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LEARNING/TEACHING

A Computer-Based Epidemiological Skills Module for Medical Undergraduates in Nepal

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ABSTRACT **Objective:** *To ascertain whether undergraduate medical students could acquire the basic competence needed to design, analyze and use a computer-compatible database in an epidemiologically meaningful way.*

Setting: *Since 1998 the Manipal College of Medical Sciences (MCOMS) of Kathmandu University (KU), Nepal has included in its undergraduate medical curriculum a training module that incorporates knowledge and skills in doing computer-assisted data analyses of epidemiological questions. The present study was designed around the implementation of this module.*

Subjects: *All 96 students of the seventh semester (first six months of the fourth year) of the MBBS course at the MCOMS.*

Methods: *The teaching–learning activities for the module were carried out mainly in six 2-hour sessions, for groups of 16 students at a time. The software used was EPI-INFO.*

Main outcome measures: *Knowledge and skills of computer-assisted data analyses were assessed. In addition, feedback was obtained from the students and scored on seven dimensions.*

Findings: *The pre-test/post-test questionnaire score difference, which evaluated the knowledge component, was highly significant* ($t = 51.3$, $p < 0.001$). *In the skills assessment session, 83% were successful. The students gave high average scores on the satisfaction, small group learning environment, curricular relevance and evaluation dimensions; but the scores were relatively low on the time, other resources and confidence dimensions.*

Conclusion: *The module was successful in achieving its objectives and can be implemented even under tight resource constraints. Our plans for improving upon this first run of the module are outlined in the paper.*

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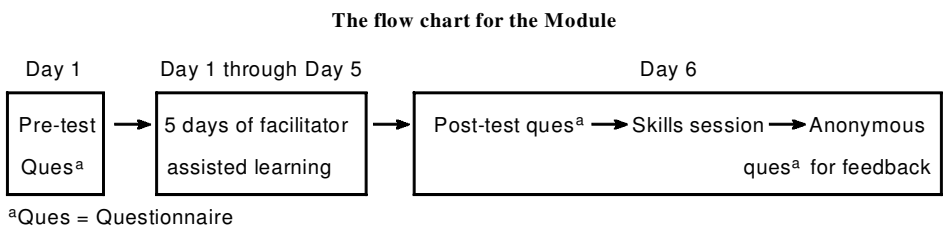

Figure 1. The flow chart for the module.

Introduction

Many of the medical undergraduates in Nepal, and other developing countries, will be assuming health care managerial responsibilities at the district or sub-district levels. To deliver primary health care properly to the community, diverse skills are required. Proficiency in collecting and doing a quick analysis of epidemiological data is certainly among them. However, modern epidemiological practice and teaching have become closely linked with computer-assisted data analysis (Cuevas *et al*., 1993; Frerichs & Tar, 1989; Macfarlane *et al*., 1996). Unfortunately, in Nepal, as in most developing countries, there is often a shortage of manpower trained in such computer skills.

Recruiting specialists in computer operations and data analysis to assist health care managers is not economically feasible in most developing countries. It is therefore important to equip medical undergraduates with the necessary skills for epidemiological data analysis with the assistance of computers. Such training has been given to medical doctors in Bangladesh, Myanmar and Thailand, among other countries (Gould & Frerichs, 1986). The need for general computer skills by medical students was recognized by a project panel of the Association of American Medical Colleges (AAMC), who included "application of information sciences and computer technology" in their recommendations for curriculum planning for 21st century doctors (AAMC, 1984). Similar views have been expressed by others (Kaikkonen, 1996).

The conventional medical undergraduate curriculum in Nepal, as in many other countries, does not include training in computer-assisted database analysis. To correct this shortcoming in the curriculum we proposed a module for such training (Bose, 1997). The flow chart of the module is given in Figure 1. Broadly speaking, each day's session was split into three phases (Table 1). In Phase A the facilitator introduces the day's topics. In Phase B the learners work through the problem of the day, with guidance from the facilitator. In Phase C the facilitator summarizes the day's activities and briefly outlines the next day's activities. For the success of the program, Phase B is the vital component. Thus half of days 1 and 2, and more than half of days 3, 4 and 5, are scheduled to be entirely learner centered (Phase B).

