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Application of E-Learning in Computer Science Intermediate Teaching

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Abstract: Students have individual learning styles that cannot be taken into account unless teachers also adapt different strategies for knowledge transfer. To this end, it is expected to improve the efficiency of delivery and evaluation methods, which should be based on technology. The purpose of this study is to investigate the impact of the e-learning environment on student achievement in the computer science course used in secondary schools in Pakistan. The proposed research is being conducted at a local private school in Punjab. For this, significant topics of the 10th grade informatics course have been translated into electronic format. This study is a quantitative study that uses a quasi-experiment that consists of two groups (control group and treatment group), a pre -test and a post- test test design model. The time horizon of the cross section is most appropriate for this study due to the time constraint factor. The important findings of this study are that students in the eLearning group are significantly better at problem solving as well as gaining better hands-on computer science knowledge. This study shows that e-learning has bright prospects in Pakistan. It can help in solving the various problems of secondary education in Pakistan if applied properly.

Keywords: E-learning, learning effectiveness, intermediate level, informatics course.

1. Introduction

The advent of new technologies plays the role of a catalyst between learning and teaching. E-learning is an electronic way to transfer lessons to digital devices. It has the potential to increase the availability of quality education and supports a constructivist approach [1]. In order to provide quality education, the e-learning methodology includes three different learning styles i.e. visual learners, auditory learners, and kinesthetic learners. It targets individual learning preferences. It provides unprecedented control over the pace of learning content. In [2], the author emphasized that secondary education is an area of education that receives less attention in Pakistan. Dropouts at this level are high at almost 45%. The reason for such a high dropout is the lack of quality education and stereotyped learning, when the same learning pace is used for the whole class [3]. Traditional style teaching in Pakistan faces various barriers and challenges. Classes are overcrowded, students lose individual attention. Untrained teachers emphasize reading content rather than explaining with visual aids. No assessment method is used to provide an instantaneous response to student satisfaction with learning. Only the lecture style of teaching is observed, which does not arouse interest. The traditional middle-level learning style encourages a teacher-centered approach and students are passive listeners. We know

that students learn differently. One traditional method is not the best for all learning needs [4]. Researchers and analysts note that students in an e-learning environment have shown greater improvement in practical ability, critical thinking, problem solving, academic performance, and time management compared to students in a traditional classroom environment. This article shows how effective is the e-learning environment in teaching computer science course at high school level in Pakistan? Does it help to increase the effectiveness of student learning and to what extent does it satisfy them ?

2. Literature review

In [5], the authors described the history of the technological revolution. Since the advent of computers and the Internet in the late 20th century; the choice of flexible teaching and learning methods has been expanded. This extension enabled the use of e-learning and various learning opportunities. E-learning takes various forms, for example, in the form of recorded lectures or using various multimedia features such as graphical and textual representations. Thus, e-learning is a broad terminology that has various aspects regarding the "what", "why" and "how" of e-learning. Which aspects include both content and teaching methodology. The "why" of e-learning refers to the purpose of supporting personal learning goals. The "how" of e-learning refers to how courses are delivered using computers or printed text. Therefore, e-learning can be defined as “how courses are digitized”, “what content they include”, which helps a person achieve personal learning goals [6]. In the last decade, the growth of e-learning has increased dramatically, which helps to overcome various educational barriers, such as a lack of experienced teachers and quality education [7]. MCQ-based assessments are a boon for the e-learning environment, so it should do more than just promote memorization. It should be designed in such a way that it also provides support for a deep understanding of the subject content [8]. A public school in St. Tammany County, Louisiana, experimented with applying e-learning and blended learning models to core English and world geography courses. The focus of this study was on the effective use of technology to improve student achievement. The results showed that adherence to these learning conditions had a positive impact on student achievement. Now the school management plans to teach English II and social studies with a similar approach in the upcoming session. Henrico County Public Schools , Henrico , Virginia have used e-learning and blended learning environments in their physical education program. They reported that these environments helped satisfy all types of students [9].

According to reference [10], the ideal learning environment should be based on:

- multimedia learning
- Maintain a Student-Centered Environment
- Adapts to different learning personalities of students
- Learning content should be available anytime, anywhere
- Encourage activities with students that help satisfy their curiosity.

