education qualification in Sri Lanka is known as the Sri Lankan Advanced Level. The Examination conducted by the Department of Examinations of the Ministry of Education. It is usually taken by students at the end of the collegiate level (Grade 13) or external (non-school) candidate after they have completed the GCE Ordinary Level exams. The larger numbers of candidates enter the exams via their schools, while candidates who have finished school education can also apply as a private candidate. The qualification is also used as an entrance exam for Sri Lankan government universities and other government higher education institutes. The GCE Advanced Level exams are held in three mediums Sinhala, Tamil, and English.

The examination takes place over 5 major fields of study,

- Physical Science Stream
- Biological Science Stream
- Commerce Stream
- Arts Stream
- Technical Stream

Usually, the exams are conducted each year in August, in selected national schools across the country. The students are authorized to sit for the exam 3 times only that provides Qualification to Government University and other Government higher education institutes. Any candidate can sit many times but the final result could not a qualification to Government University / other Government higher education institutes Entrance.

In recent years the exam has become extremely competitive and even challenging for most high school students in Sri Lanka since only the top 11% of students who pass this exam are selected to the government universities and other government higher education institutes.

## 1.1 Mathematics Stream

- Mathematics Stream has four main subjects. There are Combined Mathematics, Physics and Chemistry and ICT (Information and Communication Technology), Though Combined Mathematics and Physics are mandatory.
- Under the latest syllabus, students can choose between either Chemistry or ICT as subjects for study.
- Combined Mathematics is a combination of Pure Mathematics and Applied Mathematics.
- There are some practical sessions included only for Chemistry and Physics. The students should participate in these practices at the schools. But there aren't practical subjects on the examination.
- G.C.E. (Advanced Level) Physics syllabus is designed as a two-year course to provide the basic background in physics that would be required by those intending to proceed to higher studies as well as by those who would utilize the knowledge of physics in various fields and daily life.

Table 1: List of topics and allocated number of periods

Unit No	Topic	Number of periods
<b>Unit 01</b>	<b>Measurement</b>	<b>22</b>
Unit 02	Mechanics	102
Unit 03	Oscillations and waves	86
Unit 04	Thermal Physics	46
Unit 05	Gravitational Field	12
Unit 06	Electrostatic Field	30
Unit 07	Current Electricity	42
Unit 08	Electromagnetism	34
<b>Unit 09</b>	<b>Electronics</b>	<b>30</b>
Unit 10	Mechanical Properties of Matter	32
Unit 11	Matter and Radiation	22
	<b>Total</b>	<b>458</b>

(Source: Department of Education – Sri Lanka) [1]

At the moment in Sri Lanka, the advanced level examination is the most important event of the student's life. The majority of their future depends on the results of the examination. When we consider who are following Science or Mathematics streams as their higher studies, one of the most important subjects is physics. When we consider advance level physics as a subject it contains many theoretical as well as practical sessions. Unfortunately, most of the students are facing difficulties in learning some topics under the physics Stream. Electronics is one of them. There are several reasons for that.

Usually Electronic course unit teaches at the end of the syllabus. Students do not have sufficient time to refer to course materials and practice electronic questions. So many students are afraid to choose essay type questions under electronic in the examination.

Also, there are few online learning materials related to GCE electronics. Many of them are a brief introduction to electronics. Students cannot get sufficient knowledge from such online learning materials.

The objective of this project is to overcome these kinds of difficulties and construct online learning material with complete course materials, quizzes, examples, animations/videos/audios with an easy and pleasurable way to learn all they want about advanced level electronics while accommodating as many learning styles as possible. On the other hand electronic is one of the subject suites for e-Learning. Because the syllables can be reconstructed and map into the digital environment signally.

The LMS was created using moodle and hosted on the web. Worldwide people can freely access the LMS reaching the web address <http://eleclal.net/>.

The LMS contains five courses related to the G.C.E Advanced level electronics syllabus. Each course contains Notes, video tutorials, several types of questions relevant to the course and educational chat as well.

## Chapter – 2      Background

In this era, there is a huge competition among the students who are following for the G.C.E. A / L examination. This situation has arisen because of the large number of students, only a limited number of students choose for higher education. This competition is more stringent among students studying science and mathematics. Therefore, it is necessary to pay more attention to each subject.

The subject of physics is a very important subject among A / L science and mathematics stream. Electronic lessons is an important lesson when considered lessons in this subject. This is because there are compelling short questions (MCQ) and essay questions regarding this lesson in the A / L physics Question paper. Authors' experience, as well as authors colleagues' experience, was that less attention was paid to electronic lessons. There are some reasons for that. The majority of students do not want to learn this lesson properly because of the lesson teaches at the final stage of the syllabus and looking like a difficult subject at a glance. There is no change in the attitude of students during our A / L examination as well as today in this regard. Therefore, there is a need for a solution. The purpose of this is to provide a solution through e-Learning.

Currently, there are LMSs for both A / L and other subjects. Web-based learning materials cannot be found, especially for electronics in the e-learning concept. Most web sites and LMSs which already exist only use Video lessons or Course materials or both as an outfit. There is still no discussion of the issues regarding the subject matters, model questions, and past paper question reviews, etc. Therefore, to solve this problem, it was decided to develop web-based LMS for electronic in physics.



## 2.1 Motivation for the project

The main motivation for the completion of the project is to complete the requirement of the “individual project in e-Learning” to qualify, Master of Information Technology (MIT).

Taking part in this project would result in improving the author’s knowledge, creation of learning management system skills, as well as project writing skills.

Besides, while the authors’ survey of learning matters in the education system for an individual project in e-learning, many A/L students and teachers requested an easy way to learn /teach electronic subject under physics in A/L. The author identified this is as a problem in this traditional education system. As a result of interviews and discussions conducted with them, the author has identified their requirements and decided to give them e -learning-based solution.

## 2.2 Objectives

- To impart GCE A/L students the knowledge of electronics under physics, to absorb the subject.
- To guide the students to use prevailing resources as well as new learning materials.
- To increase learners' self-learning time on their own relative to Electronics.
- Direct students to solve model questions relevant to the lesson and provide facilities under e-learning.
- To increase course content that can be reused.
- To use multimedia technologies to improve the clarity and simplicity related to electronics.
- To increase the use of the e-learning method other than the traditional learning methods/materials.

### 2.3 List of deliverables

The subsequent deliverables were expected upon completion of the system.

- To create web-based learning materials where students and instructors can meet virtually.
- To Create an LMS an effective and responsive way for teachers/Instructors to create, deliver, and manage their content, as well as monitor participation and assess performance among learners.
- To provide means for Students/Users to login to the system and find the required course unit.
- To provide Learning materials in an attractive manner using GUIs, Audio, Animation files, and other graphics.

### 2.4 Scope of the project

There are 4 major topics and 70 sub-topics under the syllabus of the electronics. The web-based course contains all the course materials in HTML, PHP, PDF, Video/Audio formats. There are four major courses on the web-based course. Every Course contains Topics and subtopics. Every topic and subtopics describe by PDF notes video clips/tutorials. Some of the theories, equilibriums, mechanisms, and questions presented by the animations.

At the end of each topic and subtopics, there are sample questions. Most of the questioners contain multiple Choice Questions, Drag, and drop type questions. Animations are used for some of the questionnaires.

At the end of the questionnaire, marks, results, and grades will be given. Besides, there are miscellaneous course units available. Under this course, there are some interactive videos related to general electronics. Assigning assessments and assignment facility are available for administrators. Also, the education chat is available to improve communication and collaboration between students, users, and administrators for educational purposes.

#### 2.4.1 Summary of the implementation available

- LMS
- User login
- Online course materials (Videos, Audios, Animations, PDF Format...Etc)
- Discussion forums and Educational Chat
- Assessments (questioner, assignments)
- Feedbacks and rewards

## 2.5 Assumptions and theoretical foundation

e-Learning theory describes the cognitive science principles of effective multimedia learning using electronic educational technology.

### 2.5.1 What is e-Learning?

A learning system based on formalized teaching but with the help of electronic resources is known as e-Learning.

While teaching can be based in or out of the classrooms, the use of computers and the Internet forms the major component of e-Learning.

### 2.5.2 The history of e-Learning

The term “e-Learning” has only been in existence since 1999. When the word was first utilized at a CBT (Creative Broadcast Techniques) systems seminar. Other words also began to spring up in search of an accurate description such as “online learning” and “virtual learning”. However, the principles behind e-Learning have been well documented throughout history, and there is even evidence which suggests that early forms of e-Learning existed as far back as the 19th century. [2]

Table 2: The benefits and drawbacks of online learning

<b>Benefits</b>	<b>Drawbacks</b>
No Boundaries, No Restrictions	Health Related Concerns
More Interactive	Isolation
Cost Effective	Practical skills are somewhat harder to pick up from online resources
Ease, flexibility and the ability to remotely access	Require good time-management skills.
It Just Fits	The Workload Is Bigger Than in Traditional Education

### 2.5.3 Can we learn online by utilizing e-Learning tools?

Not only has e-Learning made the work of Learning and Development professionals more scalable, but it has also made the content they produce better. By making lessons available on-demand, Learning and Development professionals have ensured that employees can review whatever content they need, and learn anytime, anywhere with ease. Mobile learning is the next step for this industry, whereas game-based learning apps can be a great use of technology for future generations. Best practices of online training

- A supportive community
- Clear expectations
- Asynchronous and synchronous activities
- Effective usage of available resources

### 2.5.4 Future of e-Learning

As computer ownership grows across the globe e-Learning becomes increasingly viable and accessible. Internet connection speeds are increasing, and with that, opportunities for more multimedia training methods arise. With the immense improvement of mobile networks in the past few years and the increase in telecommuting, taking all the awesome features of e-Learning on the road is a reality with smart phones and other portable devices. Technologies such as social media are also transforming education constantly.

Several e-Learning trends can give us a clear view of how the future of e-Learning and learning tools will be shaped.

E.g.:

- Gamification
- Virtual Reality & AI
- Micro learning platforms and mobile learning
- Video learning

### 2.5.5 SCORM & Tin Can Api

SCORM, or Shareable Content Object Reference Model, defines a specific way of constructing Learning Management Systems and training content so that they work well with other SCORM conformant systems.

SCORM is a really powerful tool for anyone involved in online training. Content can be created one time and used in many different systems and situations without modification. This plug-and-play functionality can be powerful within an organization but even more so across organizations. Content can be sold and delivered to the user more quickly, more efficiently, and at a lower price. [3]

### 2.5.6 LMS

A learning management system (LMS) is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs. Learning management system is a concept emerging directly from the e-Learning, even though there were other tools, informatics or not which have encouraged distance education Distance Education Learning Environments Survey. The first introduction of LMS is in the late of 1990s

What are the types of learning management systems?