This implementation scheme for the module was presented and discussed amongst peers and resource persons at the Third World Health Organization

Table 1. Plan of each session's teaching–learning activities (16 students per group)

Day	Phase A: 30 minutes	Phase B: 1 hour	Phase C: 30 minutes
1	1. Pre-test of knowledge. 2. Advantages and disadvantages of computer assisted data analysis. 3. Drive, directory, file, filename and extensions, path. 4. Enlisting types of data base fields.	1. Students designed a questionnaire on an epidemiological research question of their own choice, having community relevance. Done separately by each of four smaller subgroups of four students each.	Discussion on each questionnaire pointing out good features and deficiencies of each *vis-à-vis* analysis. Evening task: correcting the questionnaire.
2	Discussion on corrected questionnaire.	Students designed questionnaire on computer and took a printout in the EPED[a] program. Then they inputted a few random data through the ENTER[a] program.	1. Random data sets were generated for each questionnaire with the help of the EPI-INFO program and a line list given to students. 2. Basic steps of analysis introduced. Evening task: students checked and cleaned the data sets.
3	Introduction to ANALYSIS[a] commands used in the EPI-INFO program with their functions.	Students analyzed the artificially generated data sets at first manually (some illustrative examples) and then on the computer.	
4	Further ANALYSIS commands introduced.	Students analyzed the same data sets themselves and obtained suitable printed outputs.	
5	Further use of ANALYSIS: analysis of another group's questionnaire data.		
6	Assessment of computer skills/knowledge: post-test questionnaire followed by 10-minute skills session.		Students' feedback: assessment of teaching–learning activities by students.

Notes: Phase A: short introductory discussion by facilitator; Phase B: active learning through doing by students. Facilitator's role limited to observation and tactful guidance only; Phase C: summing up of day's activities by the facilitator.
[a]EPED/ENTER/ANALYSIS: names of programs in the EPI-INFO software package.

Regional Training Program on Innovations in Health Personnel Education. The general consensus of opinion was that the implementation scheme was eminently feasible. Two changes were suggested:

1. the choice of the research question should be left to the students; and

2. the implementation should be carried out as a well-documented project so that its feasibility and applicability in other situations could also be assessed.

Both these suggestions were given due consideration during actual implementation of the module by the Faculty of Community Medicine at the Manipal College of Medical Sciences (MCOMS), Pokhara, a college affiliated to the Kathmandu University (KU) in Nepal.

The KU curriculum for undergraduate medical education consists of nine semesters (four years) of classroom-based and practical training, plus one year of compulsory rotating internship through clinical departments leading to the award of the degree of Bachelor of Medicine, Bachelor of Surgery (MBBS). The basic sciences are taken in the first four semesters (2½ years). The clinical sciences are taken in the next five semesters (two years). The community medicine (CM) curriculum stretches from Semesters 1–7. It has thus the role of linking basic science concepts to clinical applications, in a community setting.

MCOMS is one of the few medical schools in Southeast Asia to initiate such a module in computer training for medical undergraduates. We decided it was important to document the effectiveness, resource considerations and student perceptions about this module, so that other medical colleges in Nepal, or in other developing countries, could learn from our successes and failures.

Specific Instructional Objectives of the Module

The specific instructional objectives for this module were that at the end of the module the student should be able to:

1. select a population-based research question having relevance to the community;
2. design a data collection method and a computer database for the research question; and
3. select and perform appropriate data analyses for the research question.

Methods

Implementation

The module was implemented by the faculty members of the Community Medicine Department at MCOMS, including the first author, from January through May of 1998. Each group of 16 students was further subdivided into smaller working subgroups of four to encourage more active participation and facilitate peer group interaction. On the first day the learning objectives and the detailed breakup of the module (Table 1) were distributed. The assessment scores were declared as soon as each subgroup's session of six days was over.

Resources

Computers. Four desktop computers and the EPI-INFO software package, version 6.03, were used to implement the module (Dean *et al.*, 1994). EPI-INFO is a word processor cum epidemiological cum statistical analysis program distributed free by the World Health Organization (WHO), Geneva and the Centers for Disease Control (CDC), Atlanta. It can be run on an IBM compatible desktop or laptop computer.

Time. The students were taught in groups of 16 each, taking 12 hours (2 hours per day for six days) for each group. In addition to these planned sessions, additional sessions were arranged for individual students in the evenings. To encourage self-directed learning, these extra sessions were arranged only on the student's request.

Faculty Members. One facilitator was needed during Phases A and C and two facilitators were needed during Phase B each day (see Table 1). The principal facilitator needs to be skilled with both computer databases and epidemiological analysis.

