

## A STUDY ON THE MULTIMEDIA COURSEWARE FOR INTRODUCTORY STATISTICS

Tae Rim Lee, Korea National Open University, Korea

*The purpose of this study is to develop computer aided instruction courseware for introductory statistics and to examine the effectiveness of this type of instruction for schooling. Following the theory of educational technology, statistics is a subject area that needs CAI for university students. The courseware of statistics developed meets this need. Using CAI, students not only receive tutoring in statistics but also get direct experience using a computer. This results in a high achievement level that is particularly effective in a group of students with diverse individual needs and very conducive to a distance education program.*

### INTRODUCTION

In recent years, there has been widespread hope that the new generation of instructional computers, microcomputers, will solve educational problems, and realize educational goals. For many educators, computer based education has become a catch word for modern education.

Particularly in distance education, or cyber education, it is an excellent media for self-study by students. However, when the reality of the microcomputer in the school falls short of the dream, because of a lack of suitable software and professional support, this new media may well fall by the wayside.

Most of the courseware available today is for elementary and high school students. There is a greater need for courseware designed for a university education because there are many computer systems in the universities currently used only for computation and because the potential of the computer is limited by not demonstrating all its roles and abilities.

There have been many studies that compare the effectiveness(in terms of achievement scores) and efficiency(in terms of instruction time) of CAI with traditional instruction for various needs and in various subject areas.

Kulik(1983) surveyed CAI studies and reported that :

1. At the university level, there was an increase in the achievement scores.
2. Student's attitudes became more positive toward schooling.
3. Schooling time was about one-third less than the classical schooling method.

There has been little research in Korea into the effectiveness of the CAI

courseware for teaching statistics, although the awareness of CAI as a possible instructional tool has been rising rapidly in recent years in Korea educational circles. Consequently this study aims both to determine if similar results can be found in a Korean educational setting and to serve as a springboard for further studies in this area.

Based on programmed instruction, CAI proves as to be an effective media for learning concepts, principles and techniques. It is developed according to the programmed instruction theory and compensates for the disadvantages of computer devices and books. Students receive instructions from the computer using courseware and then respond to the computer. Using this method of schooling, the students achieve the educational objectives.

The reasons for developing CAI courseware for statistics are as follows :

1. CAI efficiency (high achievement and less schooling time) increases the interest in subjects like mathematics or statistics. Statistics particularly covers the data assessment methods, therefore, high achievements in schooling can be expected.
2. The need for statistics is widespread in many fields such as medicine, administration, management, economics, psychology, agriculture etc.
3. The direct handling of computers results in a fundamental knowledge of computers for the students.

This statistics courseware also contains a program for statistical package practice. Also by analyzing the data from the evaluation, the courseware can be made more efficient at providing feedback to the student.

Wang (1987) studied the evaluation of CAI schooling and suggested the following to improve the courseware :

1. More frequent feedback must be given to the students to create an individual teaching relationship.
2. The courseware must provide suitable levels of the feedback and instruction contents for individual needs.
3. The courseware must supply the various schooling activities required and support higher achievement by setting clear objectives.

This study, following the above recommendations, developed CAI courseware for statistics and evaluated its efficiency.

## METHOD OF STUDY

The courseware is a software program for education that allows a student to attain the particular educational objectives by computer. In this study, the preparation of the courseware followed the design, framing, and evaluation process.

### *Selection of target students*

Since this courseware can be viewed as a general set of supplementary lessons or a review of regular lessons, students taking a preliminary (beginners) course in statistics who have completed elementary calculus are suitable target students.

The objective of the study is for beginners to learn statistics easily, particularly data representation, estimation, testing, regression and experimental design.

### *Need analysis for CAI*

Before development of the CAI courseware, the educational needs and problems that are to be solved must be understood. Based on Kafman and English's three steps the following analysis is needed.

- a) Analyze the gap between student's current performance and the object level for learning, identifying it as an educational problem. Since there is an obvious gap between students' performance and objective level by individual ability, particularly in the distance education field, there is a big need for CAI learning.
- b) Define which functions of teaching need to be corrected to solve the needs identified above. For example, the lower performance students group could be guided in learning individually by considering the student's ability using the replications and review method. Considering this concept, statistics is a suitable subject for the development and adaptation of CAI courseware.
- c) Analyze the concentration of attention, presentation of education objectives, review of preliminary knowledge, presentation of data, offering of study guidance, feedback of response, evaluation of performance, and transformation as an index of the efficiency of CAI courseware for statistics.

### *Classification of Statistics details into CAI form*

After the analysis of the needs of CAI, classification of the detailed statistics contents is done in the CAI form and then complete framework of detailed learning

objectives are built.