- Open source
- SAAS/Cloud
- Proprietary
- Historical

### 2.5.7 Content authoring tools

An e-Learning content authoring tool is a software package which developers use to create and package e-learning content deliverable to end-users with following features

- Ease Of Use
- Capability
- Built-In Comment And Review Tools
- Mobile-Ready And Responsive
- Fast Publishing And Maintenance

- Setting Up Themes And Branding
- Related: Building custom themes in Elucidat
- Integration And Analytics
- Easy Localization

### 2.5.8 Synchronous e-Learning vs. asynchronous e-Learning tools and technologies

Synchronous e-Learning involves online studies through chat and videoconferencing. This kind of learning tool is real-time. It is like a virtual classroom which allows students to ask, and teachers to answer questions instantly, through instant messaging, which is why it is called synchronous. Rather than taking lessons alone, students associating themselves with synchronous e-Learning software or online courses can easily interact with fellow students and their teachers during the course.

On the other hand, Asynchronous learning can be carried out even while the student is offline. Asynchronous e-Learning involves coursework delivered via web, email and message boards that are then posted on online forums. In such cases, students ideally complete the course at their place, by using the internet merely as a support tool. The US Department of Defense has specified that all of its content must be delivered via SCORM. All of it! The industry is following suit, and the standard appears in a vast majority of RFPs to procure both training content and Learning Management Systems.

SCORM was developed over a decade ago now. Times have changed and the requirements of educators have changed, and so Tin Can was developed. Tin Can is an open source API that adds some needed extra functionality to SCORM and lifts many restrictions of older specifications.

The extra features provided by Tin Can include simplicity, extra security measures, the ability to run courses outside the LMS, better support for offline and mobile learning and (potentially) more detailed reporting.

Development of Tin Can is an ongoing project so we should expect more from it in the future.

[4]

### 2.5.9 e - learning tools and technologies used in online training /online courses

e - Learning makes use of many technologies - some of which have been developed specifically for it, whilst others conveniently complemented the learning process, for example computer games. Communication technologies are also widely used in e-Learning. Starting with the use of email and instant messaging, message forums and social networks, we see a plethora of tools that any internet user would use in any case.

There are also some technologies that work in a complementary manner to other software and enable new features, for example software that adds a whiteboard on your video conferencing tool to allow you or your peers to make changes on other people's work for review, or screen-sharing which allows someone to make a presentation while still making comments and giving input using the microphone.

e - Learning makes good use of database and CMS (Content Management System) technologies. These two work hand in hand to store your course content, test results and student records. The data is stored in the database and the CMS provides a user interface for you to add, update and delete data. A good LMS will often provide reporting tools to generate and store progress reports.

e-Learning tools and technologies used to improve the quality of content are manifold. Software such as Flash and PowerPoint will help you make your presentations slick and interesting, with high quality, graphically rich content. There are word processing packages and HTML editors available these days that make formatting your text or web pages a breeze, removing a lot of the complexity. There are also lots of online services available that you can use to create interactive elements for your courses such as quizzes and games.

---

### 2.5.10 Best productivity tools for e - Learning

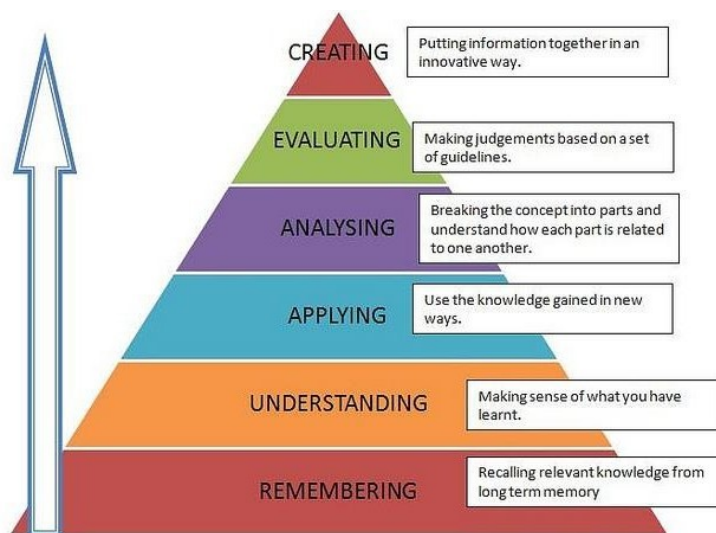
- Tool: Trello
- Tool: Google Drive
- Tool: IFTTT
- Tool: Momentum
- Tool: Google Calendar
- Tool: Camtasia
- Tool: Elucidat
- Tool: Articulate Storyline
- Tool: YouTube [5]



## 2.6 Bloom's Taxonomy

Bloom's Taxonomy (*Figure 1*) was created in 1956 under the leadership of educational psychologist Dr Benjamin Bloom in order to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts (rote learning). It is most often used when designing educational, training, and learning processes.

### 2.6.1 Bloom's Revised Taxonomy



**Figure 1: Blooms Revised Taxonomy**

Lorin Anderson, a former student of Bloom, and David Krathwohl revisited the cognitive domain in the mid-nineties and made some changes, with perhaps the three most prominent ones being. [6]

## 2.7 Learning Management System (LMS)



**Figure 2: Learning Management System**

A learning management system (LMS) (*Figure 2*) is a software application for the administration, documentation, tracking, reporting and delivery of electronic educational technology (also called e-learning) education courses or training programs.

Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. A learning management system may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums [7].

### 2.7.1 The available web based learning support Systems

Sri Lanka's web based learning support is not very common. [www.edulanka.lk](http://www.edulanka.lk) and [guru.lk](http://guru.lk) are the web based educational support systems available in Sri Lanka currently.

### 2.7.2 eduLanka.LK

When we consider the eduLanka.LK web site;

As they say “eduLanka.LK is a largest online education web site in Sri Lanka & most popular educational web site among Sri Lankan students. EduLanka, best nonprofit & educational website is provided large numbers of online lessons, education related course information, teachers information, E books, examination result alerts, government job alerts, tuition class information, career guide for school leavers and more resources related to education in Sri Lanka. Edulanka provides education related resources from primary education, O-Level & A-Level education, University & Postgraduate education and vocational training education.”

As per the mentioned in the web site, Digital Library, Video Gallery, Gallery, Education Courses, Education Institutions, Lessons Downloads, Past Question, Education Syllabus, etc can be seen.

This site has articles related to the following subjects under the GCE A / L syllabus.

Chemistry ( 10 Articles ), Physics ( 6 Articles ), Economics ( 11 Articles ), Combined Maths ( 30 Articles ), Biology ( 12 Articles ), Accounting ( 11 Articles ), Business Studies ( 3 Articles ), Sinhala ( 3 Articles ), Logic ( 3 Articles ), History ( 0 Articles ), Geography ( 0 Articles ), Buddhist Civilization ( 3 Articles ), Statistics ( 0 Articles ), Political Science ( 1 Article ), Music ( 0 Articles ), Science for Technology ( 1 Article ), Bio Systems ( 8 Articles ), Engineering Technology ( 0 Articles ).

There are no articles under certain topics here can be identified as a weakness. When consider the Advanced Level physics subject, there are only six articles. Articles and relevant comments are as follows;

Table 3: Articles and relevant comments

Nr	Article Title	Comments on Articles
1	Hydrostatics - Physics	There is a MCQ question paper related to Hydrostatics.
2	Physics Practicals - Tamil Medium	Web link doesn't working.
3	Physics Practicals - English Medium	Web link doesn't working.
4	Physics Practicals - Sinhala Medium	Web link doesn't working.
5	A/LPhysics Practical Notes	There are practical notes for 13 experiments in Sinhala Medium
6	Micro PIC Programming Lesson Series	There is no any Article.

Whether the designers of the website mentioned, there are many features such as Digital Library, Video Gallery. Etc.; Most of the features are unserviceable or not properly arranged.

On the other hand, there is no any article related to A/L Electronics under Physics. [8]

### 2.7.3 Guru.lk

Guru.lk is a web-based online learning portal, powered by Headstart (Pvt) Ltd.

It contains learning materials under free courses, primary education, GCE O/L, GCE A/L, Certificate Courses, Banking and Finance, Office Skills, IT and Technology, etc.

When we consider the Advanced Level Physics there are course materials for all the lessons under the physics syllabus.

The web site has facilitated course lessons as video lessons. Also, there are discussion forums as well.

But there is no active discussion forum that can be seen.

Video tutorials have edited using video animations and need the flash player to run the lessons files. It provides clear and required information about the lessons. The presentation is also at the standard level and interfaces are also user-friendly.

But there are no any past paper or model paper discussions under Guru.lk related to A/L physics.

As a whole, Guru.lk provides quality and productive course material than eduLanka.lk . [9]

## 2.8 Assumptions of the project

- All course materials will be provided in electronic format
- This course will be conducted in English
- This educational service will be free of charge
- Students have enough computer literacy to follow this course
- Students have enough English literacy to follow this course
- Students have already obtained the basic knowledge of the mathematical concepts for this course.
- There are already enough computer facilities, internet facilities and software facilities for students to take this course.
- The students' attitudes are positive towards e-Learning.

## Chapter – 3 Analysis and Design/Methodology

### 3.1 Domain analysis

e-learning is not commonly used in school education, especially in advanced level education. The G.C.E A / L in schools and many educational institutions use the traditional face-to-face learning method.

Moreover, students' experience and knowledge on the use of E-Learning is not adequately developed.

By now, most schools do not use e-learning. But computers and Internet facilities for e-learning are available. Some students have personal access to the Internet. Therefore, they can easily refer to their e-learning.

E-Learning is cost-effective as compared to traditional forms of learning. The reason for this price reduction is because learning through this mode happens quickly and easily. A lot of training time is reduced with respect to trainers, travel, course materials, and accommodation.

International Business Machines Corporation has found that participants learn five times more material in online learning courses using multimedia content than in traditional face to face courses. Because online courses give students full control over their own learning, students are able to work at their own speed.

### 3.2 Stakeholder Analysis

Stakeholder Analysis is an important technique for stakeholder identification and analyzing their needs.

First, identify the important stakeholders who affect the project and their interests.

The following are the list of stakeholders directly affects the project.

