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Development and Evaluation of a Computer Literacy Course for Preservice Teachers in Singapore

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ABSTRACT

The problem was to identify topics and concepts for a computer literacy course for preservice teachers in Singapore, to develop curriculum materials, and to evaluate the course in terms of achievement, attitudes towards computers, and reactions to the course by the participants.

The syllabus was designed and curriculum materials were developed for the course. The results of the study showed that the course had been effective in raising the computer literacy achievement of the preservice teachers but not attitudes towards computers. Reactions to the course were favourable and hands-on experience on the computer was considered the most effective aspect of the course.

Introduction

In 1975, the Institute of Education, the only teacher-training institution in Singapore, first introduced its computer programming courses as electives for its preservice teachers. Since 1981, with the purchase of microcomputers, more courses have been conducted for preservice teachers enrolled in the various teacher education programmes. More preservice teachers wished to take the courses as they perceived that knowledge about computers would be useful to them as teachers in schools. Such perception was partly due to the greater use of computers by government departments, a keen interest in computers shown by the public, and an influx of low-cost microcomputers affordable by the average family.

Since July 1986, all preservice teachers in the Diploma-in-Education programme have been required to undergo a 30-hour Information Technology in Education course. This course was also offered to preservice teachers in the Certificate-in-Education programme (for General Certificate of Education 'A' Level holders) with effect from July 1987.

There is a need to develop a more comprehensive course for a number of reasons. Firstly, because computer literacy is now considered as a goal of education, it has an important place in the education of students in Singapore. Secondly, a more comprehensive course will enhance the general understanding of computer literacy, which should include various areas of interest, such as the history and evolution of computers, the impact of computers in society, and courseware evaluation techniques. Thirdly, in the present state of societal development of Singapore, with its commitment to computerisation, it has become relevant for preservice teachers to know more about computers not only in connection with their training at the Institute of Education but also in the larger context of society.

Computer Literacy

The definition of computer literacy undergoes constant changes as innovative computer languages, new communication devices, applications software and additional automation technologies emerge as and when man enters into new eras of scientific and technological development. It varies according to the development of computer technology and its impact on the lives of the people. It also differs among people in various positions and in different subject areas. It is relative and holds true for a given culture at a given time (Cheng and Stevens, 1985).

In the context of higher education, the definition of computer literacy depends on the kind of institution and the kind of graduates it tries to turn out (Klassen, 1983). Also, it has to take into account the events in computing in primary and secondary schools, which supply entering students for colleges (Luehrmann, 1983). Where large computers are available, a narrow definition of computer literacy constitutes the ability to use computers in simulation and modelling, especially in modelling and the learning of physical and biological sciences. For a general education, the term has evolved to mean basic knowledge about the computers and their use, applications of computers, the impact of computers on society and the trends and issues in computing.

As computers have become more widely used, computer literacy is defined now more in terms of one's ability to function in society. Many computer educators have defined computer literacy as the knowledge about computers and the abilities essential for a person to function well in a computer- and technology-oriented society. Thus, it is necessary for students to understand computers and their applications in the world around them, develop the skills to communicate with computers, and recognise the computer's capabilities, limitations, and implications for society. Kelman (1984) views computer literacy as "a continuum in which all citizens possess the minimum skills needed for social survival, a few citizens possess a professional level of skill in areas, such as programming or engineering, and most people have a level of computer literacy skills somewhere in between these two extremes, such as the ability to use computers for word or data processing" (p. 15).

Computer Literacy Curricula for Teacher Colleges

Although the computer has generally been recognised as an efficient tool for solving problems, it is also an educational tool, capable of supplementing instruction in the classroom and enriching the learning of various subject areas. A knowledge of computer vocabulary, operations and functions enables teachers to communicate intelligently with computer professionals. Being able to use the computer as a tool in word processing helps teachers to function more effectively, and thus makes them more enlightened teachers. These aspects of computer education are desirable for teachers who will then be well prepared to operate in schools that will change in character and emphasis in the future.

The elementary education faculty of Northern Illinois University developed six STUDY-PACs which are individually designed, self-paced courseware packets infused into the curriculum. The courseware includes directions for hands-on experience with microcomputers that give students opportunities to become familiar with the keyboard, disk drive operations, microcomputer terminology, word processing, programming languages, courseware evaluation, and teacher utility programs. Student evaluations of the STUDY-PACs in terms of the cognitive and affective domains have been positive. The cognitive domain consists of microcomputer knowledge and skills development. The affective domain consists of students' attitudes towards STUDY-PAC experience. Each STUDY-PAC includes a four- to six-page instructional leaflet complete with objectives; required reading, audiotapes, videotapes and filmstrips; hands-on microcomputer software and hardware; and feedback.

