

# Investigating the Effect of E-Learning in Science Education at GCE/O/L

Damith Wickramanayaker<sup>1,\*</sup>, Col. H. A. I. U. Hewarachchi<sup>2</sup>, Sharlene Brown<sup>3</sup>

<sup>1</sup>School of Computing & Information Technology, University of Technology, Jamaica, Kingston, Jamaica

<sup>2</sup>Faculty of Graduate Studies, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

<sup>3</sup>Finance & Accounts, Maritime Authority of Jamaica, Kingston Jamaica

**Abstract** The purpose of this educational research study was to investigate the effect of E-Learning in Science education at General Certificate of Education at Ordinary Level in Sri Lanka. This research examined (i) the differences of the results of students who used E-Learning and who did not (ii) whether the differences were positively or negatively related (iii) and whether the differences are statistically significant or not. This study was a quasi-experimental study design (nonequivalent control group design) which included a nonrandomized sampling design involved an experimental group (treatment group) and a control group both have a pretest and posttest assessment. The study population comprised 270 students of a girl's school in the western province. Due to the convenience of preparation of additional E-Learning material, one English medium class was selected as the treatment group. As there was only one English medium class, the control group was selected from one of the Sinhala medium classes. Each group consisted of 37 students. This study has one independent variable, which was video lessons, and one dependable variable, which was student performance. The quantitative data was collected through pretest and posttests. A question paper was given at the pretest for both the groups at the end of one month of teaching of the chapter one lessons. The treatment group was intervened by giving a CD which contained video lessons. The posttest was conducted on both groups using the same question paper after one month. A questionnaire was given to the students of treatment group and a face interview was conducted with the control group students to obtain students' background environment and activities at school and at home. The study has a null hypothesis ( $H_0$ ) which was *E-Learning does not enhance students performances* and the alternative hypothesis ( $H_1$ ) which was *E-Learning enhances students' performance*. The directional hypothesis was tested using one tailed t-test in order to find out whether there was a statistically significant difference between the posttests means of the treatment and control groups. Three additional tests between groups' and between pretests and posttests were also conducted in order to confirm the validity of the results. The findings showed that there was a statistically significant difference between the means of posttests of both groups. The treatment group posttest mean was higher than the control group posttest mean. Therefore, the results suggested that the intervention might have helped to increase the students' performance.

**Keywords** Effect of E-Learning, GCE/OL, Science Education, Sri Lanka

## 1. Introduction

Information and Communication Technology (ICT) has become the state of the art technology of the modern-day world. Every sector of the economy is forced to use this technology to make their work effective and efficient and thereby maintain a competitive edge. This has changed the types of skills and knowledge needed in the world of work. Even though, Information Technology (IT) education is an integral part of the need of the society; there is no national plan for IT education in Sri Lanka. However, ministerial level decision had not been taken to include IT based

learning as a formal education system whereas libraries and computer labs facilitate for IT based learning has been established to enhance the subject knowledge of Students as in [1]. As stated in [2] advances in digital technology have opened up many avenues of learning. Technology has made information accessible, transmittable from anywhere and by all groups of people. Education has reached most parts of the world and ICT has become an integral part of human life. At present, school children are attracted to IT education without proper guidance from the education system as in [1]. Computer literacy is an imperative precondition for learners to benefit from technology-based learning. E-learning can only build on a set of basic computer literacy skills. Learners should go through an introductory session for each programme that focuses on professional development in the use of technology in the classroom, as in [3]. The Ministry of Education as in [4] has implemented a scheme called

\* Corresponding author:

damithwick@gmail.com (Damith Wickramanayaker)

Received: Aug. 20, 2021; Accepted: Sep. 21, 2021; Published: Sep. 26, 2021

Published online at <http://journal.sapub.org/computer>

“Mahindhodaya Schools” and all Mahindhodaya schools have computer laboratory facilities which provide use of computer and Internet access to students. Also the government of Sri Lanka has set up “Nanasala” E-Learning centers Island wide.

### 1.1. Background

Sri Lanka has intended to give more priority to develop an education hub. There are three dedicated Ministries in this regard to focus on a formal education system of Sri Lanka and those ministries are Ministry of Education, Ministry of Higher Education and Ministry of Education Services. With the direction of aforesaid ministries run by Government of Sri Lanka, provides free education from primary level to tertiary level. The government is insisting schooling for children at age 5 to 16 years. At the age of 16, they undergo Ordinary Level (O/L) and based on the results of O/L they are selected for their advance formal education. The education in the state is fully funded and offered free of charge at all levels, including the university level.

The medium of language in schools education in Sri Lanka is Sinhala, Tamil or English as per preferences of students. Students sit for O/L examination at the end of 11 years of formal education. A teacher centric education is prevailing in Sri Lanka education system and family support also contribute immensely for one's education.

The language of private and international schools is English whereas many government schools use all the three languages for teaching as the medium of instructions. In fact, English Language is mainly used in schools in urban areas. However, the Government has taken many steps to implement teaching in English medium from at least grade six and achievements are yet to be received.

As stated in [5] learning is a process inclusive of an interaction between agents and activities, there is another definition that has highlighted and according to that learning is “gaining knowledge, educating, understanding, and researching, teaching, instructing and gaining wisdom”. There is also another definition which states that, learning is a process which can change the experience of pupil by building skills, attitude and behavior towards work. In [6] mentioned was made that learning uses mutually constructive elements such as the learner, learning process which includes the learning materials and the teachers. However, with the evolution of technology, students have the freedom to learn through Internet and other technology based methods like mobile learning, online courses, and educational Compact Disks (CDs).

### 1.2. Research Problem, Objectives and Hypotheses

The research had the following research problem, “Can E-Learning Enhance the Student's Performance of the Science Subject? The researchers investigated whether the students performance were better when they use E-Learning than the students who do not.

The primary objective of this study was to find out whether E-Learning has an effect on students' performance.

To achieve the above primary objective, the researchers have the secondary objectives (1) to find out the differences of the results of students who used E-Learning and who did not. (2) to find out whether the above mentioned difference was positively or negatively related (3) to find out the above mentioned impact was significant or not.

There were two hypotheses in this research. The null hypothesis ( $H_0$ ) was E-Learning does not enhance students' performances. The alternative hypothesis ( $H_1$ ) was E-Learning enhances students' performance.

### 1.3. Research Questions

The researchers had the following three research questions:

Is there a statistically significant difference between the Science tests score of the students using E-Learning compared to those students without E-Learning?

Can students use E-Learning to improve their subject knowledge?

Can a CD containing video lessons be used as a learning material to teach Science subject to students?

## 2. Related Work

The Researchers researched related work in the era of E-Learning, types of E-Learning, History of E-Learning, Advantages and Disadvantages in E-Learning, Theories of motivation, The E-Learning models and theories. The Researchers also examined similar research conducted in Sri Lankan context and other countries.