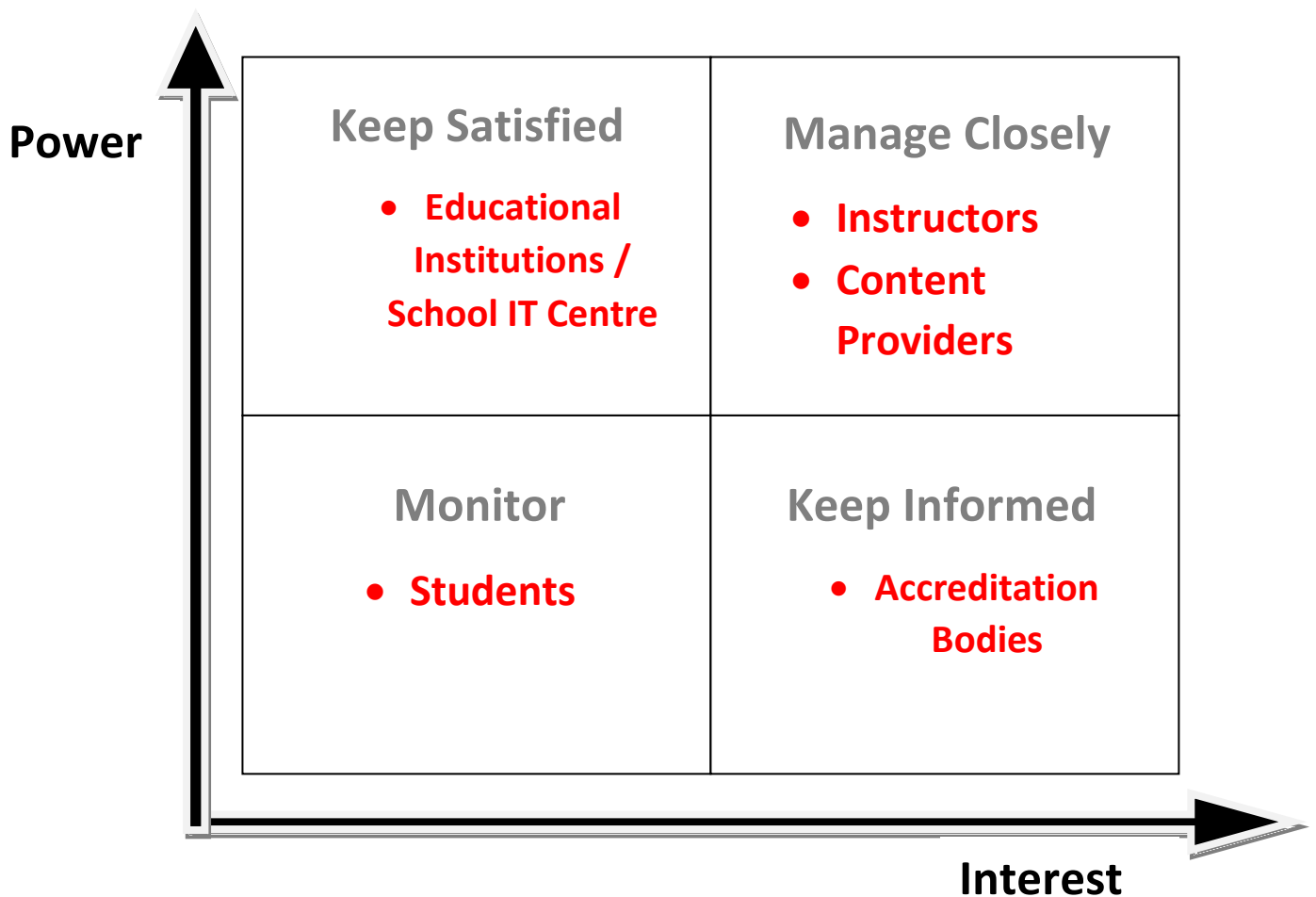
### 3.3 Identifying the stakeholders

This was done by identifying all the people who are affected by the project, people who have influenced them.

Following are the stakeholders who are directly affected by the project

The stakeholders may include the following.

1. Students
2. Instructors
3. Educational Institutions / School IT Centre
4. Content Providers
5. Technology Providers
6. Employers
7. Accreditation Bodies



*Figure 3: Power/Interest Grid for Stakeholder Prioritization*

Stakeholders with high power and interests aligned with the purpose are critical to achieving the purpose. According to this graph (*Figure 3*), high power and high-interest stakeholders are Instructors, Content Providers, and Technology Providers.

They are Technical and subject matter experts as well.

Stakeholders with high interest but low power, or high power but low interest, should be kept informed and satisfied. Ideally, they should be supporters of the project. They help during the key moments in the project.

Students are low power and less interested stakeholders in the project. They should be monitored.

According to the stakeholder analysis, most affected stakeholders are Students. Although they have low power and low interest in the project they are the people address in this project.



### 3.4 e-learning readiness Analysis

To identify the readiness, the following steps were taken

Conducting debriefing sessions with Administration school IT centre, Teachers and Students

Collecting data from the target audience through a questionnaire.

Conducting debriefing sessions with administration school IT centre, Teachers and Students

During the debriefing sessions with administration school IT centre, Teachers and Students, the issues mentioned in the section were confirmed.

To overcome the above problems, proposed to implement an e-learning solution.

To address the issues/problems, an e-learning solution is proposed.

To identify the readiness of e-learning, debriefing sessions were conducted focusing following areas

- Human Resources
- Learning management system
- Content
- finance

### 3.5 Human resources

Since training Body and IT centre are already available in the many schools, it is decided to give the responsibility of Implementation to them and since the training department has more experience in training, it is decided to give the leadership authority of the e-learning implementation to it.

### 3.6 Learning Management system

The School system doesn't have any Learning management system and it is discussed to introduce Learning management system to the users.

### 3.7 Content

The School system has wide range of training requirements and lots of training is ongoing.

### 3.8 Finance

Because of the availability of hardware and software resources, an additional cost will not need for implementation, only human resource is needed. The administration has approved to allocate time-based on the project plan.

### 3.9 SWOT analysis

Based on the questionnaire and discussions during the e-learning readiness evaluation, the following Strengths, Weaknesses, Opportunities, and Threats were found. (Figure 4)

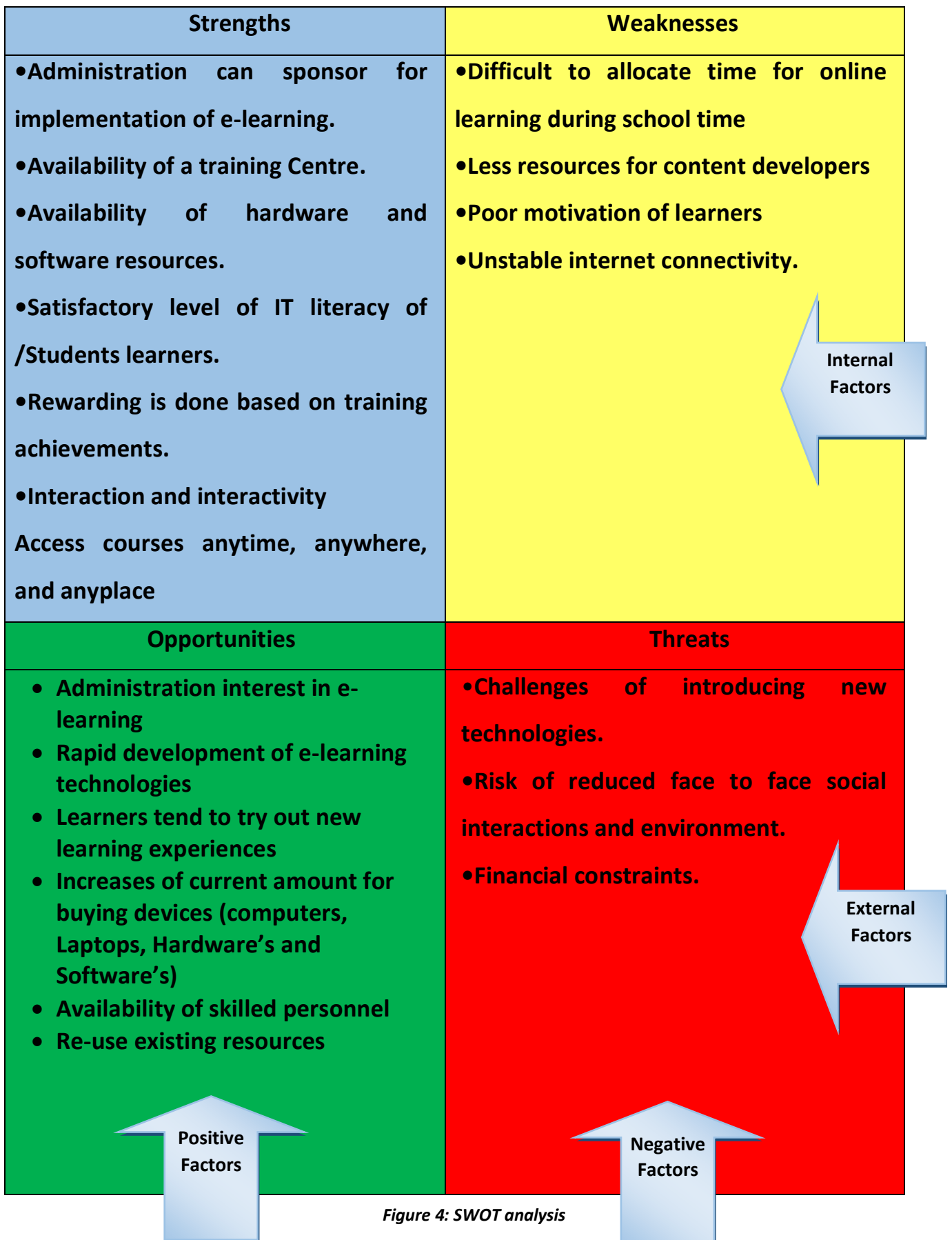


Figure 4: SWOT analysis

### 3.10 Technical and Software Requirements of the System

Table 4: Hardware and software requirements of the system

System requirements	Sub-section	Requirements	Purpose
Hardware	Processor	Intel Core i3 or higher	Tested on Basic hardware Requirements
	Memory	2 GB	
	Storage	80 GB	
	Internet Access	512 kbps or high bandwidth connection	
Software	Operating System	Windows 7 or Latest	Intermediary between programs and the computer hardware
	Moodle	As content management system	The tool for creating online dynamic applications for learners
	iSpring Suite 9 (Trial version)	SCORM packages	To create SCORM Packages
	FlippingBook Publisher (Trial version)	Flipping Book	To create Readable content.
	Web Browser	Google Chrome Internet Explorer Opera Mozilla Navigator Safari Mozilla Firefox Microsoft Edge	For retrieving, presenting, and traversing information resources on the WWW
Other	Web Applications	Java ,Script ,CSS, HTML FLASH	Uses as developing Languages/tools

### 3.11 Need Analysis

Need analysis is a systematic approach for determining and addressing needs or gaps between current situations. The discrepancy between the current condition and desired condition must be measured to appropriately identify the need. The need is a desire to improve the current condition and correct deficiencies in the current situation.

Need analysis was conducted as follows;

1. Provided questionnaire (Appendix A) to the target audience to gather information about their ICT skills, staff supportive, availability of computers and internet facility, etc.
2. Observation of the target group and existing teaching and learning process

### 3.12 Objectives

Following are the objective of preparing a need analysis

- Identify the level of learners
- Identify the problems faced in current leaning process.
- Measure the ability of using technology in learning process

### 3.13 Target Audience

Target audience divided into following groups

- Learners
- Facilitators
- Decision makers

### 3.14 Sampling Procedure

Target audience is a broader audience and conducting needs assessment is a difficult task with the whole population. So that a small representative group was selected to conduct a needs assessment. In order to do that, a sampling method was selected.