Participants

The participants were all 96 students of the seventh semester of the MBBS course at MCOMS. All students had completed at least 12 years of schooling before joining the medical course. Although some had had exposure to computers, mainly with word processor programs, almost none had experience doing epidemiological/statistical analysis on computers and none was familiar with the EPI-INFO program.

Choice of the Research Questions

The working subgroup of four students was free to choose any research question of their interest. The only stipulation was that it must have some community relevance to Nepal or other developing countries. The student groups showed commendable initiative. For example, some of the research questions chosen were:

1. Which is more strongly associated with health related behavior: literacy level or socioeconomic status?
2. Is choice of contraceptive method influenced by type of family (joint/nuclear)?
3. Case–control study in the hospital to assess risk factors associated with rheumatic heart disease (RHD).

4. Case–control study in the community to assess risk factors associated with iodine deficiency disorders (IDD), especially goiter.

Evaluation

The following instruments were used to evaluate the program.

1. *Pre-test/post-test*: a 48-item objective restricted response and multiple choice type questionnaire was used as a pre- and a post-test. If all responses were correct the maximum score would be 50. The primary concepts assessed were: basic knowledge about computer database structure (e.g. relationship between fields, records and a file); applicability of different risk measures used in epidemiology (e.g. risk ratio versus odds ratio); and applicability of statistical tests of significance (e.g. *t*-test, chi-squared test).
2. *Computer skill assessment*: a session at the computer terminal was used. To be considered successful the student had to complete the given epidemiological analysis task and obtain a printed output within 10 minutes. Basically the learners were expected to perform the following types of simple analyses and interpret them: frequency distributions (sometimes after regrouping the raw data into suitable class intervals); cross tabulations and some graphical output like pie charts, histograms, line diagrams. Some examples of the tasks set are given in Table 2.
3. *Students' feedback*: an anonymous 20-statement questionnaire was used (Table 3). A five-point Likert-type scale was used with the scores ranging from 1 ("strongly disagree") through 5 ("strongly agree") with a score of 3 for having "no opinion." The statements were grouped into seven dimensions. A high score would be desirable on all the dimensions. The students filled up this questionnaire, alone in a room, after taking the post-test and the skills session on the last day of the module.

Results

All 96 students participated in the module. Ninety-one students completed both the pre- and the post-test. Four could not take the pre-test, and one did not take the post-test. Ninety-five took the skills session and also responded to the anonymous questionnaire.

The pre-test/post-test questionnaire score differences were highly significant ($t = 51.3$, $p < 0.001$). The mean and the quartile values are presented in Table 4. Whereas in the pre-test 75% of the students scored under 6, in the post-test the entire distribution shifted to the right so that 75% of the students scored above 42 out of a maximum possible score of 50. In the skills assessment session 83% (79 out of 95 students) were successful in completing the epidemiological analysis task set within the stipulated time of 10 minutes.

Table 2. Some examples of the tasks set at the skills assessment session

Instructions common to all students
1. Analyze the File HEAD. REC in the Root Directory of your 3 1/2 inch floppy drive.
2. You must obtain a *printed output* of all the tasks set and then quit the program.
3. Please note that all FIELD/VARIABLE names are printed in UPPERCASE letters.
Some examples of the specific tasks set
1. Produce a frequency distribution of AGEYR (age in years) in class intervals of *five* and create a printed output.
2. Obtain frequency distribution tables of LITERACY and SMOKEOUT (smoke outlet in the kitchen). Test for the presence/absence of an association between LITERACY and having a smoke outlet in the kitchen and give your interpretation.
3. Obtain a frequency distribution of FAMILYSIZE. Produce a suitable graphical output.
4. Obtain a frequency distribution of SES (socioeconomic status) and COOKSALT (cooking salt iodized or not). Test for presence/absence of an association between socioeconomic status and type of cooking salt used and give your interpretation.

The mean scores of the seven dimensions of the anonymous questionnaire are presented in Table 5. While there were high mean scores on the satisfaction, small group learning environment, curricular relevance and evaluation dimensions (range: 75% to 88%), the scores were relatively low on the time, other resources and confidence dimensions (range: 51% to 69%).

During the implementation of the module the interaction between the facilitator and students, and amongst the students, was extremely active. As mentioned, additional evening sessions were arranged for the students. These sessions were a vital aspect of the program, wherein the students learned not only from the facilitator but also from each other. Those students who had already completed their computer skills module volunteered to teach the current group. To our surprise, almost all students attended these voluntary, additional sessions.