### 2.1. Introduction to E-Learning

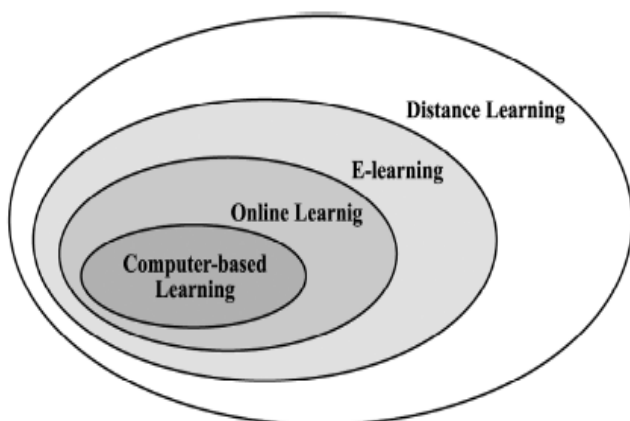
The ‘E’ in E-learning as in [7] joins many common hybrids such as e-mail and e-commerce in signifying enactment through electronic means, typically interpreted as computer based. Essential components of all ‘e’ enterprises are the computer hardware and software, but also the networking infrastructures that make it possible to collect and distribute data, information and knowledge to people at different times and locations. Devices that permit access to these data streamed there no longer needs to be the fixed desktop computer. The mobility and multimedia capabilities afforded by laptops, palmtops (also known as Personal Digital Assistants (PDAs), mobile phones, and media players (e.g. MP3 players), shatter our notions of where and by what means ‘e’ activities can take place. Thus, in considering e-learning, we include a range of electronically networked Information and Communication Technology (ICT) via which learning can take place.”

The second element in the ‘e-learning’ is learning itself. It is well recognizing that there is already much material on learning theory relevant to e-learning. As in [7], “e-learning system means having people talking, writing, teaching, and learning with each other online, via computer-based systems. While e-learning is usually implemented via a suite of software tools, such implementation is only the surface of

the e-learning environment. E-learning encompasses any and all means of communication available to participants, from dedicated course management systems to late-night phone calls and e-mail in the early hours of the morning, from instructor-prepared lectures to collaborative products generated through discussion boards, blogs and Wikis.”

Information literacy was being recognized as an essential skill for the 21<sup>st</sup> century as in [8] and E-Learning emerged as a method of self-motivated learning with development of the technology. Therefore E-Learning can be considered as a computer aided learning system as in [9] and Digital technologies such as computers, mobile devices, digital media creation and distribution tools, video games and social networking sites are transforming how we think about schooling and learning as in [10]. As described in [11], the world is described as an e-World where technology was used in our day to day lives thus in future we can predict with no hesitation that technology was even more important for the development of society. It facilitates to share the knowledge worldwide in a very shorter period and it facilitates learning of one part of the world to share that knowledge with the other part of the world in a common dialect as in [12]. Even before E-Learning came to the world, distance learning was practiced using different methods. Later E-Learning was rapidly developed as a subset of distance learning. Both E-Learning and distance learning concept was now used interchangeably in the modern learning arena as in [13]. This E-Learning or virtual learning was named in various terms by different scholars and practitioners. Some of the popular used names are virtual campus, electronic university, cyber training, electronic learning, open learning, network learning, online education, third generation distance learning, Keyboard College and hyper university etc as in [14] even used different names to the E-Learning, the basic concept are same and it helped every one around the world to share the updated knowledge without geographical differences. This E-Learning makes a platform to worldwide students to share their knowledge without geographical barriers.

E-Learning was developed as a distance learning method and the relationship between distance learning and E-Learning can be shown as follows as in [15]:



**Figure 1.** Relations between learning technologies, as in [14 & 15]

As a result of the development of the E-Learning, the E-Learning process was most commonly used by students who sit for online degrees and are able to do their studies through a web based portal. This same method was used by the companies to their staff as well and this has helped companies and employees in various ways. Since employees can save time and money they prefer web based training than the traditional class room learning as in [16]. Electronic learning has become very popular for its flexibility and its cost effectiveness.

The E-Learning Workgroup of the National Information Technology Council of Malaysia describes E-Learning to be constant of hardware, persons and software encouraging multifaceted learning as in [17]. For this purpose distant learning mechanisms are used with interactive cable Television (TV) or sophisticated Internet connection enabling learning in the office or at home by an individual or a large community of people. They further explained that “distance E-Learning”. Distance E-Learning was an instructional delivery done electronically to a student who was physically present with the teacher, which was the computer system that would guide the student through the process of learning or acquisition of knowledge. This was enabled by the video computer technology which was developing as a commonly used information delivery mode as in [16]. As [12] believes that virtual education was where the information and communication technology provides support to a higher form of learning. According to [12], this distance learning support electronic networking, lectures that are delivered on line mostly through the Internet, programs introduced through multi media and the tuition was provided through video conferencing where the course material was mailed to the student.

#### 2.1.1. The Different Types of E-Learning

As mentioned before, people used computer and Internet for their E-Learning purposes in various ways. Four types of E-Learning has been introduced as in [13] and those are informal, self-paced, leader-led and through performance support tools. An explanation of the four types of E-Learning as in [13] is as follows.

**Informal E-Learning** - A learner could access a web site or join an online discussion group to find relevant information.

**Self-paced E-Learning** - Refers to the process whereby learners’ access computer based or web-based training materials at their own pace.

**Leader-led E-Learning** - Refers to an instructor, tutor or facilitator leading the process. This type of learning can further be divided into two categories: learners accessing real-time (synchronous) learning materials and learners accessing delayed learning materials (asynchronous).

**Use of performance support tools** - Refers to materials that learners can use to help perform a task (normally in software) such as using a wizard.

As in [13] the author was in the opinion, that anyone can use any of the E-Learning types according to the requirement

and the availability of the services. Even though E-Learning was used and spread rapidly throughout the world, there are advantaged and disadvantages in the new concept called E-Learning. Anyone who uses Internet or E-Learning should try to maximize the advantages and reduce the disadvantages as in [13].

## 2.2. E-Learning in the Region

Information has become a fundamental resource in developing countries such as Sri Lanka in order to improve quality of governance and socio-economic development as in [18,19]. It was recorded that 25.6% of the world's population uses the Internet and 42.6% of this population are users in Asia as in [15]. Studies of E-Learning in Asia found that E-Learning in India can be found easily. As stated in [20], India has got the attentions as a South Asian country which mostly uses E-Learning. Although India was a developing country it has given more priority for E-Learning. India has now moved away from the traditional class rooms to, E-Learning classes, e-tutorials and e-books. India has become a technological innovator within the region. Countries like Bangladesh, Pakistan, Myanmar and Nepal also display similar characteristics as in [21].

In South Asian countries, most people educated in specialized areas of work seek work in foreign countries. There were families that migrated with the hope of giving their children better education abroad as in [19]. Due to these two reasons most of the specialized resources were not retained in South Asia but were in other parts of the world. With E-Learning; there was a significant amount of knowledge that was retained because of the education system that was developed within India and in Sri Lanka. The e-classes that were provided in India, Pakistan and other such countries were educating people in thousands. E-Learning has been able to coexist with other technologies despite the fact that they were arch rivalries in the techno world. The cost of tablets and personal computers were reducing and the ability of the use of broadband to penetrate deeper areas makes it possible even among the rural people.