- Users (Learners) selected from different districts and different schools.
- Considered the educational levels and economical levels of the learners.
- Students were randomly selected from both national schools and provincial schools.
- All the instructors participated in the analysis.

### 3.15 Data Collection Methods

After selecting the sample audience, the next step was to collect the information. To collect the data, several data collection methods were used.

#### 3.15.1 Interviews

Interviews were conducted over the phone and face to face based on the geographical location. Interviews were mainly conducted with the learners and IT Centre staff. Rather than giving them a questionnaire, it was Useful to obtain detailed information about personal feelings, perceptions, and opinions. They allowed more detailed questions to be asked. They usually achieved a high response rate.

Basically, Interviews were targeted on getting information on the following areas.

- i. Computer literacy
- ii. Capability of internet usage
- iii. Time spend for learning
- iv. Communicate with others
- v. Identify the level of learners
- vi. Requirement of e learning
- vii. Interest of online learning

### 3.15.2 Questioner

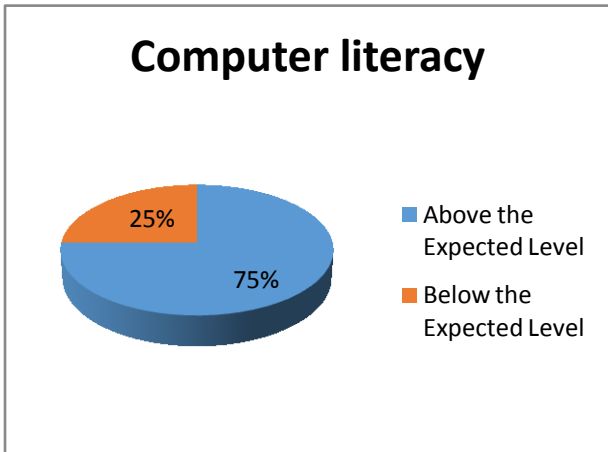
Obtain information about attitudes, qualitative data and can have a greater understanding of issues. This involves asking questions, listening to and recording answers from an individual or group. Verbal, online and paper versions of questionnaires were used.

Provided questionnaire surveys to the target audience to assess the following areas.

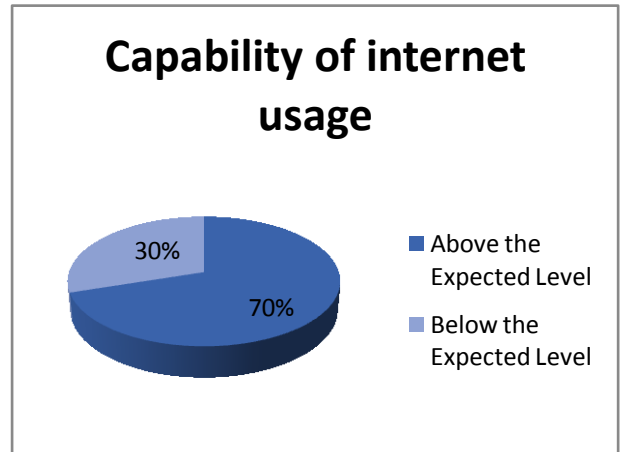
- i. Computer literacy
- ii. Capability of internet usage
- iii. Time spend for learning
- iv. Communicate with others
- v. Requirement of e learning
- vi. Interest of online learning

### 3.16 Methods of data analysis

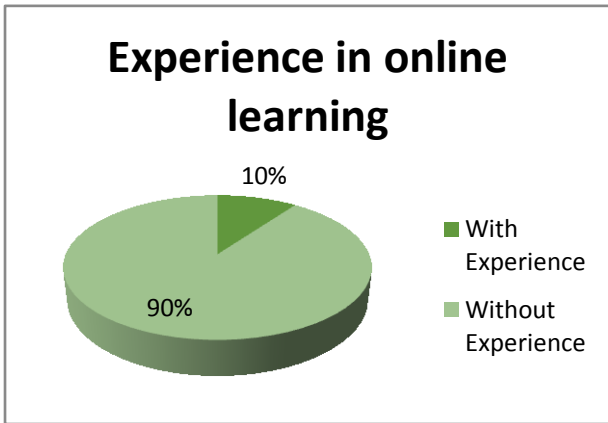
The data analysis stage is a very important stage of the research since it changes the raw data obtained from the data collection instruments into meaningful information. All the data gathered from interviews and survey questionnaire were prioritized based on the questions and display these data using graphical representation (*Figure 5 – Figure 10*) and analysis and decided what the learners needs.



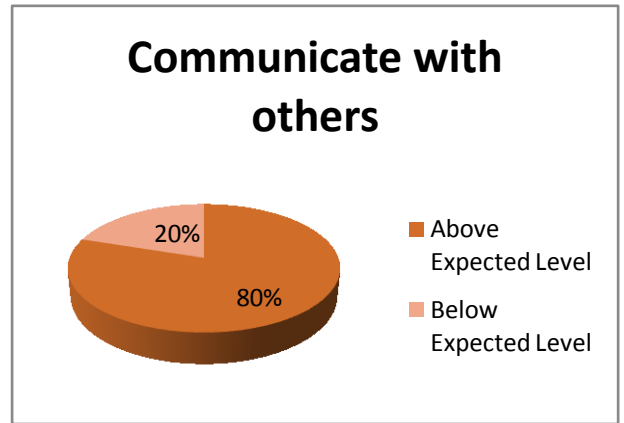
*Figure 5: Computer Literacy*



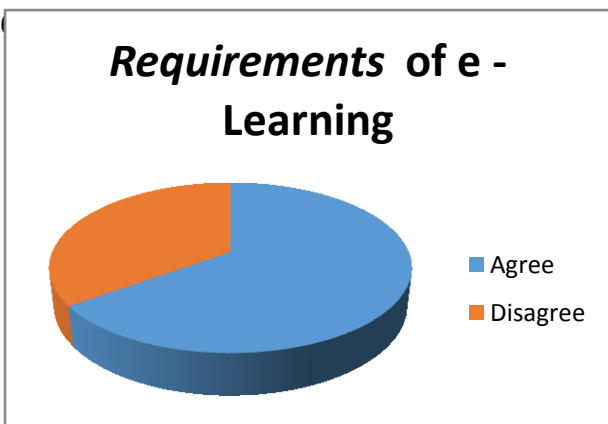
*Figure 6: Capability of internet usage*



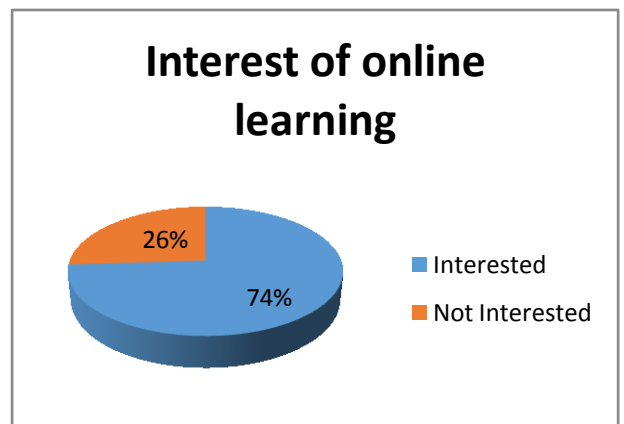
*Figure 7: Experience in online learning*



*Figure 8: Communicate with others*



*Figure 9: Requirements of e - Learning*



*Figure 10: Interest of online learning*



### 3.17 Data Analysis and decisions made

Data captured during the interviews and online/ paper version questioners were analyzed to identify the true needs of learners Data was analyzed qualitatively and quantitatively to make decisions. Decisions were made based on analyzed data.

- Resources available to access the online course (Computer facilities and Internet Facilities)
- There is a requirement for the e-learning course.
- The learner is ready to access the e-learning course.

### 3.18 Learner-related characteristics

Learner-related characteristics into two categories: prerequisite knowledge, skills, and attitudes; and other learner-related characteristics. Prerequisites also referred to as entry behaviours, including all those things that learners must know or be able to do to begin instruction. Learners have basic computer knowledge, how to navigate the web and to use an e-mail to communicate with other learners and the instructor, etc.

### 3.19 Current learning habits

Currently, they use a face-to-face learning environment. Here the instructor is active and learners are less active for their learning. Currently using traditional tools such as Blackboard, whiteboard, and notebooks, etc.

### 3.20 Future learning habits

In this instance, having e-learning the instructor uses the information and communications technologies to replace part of face-to-face in-class instruction. Learners will participate in technology-enabled activities such as online discussions, chat as part of their course work.

Learners can be directed to a more active environment, a learner centered environment via the introduction of e-learning.

### 3.21 Situation-related characteristics

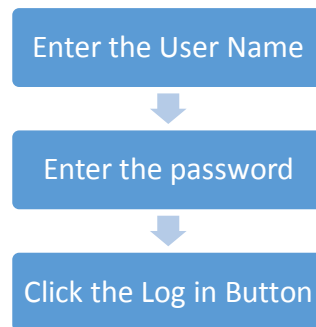
The main focus of the instructional design effort should be directed to learners with less knowledge of computer literacy and who are most affected by it.

### 3.22 Learner Task Analysis

Task analysis is the systematic procedure used by instructional designers to decide what a learner needs to learn or understand by participating in instruction. After discussing with instructors and the target audience, the following tasks and sub-tasks were identified.

1. Register with the course
2. Login with the course
3. Edit profile
4. Select the lessons
5. Enrol with the lessons
6. Follow the lessons
7. Complete the activities
8. Complete the assignments
9. Communicate with peers and the teachers via forum discussions, chat and messages
10. Read the announcements
11. Read the latest news
12. Download the course materials

All the above tasks decompose into sub-tasks. The following figure (*Figure 11*) illustrates the sub-tasks splitting for the login with the course.



**Figure 11: The task to access the course**

### 3.23 Content Analysis

Content analysis is the first step before developing an eLearning course. It enables us to classify content into different categories and types of content. It also allows us to know and understand the structure of the information, as well as the relationships between them.

Discussed with the Instructors/ Content Providers/ Technology Providers and they gave the knowledge, information, learning materials which are required to design the course. The course content was defined with the help of them. Based on the syllabus (Published by NIE) and learner requirements, a detailed syllabus (Appendix C) was prepared.

E-learning content for the course includes;

- Interactive lessons  
Lessons with sequence screens including text, graphics, animations, audio, video, links to useful resources relating to the topic
- Learning resources  
Non interactive resources such as MS power point presentations, video, documents. Here learners do only watching or listening to the lessons.
- Activities  
Linear sequence screens that include interactive activities for learners
- Collaborative learning  
Discussion forums and chats for learners to synthesize, evaluate, and extend their knowledge and understanding of the materials they have read.
- Useful Links

To access links of videos tutorials and other resources already exists in the internet related to the subject.