Research question no. 2 (see "Choice of the research questions" above) was likely prompted by an observation noted during our visits to the community with the students. We have seen that often in joint families it is the mother-in-law who decides the contraceptive method to be accepted by the daughter-in-law, and it is usually a terminal method after three or more children. Conversely, for small nuclear families, especially when the wife is literate, the choice of a temporary method for spacing of childbirth is more common.

Research question no. 4 recalls an interesting anecdote. The student group had prepared a detailed questionnaire for assessing risk factors for IDD/goiter. But in their enthusiasm to include all known scientific details about goitrogenic foods they had forgotten to include a field to record whether the person was suffering from IDD or not. Once the questionnaire was designed and random data generated, there was no way to identify who was a case and who was a control. The facilitator played along with the students and asked them to calculate odds ratios for the different risk factors they have considered in their questionnaire.

Table 3. Statements in the anonymous questionnaire for student feedback

Dimensions (% scores)	Statements
Satisfaction (85%)	1. I enjoyed working through the module. 2. I think that the content areas covered in the module were interesting and useful.
Small group learning environment (88%)	3. I feel that the same knowledge and skills could *not* have been acquired through a lecture class. 4. The interaction with the facilitator(s) helped me to solve the problems I faced while working through the module. 5. The facilitator helped me to work through the module.
Curricular relevance (80%)	6. I feel that computer database skills should form an essential part of MBBS curriculum. 7. I believe that assessment of computer database skills should be made a part of the university examinations. 8. I believe that working on this module is useful even if it were not included in the university examination. 9. I would have liked to work through this module whether or not it were a part of the university examination.
Evaluation (75%)	10. The pre-test post-test and skills evaluation system helped us to evaluate ourselves in a meaningful way. 11. The pre-test post-test evaluation system should be kept as it is.
Time (69%)	12. Overall the time allotted was just right, neither too much nor too little. 13. The time available for hands-on experience with the computer was adequate. 14. The time available for interaction with the facilitator was adequate. 15. The time available for interaction amongst ourselves (peer group) was adequate.
Other resources (51%)	16. The number of computers per person was adequate. 17. The number of facilitator(s) per person was adequate.
Confidence (68%)	18. The knowledge and skills that I have acquired in this computer skills module will help me serve better as a doctor. 19. After doing the exercises in the module I feel confident to handle small databases on my own. 20. I feel that I have had adequate practice on database handling through this module.

At this point the error was apparent to the students. It was a lesson well learnt, because they had learnt it themselves.

In general we were pleasantly surprised to see the degree of initiative shown by the students in choosing and discussing the research questions. Usually it would involve an animated discussion amongst themselves supplemented by some reference hunting in the library. The facilitator was sometimes prodded to

Table 4. The distribution of the pre-test, post-test and difference scores

	Mean	SD	25 percentile	Median	75 percentile
Pre-test score	4.4	4.8	2	3	6
Post-test score	44.3	6.9	42	47	49
Post–pre difference	39.9[a]	7.4	38	42	44

[a] t-statistic = 51.32, df = 90, p-value < 0.001.

get a quick answer to their queries, but in our experience it is better to hold back the answers and let the students find out on their own. More often than not, they came up with the right answers.

Discussion

Computer-aided learning packages have been developed to help medical students master discipline content areas and epidemic investigations (Clayden & Wilson, 1988; Cuevas *et al.*, 1993). Such computer programs simulating real life situations are excellent. But they require a degree of computer sophistication, which may not be readily available or applicable in Nepal, especially at the district or the sub-district levels. We wanted to develop a model that is replicable in Nepal, and implementable by the teaching faculty in medical schools here and in other countries with limited resources. Toward those ends, the software and the level of epidemiological analysis tasks have been kept relatively simple.

We did not include training in word processing skills directly, beyond what is necessary to type a questionnaire. Such training is already freely available in the open market and so would be a waste of valuable curriculum time. Altman & Golub (1994) had also considered training in word processing skills to be

Table 5. Student feedback: mean (maximum possible) score, standard deviation and percent scores on the seven dimensions

Dimension	Mean score (maximum possible)	SD	% score
1. Satisfaction	8.46 (10)	1.17	84.63
2. Small group learning environment	13.23 (15)	1.66	88.21
3. Curricular relevance	16.02 (20)	2.29	80.11
4. Evaluation	7.47 (10)	2.08	74.73
5. Time	13.71 (20)	2.78	68.55
6. Other resources	5.11 (10)	1.67	51.05
7. Confidence	10.27 (15)	2.23	68.49
8. Total score	73.61 (100)	8.60	73.61

redundant for their students. On the other hand, training in epidemiological analysis is not readily available. Hence our module was geared towards testing whether the students had acquired the basic competence for making an epidemiological analysis of a given database.