India and Pakistan were leading the regain in E-Learning and information technology, while Sri Lanka is trying to go par with them as in [19].

The shortages of skilled persons in IT in Sri Lanka have prevented increased use of E-Learning. The trainers were not able to identify their role in supporting the learners to obtain an advanced knowledge as in [22]. The backing of the organizations, support of the trainers and the own need to study using E-Learning were also vital factors as in [15]. Lack of staff awareness about information skills, lack of understanding about constructivist-based pedagogy and lack of training opportunity for academics were also barriers for the use of E-Learning in Sri Lanka.

Developed countries in Asia like, Malaysia, Singapore and Brunei have found ways to promote E-Learning in their own techniques but Bangladesh, Maldives, Pakistan and Sri Lanka struggling to face the issues that makes E-Learning

unpopular. Even with a skilled IT based set up, E-Learning was not used to the full extent in India. Sri Lanka won the outsourcing destination of the year award for 2013 and 2014 due to its IT based services, but when it comes to the E-Learning it was far behind than Pakistan and India as in [23].

## 2.3. E-Learning in Sri Lanka

Sri Lanka maintains high educational standards as compared to the rest of Asia as in [24]. However, examined researched papers with regard to the local context it was quite clear that even though there was potential for E-Learning it was not implemented on a broad scale [15] but now E-Learning is becoming popular, especially among higher education institutes (universities) in Sri Lanka [23] and now several universities have transformed their traditional face to face learning into E-Learning.

The government and private sector organizations have implemented E-Learning services to facilitate school children in Sri Lanka. E-Learning ensures access to information about recent education through the use of information and communication technologies (ICT). The recent growing trend of E-Learning mostly benefits the students in Sri Lanka even though lack of infrastructure facilities, lack of connectivity and lack of IT qualified teachers in schools in some parts of the country. The Ministry of Education with the help of Information Communication Technology Agency of Sri Lanka (ICTA) had implemented E-Learning to facilitate specifically rural and state sector school children.

One such project implemented was "Nenasala" Tele Center as in [25] started by Sri Lanka government under the e-Sri Lanka initiative has distance and E-Learning services included of all infrastructure facilities for E-Learning environment. The overall objective of the Nenasala project was to provide new information sharing and learning opportunities to the rural areas.

Another project launched by the Ministry of Education to facilitate e-education in Sri Lanka was E-thaksalawa as in [26] paying attention to educational situations at international level and e-educational situations experienced by the children of the other countries. E-thaksalawa was a platform which was updated every day. It has provided online services from grade 1 to grade 13 students.

Web Patashala, [27] is another E-Learning platform which was implemented by Etisalat telecommunication Sri Lanka. It allows students and teachers to access educational material from the national syllabus. This E-Learning platform constantly reviewed to ensure that the highest standards are maintained by the National Institute of Education (NIE) under the guidance of the Ministry of Education.

Mobile Sri Lanka has introduced master level programs collaboration with some universities in Sri Lanka under their flagship brand "m-learning". This has helped several outstation students to follow their master degree programs while staying in their working place or at home without

traveling to those universities.

Under the Mahindodaya thousand secondary schools development programme as in [4], each school was provided with computer laboratory facilities. According to the ministry report, every Mahindodaya technological computer laboratory consisted of a computer center with 40 computers, a language laboratory with 20 computers, a Science Laboratory, Mathematics Laboratory and a Nenasu unit for distance education.

#### 2.4. Advantages of E-Learning

Even before introducing the E-Learning, there were different distant learning courses in the world. That distance learning was mainly conducted through the postal services but time consuming was one of the barriers of those distance learning courses since the traditional snail mail was not quick as today's E-Learning courses as in [16]. After the introduction of Internet and computer based learning platform, this traditional distance learning programs faded. Therefore, now educational institutes have introduced a wide range of distance E-Learning courses. Barron (2001) observes that learning technology providers have been increasingly able to "demonstrate cost-savings and broader benefits, develop integrated offerings, and propose innovative ways of applying E-Learning"[28]. Those new E-Learning courses help learners to save their time and money. This led educational institutes to change their training and development function from traditional classroom training to E-Learning as in [9]. Since employees do not want to commute from work place to training location it helped them to learn while sitting on their own work place. As a result, employees have extra time for learning purpose and they would not miss their work or training opportunity. It is a time saver and by that, it also saves money. These save travel time and save material cost lead students and organizations to prefer using E-Learning methods than following the traditional way of studying.

Students can use E-Learning according to their convenience anytime anywhere. In the traditional learning, students should attend the particular class on particular time. E-Learning supports students to log in to the college website from their home. E-Learners can use their own pace and schedule their activities accordingly as in [16]. Since the students can study using web, they feel more satisfied than traditional learning methods. Also E-Learning permits each student to select learning material of their choice. Since they can select their reading material and those reading material would suit each individual to enhance their knowledge and their performance in an effective and efficient manner.

In a traditional learning scenario within a classroom, it is the Lecturer or the Teacher that is assessed but in E-Learning, there was a self-assessment of the student. This helps students to find out where exactly the student stands with his training and set standards. Such a self-assessment offered by E-Learning helps the student to access what knowledge that was gained post and pro assignment and quantify actually

how much the student has gained from the training as in [29].

The corporate world is also using E-Learning as a powerful learning and training tool as in [12]. This is because E-Learning offers timeless business solutions, that helps in reducing cost and increase the work place satisfaction and also motivate employees to pursue such innovative and technologically advanced training practices [12]. One of the mostly used training methods in the corporate sector was on the job training, but now companies have moved from on the job training to e-based learning. As technology has advanced, the uses of computers were slowly reducing and the use of mobile technology was emerging. In modern times E-Learning employs hand held devices to promote E-Learning. Tablets and mobile phones are widely used as E-Learning devices. Leading mobile telecommunication providers in Sri Lanka also have introduced E-Learning services combining with several educational institutes.

#### 2.5. Disadvantages of E-Learning

Since most of the time computers are used as the main equipment for E-Learning, it is very difficult to use E-Learning without computer literacy. Therefore if any institution or organization wishes to use E-Learning, they would need to train their staff / students on how to use computers before they could provide the E-Learning facilities [30]. E-Learning offers students' access to the opinions of peers and the resources of the web, such self-directed study requires competence in computer literacy as in [31]. Hence, lack of computer literacy may affect students' self-directed studies in E-Learning.

For E-Learning to thrive, there is a necessity to invest in computer hardware and in the Internet facility. The users must be skilled in programs such as word processing, Internet browsing and email as in [32]. Having the software in relation to E-Learning available, while the student does not have the skill to access such information is useless. Without these skills and software it was not possible for the student to succeed. As much as the E-Learner needs to be comfortable with the use of computers, the appliance that uses cannot be outdated nor can the Internet connection be extremely slow. This would make accessing the information difficult and that would frustrate the student. The student may become discouraged and give up his/her studies if these limitations prevail. A study conducted as in [33] stated, that user satisfaction with technology was the largest barrier to positive acceptance of E-Learning and for E-Learning to be successful the reading material has to be stored in an organized manner that would make it possible for the user to access the information whenever required as [34] found out in his research that for E-Learning to be success, the major contributions come from the system quality parameters, that means for any academic institution irrespective of its stake holders and the organizational conditions, can successfully utilize and E-Learning solution if the system behave as a good software solution. If the user was not computer literate, there was a chance that user may lose the reading material

folder.