E-learning has changed the education system. It changes thinking and practice, introducing new concepts of how students are taught and how they learn easily, in addition to how digital resources can be used more effectively in the education sector [1]. The benefits of e-learning (Fig. 1) can be categorized as convenient; multimedia is rich and consistent. This is convenient because students can control the pace, and topics can be revisited each time students need to refresh. Having a choice of media helps deliver content in a diverse and more effective way. It also offers consistency, ensuring the same

quality of education for everyone. Using learning management systems and other similar tools, students can now evaluate their progress. Other benefits of e-learning include that it helps increase enrollment in schools. It is flexible (in terms of time, location mode, etc.) for those students who cannot attend mainstream schools. This is available due to economies of scale; saves time and gives measurable results [11]. Through the use of media, learning content is easier to understand, more engaging, and can accommodate multiple learning styles [12]. E-learning not only connects digital media and learning, but also provides a student-centered approach. This helps to transform students from passive receivers into active seekers in the learning process [13].

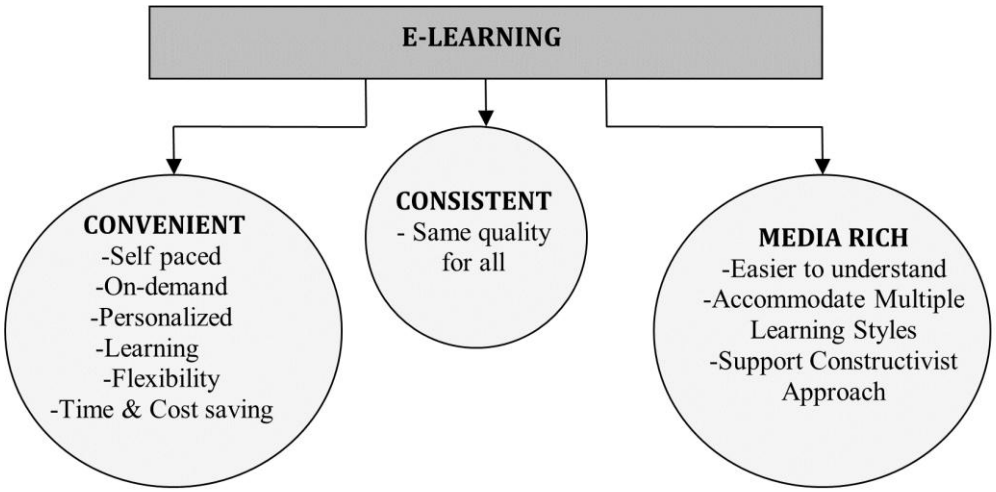

Figure 1. Benefits of e-learning

Besides other benefits of e-learning, educational content can also be easily uploaded to school computer labs, flash drives, school servers, etc., making it available everywhere. Videos of experiments, animated procedures for installment, compilation and running of programs can be easily demonstrated using various software tools that help students visualize and retain knowledge more effectively [14].

Basically, e-learning has three interaction modes, namely asynchronous (non-real-time), synchronous (real-time) and blended learning (e-learning and traditional). Synchronous e-learning includes technologies such as virtual worlds, video conferencing, etc. The presence of students is required during content delivery. Asynchronous (time-flexible) e-learning includes technologies such as pre-recorded audio and video lectures , tutorials, online tests that allow students to work at their own time and at their own pace. In an "asynchronous learning environment", textual material can be used both in electronic and printed form, using web-based assessment methods, etc. [5]. Almost 75% of the existing courses available on the Internet are developed using an asynchronous learning environment [13]. Different students had different personality traits, mindsets, interactions, and learning needs. Typically, traditional classes support a "quick speed" that rewards those who are smart/vocal and applauds extroverted students. Introverted students suffer losses in such traditional learning environments. An asynchronous environment can provide the introvert learner with the ideal space needed for learning [15].

3. Research problem

The purpose of this study is to determine the possibilities of secondary school students in an e-learning environment by examining their use in a computer science course. The

computer science book published by the Punjab Text Board for 10th grade has seven chapters and 80% of the topics are practical in nature. Students memorize theoretical topics in a traditional classroom, but it is usually observed that they do not have a realistic understanding of the functional aspects and area of problem solving. Recent research in e-learning has shown positive results, especially in practical nature courses. The above literature review led us to hypothesize the hypotheses of this study.