The selected topics in CAI form are as follows :

- a) Basic descriptive statistics
- b) Probability and distribution
- c) Estimation and testing
- b) Correlation and regression
- e) Experimental design

#### *Selection of Hardware*

The final specification for hardware that is suitable for the objective of this study, for coverage of contents and for mass education were determined. They include the use of graphical interface as an educational necessity, regardless of whether sound effects and the clock function are used.

Hardware specifications for CAI courseware for statistics are as follows :

- Computer device : minimum 286 IBM PC for dos version and 386 IBM PC for Windows version.
- Secondary memory device : one disk drive
- Monitor

#### *Preparing the manuscripts for CAI courseware*

Manuscripts of CAI courseware contents must be prepared, ensuring that the courseware is highly effective. The manuscript should be adjusted to provide 30 minutes of study for each chapter, since this is student's attention span. After the manuscripts are prepared, they are transcribed onto a video display worksheet, programmers can understand the contents of the courseware including the position of each exercise and the locations of hints and solutions that influence the educational efficiency.

The CAI courseware in this study contains five 30-minute lectures, which is reasonable for students' learning based on the analysis of the questionnaire

#### *Development of Software*

The courseware in this study follows the structured modular program development method (Dijkstra 1972, Wirth 1973) by Iconauthor and Great.

The software development process is summarized as follows :

1. Build the courseware framework at the chapter module level.
2. Create detailed frameworks for each chapter module.
3. Write detailed programs considering their effectiveness for schooling.
4. Test each completed chapter module and modify until error-free.

### ANALYSIS OF THE EFFECTIVENESS OF CAI

The final evaluation of CAI in education is justified by measure of the students' improvement of performance. After CAI coursework was completed, students wrote a post-test on in each chapter at the same level of difficulty as the pre-test on each chapter.

The improvement of performance between pre-test and post-test is shown in Table 1. The two scores can be paired and are displayed graphically with a histogram and scatter diagram. For the criteria  $Y=X$  was the same score were achieved in each pre- and post-test. Where many students are located above the line  $Y=X$  the effectiveness of CAI is show. As a result of the paired t-test, based on Table 1, CAI was significantly effective( $P<0.001$ ).

Table 1. Pre- & Post-performance of CAI for Experiment Group

Variable	group	frequency(%)	pre score	post score	significance
age	under30	24(42.10)	52.14 ± 20.45	69.29 ± 28.14	P < 0.001
	31 - 40	22(38.60)	55.00 ± 7.07	60.00 ± 4.14	
	above 41	11(19.30)	40.08 ± 2.04	51.00 ± 6.50	
sex	male	26(45.61)	46.00 ± 8.97	53.00 ± 7.51	P < 0.005
	female	31(54.39)	58.33 ± 7.22	80.35 ± 9.97	
major	computer	34(59.65)	51.43 ± 9.95	65.71 ± 8.48	P > 0.05
	admin	23(40.35)	45.00 ± 7.07	49.00 ± 11.21	
character	normal	29(50.88)	47.78 ± 8.56	53.00 ± 7.51	P > 0.05
	transfer	28(49.12)	60.00 ± 14.14	80.35 ± 9.97	
Total		57(100.0)	51.80 ± 8.80	64.70 ± 7.90	P < 0.001

The effectiveness index, which is derived by transforming the score into a standard score, is 1.389. Thus the mean score of the results of the CAI schooling is located at a 138.9%, while without CAI is considered 100%.

The correlation of coefficient is 0.783 which is interpreted that students who have

more knowledge about CAI content earn a higher score in the post test. The fitted regression line of the pre-test score and post-test score is  $Y = 4.583 + 1.16X$ , so that statistical test where  $\beta_1 = 1$  in which there is no effect of CAI, can be found to be significant ( $P < 0.01$ ).

Table 1 shows there is significant difference by age, sex, and no significant difference by major or character of entrance ( $p > 0.05$ ).

## REMARKS

The overall finding of this study show that CAI instruction, designed and developed according to the instructional system development model, is effective in the learning of introductory statistics.

The results of the analysis of the effectiveness of CAI are as follows :

1. The pre- and post-test scores show significant effectiveness of CAI for introductory statistics ( $P < 0.001$ ).
2. There is significant difference by age and sex, but no significance by major and characteristics of entrance ( $P > 0.05$ ).
3. The effective index is 1.389, the after CAI schooling the performance level is located 138.9% level relative to before CAI.

Individual learning with CAI is suitable for the teaching-learning process according to the individual ability.

In the future it is necessary to review in detail methods to measure and evaluate the response of students and make of feedback to the CAI courseware. Especially if we consider CAI as a human-machine interaction system, its development is influenced by the concepts of human and behavioral science and by the evaluation of courseware testing results.

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