When using E-Learning, most learners learn alone, therefore learners should develop an attitude of self learning. It is the motivated and self-determined student that would get through as pointed out in [16]. If students are poorly motivated and entertain bad study habits, then these students would not get through an E-Learning environment. Some students require a teacher before them to explain the contents of the lesson, monitor their progress, and motivate them to proceed with their studies. With e-Learning, The traditional classroom experience would not be provided but instead, it would be replaced by discussion forums and online supervisor chats. There are certain students that require student to student interaction. These students find it frustrating studying alone as in [35]. In most occasions, these students do not complete their programs because of these reasons.

If the routines of classroom learning were no more; students would feel lost, confused and unfocused about the learning course they were attending as in [16]. These attributes can lead to missing deadlines and failures. There are more disadvantages in E-Learning specially, if there was a shortage of skilled online Lecturers. If online instructors were not properly trained; and the manner in which contents were presented online was very different from the way it should be, the manner in which these trainers faced the camera and the tone of presenting information varies would affect the student learning as in [36]. Instructors must seek to adapt to the technical changes of an online training. The cost effectiveness of a program was difficult to calculate as in [36]. This was due to the ever evolving technology.

### 3. Methodology

#### 3.1. Theoretical Framework

The theoretical framework of this experimental study was conducted using the conceptual framework of Students performance using E-Learning students and non E-Learning students.

##### 3.1.1. Conceptual Framework

The conceptual framework related to the research problem is in Figure 2 below:

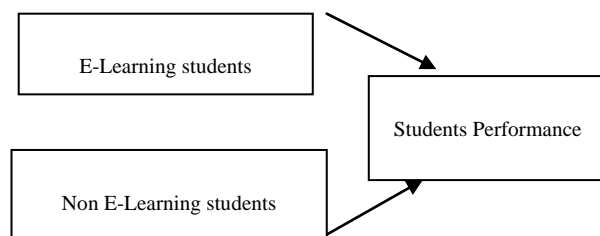


Figure 2. The Conceptual Framework

#### 3.2. Variables

There was one independent variable and one dependent

variable. The independent variable was the video lessons containing the CD (E-Learning method). The dependent variable was the student's performance.

#### 3.3. Hypothesis

The experimental method is the only method of research that can truly test hypotheses concerning cause-and-effect relationships as in [39]. It represents the most valid approach to the solution of educational problems, both practical and theoretical, and to the advancement of education as a science. This research study was an experimental research. A hypothesis was addressed by the researchers. A hypothesis was used as a map to gain a clear view and flow of the direction for the study. In this research study, two hypotheses, null hypothesis ( $H_0$ ) and alternative ( $H_1$ ) hypothesis were evaluated.

$H_0$  = E-Learning does not enhance students performances

$H_1$  = E-Learning enhances students' performance

#### 3.4. Study Design

This explanatory research was carried out to investigate the effect of E-learning in Science education at GCE O/L in Colombo, Sri Lanka. In this research, the researchers tested the directional hypothesis, "E-Learning enhances students' performance". The two key designs that help researchers address whether a program or treatment causes an outcome are the experimental design, which uses random assignment to groups or programs, and quasi-experimental designs, which do not use random assignment as in [37]. True experiments should be conducted when possible, but if they are not feasible, a quasi experiments should be conducted "we must do the best we can with what is available to us" as in [38]. Quasi-experiments represents the best available compromise between the general aim of gaining valid knowledge regarding the effectiveness of a treatment and the realization that true experiments are not always possible.

This quantitative research study used quasi-experimental study method, which was a nonrandomized, nonequivalent control group design with pre-post intervention. A non-randomized sample was selected on the basis that. It was not ethical to subsidize one group of students with additional resources, while depriving the privilege to another group and due to the convenience factor.

There were two groups included in this study, the treatment group and the control group. This research was carried out when students were on their last semester. The students had Physics lessons according to the syllabus for their last Semester. Due to the convenience of preparation of additional E-Learning material from the already available sources on the Internet, one English medium class was selected as the treatment group. There was only one English medium class; the control group was selected from one of the Sinhala medium classes. Each group consisted of 37 students.

The question paper consisted of forty multiple choice questions. The questions were prepared according to the

chapter one lessons of the third term syllabus. The question paper was given at the pretest for both groups after one month of teaching of the chapter one lesson. After the pretest, the treatment group was given the CD which contained video lessons of grade 10 Science text book as the treatment. The treatment group was given one month duration to refer the CD during the school and at home. The posttest was performed on both groups after one month. In order to know whether students had actually referred to the CD and also to know the students background and other activities at the school and at home, a questionnaire was given to the students of the treatment group. A face-to-face interview was conducted with randomly selected students of the control group to know their background and other activities at the school and at home. The hypothesis was directional; one tailed t-test was performed to find out whether there was a statistically significant difference between the posttests means of the treatment and control groups. Three additional tests were conducted to see whether a significant difference existed. One test between the pretest and posttest results of treatment group, another test between the pretest and posttest results of the control group and another test between the pretests results of both groups. Statistical analysis was done through t-test using SPSS. Only quantitative data was used for data analysis.

#### 3.4.1. Study Population

The study population was the students who were belonging to a girl's school in the Western Province in Colombo District, Sri Lanka. The school is classified as a National School by the Ministry of Education in Sri Lanka. The school provides shelter for more than 2500 students. The students were provided education in Science, Mathematics, Commerce and Arts streams. The school has both Sinhala and English medium classes. Students were receiving instruction in both Sinhala and English medium for Science subjects.

#### 3.4.2. Sample Population

The sample population of this research was 270 students of grade 10 in both Sinhala and English medium classes. The participants were from different social backgrounds, from middle to upper class. The students were between 15 - 16 years old.

#### 3.4.3. Sampling Design and Size

This study used non-probability sampling method. A nonrandomized sample was selected as there were two groups included in this study, the treatment group and the control group. Due to the convenience of preparation of additional E-Learning material from the already available sources on the Internet, one English medium class was selected as the treatment group. There was only one English medium class in the school and the control group was selected from one of the Sinhala medium classes. Each group consisted of 37 students. Since one group consist 37 students,

total sample size consist of 74 female students.

#### 3.4.4. Method of Data Collection

Three methods of data collection were used to collect the required data. The main data collection method in this experimental study was the use of pretests and posttests. The second method was questionnaire and the third method of data collection was the face to face interview with the students.

For Grade 10, 3<sup>rd</sup> term, Science subjects commenced with Physics module. There are five chapters for the Physics module. Teaching of the chapter one lessons commenced at the first month of the term. Both groups had lectures separately. These two groups were taught by the same teacher according to the time table in the two classes. A question paper prepared in English and Sinhala mediums was given at the pretest and posttest. The two groups were told about the tests separately, but they were not told about the research study.

