

# A Comparative Study on the Effectiveness of e-Learning Technologies Used in the Blended Learning Approach

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## Abstract

This randomized multigroup with a pre-test and a post-test experimental research study aimed to compare the effectiveness of e-learning technologies used in the blended learning approach in teaching Advanced Programming. It was also aimed to find out the most commonly used e-learning tools and technologies by the faculty members of the NIPSC System teaching information technology education courses. The study was conducted with 29 teachers and 44 students that stood as respondents.

The data were obtained through the use of researcher-made survey questionnaires for the teachers and a researcher-made test instruments on specific topics in Advanced Programming for students. The instruments were submitted to validity and reliability testing. Rank and means were used for the descriptive statistical analysis, the Pearson Correlation set at 0.01 alpha level was used for the reliability correlation while the t-Test set at .05 alpha level was used for inferential statistics. Using the results of the survey conducted with the teacher-respondents, two types of e-learning materials were developed.

The study revealed that prior to the intervention, the level of competency of students enrolled in the subject was described as “satisfactory”. After the intervention, the results showed that their level of competency in the subject was “very satisfactory”. The average gain score yielded positive gains for both e-learning materials. This means that the intervention proved to have significant effects to the learning of the students. The study further showed that the mean gain score of the e-learning two material was higher and therefore more effective compared to the e-learning one material.

**Keywords:** *E-learning Materials, E-learning Technologies, Blended Learning Approach.*

## 1. Introduction

Education is a process of sharing and disseminating information from one entity to another. Such information enables people how to think, to work properly and to make sound decisions as the needs arise. Education should not only provide with the right information at a time but also should also ensure the full understanding and processing of information in a given context. In today's survival of the fittest, it is one of the most important needs in life comparable to several basic needs like foods, clothes and shelter.

There are many different ways of learning, and teaching is only one of them. Hence, the objective of education is learning, not teaching [1]. In the educational process, students must be given wide learning opportunities allowing them the freedom to decide which they could choose or even projects they can experiment to further enhance their level of understanding. Unfortunately, many of the activities in schools allow students to acquire various learning in almost the same way. Students should learn at a very early stage that “learning how to learn” is largely their responsibility. This will promote the idea of a life-long learning.

In today's so-called information age, the role of computers and similar devices in schools have been isolated and given more emphasis. Computers gave opportunities to learners to learn at their own pace. Education, in that sense becomes on-demand, as learners simply decide where, when and how are they going to access information that would in turn enable learning.

Since the growth in the advancement of the technology, the need to integrate technological tools in education has been recognized. Hence, the concept of e-learning has been established. E-learning which stands for "electronic learning", is a general term used to refer to computer-enhanced learning. It is used interchangeably in so many contexts that it is critical to be clear what one means when one speaks of 'eLearning'[2]. Today, the term e-learning has captured a wider scope from the use of personal computers (PCs) and the Internet as it was originally conceptualized to the utilization of more advanced applications, as well as devices or tools for more effective teaching and learning. Currently, the colleges and universities, and even secondary schools, have incorporated e-learning as a teaching strategy but most of these institutions are either using Internet-based or are web-based materials. E-learning is seen as a tool for raising the number of students who may be given access opportunities to higher education, especially those who are in the countryside.

## 2. Related Literature

In e-learning, the use of ICT-based technologies is adopted to create and deliver learning contents and services and can be deployed on-demand, that is, it is available anytime and anywhere. It can either be in a form of compact disk-based, network-based, Intranet-based or Internet-based. It makes use of the textual contents along with the combination of audio, video, animation as well as simulations in learning. Because of this, it can be perceived that e-learning provides a better learning experience more than the level of learning and training being imparted in any crowded traditional classroom. It provides for a self-paced and hands-on learning [3]. However, there is a great deal of motivation that is needed for the students to go into an e-learning course. Since learning is not pushed by teachers in a similar manner as in traditional teaching, students involved in e-learning must have the right attitude towards learning.

The primary importance in any learning environment is the content and the services being provided for the delivery of these contents. Unlike any other form of learning environment, such as the traditional classroom model, e-learning makes use of various ICT-based

hardware, software and telecommunications technologies to provide a comprehensive and enriching experience to learners by developing an effective learning environment.

The second theory that has a bearing in this investigation was taken from a study entitled by [4] entitled "A Conceptual Framework for e-Learning in Developing Countries: A Critical Review for Research Challenges". The authors have reviewed sixty research papers on e-learning for the purpose of understanding how e-learning is implemented in developing countries. The papers being reviewed were grouped into four major categories. These categories were individual, course or curriculum, contextual and technological. There were a total of thirty challenges or issues that were identified belonging to these four major categories.

