COMPUTER-ASSISTED LEARNING PACKAGE FOR FREQUENCY DISTRIBUTION OF PHYSIOLOGICAL VARIABLES

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(Received on March 2, 1996)

Abstract: There are a variety of ways of picturing a frequency distribution type, viz, the histogram, the frequency polygon, the smoothed curve and the ogive. We have developed a computer package to demonstrate gradual change of a histogram into a curve. For a given set of data on frequency distribution of, say blood pressure levels in specified categories, this package helps the computer to draw bars which gradually rise to the level of the frequencies, and later on are replaced by the polygon and finally by the frequency curve of the Gaussian type on the computer screen pixel by pixel. This thus demonstrates the meaning and genesis of frequency curves. This package could be very useful in learning the concept of frequency curves particularly the Gaussian form.

Key words: statistics frequency distribution gaussian curve computer-assisted learning physiological variables

INTRODUCTION

Computer-based methods in medical education are now so well defined and assessed at international level that their use is considered as the necessary goal for the coming years. Advantages of computer-based education include local control over the topic, time, place, and pace of instruction. Learners have different preferred styles of receiving information and computer programmes can be written to appeal to particular style of learning (1). They can effectively assist in the organisation of knowledge, clinical reasoning and competence, and manual skills.

In the past several years, there has been an enormous increase in the number of computer-assisted learning applications. Many medical educators and physicians have recognised the power and utility of hypertext/hypermedia which are evolving as important new measures in the education of health sciences (2). Hypertext/hypermedia is computer-based means of organising information that allows one to explore the connections among related subjects. Users can choose frames (picture or text on the screen) from an alphabetical index produced automatically from key words in each frame title, or from hierarchically organised subject index. Links between frames allow users to explore related frames and then return to the original frame. Physicians can add new frames to the system so that the specified knowledge can be shared (3). Some developers have incorporated simple diagrams, scanned monochrome graphics or still frame photographs from a laser disk or CD-ROM into their hypertext/hypermedia applications (4). These technologies have greatly increased the role of micro-computer in education and training.

A hypertext system has also been developed which allows easy courseware development with multiple authors working on a networked environment. The system benefits not only the
of microvascular flow studies (2). Clinically also this finding is confirmed by gradual claudication and foot ulcer. In conclusion, our data suggests existence of correlation between autonomic dysfunction and peripheral vascular dysfunction at subclinical level.

ACKNOWLEDGMENTS

The work was accomplished with the help of grant received from All India Institute of Medical Sciences, New Delhi during 1993-94.

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student trying to relate material between courses, but also assist the faculty in the development of appropriate instructional materials as well as course goals and objectives (5).

Computer-assisted learning (CAL) packages have been developed in almost all biomedical disciplines, viz, physiology (6, 7, 8), bacteriology (9), pathology (10), pharmacology (11), radiology (12), anaesthesiology (13), haematology (14), psychology (15), medical decision-making (16), CME (17), three-dimensional imaging (18), learning in medicine (19), public health (20) and drawing bar graphs (21) to mention a few.

Computers have also began to find a place in the education of health care staff (22, 23). They offer a cost-effective means of orienting large number of personnel to a hospital information system. Equally important, a decentralised self-administrated, self-paced tutorial allow professionals to get training where and when they want it, with as little or as much reinforcement as described.

It is very easy to discover the weakness in the computer assisted learning program by testing with students, so that conversation with the computer can be imporved from time to time. As a result both interaction and information presented are improved. Also the computer-student interaction allows better graphic facilities because the computer can draw better pictures than those drawn manually. Programmes can be developed even to provide computer based training to the teachers to upgrade and update their knowledge.

The major challenge in computer based learning is indeed the availability of the software. We at Division of Biostatistics and Medical Informatics of the University College of Medical Sciences in Delhi developed a part of a computer-assisted learning system in Biostatistics which suits our medical education curriculum.

Medical students are invariably taught about the Gaussian form of statistical distribution which many physiological variables follow. This is a theoretical form of distribution which is only approximately obtained in practice that too almost always in the form of grouped data. We have developed a computer based lesson which draws histogram for a given set of data in the first step and gradually replaces it by a polygon. It is finally replaced by a gaussian curve with mean and standard deviation same as obtained from the data. This gradual stepwise replacement seem to help the medical students to clearly visualise the concept of gaussian form –also called normality.