3.1. Hypotheses

***H 1** : Students in the eLearning group perform better overall.*

***H2:** The eLearning group is better at doing computer science practical tasks.*

***H3:** The e-learning group gets more theoretical knowledge.*

***H4:** The eLearning group is better at problem solving.*

***H5:** E-learning is positively perceived by students.*

4. Study design

The design of this study is descriptive, it is a mono-method quantitative and cross-sectional study. This implies the use of quasi-experimental , pre-test and post- test designs. The population of this experiment were students of the " Muhammadan Model High School ", enrolled in the 10th grade , session 2012-2013 The target population consisted of two sections, A and B. Randomly, section "A" formed the control group, and section "B" formed the experimental group. For this study, a computer science book published by the Punjab Text Board on the 10th was used . The first chapter of this book was about methods for solving problems, covering theoretical content. The next four chapters were based on the practical concepts of entry-level BASIC programming. The sixth chapter is an introductory chapter about computer graphics (practical basis). Chapter 7 is the longest chapter in the book and covers hands-on work with Microsoft Word. Important topics in this book, especially those that are practical and cover computer science issues, have been made available on the web. Classes in the computer science course were planned as four lectures of 40 minutes per week. Both sections (control group and experimental group) held classes on the same day.

Table 1 Study Design

Target Population	Pre-Test	Treatment	Post-Test	Difference
Experimental Group	Y1	X (E-Learning)	Y2	PreY – **PostY** ↓ Compare
Control Group	Y1	Traditional Style Learning	Y2	↑ PreY – **PostY**

Before starting treatment, the same pre-testing was done for both groups to explore their abilities and differences related to the subject. After analyzing the results of the pre-test, the students in the experimental group were presented with videos, study guides, an online test website, self-practice exercises, and review exercises based on the electronic content provided. For the experimental group, all MCQ-based review exercises were uploaded to the test website. The MCQs have been designed to cover all aspects covered during the lectures and provide context. Textbooks and lectures were developed using Internet resources. The

entire work process was practically carried out in the presence of an individual student: how to listen to lectures, how to take online tests, how to view tutorials and step-by-step problem-solving methods, etc. The control group attended lectures in a traditional classroom style. After treatment, the same post-test was performed to measure the difference in learning between both groups. Pretest and post-test were designed to analyze the student's ability to perform practical work on a computer, competence in solving problems related to computer science, and theoretical knowledge related to the subject.

The purpose of this study was to analyze hypotheses that would help to elucidate the "causal" and "effect" relationship between variables. The independent variable is the application of e-learning to the students of the experimental group. The dependent variable was student scores on the final test (assessment of practical work ability, assessment of problem solving, and assessment of theoretical knowledge) and the student's perception of e-learning. Pre -test and post- test scores were analyzed with a t-test using Excel. The pre-test was analyzed using a two-tailed test and the post-test was assessed using a one-tailed test. The instrument used to measure student acceptance of e-learning was a questionnaire (on a Likert scale of 1 to 5) that students completed at the end of the experiment.

5. Results

Before starting this experiment, students were given a questionnaire to study the use of computers in their daily lives. The results of the survey showed that the students of the experimental group had a basic level of familiarity with the use of computers, and most of them had access to the Internet both at home and in school computer classes. Therefore, the impossibility of use should not be taken into account in the results of this study. (Table 2) presents the results of preliminary testing, which showed that both groups initially had the appropriate abilities. The null hypothesis was accepted, which indicated that both groups had the same basic knowledge in terms of the ability to perform practical work on a computer, problem-solving skills, and theoretical knowledge before starting any treatment.

Table 2. Analysis of the results before testing

Scoring categories	P(T<=t) Bidirectional $\alpha = 0.05$	Result
1. Practical work skills	0.728	Accept the null hypothesis (p > 0.05)
2. Theoretical knowledge	0.599	Accept the null hypothesis (p > 0.05)
3. Problem Solving Skills	0.602	Accept the null hypothesis (p > 0.05)
4. Total score	0.475	Accept the null hypothesis (p > 0.05)

Post-test scores were again tabulated and a one-tailed t-test was applied to the data, as shown in Table 3. The results showed that students in the eLearning group performed better on hands-on computer work and problem-solving skills than students in traditional classrooms. In both of these categories, the null hypothesis was rejected in favor of the alternative hypothesis. In the assessments of theoretical knowledge, the null hypothesis was accepted, which shows that there is no significant difference in both groups.