Any initiative that involves teaching and learning process has to undergo a designed path as its life-cycle. In [5], they identified the life-cycle of the e-learning process, that is, from the planning and preparation of the course to the consumption of the materials by the learners comprises of four major phases, namely: the design phase, where the target clientele and basic requirements are specified; the production phase, where the content is identified, produced, assembled and packaged for distribution; the deployment phase, which requires the collaboration of learners in order to distribute the appropriate content per case, and the assessment phase, where the outcome of the whole process is evaluated. The figure below showed the e-learning life-cycle.

For the successful design of a learning process one should first define the required features of learners' profile and the recommended competencies. It should also specify in detail the educational targets to be achieved by the end of the learning process. The production phase integrates the production of content modules, their build up based on the initial design, and the packaging of the content to be delivered. The deployment phase that follows should consider the ability of users to access the content and collaborate during the learning process. The learning process ends up with the assessment of learners through tests and other activities and of the process itself through evaluation forms.

At the end of every phase useful information is collected and fed back to every previous phase of the process. This facilitates the improvement of the whole process and leads to better solutions for learners and educators. As an example, the information gathered during the deployment phase, which concerns actual learners' needs and level of satisfaction is used as an input in the production phase, in

order to reassemble learning objects and produce more competitive packaged solutions.

### 3. Conceptual Model

As the constructivism theory suggests, students are given the opportunities to develop their own system of understanding, and therefore, learning by reflecting through past experiences. By allowing students to work on at their own pace through the provision of alternative modes of instructional delivery other than the traditional face-to-face learning, students will develop maturity towards acquisition of learning.

Furthermore, this paper made use of the previously cited studies specifically on challenges for e-learning but will only limit to the curriculum or course and the technological challenges to determine the academic performance of the students. The curriculum challenge will focus on the mode of instructional delivery. Common modes of instructional delivery are traditional learning, e-learning and blended learning and the technological challenge will touch on the access to technology. Specific to this study, the modes of instructional delivery were based in the use of e-learning tools and technologies in blended learning. The development of the e-learning materials came from the combination of available tools and technologies to include hardware technology, software technology, communication technology and the contents of the e-learning materials. The hardware technology referred to the pieces of ICT-based equipment and peripherals that are commonly used in the delivery of instruction to students. The software technology referred to computer programs that were used in developing e-learning materials. The communication technology referred to the medium for transmitting information. The content referred to the elements within the e-learning materials. These elements were any or a combination of textual, image, video, audio and simulation. The figure that followed showed the conceptual model of the study.

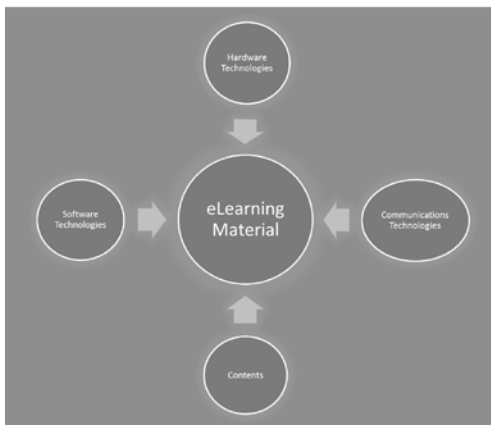


Fig. 1: The Conceptual Model

### 4. Methodologies and Discussion

To determine the most commonly used e-learning tools and technologies by the faculty members of the NIPSC System teaching ITE course, a researcher-made survey questionnaire was used. The instrument was subjected to validation by a panel of experts. It contained item options based on the four major areas of e-learning tools and technologies that the respondents were asked to rank appropriately.

The survey questionnaires were sent to respondents through emails. Upon receipt of the questionnaires, the researcher tabulated and ranked the results that later became the basis for the development of the e-learning materials.

Aside for the survey questionnaires, a researcher-made test instrument was used to determine the effectiveness of the e-learning materials as intervention in the research. The instrument was composed of 45 items multiple choice type of test. It was subjected to validation by a panel of experts in the course. After the validation, the instrument was pilot tested to the 21 BSCS 3-C students. The result of the reliability test was .809 which was significant at 0.01 alpha level using the Pearson Correlation statistic.

The test instrument was conducted to the two experimental groups through a pre-test to gauge their level of competencies in the course. The two groups were then subjected to e-learning materials intervention, with one group was influenced by the e-learning material one and the other group was influenced by the e-learning material two.