Table 1 lists the objectives for the six STUDY-PACs stated in terms of what the students will be able to do.

For the student teachers of the Oregon State University, Stiehl and Anderson (1983) developed and tested a programme that incorporates seven self-paced units in a media instructional approach. Each packaged lesson

TABLE 1: OBJECTIVES OF STUDY-PACs FOR STUDENT TEACHERS (FARRIS, JUDD, AND VEDRAL, 1984)

Packet	Objectives
STUDY-PAC I Introduction to Microcomputers	• Define and explain computer literacy and the impact of the computer on society • Define computer terms • LOAD and RUN a prerecorded program
STUDY-PAC II Introduction to Word Processing	• Explain use of word processing in the language experience approach to teaching reading, sentence combining, various teacher reports, worksheets, etc. • Create several sentences using a word processing program
STUDY-PAC III Individualizing Instruction	• Describe CAI, its associated techniques and strategies and how they relate to individualizing instruction • Using program evaluation guidelines to determine the appropriateness of an instructional progam • LIST a prerecorded program and explore how and where individualizing a program to meet the needs of students might be accomplished
STUDY-PAC IV Introduction to Programming Languages	• Explain various philosophic approaches to programming languages • Write and RUN a short program (15 lines/ procedures or fewer)
STUDY-PAC V Evaluating Instructional Microcomputer Programs	• Evaluate instructional microcomputer programs in various subject areas
STUDY-PAC VI Teacher Utility Programs	• Explain uses of record-keeping or management programs

consists of a printed guide which states the purpose, objectives, and evaluation procedures as well as a description of the activities to be carried out by students. It provides for video cassette, audiotape, and slide-sound inputs in addition to hands-on microcomputer use.

The computer task force at the University of Minnesota identified major competencies in computer literacy of preservice teachers which are listed in Table 2. To help the preservice teachers to achieve these competencies it recommended a variety of strategies which included a course emphasising hands-on experience with computers, integration with methods courses in areas such as software evaluation and materials related to computer

TABLE 2: MAJOR COMPETENCIES IN COMPUTER LITERACY OF PRESERVICE TEACHERS (CARRIER AND LAMBRECHT, 1984)

Competency	Description
Knowledge of basic computer components and operation	• Load programs • Know input/output devices • Make back-up copies of programs and data • Initialize new disks • Set up or perform routine maintenance on computer equipment
Knowledge of materials and projects related to computer education	• Use books and periodical resources • Draw upon the resources of local, regional, or national computing centres or projects for materials and technical assistance
Knowledge of educational and personal uses of computer	• Know the ways in which computers can be used to manage or deliver instruction and as a problem solving tool • Know such tools as word processing software, data base, or file management programs, and data analysis software
Knowledge of individual differences as they relate to computer-assisted learning	• Use computer to provide for individual learning styles and differences
Evaluating instructional software	• Know software evaluation criteria appropriate to their teaching specialities
Ability to develop/manage an environment in which computers are available for teaching/learning	• Choose those times in the teaching schedule when computer use is appropriate • Integrate computer use into programs which may also include other instructional activities
Knowledge of educational and societal implications of the "information age"	• Be sensitive to ways in which educational institutions can respond to and participate in changes people make in communicating, earning their living, and enjoying entertainment
Ability to use authoring languages and to program (Optional)	• Control the computer through the creative activity of modifying or developing instructional software

education, and another course in which the preservice teachers would have an opportunity to practise design computer-based lessons.

Based upon the findings of their research studies to identify computer competencies required of teachers, several researchers (e.g., Chen, 1984; Wentz, 1985) have recommended the integration of computer competencies into teacher education programmes and the inclusion of strategies to incorporate computer-assisted instruction opportunities into preservice teacher education courses.

Statement of the Problem

The main problem was the identification of topics and concepts for a 30-hour computer

literacy course for preservice teachers in Singapore, the development of curriculum materials for the conduct of the course, and the evaluation of the course in terms of achievement, attitudes towards computers, and reactions to the course by the participants.

