Mode and Application Analysis on the Computer Network Teaching

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Keywords: Computer Network Teaching; Mode; Application.

Abstract.

The network education has become one of the effective complement to traditional education. The Network education can be divided into autonomous distance education and real-time online distance education which could be applied in different conditions. The Network education has fundamentally changed the teaching method of traditional educations. It may even change the whole ideas on education. It could break out the limit of time and distance. Students will have more flexibility when they begin to study. This article investigates domestic colleges and universities technology ability and the infrastructure, analyzes the cost of software and hardware resources for network education recently, and plans three feasible network teaching system.

Introduction

Teaching and learning are still phenomenon on which educational and cognitive scientists have ongoing researches. Teaching process, with a high level of abstraction, is defined as "to cause or help (a person or animal) to learn how to do something by giving lessons and showing how it is done", whereas learning is referred as "to gain knowledge or skill by studying, practicing, being taught, or experiencing something" [1]. With these definitions, one can easily deduce that the essential components of teaching and learning processes are; having lessons, studying, practicing and gaining experience.

Moreover, these components may be classified as theoretical and practical groups, such that having lessons and studying fall in to theoretical group and practicing and gaining experience fall in to practical group. Educational and applicative requirements for these two component classes are quite different than the other. Theoretical group call for logical and procedural understanding while practical group requires experimenting and hands-on implementations. Therefore practical group generally necessitates a special learning environment, such as a laboratory, and particularly engineered experimental problems. Additionally practicing and gaining experience require reasonably more time than theoretical studying and tools to be acquired. Hence, in most of the learning environments in the universities, theoretical teaching is preferred as educational methodology (curriculum, course contents and educational environment), neglecting the noteworthy component of learning; that is to gain experience. On the other hand, in order to enhance logical understanding, to facilitate gaining real life practices and to measure educational achievements adequately, problem solving approach can be used in educational settings as well [2]. Problem solving entails significant amount of theoretical knowledge and experience collectively. It intrinsically includes the design of a solution path which is composed of measurement, calculation, detection and management tool usages. Therefore, considerable amount of experience is essential for a good problem solving skill. Computer networks are almost inevitable infrastructure in today's business and social transactions. Moreover, their technology is rapidly changing and new applications, new protocols are introduced in short intervals. Preparing the computer, software and information systems engineering students for real-life network problems is a challenging task [3]. Besides the theoretical education, teaching the technology used in computer networks should include a good amount of practical case studies [4]. Students should better be ready to solve real life network problems when they graduate. In this study we have presented the results of an educational

methodology change in teaching data communication and networks course. Students are forced to solve more theoretical problems and have more hands on practices. The findings point to a better educational achievement when compared with the previous teaching methodology.

Methodology and Hypotheses

Teaching the fundamentals of data communication and computer networks is a challenging task, since it relies on a versatile infrastructure and there are quite amount of real-life applications used in daily routines [5]. Moreover, the excessive number of terms and locutions in the domain, and sometimes their misusage, do not help in describing the technological details. On the other hand special educational methodologies yield better results in different education realms. An educational methodology may result superior consequences in teaching a specific course, whereas it fails in that of the other course [6]. Thus finding the best educational methodology for a definite course is a special problem which needs to be scrutinized in the context of present and particular educational settings. The order of course in the current curriculum, course prerequisites, instructor's conducts, student's readiness and alacrity have impact on the success of the educational methodology in the course as well, while the course content deserves to be the most important factor in choosing the methodology [7]. In this study we reported the outcomes of a methodology change in data communication and computer networks education through a comparison with the previous application. The research model was developed to find an answer to the following main question.

Does the proposed educational methodology have positive impact on teaching the data communication and computer networks course? For this purpose we have elaborated following sub-hypothesis. By the virtue of these sub-hypotheses we examined the answer to the main question in the study.

Hyp. Definition

H1: Conducting in-class quizzes increase student success more than that of homework assignments.

H2: Hands-on examination on network diagnostic tool usage and network application development provides better educational measurement framework for individual evaluations.

Research Design

A. Data Collection

Data used in this study were collected in Data Communications and Networks course which was given in university engineering faculty for computer engineering, software engineering and information systems engineering students as a must course. Data covers five semesters with a total of 532 students. The course is offered in spring semesters in each educational calendar. The course is offered in multiple sections with around 30 students in each in maximum. Hence total number of sections differs depending on the total number of students who has registered to the course. The semesters scrutinized in this study are the spring terms of 2009-2010, 2010-2011, 2011-2012, 2012-2013 and 2013-2014 educational years. Student grades in the midterm-I, midterm-II and final examinations are used as dependent variables. Data set is divided into two groups where 2009-2010 and 2010-2011 spring semesters fall in to the previous educational methodology group and 2011-2012, 2012-2013 and 2013-2014 fall in to the new educational methodology group. The former data group is named as homework-project, while the latter group is named as problem-solving, in order to represent the educational methodology change between the groups. Details of the change in educational methodology are reported in the following section.

B. Network computer tests

Computer tests are appointed to be the instrument in the quantitative research. In the nearly two academic years, one proficiency test was given and three achievement tests were carried out to the two groups at the end of each term as final exams. Another test is College computer test for

non-computer majors as the final exam of the forth term. The tests designed for final exam contains the same items as College computer test for non-computer majors. But the level of the tests was designed according to the learners' computer level and the teaching goals of each term. The test was designed scientifically and carefully by several experienced teachers. After each test, the evaluation about the validity, reliability, difficulty, discrimination and practicality would be examined by a special software designed by some University to make sure it is suitable and useful.

C. Data procedures

The study was composed of the following steps:

1. The first test (proficiency test) was conducted before the process of the computer-assisted teaching model (1) to get deep understanding about the English level of the students and (2) to make the choice of subjects more scientific and accurate.