In the MCOMS training module we attempted to put the students in charge of their own learning. They chose their own research questions and could approach their learning task in a problem-solving manner. This approach generated a lot of interest among the students and possibly helped us achieve the high rate of success at the skills session (83%). Restructuring of training in public health with a computer-based project work approach has also occurred in some schools of Eastern Europe (Bojan *et al*., 1995).

As mentioned, almost all the students came for additional evening sessions. Because of the active and enthusiastic peer group interaction these additional sessions needed very little time from the facilitator. The sharing of the teaching–learning responsibilities by the students is both sound pedagogy and good management of resources.

The module can easily be modified to serve for the training of trainers. The trainer needs to be trained in the random data generation function (this was not taught to the students) in addition to learning the students' module. In fact, a faculty member was actually trained during the course of the training of the first group of 16 students and she assisted competently in the module for the latter groups. The computer files created by the students, in which artificial data were generated, were always kept in the custody of the faculty members.

The only resources needed to implement this module are a few desktop computers, some stationery and the free software program EPI-INFO. A team of motivated and competent faculty members, skilled both in epidemiology and computer use, is also a vital component of the program. A degree of boredom can set in when repeating the same module multiple times (in our case six) with separate student groups throughout a semester. The solution is to share the workload amongst faculty members, and to energize the students to learn on their own initiative.

It is thus possible to implement this module even with limited resources. However, while implementing the module at MCOMS or other medical schools in the future, due attention should be paid to the resource constraints and low scores on the confidence dimension among our participants. The student feedback also helped the administration and the faculty at MCOMS to assess the optimal resource requirements. For example, the optimal requirement for desktop computers appears to be one for two students and not one for four as obtained during the first run of this module. The level of epidemiological analysis may also be raised in future cycles of the module.

We consider it safe to conclude that the module is eminently implementable, with a high success rate, and could generate a level of enthusiasm among the students not usually seen in the other components of the community medicine curriculum.

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References

ALTMAN, M & GOLUB, R.M. (1994). A compact course in basic computer skills for freshman medical students. *Academic Medicine*, *69*, 429.

ASSOCIATION OF AMERICAN MEDICAL COLLEGES (1984). Report of the project panel on general professional education of the physician and college preparation for Medicine. *Journal of Medical Education*, *2*, 11–13.

BOJAN, F., BELICZA, E., HORVATH, F. & MCKEE, M. (1995). Teaching public health: an innovative method using computer based project work. *Medical Education*, *29*, 48–52.

BOSE, A.S. (1997). A computer database literacy module for MBBS students. Paper presented at the Third World Health Organization Regional Training Program on Innovations in Health Personnel Education.

CLAYDEN, G.S. & WILSON, B. (1988). Computer assisted learning in medical education. *Medical Education*, *22*, 456–467.

CUEVAS, L.E., MOODY, J.B., MACFARLANE, S.B., RADA, R. & GHAOUI, C. (1993). The use of hypertext: demonstration of the methods for investigating an epidemic of meningitis. *Medical Education*, *27*, 91–96.

DEAN, A.G. *et al*. (1994). *EPI-INFO version 6: a word processing, database and statistics program for epidemiology on microcomputers*. Atlanta: Centers for Disease Control and Prevention.

FRERICHS, R.R. & TAR, K.T. (1989). Computer assisted rapid surveys in developing countries. *Public Health Reports*, *104*, 14–23.

GOULD, J.B. & FRERICHS, R.R. (1986). Training faculty in Bangladesh to use a microcomputer for public health: follow-up report. *Public Health Reports*, *101*, 616–623.

KAIKKONEN, A. (1996). Computers in medical education. In: R.K. ADHIKARI & P.T. JAYAWICKRAMARAJAH (Eds), *Essentials of medical education*. Kathmandu: Health Learning Materials Centre.

MACFARLANE, S.B., CUEVAS, L.E., MOODY, J.B., RUSSELL, W.B. & SCHLECT, B.J. (1996). Epidemiology training for primary health care: the use of computer assisted distance learning. *Journal of the Royal Society of Health*, *116*, 317–321.