Design and Procedures

There were five phases in this study, namely, the identification of computer literacy topics; the development of the computer literacy course; the validation of the topics, the curriculum materials and the measuring instruments; the pilot study; and the main study involving the implementation of the course on samples taken from the target population.

The topics were identified based on literature review, especially of computer literacy curricula developed in teacher education institutions in the United States. The curriculum materials were developed by stating objectives, writing lesson plans, and designing assignments and tests. Three instruments were developed, namely, Questionnaire on Attitudes Towards Computers, Computer Literacy Achievement Test, and Course Evaluation Form. Validation was done by six local and overseas computer literacy experts and the instruments were tried out in the pilot study.

A four-group pre-test-post-test control group randomised design was adopted in the main study. The form of the design is represented in Table 3.

The Questionnaire on Attitudes Towards Computers and the Computer Literacy Achievement Test were administered as pre- and post-test to the four groups and the Course Evaluation Form was completed only by the experimental groups. For the purpose of establishing reliability, the Questionnaire on Attitudes Towards Computers and the Computer Literacy Achievement Test were administered again two weeks after the post-test.

Major Findings and Conclusions

Computer Literacy Curriculum

Based on the literature and related research, a syllabus on computer literacy was formulated.

The duration of the course is 30 hours and the instructional objectives are as follows:

(1) To arouse the interest of preservice teachers in computers and their applications;
(2) To provide them with knowledge about computers and skills in using computers for school administration, classroom instruction, and learning;
(3) To equip them with skills to write simple computer programs and to utilise commercial software for doing their assignments;
(4) To provide them with knowledge about laboratory organisation and maintenance, computer shopping and costs, and reading resources on computers; and
(5) To enable them to understand the impact of computers in society, capabilities and

TABLE 3: RESEARCH DESIGN

Group	Size	Pre-test	Treatment	1st Post-test	2nd Post-test
Experimental Group 1 (Cert Ed)	30	Yes	Yes	Yes	Yes
Experimental Group 2 (Dip Ed)	30	Yes	Yes	Yes	Yes
Comparison Group (Existing Course)	30	Yes	Yes	Yes	Yes
Control Group	27	Yes	No	Yes	Yes

TABLE 4: TOPICS FOR COMPUTER LITERACY COURSE

Course Unit	Topics
1. Computer Systems	1. Mainframe, minicomputer, microcomputer 2. Configurations of computer system 3. Hardware and software 4. Computer languages
2. Computer Use in Classroom Instruction	1. Computer-assisted instruction 2. Courseware selection, utilisation, evaluation 3. Test generation 4. Item banks
3. Computer as a Learning Tool	1. Report writing (e.g. word processing) 2. Computer use in solving problems 3. Learning of creativity by means of LOGO
4. Computer Use in Administration	1. File and database management 2. Word processing 3. Electronic spreadsheets 4. Packages related to student data
5. Computer Laboratory Skills	1. Laboratory organisation and maintenance 2. Computer shopping and costs 3. Computer book and periodical resources
6. Computers in Society	1. History and evolution of computers 2. Strengths and limitations of computers 3. Applications and impact of computers in our daily lives 4. Issues and trends in computing
7. Computer Programming	1. Program design 2. Writing of simple BASIC programs 3. Flowchart 4. Graphics, sound, and colour generation

limitations of computers, and issues and trends in computing.

The content of the course is divided into seven course units with topics listed in Table 4.

The assessment of preservice teachers' performance is based on the satisfactory completion of essay and practical assignments and a pass in the Computer Literacy Achievement Test at the end of the course.

Hypotheses

Six hypotheses were formulated comparing the four groups with respect to their attitudes towards computers and computer literacy achievement. The analysis of covariance (ANCOVA) using pretest means as covariate was used to test the hypotheses.

Results of Analysis

Table 5 shows the means and standard deviations of attitude ratings and achievement scores.

Attitudes Towards Computers

The results of the tests of significance carried out in the main study indicate that although there was attitudinal change, the change was not significantly different among the four groups of preservice teachers in this study (see Table 6).