### 3.24 Design Solution

#### 3.24.1 Methodology

There are different strategies for the creation of teaching content for e-Learning. These approaches often use a similar set of stages or phases for content development. Among them, the ADDIE model is used to design course materials.

#### ADDIE model

The ADDIE model [Figure 12] is the generic process traditionally used by instructional designers and training developers. The five phases Analysis, Design, Development, Implementation, and Evaluation represent a dynamic, flexible guideline for building effective training and performance support tools. This model is a very effective and easy way of developing any training material from scratch.

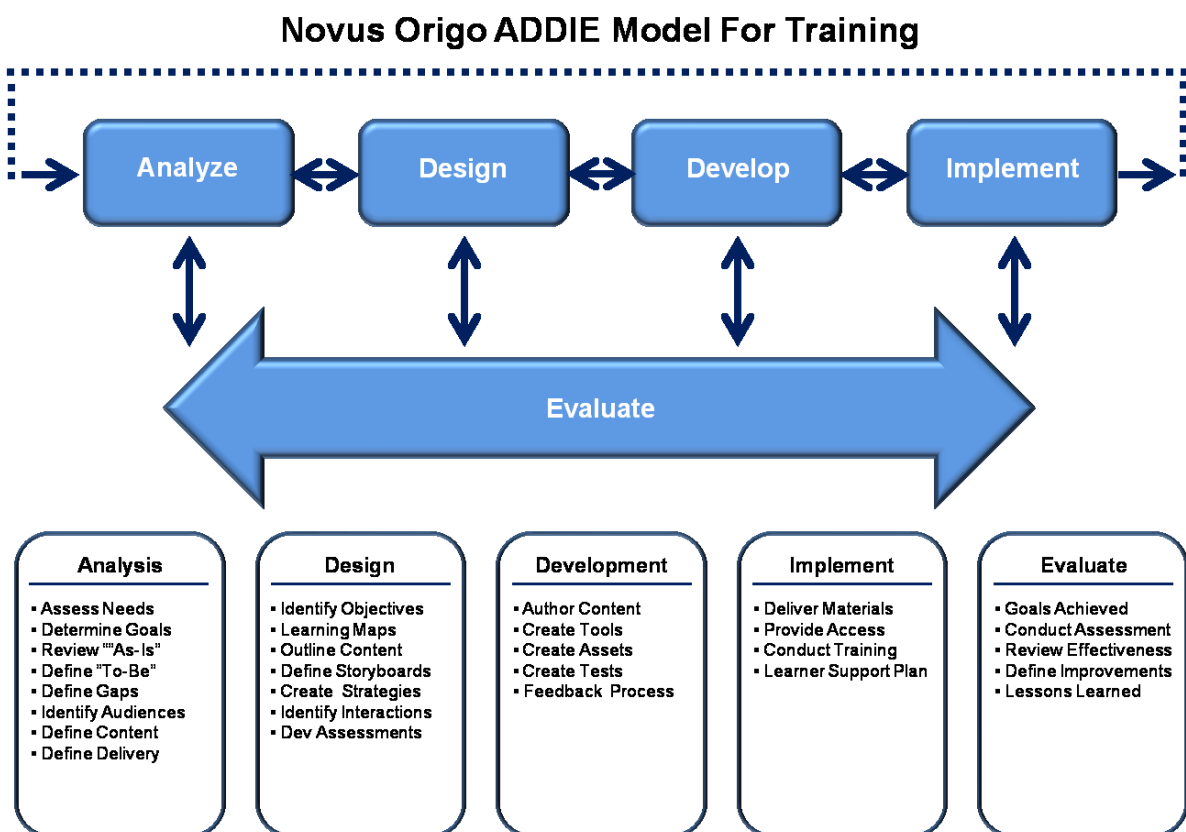


Figure 12: ADDIE model [10]

In the ADDIE model, each step has an outcome that feeds into the subsequent step.

Analysis > Design > Development > Implementation > Evaluation

### 3.24.2 Analysis Phase

In the analysis phase, the instructional problem is clarified, the instructional goals and objectives are established and the learning environment and learner's existing knowledge and skills are identified. Below are some of the questions that are addressed during the analysis phase:

- Who are the audience and their characteristics?
- Identify the new behavioural outcome?
- What types of learning constraints exist?
- What are the delivery options?
- What are the online pedagogical considerations?
- What is the timeline for project completion?

### 3.25 Design Phase

The design phase deals with learning objectives, assessment instruments, exercises, content, subject matter analysis, lesson planning and media selection. The design phase should be systematic and specific. Systematic means a logical, orderly method of identifying, developing and evaluating a set of planned strategies targeted for attaining the project's goals. Specific means each element of the instructional design plan needs to be executed with attention to detail.

### 3.26 These are steps used for the design phase:

- Documentation of the project's instructional, visual and technical design strategy
- Apply instructional strategies according to the intended behavioral outcomes by the domain (cognitive, affective, psychomotor).
- Create storyboards
- Design the user interface and user experience
- Prototype creation
- Apply visual design (graphic design)

### 3.27 Development Phase

The development phase is where the developers create and assemble the content assets that were created in the design phase. Programmers work to develop and/or integrate technologies. Testers perform debugging procedures. The project is reviewed and revised according to any feedback given.

### 3.28 Implementation Phase

During the implementation phase, a procedure for training the facilitators and the learners is developed. The facilitators' training should cover the course curriculum, learning outcomes, method of delivery, and testing procedures. Preparation of the learners includes training them on new tools (software or hardware), student registration.

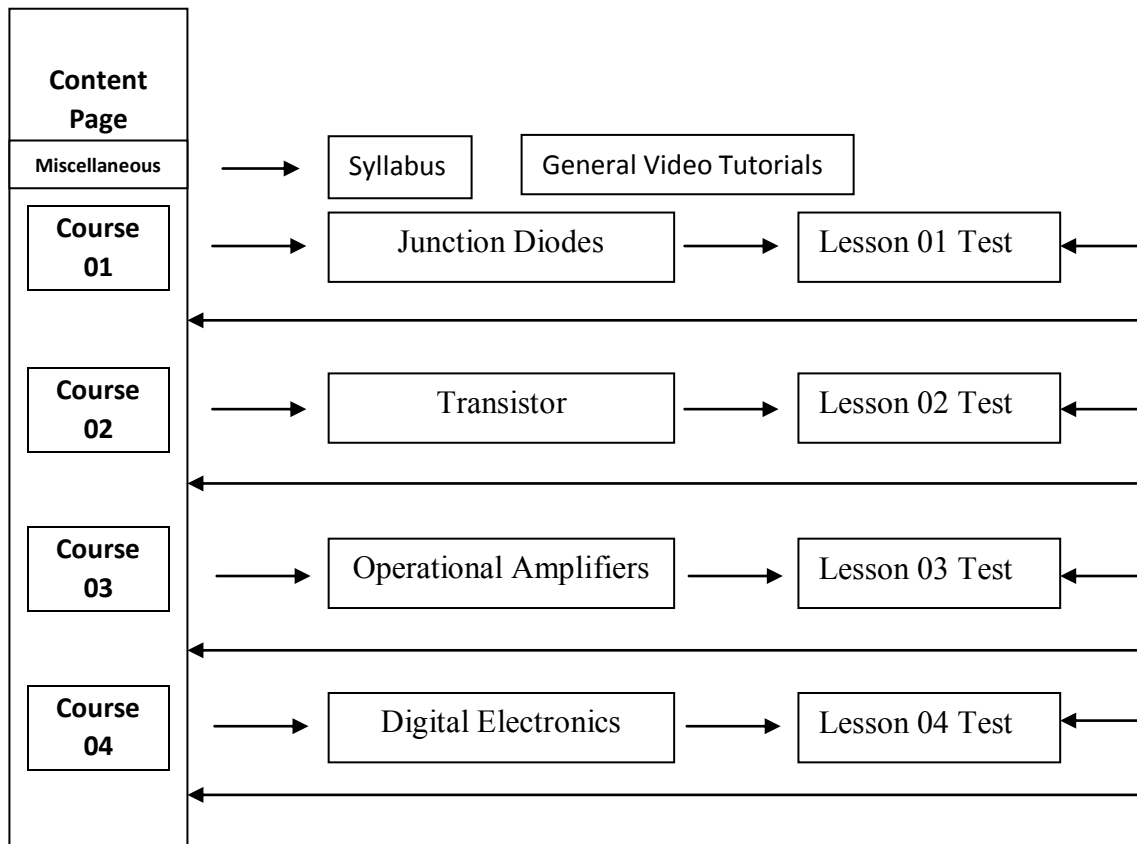
This is also the phase where the project manager ensures that the books, hands-on equipment, tools, CD-ROMs and software are in place and that the learning application or Web site is functional.

### 3.29 Evaluation Phase

The evaluation phase consists of two parts: formative and summative. Formative evaluation is present in each stage of the ADDIE process. Summative evaluation consists of tests designed for domain-specific criterion-related referenced items and providing opportunities for feedback from the users. [11]

### 3.30 Level 1 Course Map

Level 1 course map shows high level of the content development path



**Figure 13: Level 1 Course Map**

This Level 1 Course Map (**Figure 13**) shows the basic structure of the courses. There are five courses with a miscellaneous course. Under all courses, there are course materials and questionnaires except under a miscellaneous course.