The question paper was prepared according to the lessons in chapter one. The question paper was given to the teacher for verification before the paper is finalized. The duration of each test was 45 minutes consisting 40 multiple-choice questions. The question paper was same for the pretest and posttest. After the pretest, each student of the treatment group, English medium students, were given a CD containing the first chapter of Physics lessons: "**Force and Linear Motion**". They were asked to refer to the CD during the school and at home. The CD contained video lessons in accordance with their 3<sup>rd</sup> term Physics syllabus. The control group was kept under the normal condition. To obtain how student's habits and activities towards learning in the school and at home; students of the treatment group were given a questionnaire.

Since the questionnaires were given only for the treatment group, few students randomly selected from the control group were also interviewed in order to obtain students learning habits and their learning activities at home and at the school.

#### 3.4.5. Instruments

The main instrument of the research study was the pretest and the posttest. At the end of the 1<sup>st</sup> month of the 3<sup>rd</sup> term both groups were given the pretest. At the end of the 2<sup>nd</sup> month of the 3<sup>rd</sup> term both groups were given the posttest.

After the posttest the treatment group students were given a questionnaire as an instrument to obtain more details about student's background and their activities in the school and at home. A face to face interview with randomly selected control group students was also conducted to obtain more details about student's background and their activities in the school and at home.

#### 3.4.6. Assumptions

For this experimental study, two assumptions were used, namely

1. That all the students know ICT and they have fair knowledge on the use of internet and E-Learning methods.
2. That all the students' knowledge levels were equal. There was no knowledge gap between students in two mediums.

### 3.5. Data Analysis and Validity

In this study the instrument used for measuring the achievement (dependent variable) was the pretest and posttest results. These tests were set according to the course outline (syllabus) that clearly defined the objectives of the third term contents. Hence, the measurements of the grades from these tests were a true reflection of the students' achievements. Hence, in this sense the instrument was valid.

The data was analyzed using Statistical Package for Social Sciences (SPSS) software and MS excel. A significance level of .05 was utilized for this study. As the hypotheses were directional, one tailed t-tests were done to measure the deference between the two samples. To see how likely that such a difference would appear from the two samples was done by looking at the *p-value* (Significance level  $p=.05$ ).

## 4. Results

These results indicated that almost half of the students of the treatment group had spent 3 – 5 hours for studies. These results indicated more than half of the students in the class were keen to learn Science subject with 67% of the students have spent between 1-2 hours per day to study the Science subject while 23% students had spent less than one hour to study the Science subject per day. For students referring to CD, the results showed that around 80% of students had referred to the CD at least 30 minutes or more per day which would increase the treatment effect.

The number of hours spent on the internet per day for studies by students' shows, 37% of students had used the Internet less than 30 minutes for studies while the same amount of students had used Internet between 30 minutes to one hour for studies per day. Around 26% of students had used Internet more than one hour for studies. These results indicated that all the students had used Internet in a day whereas around 37% of students had used Internet at least 45 minutes a day. This may have caused to a threat to the treatment.

The number of hours spent in the school library for studies per day by students 50% of students had spent less than 30 minutes in school library for studies while 50% of students had spent 30 minutes to one hour in the school library for studies. The use of library for study may also affect treatment.

The results for additional reading per day by students' shows 43% students had used 30 minutes to one hour every day for additional reading. Around 37% of the students had spent one to two hours. Also 10% of the students had spent

less than 30 minutes for additional reading while similar percentage had spent more than two hours for additional reading per day. These results indicated that more than 75% of students had spent at least 30 minutes to 2 hours for additional reading.

The results for the number of students attended Science subject tuition classes showed 93% students had attended tuition classes for Science subject while only 7% had not attended tuition classes. These results indicated that almost all the students had attended tuition classes for Science.

The result from the support received by students from family members shows 70% of the students had obtained study support from their family members and relatives while only 30% had not sought any support for studies from their family members and relatives. This indicates more than half of the students had support from their family members for the Science subject.

The results for the number of students who discussed their Science subject issue with their classmates showed 100% of the students had discussed Science subject with their classmate. These discussions may have improved their Science knowledge as well as may have helped to increase their posttest result.

The results for the students' favourite subject showed Mathematics with 34% as the most favorite subject of the treatment group. Science subject was the second favorite subject of the students with 23%. Both French and ICT showed results of 3% which has become the least preferred subject of the students in the treatment group. This indicates the students' interest of the Science subject is more than the other subjects except Mathematics.

Students who likes Science subject showed 90%, while only 10% of the students did not like the Science subject. This interest shown by the students for Science subject may incorrectly assumed that the treatment itself might have caused the effect. For students who liked Science subject as their career showed a 50% result while

The results for the number of students who used additional reading other than the given CD showed that 77% of the students used additional reading for Science subject other than the given CD while 23% students had not referred any additional reading. The students reading additional materials to study Science subject may have affected the posttest result and may incorrectly assumed that the treatment itself might have caused the effect.

The number of students who used Internet to study the Science subject showed 67% of the students had used Internet to learn Science subject while 33% students had not used Internet to study the Science subject. This result indicated that more than half of the class had used Internet to lean the Science. This finding may also affect the treatment causing a threat to the internal validity.

While students' understandings of the teaching of Science resulted in a 40% rate of understanding when the Teacher explained, there was a rate of 60% of the students who did not understand the subject well when the Teacher explained.



This may be due to the understanding of English language or teacher's poor teaching ability in English or may be due to lack of interest.

The students assessment of their Teacher showed 73% of students had rated their Science teacher as average while 14% rated as good and 10% had rated as their Science Teacher as bad where as only 3% had rated as very bad. This shows most students assess their Science Teacher as average and below the average. This may be due to the teachers teaching ability or very low Teacher – Student interaction.

#### 4.1. Presentation of Data Collected Through Face to Face Interview

The researchers had face-to-face interview with seven randomly selected students' from the control group in order to get a better understanding of their learning habits and family background. All the respondents had answered "No" at the interview when asked whether they have used Internet to learn Science at home. They have said "No" at the interview when asked whether they shared the CD given to the treatment group. When asked, whether they have used any distance learning (eg. e-patashala) method for study purposes, all the respondents had answered "No".

When asked, Six (6) out of Seven (7) students had attended tuition classes and had used other reading materials to study the Science subject. Only two (2) had received the help from their family members to study the subject. Similar to the treatment group, all of the respondents had discussed the subject matters with their class mates. Only one (1)

respondent had no computer or Internet facilities at home. Six (6) out of seven (7) students had computer facility at home and four (4) out of seven (7) students had Internet facility at home.

#### 4.2. Testing of Hypothesis

The researchers tested the following hypothesis,

$H_0$  = E-Learning has no relationship with students' performance

$H_1$  = E-Learning enhances students' performance

As the hypothesis was directional, the researchers conducted one tailed paired t-tests in order to see whether there was a statistically significance difference between the groups test results. The t-tests conducted were as follows.