TABLE 5: MEANS AND STANDARD DEVIATIONS

Group	Attitudes Towards Computers					Computer Literacy Achievement				
	Pre-test		Post-test		Adjusted Post-test	Pre-test		Post-test		Adjusted Post-test
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$
Experimental (Cert Ed)	68.9	7.20	72.8	8.64	73.8	27.6	5.46	50.1	7.39	50.6
Experimental (Dip Ed)	70.7	9.20	77.8	7.28	77.8	27.5	10.78	59.4	5.10	59.9
Comparison	71.3	8.67	73.7	11.47	73.2	33.7	9.82	44.8	5.78	43.1
Control	72.3	8.57	75.0	7.08	74.4	26.8	6.45	29.6	5.99	30.8

$\bar{X}$ = Mean
SD = Standard Deviation

TABLE 6: COMPARISON OF POSTTEST MEAN ATTITUDE RATINGS OF THE FOUR GROUPS BY ANCOVA

Source	DF	SS	MS	F	P
Equality of Adjusted Means	3	381.00	127.00	2.21	0.092
Error	106	6098.30	57.53		
Total	109	6479.30			

DF = Degrees of Freedom
SS = Sum of Squares
MS = Mean Squares
F = F-value
P = Probability

Computer Literacy Achievement

The major finding as regards computer literacy achievement is that there was significant difference in achievement gains among the four groups under study (see Table 7). Pairwise comparisons also produced significant results (see Table 8). The experimental groups achieved greater gains than the comparison group and the control group. The groups in descending order of their performance (i.e. from the best downward) were experimental Diploma-in-Education, experimental Certificate-in-Education, comparison and control.

Reactions to the Course

The preservice teachers in the experimental groups responded favourably to the proposed course. They perceived the content and materials developed for the course as important for their personal growth, relevant in their work as future teachers in schools, and useful to them as teacher-trainees at the Institute of Education.

Word processing was considered by both experimental groups as most important for their personal growth and most useful to them as teacher-trainees, and by the Diploma-in-Education group as most relevant in their work as future teachers in schools. Evidently, the preservice teachers regarded word processing as a learning tool they could use in writing, editing, and printing assignment reports. Further, those in the Diploma-in-Education group anticipated their potential roles as school administrators and as secondary school and junior college teachers requiring the ability to

TABLE 7: COMPARISON OF POSTTEST MEAN ACHIEVEMENT SCORES OF THE FOUR GROUPS BY ANCOVA

Source	DF	SS	MS	F	P
Equality of Adjusted Means	3	12111.63	4037.54	143.85*	0.0001
Error	106	2975.22	28.07		
Total	109	15087.85			

* Significant at $\alpha = 0.05$ level

TABLE 8: POST HOC PAIRWISE COMPARISON t-TEST MATRIX FOR ACHIEVEMENT

Group	EC	ED	CM	CN
Experimental Cert Ed (EC)				
Experimental Dip Ed (ED)	6.66* 0.0001			
Comparison (CM)	-5.18* 0.0001	−11.76* 0.0001		
Control (CN)	-13.47* 0.0001	20.06* 0.0001	8.09* 0.0001	

* Significant at $\alpha = 0.05$ level

use a word processor. On the other hand, those in the Certificate-in-Education group saw their future role as elementary school teachers requiring their knowledge and expertise in computer-assisted instructions which they had picked as most relevant to them as future teachers in schools.

At the other end of the scale, the Certificate-in-Education group consistently chose history and evolution of computers as least important, least relevant, and least useful, whereas the Diploma-in-Education group considered it the third least important, the second least relevant, and the second least useful. The Diploma-in-Education group considered laboratory organisation and maintenance as least important for personal growth.

The preservice teachers preferred to have sole use of a microcomputer during laboratory sessions as they did not think the sharing of one microcomputer by two or three people was ideal for learning. They considered the duration of the course to be inadequate. Extending the duration of the course would allow for a slower pace, more in-depth coverage of the topics, and more practice on the computer. Another finding is that a large majority of preservice teachers were not confident enough to teach computer literacy in schools after taking the proposed course. Their reactions revealed many probable reasons to this problem. One reason is that the preservice teachers had not completely mastered the practical aspect of the course owing to insufficient time spent on the microcomputer. Many topics discussed had to be crammed within the allotted time because of the wide scope of the course. To many preservice teachers in the study, this course was the only computer literacy course they had ever taken. Hence, many of the topics and activities were new and strange to them. Time and practice are needed for more in-depth understanding of the concepts involved and greater familiarity of the microcomputer.

One way to enhance the confidence of the preservice teachers to teach computer literacy in schools is to increase their knowledge and understanding of the concepts involved and to enable them to be more skillful in using microcomputers. These could be incorporated into

an extended course in which the pedagogical elements could also be introduced and instructional materials designed and developed to support them in their teaching.

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