3.31 Level 2 Course Map

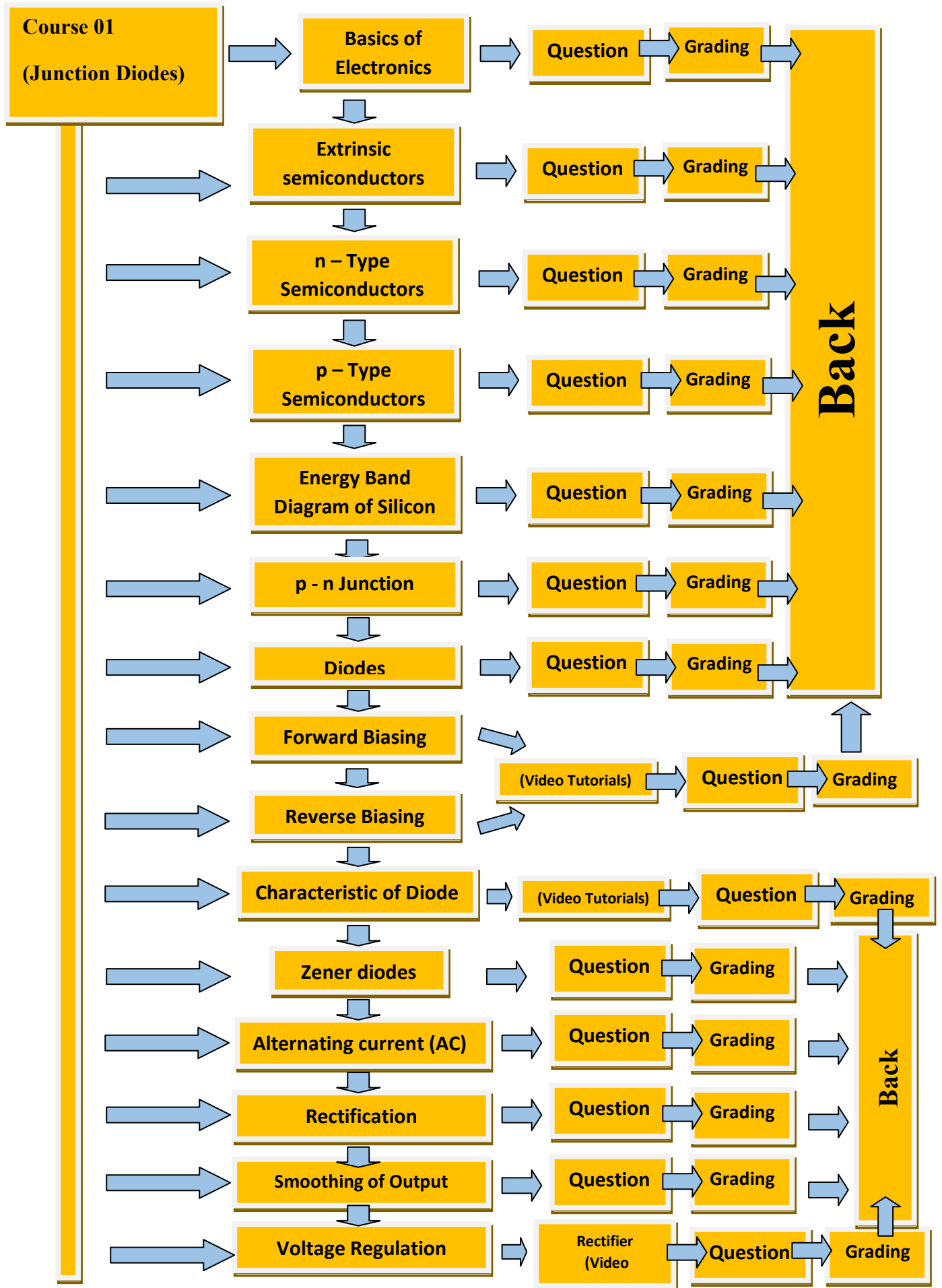


Figure 14: Level 2 Course Map for Sub Topic "Junction Diodes"

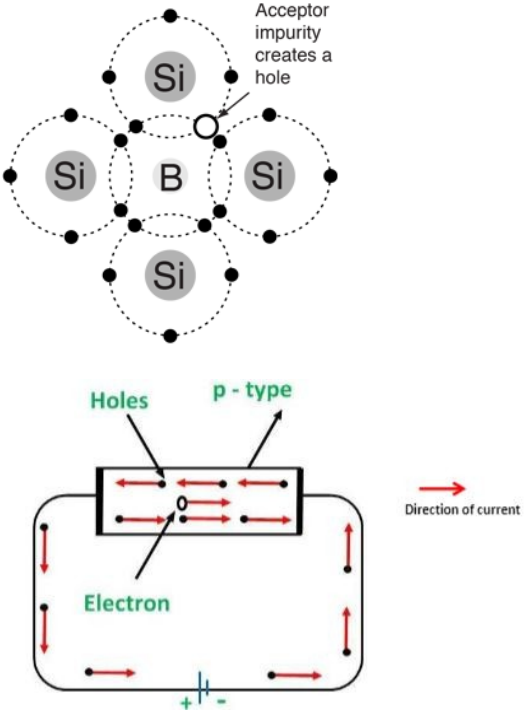


Course 01 (Junction Diodes) contains 19 topics (***Refer to Figure 14***). Each topic contains course materials in Flipping Book format, PDF format and some lessons with video tutorials. After every topic, there are questions related to the lesson. There is a grading facility after the completion of the questionnaires.

After each course, there is a questionnaire covering all the course topics.

All lessons have arranged according to the syllabus and there is an order. But the user can choose any lesson as per the choice. All the other courses have similar arrangements.

### 3.32 Sample Storyboard

Course Name: <b>Web Based Course for G.C.E Advanced Level Electronics under Physics.</b>		Storyboard File no. 01.03.01.01
Course section: 1.3		
Lesson Name: P-type semiconductor		ID's name: Venura Liyanagama
Objective(s): 1. Define P-type semiconductor		SME's name: Venura Liyanagama
Page Title: <b>P-type semiconductor</b>	Page no. <b>01.01.03.00</b>	CD's name:
Date Designed: <b>03.03.2019</b>	Date SME contributed: <b>04.03.2019</b>	Date verified: <b>04.03.2019</b>
Design		
<p><b><i>P-type semiconductor?</i></b></p> 		<ul style="list-style-type: none"> <li>• P-type semiconductor             <ul style="list-style-type: none"> <li>○ Definition and description of <i>P-type semiconductor</i></li> </ul> </li> <li>• Charge on p-type semiconductor             <ul style="list-style-type: none"> <li>○ description of Charge on p-type semiconductor</li> </ul> </li> <li>• Conduction in p-type semiconductor             <ul style="list-style-type: none"> <li>○ Description of Current through the P – Type Semi conductor</li> </ul> </li> </ul>
<p>Special comments –            Font: Calibri (Body) Font size : 12            Resolution of the images : 435 x 270 pixels</p>		

**Figure 15: Story Board (P-type semiconductor)**

Generally, a storyboard (*Figure 15 and Appendix: C*) for e – learning is a document that specifies the visual elements, text elements, audio elements, interactions and branching (where the system or user will go next) of every screen in an online course. Many people also add the learning objectives to the storyboard.

### 3.33 Developing Tools: Development and Implementation

Various tools can be used to produce e-learning content, depending on the file formats you are going to use and the final product you aim to deliver.

To develop interactive content, various elements are assembled (e.g. text, illustrations, animations, audio, and video). There are two main ways to do that:

- Use programming tools which have been created to develop web content (not only for e-learning) and customize them to specific e-learning needs; or
- Use special tools – known as authoring tools or author ware – which have been created specifically to develop e-learning courses.

### 3.34 Implementation of Moodle as Learning Management System

Moodle is used as the main platform of the project and interact with users. It helps to integrate SCORM packages.

### 3.35 The Pros of Using Moodle to Built LMS

#### 1. Free

There are no charges for using MOODLE LMS, it's an open sourced project and free of cost.

#### 2. Customized

Moodle LMS can be customized as per user's requirement.

#### 3. Unlimited Users

Moodle LMS supports unlimited users, so there is no capping on the number of users or restrictions to add more users.

#### 4. An Enormous amount of add-ons and plug-ins

The user can add a large number of add-ons and plug-ins to the Moodle LMS and he can make the LMS to have features as he desires.

#### 5. Great Community

There is a great community of Moodler more than willing to help you solve any problems you may come across.

### 3.36 The Con of Using Moodle to Built LMS:

#### 1. No Support 24\*7

There is no dedicated 24\*7 support in Moodle LMS, the user has to go through the forums and he has to post his problems or issues and wait for the concerned person to respond. In case of emergency and urgency it will be tough to solve.

#### 2. Takes a little tech-savvy

Not just any trainer or teacher can download Moodle and be up and running with a quality LMS. It takes a little tech-savvy and access to IT Dept resources to implement.

#### 3. UI

Moodle has a very basic UI which is not very user-friendly, for instance, if you click on any course, you wouldn't get more information on it. Dashboard UI is hard to grasp.

#### 4. Reporting

Basic Reporting is possible. But it is impossible to know which courses to watch, the most popular course, etc.

**Electronics Course for G.C.E Advanced Level**

Home > Log in to the site

### Log in

Username

Password

Remember username

[Forgotten your username or password?](#)

Cookies must be enabled in your browser

---

Some courses may allow guest access

Figure 15: "Login" Interface

### Is this your first time here?

Hi! For full access to courses you'll need to take a minute to create a new account for yourself on this web site. Each of the individual courses may also have a one-time "enrolment key", which you won't need until later. Here are the steps:

1. Fill out the [New Account](#) form with your details.
2. An email will be immediately sent to your email address.
3. Read your email, and click on the web link it contains.
4. Your account will be confirmed and you will be logged in.
5. Now, select the course you want to participate in.
6. If you are prompted for an "enrolment key" - use the one that your teacher has given you. This will "enrol" you in the course.
7. You can now access the full course. From now on you will only need to enter your personal username and password (in the form on this page) to log in and access any course you have enrolled in.

Figure 16: "Create New account" Interface

Electronics Course for G.C.E Advanced Level You are logged in as Venura Lijanagama (Log out)

**Main menu**

- Site news

**Navigation**

- Home
  - My home
  - Site pages
  - My profile
  - My courses

**Administration**

- Front page settings
  - Turn editing on
- Edit settings
  - Users
  - Filters
  - Reports
- Backup
- Restore
- Question bank
- My profile settings
- Site administration

## Welcome to the Virtual Learning Environment for the Electronics



Educational Chat

Course categories



**Calendar**

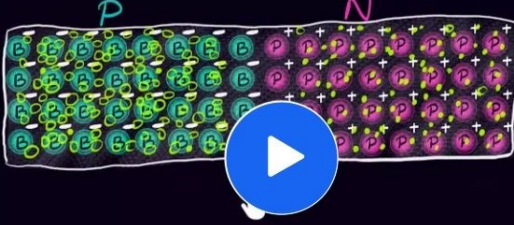
September 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Figure 17: "Lesson 01 – Basic Electronics" Interface

- ▶ The PN junction
- ▶ Diffusion, drift & barrier voltage

Next lesson  
PN junction biasing



The PN junction

Figure 18: Video Tutorial –The P-N Junction

## Chapter – 4 Evaluation

Evaluating the e-learning course helps us to assess its effectiveness. We need to know if the e-learning course is effective; that is if it achieves its goals and meets its objectives. To determine if the e-learning deliverable works, evaluating it is essential. The evaluation of the eLearning course enables us to assess its quality and effectiveness and, most importantly, understand what did or didn't work to keep it or change it.

Evaluation should be an ongoing process; need to constantly evaluate the eLearning course to keep improving it and making regular changes and updates.

The main goal of this project is to overcome difficulties in face to face learning and the main goal of evaluating this project is to observe working on the online environment and their feedback on learning material.

### 4.1 Question Design

Questionnaire (Appendix D) was prepared based on the following categories.

1. Visibility of system status and content
2. Navigation, organization and structure
3. Consistency and relevance of course content
5. Learn ability) & accessibility
6. Flexibility and efficiency of use
8. Effectiveness and satisfaction

### 4.2 Methodological Approach

There are two main approaches to evaluation and assessment, they are quantitative and qualitative. It helps to emphasize different procedures and methods to review the success or failure of a user when studying Electronics and applying that knowledge.