- The Control group and the treatment group posttest results
- The Control group and the treatment group pretest results
- The Pretest and the posttest results of the control group
- The Pretest and the posttest results of the treatment group

##### Test 1 - between the control group and the treatment group posttest results

Table 1 shows the mean value and the standard deviations between the control group and the treatment group posttest results. Note:  $P < 0.05$

**Table 1.** Mean and Standard Deviation for the control group and the treatment group posttest results

	Mean	N	Std. Deviation	Paired Differences		p (1-tailed)
				Mean	Std. Deviation	
Pair 1 control group	40.00	37	4.63	-6.55	5.28	.000
treatment group	46.55	37	6.49			

The results showed, mean (M) value of the posttest result of the control group was 40.00 and the Standard Deviation (SD) was 4.63 (M=40.00, SD=4.63). The treatment group mean was 46.55 and the Standard Deviation (SD) was 6.49 (M=46.55, SD=6.49). The Mean Difference of both groups (MD = 40.00 - 46.55) was -6.55 (MD= - 6.55). The mean of control group was lower than the mean of treatment group. The p value 0.000 (p=.000) was less than 0.05 ( $p < 0.05$ ), there was a statistically significant difference between the

control group and the treatment group posttest results. Hence, the null ( $H_0$ ) hypothesis was rejected.

##### Test 2 - between control group and the treatment group pretest results

Table 2 shows the mean value and the standard deviations between the control group and the treatment group pretest results. Note:  $p > 0.05$

**Table 2.** Mean and Standard Deviation for the control group and the treatment group pretest results

	Mean	N	Std. Deviation	Paired Differences		p (1-tailed)
				Mean	Std. Deviation	
Pair 1 control group	39.73	37	7.58	2.51	10.97	.086
treatment group	37.21	37	8.99			

The results showed, mean value of the pretest result of the control group was 39.73 and the Standard Deviation (SD) was 7.58 (M=39.73, SD=7.58). The treatment group mean

was 37.21 and the Standard Deviation (SD) was 8.99 (M=37.21, SD=8.99). The Mean Difference of both groups (MD = 39.73 - 37.21) was 2.51 (MD=2.51). The mean of

control group was higher than the mean of treatment group. The p value 0.086 ( $p = .086$ ) was greater than 0.05 ( $p > 0.05$ ), there was no statistically significant difference between the control group and the treatment group pretest results.

### **Test 3 - between pretest and posttest results of the control group**

Table 3 shows the mean value and the standard deviations between pretest and posttest results of the control group.

Note:  $p > 0.05$

**Table 3.** Mean and Standard Deviation for pretest and posttest results of the control group

	Mean	N	Std. Deviation	Paired Differences		P (1-tailed)
				Mean	Std. Deviation	
Pair 1	pretest	37	7.58	-.27	8.53	.424
	posttest	37	4.63			

The results showed, mean value of the pretest result of the control group was 39.73 and the Standard Deviation (SD) was 7.58 ( $M = 39.73$ ,  $SD = 7.58$ ). The posttest mean was 40.00 and the Standard Deviation (SD) was 4.63 ( $M = 40.00$ ,  $SD = 4.63$ ). The Mean Difference of both tests ( $MD = 39.73 - 40.00$ ) was  $-.27$  ( $MD = -.27$ ). The mean value of the posttest was higher than the mean value of pretest. The p value 0.424 ( $p = 0.424$ ) was greater than 0.05 ( $p > 0.05$ ), there was no

statistically significant difference between pretest and posttest results of the control group.

### **Test 4 - between pretest and posttest results of the treatment group**

Table 4 shows the mean value and the standard deviations between pretest and posttest results of the treatment group.

Note:  $p < 0.05$

**Table 4.** Mean and Standard Deviation for pretest and posttest results of the treatment group

	Mean	N	Std. Deviation	Paired Differences		p (1-tailed)
				Mean	Std. Deviation	
Pair 1	pretest	37	8.99	-9.33	10.30	.000
	posttest	37	6.49			

The results showed, mean value of the pretest result of the treatment group was 37.21 and the Standard Deviation (SD) was 8.99 ( $M = 37.21$ ,  $SD = 8.99$ ). The posttest mean was 46.55 and the Standard Deviation (SD) was 6.49 ( $M = 46.55$ ,  $SD = 6.49$ ). The Mean Difference of both tests ( $MD = 37.21 - 46.55$ ) was  $-9.33$  ( $MD = -9.33$ ). The mean value of the posttest was higher than the mean value of pretest. The p value ( $p = 0.000$ ) was less than 0.05 ( $p < 0.05$ ), there was a

statistically significant difference between pretest and posttest results of the treatment group.

## **4.3. Data Analysis and Discussion**

### **4.3.1. Analysis of Findings from the Four T-Tests**

The summary of the four t-tests results conducted is presented in table 5.

**Table 5.** The summary of the four t-tests results

Test	N	Differences		P (Value) one tail	Sig. Difference
		Mean	SD		
1. Posttest results of treatment group - control group	37	6.55	5.28	.000	Yes
2. Pretest results of control group - treatment group	37	2.51	10.97	.086	No
3. Control group's posttest - pretest results	37	0.27	8.53	.424	No
4. Treatment group's posttest - pretest results	37	9.33	10.30	.000	Yes

### **Test 1 - posttest results between the control group and the treatment group**

Test 1 found that, there was a statistically significant difference between the control group and the treatment group posttest results (table 5). The alternative ( $H_1$ ) hypothesis "E-Learning enhances students' performance" was accepted. The mean of posttest of the treatment group ( $M = 46.55$ ) was statistically higher than the mean of posttest of the control group ( $M = 40$ ). The mean difference between the posttests was  $MD = 6.55$  ( $MD = 46.55 - 40$ ). Hence, by observing the

posttest difference of both groups, it can be assumed that this difference may have caused due to the intervention to the treatment.

### **Test 2 - pretest results between the control group and the treatment group**

Test 2 found that there was no statistically significant difference between the control group and the treatment group pretest results (table 5). The pretest was held for both groups before the intervention. In this test, both groups had answered the same test paper. Hence, no significant

difference between the groups suggests that the Science knowledge of both groups were equivalent at the beginning. This improves the validity of the results.

### **Test 3 - between pretest and posttest results of the control group**

Test 3 found that, there was no statistically significant difference between pretest and posttest results of the control group (table 5). The mean difference between posttest and pretest was .27 (MD=.27). This may be due to the fact that the face to face teaching was not effective or control group students did not have any interest to study.

### **Test 4 - between pretest and posttest results of the treatment group**

Test 4 found that, there was a statistically significant difference between pretest and posttest results of the treatment group (table 5). The mean difference between posttest and pretest was 9.33 (MD=9.33). This result further confirms that the treatment was very effective. This also improves the validity of the results.

#### **4.3.2. Discussion of Findings from the Questionnaire and Face-to-Face Interview**

It was important to point out that when comparing the answers given by the treatment group participants and responses given at the face-to-face interview with the control group participants, effect of noise variable was observed.

The results showed, 93% students had attended Science tuition in the treatment group and as similar to this, in the control group students. Six (6) out of Seven (7) (almost 90%) students had attended tuition to study the Science subject.

All the students in the control group had discussed Science subject with their classmates as similar to this, in the control group students, all of the respondents had discussed the subject matters with their classmates.

