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Introduction

Phenomenal developments in the technologically advanced countries in the world have posed an immense challenge to the island republic of Singapore. Being their trading partner, Singapore has within the past few years embarked on a number of high tech projects that keep pace with the changes in the "microchip revolution". Since the Eighties, the government and local private enterprises have produced some hardware and software and established more effective communication and information systems in Singapore. This undoubtedly has serious implications for the education system.

Objectives

This paper intends to examine the state-of-the-art of computer education in the world and in Singapore. It will analyse recent developments in educational computing and how they have affected the Institute of Education in its design and implementation of a computer education programme that attempts to meet the needs and challenges of the time.

State - of - the - Art

Recent trends in computer education have indicated major changes in the concept of computer literacy and a decreasing interest in programming at the lower level of computer learning. The concept of computer literacy has changed as societal values and technology change. The earlier concepts of operational literacy, instrumental literacy, and literacy as algorithmic reasoning while still in use are found to be not entirely satisfactory (Culbertson, 1986). The latest proposition is literacy as education for altered roles. Noble has identified "consumer literacy", "worker literacy", and "citizen literacy" as the major role-related concepts (Noble, 1984).

Operational literacy emphasizes knowledge about the basic components of hardware and software and machine - related skills to make computers work. As such it has too narrow a focus. With rapid technological developments, teachers and students who are exposed to only one machine, may have to relearn the operational skills every year.

The instrumental literacy approach uses the computer as an instrument for acquiring stipulated learnings or bodies of subject matter. In Sweden, for example, teachers coordinated instruction in physics and mathematics using computers so that students gained new insights into mathematical relationships, some in social studies acquired new understanding of environmental problems through simulations and others in language art used computers to enhance vocabulary and spelling skills (Megarry, et al, 1983). This approach confines computers to only teachers who are competent in programming or the use of application software to create computer teaching materials. The less competent programmers may have difficulty in teaching computer literacy.

Algorithmic reasoning, perhaps the most controversial concept of computer literacy, is acquired through computer programming. Mathematician John Kemeny believed in programming as a means to develop algorithmic thinking for solving problems or accomplishing a task (Kemeny, 1986). Seymour Papert stressed that programming helps to provide fundamental insights into mathematical and related abstractions (Papert, 1986). These and other like-minded computer scientists have many followers in many of the developed countries. To date, they still adhere to programming in BASIC or LOGO as an introduction to computers.

Noble advocated that role-related literacy seems to be more relevant for present day and future learning and teaching. Consumer literacy carries two meanings, one linked more to hardware and the other more to software. The first stresses that individuals should be effective acquirers and users of computers and associated hardware or peripherals. The second centers upon the "applications" individuals will be making "as part of their strategies for information retrieval, communication and problem solving."

Individuals using the expanding sources of information will need requistie knowledge and skills. They will need to learn, for example, how to enhance their education through electronic media, exchange ideas through computer networks, and use shared databases to solve problems. Schools, then, should provide students with the literacy skills required to function in tomorrow's microelectronic environment. Teachers should therefore acquire computer literacy skills that are transferable to their students.

As a result of the changing view on computer literacy, from that of an operational to that of a consumer - oriented one, the current focus of computer instruction in most parts of the world has been changed. Alternatives to computer programming courses include the long-term objective of integrating computers into the curriculum, and the short term objective of developing a computer education curriculum based on applications software.

To integrate computers into the curriculum as a tool

for students, computer applications would be taught in conjunction with the subject areas. For example, word processing would be taught in writing as part of the English language and literature courses, spreadsheets could be used in math, home economics, history and physical education, databases of specific information could be used as instructional materials in social studies and science courses; and graphics packages could be introduced in art, math or science. Simulation and games could be integrated into various content-appropriate classes - management, economics and decision making situations.

Some studies on the applications-based computer learning have been conducted in the United States. They seemed to appeal to students more than programming courses. For example, in a study of 100 seventh-grade students enrolled in a computer literacy course featuring word processing and data-base managers nearly two-thirds (63%) of the students agreed with the statement "I enjoyed working with computers"' and more than half (56%) disagreed with the statement "computers are boring" (Lockheed, Gulovsen and Morse, 1985).