Quantitative data are numerical data and they are analyzed using statistical data. As the main quantitative method, questionnaire was used which covers important sections. Therefore, data such as how many times a learner access a page, how many marks that a learner scores for an assessment and how many incorrect answers are there when compares to the number of correct answers were evaluated using this method. From the result, it will be indicated whether a learner has achieved the given objectives.

As the Qualitative method used informal procedures and methods with other non-numerical data. This method analyzes data using non-statistical methods. Evaluation and assessment



tools are used to collect information from structured and unstructured observations of a user at different times. These tools include text, photographs, video, audio, and word sampling.

#### 4.3 Sampling

In order to collect the data for the evaluation process, the sample has to identify. Therefore a questionnaire was provided for the users. The sample should consist with both learner and teachers who are the main users of this scenario. Stratified sampling was used in forming the sample group.

#### 4.4 Type of evaluation

There are many different types of evaluations, depending on the object being evaluated and the purpose of the evaluation. The two of the evaluation types are that the formative and the summative evaluation.

Formative evaluation, programs or projects are typically assessed during their development or early implementation to provide information about how best to revise and modify for improvement. This type of evaluation often is helpful for pilot projects and new programs, but can be used for progress monitoring of ongoing programs. In summative evaluation, programs or projects are assessed at the end of an operating cycle, and findings typically are used to help decide whether a program should be adopted, continued, or modified for improvement.

Summative evaluation methods were used in this process. Summative evaluation was done quantitatively and the data which was gathered at the end of each question type were evaluated by this method.

#### 4.5 Results of the evaluation process

Table 5: Results of the evaluation process, is presented in the following chart.

	<b>Strongly agree/ Somewhat agree</b>	<b>Percentage %</b>	<b>Somewhat disagree Strongly disagree</b>	<b>Percentage %</b>
<b>Visibility of the system</b>	45	90%	5	10%
<b>Visibility of the system</b>	40	80%	10	20%
<b>Relevance of course content</b>	42	84%	8	16%
<b>learn ability and accessibility of the system</b>	37	74%	13	26%
<b>learn ability and accessibility of the system</b>	38	76%	12	24%
<b>efficiency of use and finally effectiveness and satisfaction of the system</b>	45	90%	5	10%

Visibility of the system, Navigation and structure of the system, Relevance of course content, learn ability and accessibility of the system, Navigation and structure of the system Flexibility and efficiency of use and finally effectiveness and satisfaction of the system has measured by results of the of the questionnaires (Appendix D) .

The evaluation results are presented in the following chart

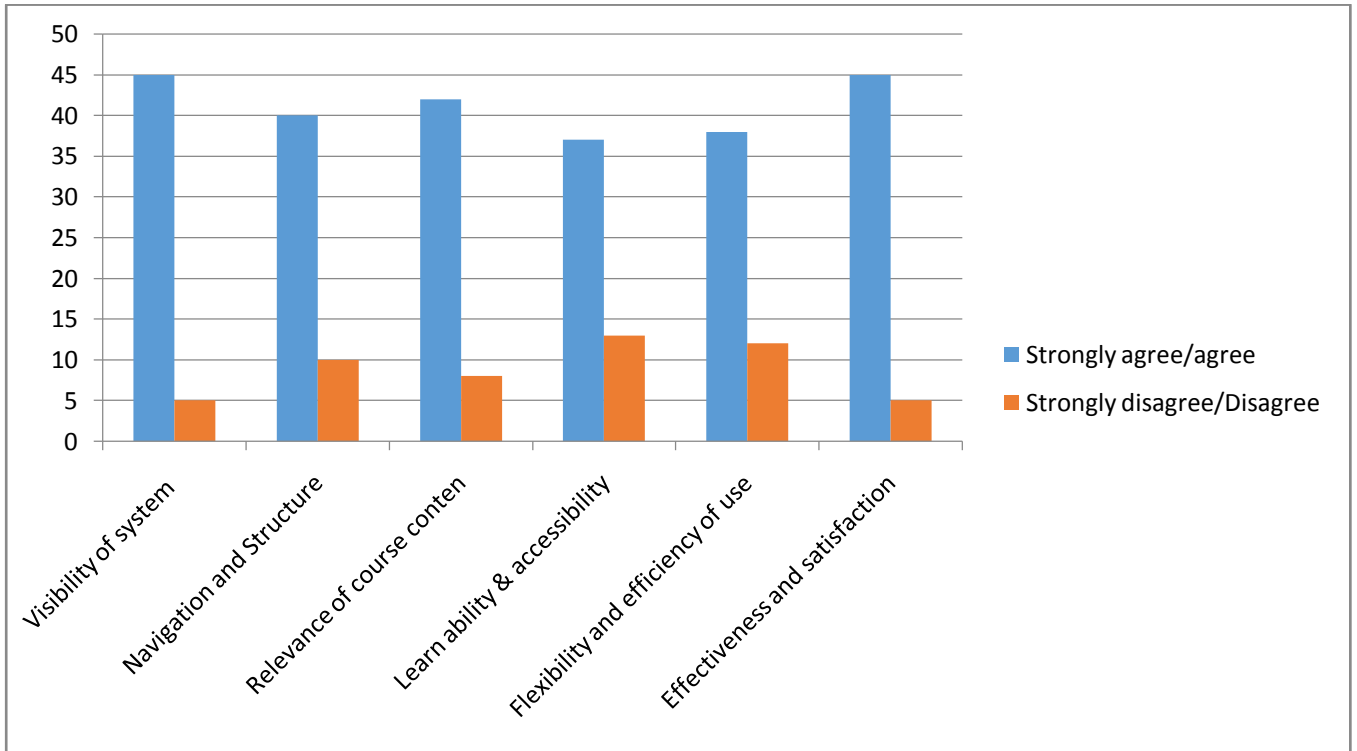


Figure 20: Result of the evaluation

Results of a survey questionnaire depicts that online learning is useful and good learning tool for Learning of Electronics under physics in G.C.E A/L. Although most of the learners haven't experience in online learning environment, some of them had faced difficulties in navigation.

## Chapter – 5 Conclusion

It is important to note that the aim of online course of “Electronics under physics in G.C.E A/L” is to provide enhanced educational and training support to the learners in addition to traditional learning. It should be noted that this tool is very effective to increase the efficiency of learning and training.

**Chapter 1** defined Introduction of the project. **Chapter 2** illustrates Background of the project including Motivation for the project, Objectives, List of deliverables, Scope of the project, Assumptions and theoretical foundation of project. There were discussed e-learning frameworks, benefits and drawbacks of e learning, how e learning differs from traditional learning and some other existing online learning systems. An analysis of the current learning system and tried to understand the system and made an effort to find system minuses, by finding user requirements created online course on “Electronics under physics in G.C.E A/L”.

In **chapter 3** describes the Analysis and Design/Methodology. ADDIE [**Figure 12**] model was used to design course material. Storyboards were used as prototype to develop the course material. Storyboard specifies what the graphic designer will create, what the illustrator will draw, what the narrator will say and the interactions that the programmer will produce. The storyboard is usually reviewed by the Instructor, Content Providers, and Technology. It's the central document of eLearning development.

Implementation consists of creating SCORM packages using interactive tool such as iSpring Suite , FlippingBook Publisher . Moodle an open source software package was used to create effective online course with LMS. Evaluation of the project was done according to the evaluation plan.

**Chapter 4** is all about Evaluation

This project aims to optimization of e learning system to enhance learning of electronics under the physics in G.C.E A/L. It was shown that optimization of the current platform through new technologies and optimization of existing in numerous directions.

The future procedure is designed to create such e-learning courses for all subjects under Physics in G.C.E. A/L.

Also, Sinhala, Tamil and English can be accessed through all three languages. Provide facilities to use it in Sinhala, Tamil and English.

**Chapter 5** is devoted to conclusions.

## References

- [1] <http://nie.lk/> (National Institute of Education – Sri Lanka)
- [2] [https://en.wikipedia.org/wiki/History\\_of\\_virtual\\_learning\\_environments](https://en.wikipedia.org/wiki/History_of_virtual_learning_environments) (Wikipedia)
- [3] <http://www.slideshare.net/ayounce/e-learningproposalannounce>
- [4] [http://www.physics.ohio-state.edu/~wilkins/onepage/first\\_funds.html](http://www.physics.ohio-state.edu/~wilkins/onepage/first_funds.html)
- [5] <https://www.learnupon.com/blog/best-elearning-tools/>
- [6] Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., Wittrock, M.C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*. New York: Pearson, Allyn & Bacon.
- [7] <https://www.revolvy.com>
- [8] <https://edulanka.lk/>
- [9] <https://guru.lk/>
- [10] [www.novusorigo.com](http://www.novusorigo.com)
- [11] <https://www.instructionaldesign.org/models/addie/>

## Appendix A

### Questionnaire to the target audience to gather information

The following questionnaire is for your benefit only. To find out whether online learning is right for you, please respond to these questions honestly. You **must** make a selection for each question to proceed with results.

1. What is the highest level of education you have completed?
  - a) G.C.E. Advanced Level
  - b) G.C.E. Ordinary Level
  - c) Other
  
2. I have access to a computer with an Internet connection.
  - a) Strongly Agree
  - b) Agree
  - c) Disagree
  - d) Strongly Disagree
  
3. I have access to a computer with adequate software (e.g., Microsoft Word, Adobe Acrobat, Internet browser).
  - a) Strongly Agree
  - b) Agree
  - c) Disagree
  - d) Strongly Disagree
  
4. Do you currently use a personal computer at home?
  - a) Yes
  - b) No
  
5. I can access an e-learning module at times/ locations convenient to me.
  - a) Strongly Agree
  - b) Agree
  - c) Disagree
  - d) Strongly Disagree
  
6. Senior staff is supportive if I take e-learning courses which are related to my work during office hours.
  - a) Strongly Agree
  - b) Agree
  - c) Disagree
  - d) Strongly Disagree
  
7. I have the basic skills to operate a computer (e.g. saving files, creating folders).
  - a) Strongly Agree
  - b) Agree
  - c) Disagree
  - d) Strongly Disagree