The results showed 77% of the students had used additional reading for Science subject other than the given CD, as similar to the control group students, Six (6) out of Seven (7) students had used other reading materials to study the Science subject.

#### **4.3.3. Discussion of Low Marks Obtained Students of Treatment Group at Posttest**

Some students of the treatment and the control groups have obtain low marks at their posttest. This may be due to the following reasons. Seven students of the treatment group have obtained low marks for their posttest comparatively to the pretest. Based on such results, the researchers felt to interview students to identify the real reasons for obtaining low marks.

During the interview, it was highlighted that student No ST3's mother had gone on an overseas training for 3 months. Therefore, that may have affected her results.

- a. ST7 did not give any reason.
- b. ST12, ST31 and ST34 had participated for Interschool Netball tournament.

- c. ST14 and ST18 had suffered from Chicken Pox.

Indeed, the reasons that had been given by the students other than the students who had suffered from Chicken Pox cannot be much accepted as they could have found time for their studies. However, the researchers, had observed that the seven students who have obtained low marks had a very slight difference on results comparatively pretest which was negligible.

#### **4.3.4. Discussion of Low Marks Obtained Students of Control Group at Posttest**

There were 15 out of 37 students of the control group who have obtained low marks for the posttest than the pretest. The researchers interviewed those students to find out the reason for obtaining low marks. There was no valid reason found for obtaining low marks at the posttest. There were few points revealed at the interview which were mentioned below,

- a. Three students numbering had suffered from Chicken Pox.
- b. One student stated that her family member was suddenly died and engaged for commitments.
- c. Three students have been practicing for a Netball tournament and therefore did not have enough time.
- d. The rest of the students did not give any reason.

## **5. Conclusions**

The research question of this study was "Is there a statistically significant difference between the Science tests score of the students using E-Learning compared to those students without E-Learning?"

The related work and the results related directly to the purpose of the study, investigated the effect of E-Learning in Science education at G.C.E O/L. The related work also clearly supported the importance of E-Learning in education.

Research studies conducted previously, found in the related work, suggested that, there were significant difference between computer based learning and the traditional learning. The computer based learning students had performed better than the traditional learning students. Previous research as in [40] and [41] also supported this viewpoints based on their research studies of comparing groups of supplementary E-Learning / computer based learning methods with traditional learning. Research findings in [42] suggested that the knowledge acquired by interactive learning method was more effective than the non-interactive learning method. Online interactions help students to minimize the failure rate as in research findings [43]. To measure the effectiveness of an E-Learning tool as in [44] suggested that significant improvements are needed due to the intervention. The previous studies have concurred with the results of this study. The students who were in the treatment group did attain a higher mean score at the posttest than the control group students at posttest.

It was concluded from the findings of the statistical tests

that the alternative hypothesis was accepted based on the level of the significance .05 and the  $p$  value. Based on the results, the statistics revealed that, the means of pretest scores of both groups did not differ significantly. This may be taken as both groups Science knowledge at the beginning of the semester was equal. This improves the validity of the results. There was no statistically significant difference between the pretest and posttest scores of the control group. This finding suggests that the face-to-face teaching was not effective or students did not have interest to study. There was a statistically significant difference between pretest and posttest score of the treatment group. The results further confirmed that the treatment was very effective. This finding also improves the validity of the results.

Finally, the results found that there was a statistically significant difference between means of posttests of both groups. Based on the findings it may be concluded that the video lessons (independent variable) may have helped student to increase their performance.

### 5.1. Recommendations

It was recommended to attach a CD containing video lessons of Science syllabus with the text book students received at the beginning of the term. The text book explains scientific theories and practical situations in illustrated format only. If a CD with video lessons could be provided, students could refer the CD at school or at home.

There were many differences between National schools and Provincial schools when it comes to facilities. E-Learning should be introduced as a distance learning method in the school system as the related work suggested that schools were provided with computer laboratory facilities and also there were E-Learning websites which had implemented by the Ministry of Education could be used to facilitate students.

It was recommended that Teachers be encouraged to experiment with different instructional delivery formats. The schools should conduct Teacher-Training sessions with respect to E-Learning activities. By encouraging Teachers to use E-Learning technologies, students will be better served and the school will remain competitive with other schools.

It was recommended that the results of this study be disseminated to the administrators of schools and to the Ministry of Education.

It was recommended that this report be distributed by sending hard copies to the appropriate parties as well as posting the study on the school website and the University website.

## REFERENCES

- [1] Karunananda, A.S., (2007). How can the Open and Distance Learning effectively facilitate IT Education in Sri Lanka?. Journal, Vol. 4. Open University of Sri Lanka.
- [2] Wikramanayake, G.N. (2005). Impact of Digital Technology on Education. Colombo: Computer Society of Sri Lanka.
- [3] Gunawardana, K.D., (2005). An Empirical Study of potential challenges and Benefits of Implementing E-Learning in Sri Lanka. International Journal of the Computer, the Internet and Management, pp.33.1-8.
- [4] Ministry of Education Annual Report, (2014). Available at: <http://www.moe.gov.lk/> [Accessed on 1 June 2015].
- [5] Herrington, J. and Oliver (1996). Interactive multimedia in education: Design and implementation. [online] Ascilite.org.au. Available at: <http://www.ascilite.org.au/aset-archives/confs/iims/1996/ek/herrington.html> [Accessed 15 Aug. 2013].
- [6] Arteaga (1999).
- [7] Andrews, R., & Haythornthwaite, C. (Eds.). (2007). The Sage handbook of e-learning research. Sage.
- [8] Nera, C.M., (2006). Information Literacy: the 21<sup>st</sup> century skills. Paper presented during the PLAII-STRLC Regional Conference on Promoting Information Literacy for Lifelong Learning: Available at: <http://www.slideshare.net/plaistrlic/information-literacy-the-21st-century-skills>. [Accessed 15 Oct. 2014].
- [9] McCall, J., (1977). Factors in software quality. 3rd ed.
- [10] Collins A. and Halverson R. (2010). The second educational revolution: rethinking education in the age of technology: Journal of Computer Assisted Learning (2010). Blackwell Publishing Ltd. Available at: <https://prezi.com/clu1jy1x5tqw/response-to-collins-and-halverson-on-certain-incompatibiliti/>. [Accessed 10 Jan 2014].
- [11] Cross, J., 2004. A history of e-Learning. [Online] California Available at: <http://www.scribd.com/doc/12913198/History-Future-of-eLearning-On-the-Horizon> [Accessed 12 February 2014].
- [12] Farrell, G., (1999). The development of virtual education. 1st ed. Vancouver: Commonwealth of Learning.
- [13] Broadbent, B., (2002). ABCs of e-learning. 1st ed. San Francisco: Jossey-Bass/Pfeiffer.
- [14] Bhattacharya, I. and Sharma, K., (2007). India in the knowledge economy –an electronic paradigm. International Journal of Educational Management, 21(6), pp.543-68.
- [15] Gunawardana, K. D. (2009). An Analysis of Student Perception of Implementing eLearning in the Sri Lankan Private Higher Education Sector: University of Sri Jayawardenapura. Sri Lanka.
- [16] Meyer, (2003). The Web's Impact On Student Learning -- THE Journal. [online] Thejournal.com. Available at: [http://thejournal.com/articles/2003/05/01/the-webs-impact-on-student-learning.aspx?sc\\_lang=en](http://thejournal.com/articles/2003/05/01/the-webs-impact-on-student-learning.aspx?sc_lang=en) [Accessed 5 May 2013].
- [17] National Information Technology Council Malaysia. Available at: <http://www.nitc.org.my/>. [Accessed on: 12 Oct 2014].
- [18] Goswami, P. R., & Jain, P. K. (2008). Information Professionals in the South Asian Region: The Challenges Ahead. Bulletin of the American Society for Information Science and Technology, 34 (3), 26-29.
- [19] Kularatne, E. D. T. (1997). Information Needs and