The survey questionnaire was composed of four specific items that covered common areas of the e-learning. These items included the hardware technologies, which determined the most commonly used e-learning hardware technologies used by the teachers-respondents. The software technologies, that determined which type of application software the e-learning materials were created. The communication technologies, that determined the manner as well as the media used in the distribution of the e-learning materials. The contents of the materials, which defines the content the e-learning materials.

In the hardware technologies, there were seven commonly used hardware technologies by teachers. These are (a) audio-visual equipment, (b) desktop or laptop computers, (c) multimedia projector, (d) multimedia television, (e) printer, (f) scanner and (g) others. It was found out that (b)

desktop or laptop computers ranked one as the most commonly used hardware technology, with a raw score of 35. It was followed by the (c) multimedia projector as rank two with a raw score of 60. Desktop or laptop computers are used for actual demonstration especially when faculty members are presenting drills or hands-on activities and electronic presentations. Multimedia projector is used for electronic presentation which is common when presenting concepts and theories to students.

For software technologies, there were nine items to select from. These are (a) digital libraries, (b) electronic presentation softwares, (c) email systems, (d) Learning Management Systems, (e) PDF distributed files, (f) ready-made coursewares, (g) simulations programs (h) web browsers and (i) others. It was found out that (b) electronic presentations rank one with a total raw score of 59 while (e) PDF distributed files rank two with a raw score of 105. Electronic presentations are common among faculty members because they are easy to create, especially because of the user-friendliness of electronic presentation softwares. PDF distributed files are also common because they can be created directly from lecture notes with PDF conversion softwares.

In the communication technologies, the respondents were presented with seven options. These are (a) advanced mobile devices such as smart phones, tablets and the likes, (b) flash disk or CD-ROM based, (c) emails, (d) social networking sites, (e) regular mobile devices for SMS messages, (f) websites and (g) others. From these options, (c) emails was revealed as rank one with a raw score of 57 while (b) flash disk or CD-ROM based came out rank two with a raw score of 67.

In the content of materials, there were seven options that the respondents have to select from. These are (a) audio elements for voice over, (b) pictures or images, (c) slideshows, (d) simulations, (e) text, (f) video elements which may include animations and (g) others. From these choices, (c) slideshows was identified as rank one with a raw score of 47 while (e) text was rank two with a raw score of 55.

The ranks per common areas of e-learning were determined by the total sum of rank of a specific item. Since the respondents wrote “1” as the most commonly used e-learning tools or technologies, the item with the lowest sum of rank became the overall rank one. The succeeding lowest scores for the sum of rank subsequently became the next overall rank. Table 1 showed the summary of the choices made by the respondents.

Table 1: Survey Summary of the Most Commonly Used E-Learning Tools and Technologies Being Utilized by Faculty Members Teaching ITE Courses in the NIPSC System

Utilization of E-Learning Technologies	Sum of Ranks	Rank
<b>1. Hardware Technologies</b>		
Audio-Visual Equipment (DVD Systems, Audio Player)	151	5
Desktop/Laptop Computer (for demonstration)	35	1
Multimedia Projector	60	2
Multimedia Television	166	6
Printer (for hand-outs production)	86	3
Scanner (content capture)	146	4
Others, please specify	196	7
<b>2. Software Technologies</b>		
Digital Libraries	226	8
Electronic Presentations	59	1
Email Systems	144	4
Learning Management Systems (eg. Moodle, Blackboard, etc)	121	3
PDF distributed files (for ebooks)	105	2
Ready-made coursewares	159	5
Simulations Programs (Flash, Real, etc.)	166	6
Web browser (for web-based systems)	199	7
Utilization of E-Learning Technologies	Sum of Ranks	Rank
<b>3. Communication Technologies</b>		
Advanced Mobile Devices (Smart phones, tablets, etc)	149	5
Flash Drive/CD-ROM based	67	2
Emails	57	1
Social Networking Sites	104	3
Regular Mobile Devices (SMS-based)	151	6
Websites	133	4
Others, please specify	196	7
<b>4. Content of Materials</b>		
Audio Elements only (voice over)	167	6
Pictures/images	90	3
Slideshows	47	1
Simulations	141	5
Text	55	2
Video Elements (including animations with audio)	139	4
Others, please specify	196	7

Based from the choices made by the teachers-respondents, the researcher made the two e-learning materials. These were the combinations of choices that were rank one and choices that were rank two.

Hence, the first e-learning material or e-learning one was a combination of desktop or laptop computers as the hardware to be used. It was created using electronic presentation software. The material was uploaded into an electronic group created specifically for the purpose of this study. The materials could be retrieved via email subscription to the electronic group. The material contained slideshows that they viewed with the use of a computer or printed as hardcopy.