Table 3. Analysis of the results after testing

Scoring categories	P(T<=t) one-sided α = 0.05	Result	Conclusion
1. Practical work skills	0.000152	*P < 0.05 Accepted*	The experimental group is better at doing practical work in computer science.
2. Theoretical knowledge	0.190	*P > 0.05 Rejected*	There is no significant difference in theoretical knowledge between the two groups.
3. Problem Solving Skills	0.0109	*P < 0.05 Accepted*	The experimental group is significantly better at problem solving.
4. Total score	0.000737	*P < 0.05 Accepted*	Students in the eLearning group generally do better.
5. Student perception		*m ≥ 3*	Students' attitudes towards e-learning were positive.

At the end of this study, the students in the experimental group were given a post-questionnaire to ascertain their perception of the e-learning environment. The questionnaire was based on 10 questions (Appendix) that were about their general experience of using the e-learning environment. The Likert scale was used to assess student perception . Number 1 meant complete disagreement and 5 meant complete agreement. The descriptive statistical analysis of students' perception of e-learning was positive, $\mu \geq 3$. The results (table 4) indicated their great interest in e-learning technology. Thus, the alternative hypothesis was accepted and the null hypothesis was rejected.

Table 4. Descriptive statistics of student perception

The effectiveness of e-learning ***Likert scale from 1 to 5)***	
Keep in mind	4.89
standard error	0.0480
median	5
Mode	5
Standard deviation	0.152
Sample variance	0.023
Range	0.4
Minimum	4.6
Maximum	5

6. Observation and discussion

The above results (table 3) indicate that the students of the experimental group demonstrate better performance in problem solving skills, the ability to perform practical work on a computer, as well as in overall scores compared to the control group. Post-test results showed that in the field of theoretical knowledge, both groups do not show a significant difference.

During this study, it was analyzed that the e-learning methodology helped to improve the practical computer skills of the experimental group. Students very easily mastered practical computer skills with the help of visual components. The students of the experimental group have a clearer understanding of the functional aspects of Microsoft Word, types of programming errors, saving the program, etc. The main reason for this result seems to be interactive video lectures , in which each computer application was practically executed in realistic mode . . This study is based on the principle of "learning by doing". To do this, students were provided with animation exercises with clear instructions, with the help of which they gradually led to the solution of this problem. It was observed that the problem solving skills of the e-learning students were exceptionally improved. They had a very clear idea of what should be done at each stage and why. In one review exercise, the logic of the problem was changed so that if students have a clear idea, they can easily solve it. The researcher of this thesis was surprised to note that all the students of the experimental group solved it correctly. Much of the e-learning content provided to students focused on developing their problem-solving and computer skills. Very little theoretical content has been delivered with this e-learning methodology. Therefore, it seems rational that the experimental group performed very well in these areas in the post-test. Second, the students in the experimental group tried to repeat the exercise based on the content they listened to in the video lecture . It was observed that the repetition exercises helped them to check their own understanding after the lecture had been completed. So after each lecture, the students were very assured that what part they did not understand, and asked very pertinent questions. Compared to the control group, the experimental group was very confident in what they had done so far and how to move forward with the subject matter. The students of the experimental group were also unanimous that the electronic lectures gave them a deeply realistic view of the subject of computer science and facilitated their study. The electronic lecture helped them subsequently catch up with a lecture or part of it that was difficult to understand on the first try. After completing this study, the student came with a request to continue the e-learning methodology in this course and teach them other subjects of science similar to this methodology. Their request was passed on to senior management, which was not considered due to a lack of appropriate funds required for the requested item.

7. Conclusion and recommendations

The e-learning approach to teaching computer science at the secondary school level has not been studied before in Pakistan. In this regard, the results of the study were positive. E-learning environment effectively expands students' knowledge, improves their skills and motivates them to learn. Students in a traditional classroom usually feel excited when they are asked to do practical work. This study showed that e-learning can increase students' practical computer proficiency and ability to learn in a way that helps solve problems. Therefore, it is suggested that secondary schools switch to e-learning, especially in subjects that have practical aspects and require practice. Based on this research, a standard model can be developed for converting other intermediate science courses into e-learning. In addition, the learning environment must be designed with the student's personality in mind.

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