- Information Provision in Developing Countries. *Information Development*, 13(3), 117–121.
- [20] Kumar, A. (2013). E-Learning in Commonwealth Asia 2013. Paper presented in the Conference on Modern Practices in Library and Information Services, Nagpur, India.
- [21] Delvechio & Lounney, as quoted in Khan, S. B. and Jumani, N. B. (2007). E-Learning versus traditional learning in Pakistan, *Asian Journal of Distance Education*, 10(1), 28–34.
- [22] Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Rath, J., & Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing*. New York: Longman.
- [23] Fernando, S. (2008). Issues of E-Learning in third world countries. *Online and Distance Learning: Concepts, Methodologies, Tools, and Applications* (pp. 1880–1887). Hershey: Idea Group Publishing.
- [24] Gamage, P. and Halpin, E., (2007). E-Sri Lanka: bridging the digital divide. *The Electronic Library*, 25(6), pp.693 – 710.
- [25] Nenasala. Available at <http://www.nenasala.lk/> [Accessed on: 03 Aug 2014].
- [26] E-Thaksalawa. Available at: <http://www.e-thaksalawa.moe.gov.lk/> [Accessed 15 Oct 2014].
- [27] Web Patashala. Available at: <http://www.etisalat.lk/personal/internet/broadband/meaningful-internet/web-patashala/>. Accessed on 10 Oct 2014].
- [28] Barron, T. (2001). An e-learning industry update. [Online] Available at: [http://www.pttmedia.com/newmedia\\_knowhow/KnowHow\\_Design/Instructional%20Design/eLearning%20Knowledge/An%20E-Learning%20Industry%20Update.doc](http://www.pttmedia.com/newmedia_knowhow/KnowHow_Design/Instructional%20Design/eLearning%20Knowledge/An%20E-Learning%20Industry%20Update.doc). [Accessed on 20 Sept 2014].
- [29] Suraweera, N., Chern L. and Cranefield, J., (2012). E-Learning in Information Management Education in Sri Lanka: Information literacy meets E-learning: let's talk about interconnections and outcomes: Special Interest Group Discussion of the impact of information literacy School of Information Management, Victoria University Wellington, New Zealand. Available at: <http://conference.ifla.org/past-wlic/2012/93-suraweera-en.pdf> [Accessed 15 July 2014].
- [30] Dyson, A. & Gallannaugh, F. (2007) National policy and the development of inclusive school practices: a case study. *Cambridge Journal of Education*, 37(4), pp. 473 –488.
- [31] Macdonald, J., (2010). *Developing competent e-learners: the role of assessment* Routledge. <http://www.tandfonline.com/doi/abs/10.1080/0260293042000188483#.VaNe9l-qqkp> [Accessed on 15 Aug 2014].
- [32] Litchfield, A., Evelyn L., and Lawrence E., (2007). Directions for m-learning: Research to enhance active learning. *Proceedings Ascilite Singapore 2007*. Available at: <https://opus.lib.uts.edu.au/research/bitstream/handle/10453/2120/2007001090.pdf?sequence=1> [Accessed on 15 May 2014].
- [33] Hannon, J. & D'Netto, B. (2007). Cultural diversity online: Student engagement with learning technologies. *International Journal of Educational Management*, 21(5).
- [34] Perera, G.I.U.S. (2009), Key Success Factors for E-Learning Acceptability: A Case Based Analysis on Blended Learning End-User Experience, Department of Computer Science and Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka.
- [35] Picciano, A. G., (2000). Cost effectiveness: An overview. *Online Education*, 2, 147–148.
- [36] Laird, E. (2003). I'm your teacher, not your internet service provider. *The Chronicle of Higher Education*. [online] Proc.isecon.org. Available at: <http://proc.isecon.org/2004/3143/ISECON.2004.Spurlock-Johnson.txt> [Accessed 17 May 2013].
- [37] Shadish, W.R., Cook, T. D., & Campbell, T. D. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston: Houghton-Mifflin. Available at: [http://link.springer.com/referenceworkentry/10.1007%2F978-1-4419-1695-2\\_655](http://link.springer.com/referenceworkentry/10.1007%2F978-1-4419-1695-2_655) [Accessed on 13 Septemebr 2014].
- [38] Campbell, D.T. (1969). Reforms as Experiments. *American Psychologist*. 24. 409–429.
- [39] Gay, L. R. (1992). *Educational research* (4th Ed.). New York: Merrill, (p. 298).
- [40] Dissanayake, S.N, Karunananda, A. S. and Lekamge D.L., (2007) Use of Computer Technology for teaching of primary school mathematics. *Journal*, Vol. 4. Open University of Sri Lanka.
- [41] Weeraratne, B., and Chin B., (2014), A quasi-experiment on the effect of E-Learning on students' mathematics scores and attitudes in Sri Lanka, *Asian Development Bank and Ministry of Education, Sri Lanka, Sri Lanka*.
- [42] Algama, G. S., Wijeratne W. A. R., Weerasinghe B. & Somadasa H. (2005). Sri Lanka journal of educational research. *Research Study on the effectiveness of Learning Pure Mathematics Using Different Types of Instructional Materials*, Open University of Sri Lanka.
- [43] Davies, J. and Graff, M. (2005). Performance in e-learning: online participation and student grades. *British Journal of Educational Technology*. Volume 36, Issue 4, pages 657–663, July 2005. Available at: [http://www.readcube.com/articles/10.1111%2Fj.1467-8535.2005.00542.x?r3\\_referer=wol&tracking\\_action=preview\\_click&show\\_checkout=1&purchase\\_referrer=onlinelibrary.wiley.com&purchase\\_site\\_license=LICENSE\\_DENIED](http://www.readcube.com/articles/10.1111%2Fj.1467-8535.2005.00542.x?r3_referer=wol&tracking_action=preview_click&show_checkout=1&purchase_referrer=onlinelibrary.wiley.com&purchase_site_license=LICENSE_DENIED) [Accessed 17 October 2014].
- [44] Hagen, J.M., and Albrechtsen, E., (2009). Effects on employees' information security abilities by e-learning, *Information Management & Computer Security*, Vol. 17 Iss: 5, pp.388 – 407. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/09685220911006687>. [Accessed on 17 October 2014].