Software

This package has four easy-to-understand and easy-to-operate modules as follows:

(i) Data entry,
(ii) Drawing of a histogram,
(iii) Its gradual replacement by the polygon
(iv) Smoothening of polygon by a frequency curve of Gaussian form

The first module allows the student to enter the data on any physiological variable, e.g., number of subjects in different blood pressure categories. These categories must be of equal width. The package runs a chi-square test in the background and displays one of the following messages depending upon the data evaluation:

(a) “The number of categories are either very few (less than 5) or too many (more than 11) – please reenter the data.”
(b) “The frequencies in many categories are too small to judge the adequacy of Gaussian form of the distribution – please reenter the data with larger frequencies.” This message is displayed when more than one category has expected frequency less than 5. Note that this is the well known condition for chi-square test to be valid.
(c) “The data do not follow a Gaussian form of the distribution and so the frequency curve drawn will not be a good approximation to the data.”
(d) “The data follow on approximate Gaussian form of distribution – please proceed ahead.”
Note that in the case of either (a) or (b), the system goes back to the data entry module which also allows to exit. In the case of (c), the student can either proceed after becoming aware of the caution or can exit. The case (d) offers no problem at all and in fact ideally suited for the programme to work.

After the histogram is drawn, the message “Strike any key when ready” is displayed on the screen. On pressing any key, the CAL package enters in third module. The third module gradually joins the middle points of the tops of the adjacent bars of the histogram by a line which terminates on the x-axis (Fig. 1a). Thus the polygon is completed and the same message on the screen “Strike any key when ready” is displayed again. When we press any key, the histogram gradually starts disappearing leaving only the polygon on the screen.

Our CAL package again prompts the user to press any key. When pressed, it enters the fourth module. This module computes the mean and SD from the data and use these to draw a Gaussian curve. This can be clearly seen (Fig 1b) as being “super-imposed” on the polygon — a well-known concept in this context. If we press any key again, the polygon gradually disappears and only the Gaussian curve is finally left on the screen (Fig. 1c). In fitting the curve, the mean and standard deviation of the observed distribution are treated as population mean and population standard deviation.

**DISCUSSION**

Whether the teachers like it or not, the time has arrived for exploiting the enormous capabilities of computers to assist the teaching-learning process. The advantages CAL offers for out weigh the cost involved and it is being increasingly accepted around the world at least as a supplementary method.

Statistical concepts are generally perceived by medical profession as a difficult entity. There is sometimes tendency to avoid these concepts. At the same time there is a growing realization
that statistical methods are essential tools to deal with the profound uncertainties that medicine has to face every day. These methods help to reach to valid and reliable decisions despite such uncertainties (24). Understanding the concept of statistical distribution of data, particularly the Normal or Gaussian form, is among the first steps to reach to the other statistical methods such as tests of significance (25).

The package developed by us provides an avenue for medical students to learn the concepts of frequency distribution, particularly the bell shaped Gaussian form. It brings home the point that the frequencies observed in practice in different categories of values of physiological variables are an approximation to a smooth function. By actual visual demonstration, the concept is likely to be embedded in the mind which otherwise could remain only as a philosophy and may even be forgotten. Some students have tried this package and have given a very positive feedback but full scale scientific investigations are required in future to assess the usefulness and impact of this package.

We have not yet incorporated into this package the features which could help to actually see that (mean – 2SD, mean + 2SD) limits really cover 95% of the subjects if the form of distribution is Gaussian, and that each tail has nearly 2.5% subjects. This is under process. We may later on add the concepts of other forms of distribution into this package as well as other related topics such as location of mean, median and mode.

Whenever a student converses with a teacher, it is a small or generally one time conversation. The teacher is seldom consulted again and again because of hesitation and fear of disturbing him. With the help of this package, the student can interact and learn as many times as he needs. Such type of packages can also be developed in other topics of medical sciences in different subjects such as physiology, biochemistry and pharmacology. Such packages should be developed jointly by the medical and computer experts. The computers should ideally be connected and interlinked through a network so that, by their common opinion, standardised packages, which suit all the medical colleges according to their syllabus, can be developed. Since learning is repetitive process, computer-assisted learning (CAL) packages could be very useful.

REFERENCES