The second e-learning material or e-learning two was a combination of multimedia projector where the material was presented before the students using multimedia projector. The researcher made use of his lecture materials and converted them to PDF distributed file using PDF conversion software. It was distributed to the class by copying the PDF file to the flash drives owned by the students which they viewed using a computer or print as hardcopy. The file contained text only materials.

## 5. Results and Discussion

The computed average pre-test performance scores of students in CS302A when they were taken as an entire group and even when classified as to the modes of instructional delivery were described as ‘Satisfactory’. As previously learned, student-respondents are enrolled in the third year level of the BSCS program and as such have already taken 11 ITE professional courses in the previous semesters. Many of those courses have, at one point or another, covered topics related to some of the test items found in the instrument.

After the intervention, the average post-test performance scores of students obtained a ‘Very Satisfactory’. This means that positive gain was achieved through the influenced of the e-learning materials to the respective group of students. Figure 2 showed the bar graph indicating positive gains in the post-test mean scores as compared to the pre-test mean scores.

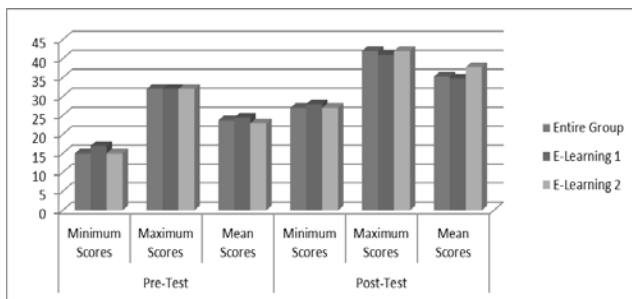


Fig. 2: Comparative Performance Scores Between Pre-Test and Post-Test

Similarly, the pre-test and the post-test performance scores of students-respondents were also tested to determine significant differences in their scores when they are taken as an entire group. The results showed that there was a significant difference in the pre-test and post-test performance scores of students in CS302A when taken as an entire group because the obtained Sig. (2-tailed) value was .000. This value is lower than the 0.05 level of significance. When the pre-test and post-test performance scores of students-respondents were classified as to the

modes of instructional delivery, it was found out that there was a significant difference in both the group one (e-learning1) and group two (e-learning2) with the obtained Sig. (2-tailed) values of 0.000 and 0.000 respectively. Table 2 showed the difference in the pre-test and post-test performance scores of students-respondents when taken as an entire group and classified according to the modes of instructional delivery.

Table 2: Difference in the Pre-Test and Post-Test Performance Scores of Students-Respondents When Taken as an Entire Group and Classified According to the Modes of Instructional Delivery

Category	Mean	t	df	Sig.(2-tailed)
Entire Group	-11.55	-18.969	43	.000
E-Learning1	-10.35	-14.987	22	.000
E-Learning2	-12.86	-13.333	20	.000

$\alpha .05$

However, it can be noted that the students influenced by the e-learning 2 (combination of multimedia projector, PDF distributed file, flash drives or CD-ROM distribution and text contents) achieved higher mean gain compared to the students being influenced by e-learning 1 (combination of desktop or laptop computers, electronic presentation softwares, email distribution and slide contents). The use of bigger screen like that of the multimedia projector can provide better retention of the lessons being discussed and therefore, better performance. Although the use of desktop or laptop computer screens have positive gain in the performance scores, the fact that the screen size is small, the vision of the students towards any lessons in electronic format is compressed to a very limited space in front or near the computer screen. While students can see the e-learning materials flashed on the projector wall comfortably from their seats, students using computer screens for viewing lecture presentations tend to crowd in a limited space. Students seated in front may have a better view of the lecture presentations but those at the back end or at the far sides may find difficulty in learning.

Similarly, the distribution of e-learning 2 under the communication technology was done by copying the lecture materials directly to a flash disk or CD-ROM disk owned by students. Before the start of a new session class, the students can then be asked to copy the materials which they printed as hardcopy references. However in e-learning 1, distribution of the lecture presentations under the communication technology was through email. The lecture materials were made available a week before the start of the session where students were advised to download. Incidentally, only few students opted to download the materials prior to the session.

## 6. Conclusion

In as far as the mean gain performance scores was concern, the results showed that the influenced made by the e-learning materials in teaching CS302A were effective. Both materials proved to provide positive results as revealed by the positive differences between the post-test performance scores and the pre-test performance scores. In fact, none of the students received a post-test score lower than the pre-test score.

In the comparison of the two e-learning materials, the result of the study found out that the e-learning 2 material was more effective than the e-learning 1 material. This was proven by the higher mean gain performance scores of students exposed to the e-learning 2 than the mean gain performance scores of students exposed to the e-learning 1.

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