2. The second test (achievement test) was carries out at the end of the first term. The purpose of its analysis is to make a comparison between the two groups and in each group in order to adjust the teaching approach and other factors to make bigger progress.

3. The third test performed at the end of the second term. Since the experiment has been on for one year, it is time for us to examine whether there are some differences in English competence between the two groups. If the answer is yes, what are they? Meanwhile, solve the probable existing problems for further study.

4. During the process of computer-based online course, the research regularly checked the computer recording and monitored the process of the learning.

5. In this study several informal interviews were conducted at the end of each test. Teachers gave their opinions based on the result analysis. A formal interview was conducted one week after the final test was finished and all the data analysis was made out. The purpose is to draw a conclusion of this study carried for two years and to find out as much as possible information that couldn't be revealed in these tests and possible, to dig out the cause for some unexplainable issue. In addition, suggested improvements were also gathered.

D. Change in Educational Methodology

Data Communication and Networks course is offered as a joint-departmental must course for computer, software and information systems engineering students in university engineering faculty. The course was directed in multiple sections with a different instructor in each section. Students are to attend three hours of lecture and two hours of laboratory studies in a week. Lectures focus on the theory and applied protocols, whereas the laboratory studies aims to learn how to use basic networking and diagnostic tools and gain experience on network-applications. Additionally fundamental principles of socket programming and network-application development is thought in laboratory studies, as well. In 2009-2010 and 2010-2011 academic years, the students were to submit three homework individually through the semester and develop a network-project in a group of four members in maximum. Homework were designed to force the students to study the topics which were not covered in the lectures and solve network-problems which need more time to find the correct answer. On the other hand, in group projects students were required to develop a simple network-application in order to deepen their understanding and widen their experience in the domain. Unfortunately, instructors who had given this course were not happy with both homework and project practices. Since, it was hard to discriminate a copy in the homework and to evaluate individual contributions in the projects. Furthermore, the instructors claimed that significant number of students had outsourced their study. Hence, evaluation of the student studies were unfair. Discontent of the instructors in student homework and project studies, directed us to develop alternative measures and applications in education methodology in data communication and networks course. In order to replace homework and project assignments, it is decided to administer in-class quizzes, hands-on problem solving and application development practices. In-class quizzes consist of two or three questions and are conducted in 15 or 20 minutes. However, prior to the quizzes, about one week before the quiz administration, a sample question set is announced with a notice indicating that the questions in the quizzes will be the same or similar to the sample questions. Hands-on examination is

held at the end of the semester with the intention to evaluate student achievements in basic network-diagnostic tool usage and socket programming.

C. Data Analysis

Hypothesis 1 was tested using independent samples t-test. Statistical inference techniques are well known and appear in many of the standard text books on probability and statistics (see for example [8]-[10]). Statistical hypothesis testing method t-test can be used to determine if two data sets are significantly different from each other or not [11]. T-test is a powerful statistical tool and is used in wide variety of applications [12]. The significance level of the difference between two sample groups is reported with sigma coefficient in t-test. If sigma coefficient is less than 5% then the difference between the groups is referred to be significant otherwise observed difference is statistically insignificant [13]. We used independent samples t-test, since we examined examination grades of different student groups in this study. In examination of hypothesis 2 we used chi-square testing. Chi-square test uses the variation of the data sets to decide on whether the two sets are statistically different or not. In other words it is a measure to quantify the amount of variation in a data set. We have used chi-square test in comparing student examination grades in project-development and hands-on examination.

Student examination papers evaluated out of 100 points. But the questions asked and the distribution of the marks in an examination was inevitably different than that of the other semester. Although the instructors tried to keep the equity between semesters in preparing the questions, the discrepancies were unavoidable. Therefore we normalized student examination grades in order to have a sound comparison between the semesters. In the normalization of grades we used following formula:

$$Nsg = \frac{Sg - min\_g}{max\_g - min\_g} \times 100$$

where:
Nsg : Normalized student grade
Sg : Student grade
min_g : minimum grade in the examination
max_g : maximum grade in the examination

Conclusion

Teaching data communication and networks is one of the challenging tasks in information systems education. It should include a good deal of theoretical and practical education mutually. Data communication is almost inevitable technology used in daily routines. Therefore students frequently encounter with new applications and networking problems in their ever day practices. Introducing network diagnostic tools and experiencing on problem solving in computer networks should be significant components of network education. In this study we have scrutinized the effect of educational methodology in learning the data communication and networks with an educational practice. The results of the study indicate that when students have sample questions in hand to study they are prone to get higher grades in the examinations. However student's perception of the necessity to study on the sample questions should not be underestimated. We believe that having in-class quizzes enhance student's need to study the sample question set. On the other hand, conducting a hands-on application examination on the practice of network diagnostic tools and network programming compels the students to have more experience on them.

Moreover some of the students expressed that they found this practice useful in understanding and sometimes in solving network problems in their daily routines. In conclusion the findings in this study suggest that, by the acceptance of hypothesis H1, conducting in-class quizzes increase student success more than that of homework assignments. Furthermore, evidences in this study show that hand-on practical examination provide better individual educational assessment than that of group project studies. With these results we can simply state in-class quizzes with preceding sample

question set and hands-on example on network diagnostic tools and network programming increase student enhancements in data communication and network course.

These results may be specific to data communication and networks topic. Since not all the courses have enough practical tools for students to practice or diagnose. But, at least for data communication and network course the suggested educational methodology provides better results when compared with homework assignment and project development application. We strongly recommend data communication and network course instructors to use sample questions and to inspire students to have hands-on experiments as much as possible for a successful data communication and network instruction.

Acknowledgements

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