8. I have the basic skills for finding my way around the Internet (e.g. using search engines, entering passwords).

- a) Strongly Agree
- b) Agree
- c) Disagree
- d) Strongly Disagree

9. I have a basic knowledge of using an email

- a) Strongly Agree
- b) Agree
- c) Disagree
- d) Strongly Disagree

10. Are you comfortable with file management: saving, deleting, and moving files on your computer?

- a) Yes
- b) No

11. Do you know how to use standard word processing software such as Microsoft Word?

- a) Yes
- b) No

12. I think that I would be comfortable using a computer several times a week to participate in an e-learning module.

- a) Strongly Agree
- b) Agree
- c) Disagree
- d) Strongly Disagree

13. I think that I would be able to communicate effectively with others using online technologies (e.g., email, chat).

- a) Strongly Agree
- b) Agree
- c) Disagree
- d) Strongly Disagree

14. Do you have any experience in online learning?

- a) Yes
- b) No

15. Do you think that online course will help solving your problem in your work place?

- a) Not at all
- b) To a certain extend
- c) A lot

## Appendix B

### **This is the Syllabus of the Electronic course unit**

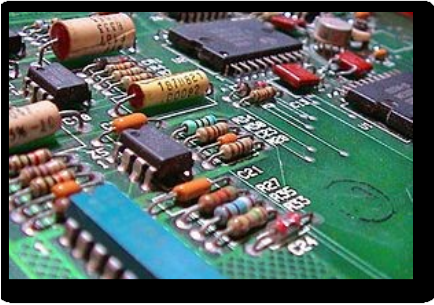
1. Junction Diodes
  - a. Intrinsic Semi-conductors
  - b. Extrinsic Semi-conductors
    - i. n- type
    - ii. p-type
  - c. p-n Junction
    - i. Depletion Layer
    - ii. Forward Bias
    - iii. Reverse Bias
  - d. Characteristic of a Diode
    - i. I-V curves of Real Diode
    - ii. I-V curves of practical Diode
  - e. Uses of Diode as rectifier
    - i. Half wave rectification
    - ii. Full wave rectification
    - iii. Smoothing
  - f. Demonstration of rectification using CRO
  - g. Diode as a Switch
  - h. Other types of Diodes
    - i. Zener Diodes
      - Voltage regulation of Zener diodes
    - ii. Light Emitting Diode (L.E.D)
    - iii. Photo Diode
2. Transistor
  - a. Bipolar Transistors
    - i. Structure and circuit symbol of npn and pnp transistors
    - ii. npn transistor circuits
      - Action of Transistors
      - Circuit configuration
        - ✓ Common –Base
        - ✓ Common – Emitter
        - ✓ Common – Collector
      - Investigating the characteristics of common emitter configuration of a transistor
        - ✓ Input Characteristic
        - ✓ Output Characteristic
        - ✓ Transfer Characteristic
      - Common Emitter transistor amplifier

- ✓ Current amplification
      - ✓ Voltage amplification
      - Common Emitter transistor switch
    - iii. Unipolar Transistors
      - Field effect transistor
      - Structure and circuit symbol of n-channel and channel FETs
      - Action of an n – channel FET
        - ✓ Characteristic
        - ✓ Voltage amplification using FET (Qualitatively)
3. Operational Amplifiers
- a. Operational amplifiers as an Integrated Circuits (IC)
  - b. Identification of pins
  - c. Action of operational amplifier
  - d. Characteristic of the open loop state
  - e. Uses of operational amplifier as a voltage amplifier
    - i. Close loop state (negative feedback)
      - Golden Rule I & II
      - Inverting amplifier
      - Non-inverting amplifier
    - ii. Uses of operational amplifier as a voltage comparator
4. Digital Electronics
- a. Boolean expression and truth tables of logical gates
    - i. AND gate
    - ii. OR gate
    - iii. NOT gate
    - iv. NAND gate
    - v. NOR gate
    - vi. EXOR gate
    - vii. EXNOR gate
    - viii. Investigating the truth tables of basic logic gates
  - b. Logic expressions for simple digital circuits (maximum of three inputs)
  - c. Converting a given logic expression to a logic gate circuit
  - d. Logic expression for a truth table
  - e. Designing simple logic circuits
  - f. Electronic memory
    - i. Single memory element with NAND/NOR gates
      - Basic SR flip-flop (Bistable)



## Appendix C

### Story Board - 1

Course Name: <b>Electronics</b>		Storyboard File no. 0x.0y.01.00	
Course section: x.y			
Lesson Name: p – n Junction		ID's name:	
Objective(s): To give basic knowledge of p-n Junction		SME's name:	
Page Title:		Page no. 0x.0y.01.00	CD's name:
Date Designed: 2018-10-10	Date SME contributed:		Date verified:2018-11-10
Design			
<b>Main Heading (font- Calibri body / font size 20) (Alignment: Left)</b>			
		Paragraph (font- Calibri body / font size 20) (Alignment: Justify)	
Image Size (295 x 195 pixels)		<b>Definition of electronics: Electronics</b> is the branch of science that deals with the study of flow..... <ul style="list-style-type: none"><li>• Bullets</li></ul>	
Special Comment(s): .			

## Story Board - 2

Page Title:: <b>Question 1</b>	Page no. 0x.0y.01.01	SME's name:
Date Designed:2018/10/15		Date verified:2018/10/20
Design		
<p>1. A P-type semiconductor results when</p> <ul style="list-style-type: none"><li><input type="radio"/> A trivalent impurity is added to an intrinsic semiconductor</li><li><input type="radio"/> Either a pentavalent or trivalent impurity is added to an intrinsic semiconductor</li><li><input type="radio"/> A monovalent impurity is added to an intrinsic semiconductor</li><li><input type="radio"/> A pentavalent impurity is added to an intrinsic semiconductor</li></ul>		
		<b>SUBMIT</b>
<p><b>Correct</b></p> <p>That's right! You chose the correct response.</p>		
<p>Special Comment(s): .</p> <ol style="list-style-type: none"><li>1. Reply of the system When Select correct answers.</li><li>2. Reply of the system When Select the incorrect answers</li></ol>		
		<p><b>Incorrect</b></p> <p>You did not choose the correct response.</p>
		<b>CONTINUE &gt;</b>

### Story Board -3

Page Title: <b>Question II</b>	Page no. 0x.0y.02.01	SME's name: Venura Liyanagama
Date Designed:2018/10/15		Date verified:2018/10/20
Design		
<p>2. A n-type semiconductor is produced by adding an acceptor impurity such as</p> <p><input type="checkbox"/> Ga</p> <p><input type="checkbox"/> B</p> <p><input checked="" type="checkbox"/> P</p> <p><input checked="" type="checkbox"/> As</p> <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"><p style="background-color: #4CAF50; color: white; padding: 5px;"><b>Correct</b></p><p style="text-align: center;">That's right! You chose the correct response.</p></div> <p><a href="#">CLOSE REVIEW</a> <span style="float: right;"><a href="#">&lt; PREV</a> <a href="#">NEXT &gt;</a></span></p>		
Special Comment(s):		
<p>3. Reply of the system When Select correct answers.</p> <p>4. Reply of the system When Select the incorrect answers.</p> <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"><p style="background-color: #F44336; color: white; padding: 5px;"><b>Incorrect</b></p><p style="text-align: center;">You did not choose the correct response.</p><p style="text-align: right;"><a href="#">CONTINUE &gt;</a></p></div>		

# Story Board -4

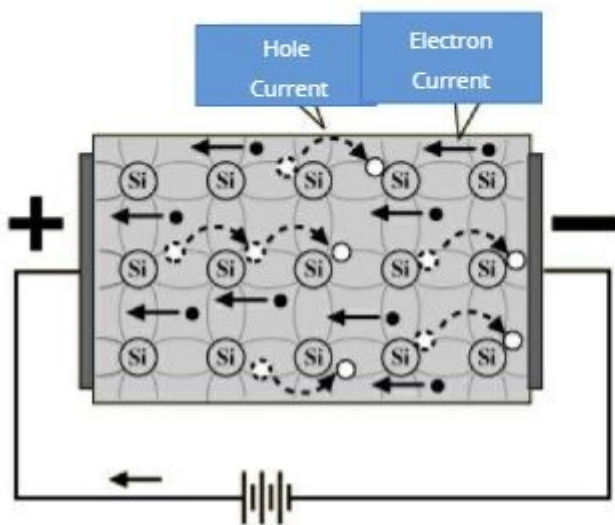
Page Title: <b>ACTIVITY: Question III</b>	Page no. 0x.0y.03.0	SME's name: Venura Liyanagama
Date Designed: 2018/10/15	Date verified: 2018/10/20	

## Design

Drag and drop the objects to their places:

Created with ispring suite evaluation version  
0 days remaining

Answers



**Correct**

That's right! You chose the correct response.

**VIEW RESULTS**

Special Comment(s): .

1. Reply of the system when drag and drop the correct answer.
2. Reply of the system When Select the incorrect answers.

**Incorrect**

You did not choose the correct response.

**CONTINUE >**

## Story Board -5

Page Title: <b>Question IV</b>	Page no. 0x.0y.03.01	SME's name: Venura Liyanagama
Date Designed: 2018/10/15		Date verified: 2018/10/20
<b>Design</b>		
<p>2. What are the Types of impurities?</p> <p>Choose the correct</p> <div style="border: 1px solid #ccc; padding: 5px;"><p>- Select -</p><p>Octavalent and Pentavalent</p><p>Monovalent and Octavalent</p><p><b>Hexavalent and trivalent impurities</b></p><p>Pentavalent and trivalent impurities</p></div> <p style="text-align: right;"><b>SUBMIT</b></p> <div style="border: 1px solid #ccc; padding: 5px; background-color: #f08080; color: white; text-align: center;"><b>Incorrect</b></div> <p style="text-align: center;">You did not choose the correct response.</p> <p style="text-align: right;"><b>CONTINUE &gt;</b></p>		
<p>Special Comment(s): .</p> <ol style="list-style-type: none"><li>1. Reply of the system When Select in-correct answer.</li><li>3. Reply of the system When Select the correct answers.</li></ol> <div style="border: 1px solid #ccc; padding: 5px; background-color: #90EE90; color: white; text-align: center;"><b>Correct</b></div> <p style="text-align: center;">That's right! You chose the correct response.</p>		

RMK: When type the correct answer "Correct" mark is appearing

## Appendix D

### Questions for the Course Evaluation

#### *Visibility of system status and content*

1. The interface of the online course is pleasant and attractive.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

2. Contents are organized in proper manner.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

3. Font size, style and colour are easy to read.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

#### *Navigation, organization and structure*

4. The course has a simple navigational structure and related information is place together Learn ability (Ease of learn) & accessibility.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

5. It is easy to learn how to us the online course

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

6. It is easy to remember how to use it.

- a. Strongly agree
- b. Somewhat agree
- c. Somewhat disagree
- d. Strongly Disagree

### *Flexibility and efficiency of use*

7. The course is easy to use and requires fewest steps to accomplish desired tasks.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

8. Both novice and expert users can use it without any difficulty.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

### *Effectiveness and satisfaction*

9. The course helps me to become more effective and productive.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

10. The course gives me to control over my learning activities and save my time.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

11. Activities and facilities available in online course encourage student- teacher and student-student interaction.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

12. I am satisfied with the online course.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

13. I work the way I want to work.

- a) Strongly agree
- b) Somewhat agree
- c) Somewhat disagree
- d) Strongly Disagree

14. What are your suggestions for improvement of online course?

.....  
.....

15. To which extent online learning supports your overall learning.

.....  
.....