Voluntary enrollments in word processing classes are also balanced by sex. In the American High School and Beyond (HS & B) survey, for example, 51% of students enrolled in data processing and applications courses and 47% of students enrolled in computer literacy courses were girls (Rock et al, 1985). In the National Assessment of Educational Progress, NAEP data, 1985, for all types of computer use, no sex differences in course enrollments were found for students at any of the three grades of junior and senior high school assessed (Lockheed, 1985a).

Computer Education in Singapore

Despite earlier attempts, computer education was only introduced fairly extensively to the Singapore schools in 1980. It focussed initially on teaching computer science as a subject at the pre-university level, computer appreciation courses at the secondary level and evaluation of the effectiveness of computer assisted instruction in primary school mathematics. Most of the school computer appreciation programmes have, until 1986, concentrated mainly on programming in BASIC and LOGO.

According to a 1986 Ministry of Education report (Seah et al, 1986), every junior college has a computer club with membership varying from 60 - 100 students. At the secondary level, some 22,000 pupils (13.6%) are involved in computer club activities and 505 teachers are in charge of the clubs.

By August 1987, there are 21 secondary schools with their own computer laboratories with at least 20 computers each. The Computer Education Section of Curriculum Development Institute of Singapore (CDIS) earlier in 1987 proposed that every secondary school should have at least 12 computers instead

of the present quota of three. Should this proposal be approved by the Ministry of Finance, more schools will have their own computer clubs and laboratories and more pupils would benefit.

To teach the computer science courses at pre-university level about 100 teachers were trained at the Nanyang University in 1980. While the Curriculum Development Institute of Singapore (CDIS) conducted courses for about 1,100 teachers in-charge of computer clubs in secondary schools from 1980 to the present. Many of them continued as club advisers while others have relinquished their responsibilities in the computer clubs or have left the teaching service (Loh, 1987).

The Institute of Education, Singapore (IE) also played its part in training some 500 teachers for the Computer Appreciation Clubs in primary schools from 1981 - 85. From 1986 onwards, IE has adopted new policies in its teacher education programme. The Practicum Curriculum was introduced to the pre-service Diploma-in-Education student teachers and computer education has become an integral part of the training programme. By 1987 all pre-service and in-service training at the Institute has included a computer education course on the use of computer application software, databases, and computer assisted instruction courseware. Computer education has also been extended to a wider range of in-service teachers. In total, about 1,000 pre and in-service teachers undergo some form of computer education in the Institute of Education each year.

IE's Computer Education Programme for Teachers

Based on the recent trends in computer education, research and evaluation findings from the advanced countries and recent studies by the World Bank (Lockheed & Mandinah, 1986), the IE computer education programme has been reconceptualized to include the following key features:

(1) applications-based learning integrated with other media across the curriculum

(2) learning theory - based teaching and software development

(3) multi - systems approach for information delivery and networking.

Integrated and Applications-based Learning

The emphasis is on the use of computer application software together with other media to create interesting learning and teaching materials in the various subject areas. Software packages like wordprocessors, databases, spreadsheets, graphic and statistical packages are usually employed across the curriculum. For example, using the wordprocessor to improve

process writing and creative writing, or using databases for accessing information and for analysing data in science, and social and management studies.

Learning Theory - Based Teaching

The importance of having a sound theoretical basis for teaching and learning with the computer cannot be over-emphasised. Psychologists and educators have developed a reasonably firm scientific basis for teaching and learning. This basis should be applied to teaching and learning with the computers. Computer learning through programming and use of applications software stimulates the acquisition of algorithmic reasoning and problem solving skills. Learners are taught to break down chunks of information into small bits that can be systematically learned. They also learn various problem solving approaches by applying certain heuristics in computer programming.

Multi-systems Approach for Information Delivery and Networking

Readiness and ability to use multi computing systems is crucial in the Information Age. Teaching and learning with computers would adopt the multi - systems approach so that all trained teachers from IE will be comfortable using different software on different machines and different databases on different delivery and networking systems. Currently, IE students are exposed to two to four kinds of machines - IBM JX, IBM PC, Macintosh SE and BBC ACORN, and two network systems - the JANET 3 network and the bilingual School Home Interactive Network Exchange (SHINE) network.

Programme Objectives

From the above rationale, three key objectives were derived for IE's Computer education programme.

Objective One: All primary and secondary student teachers and potential heads of departments and principals will be trained to use the computer as a tool for wordprocessing and creating databases.

Objective Two: Key subject teachers should have more knowledge about the computer as a complementary means of instruction across the curriculum. Computer assisted learning programmes will sometimes be used as a tutor for abstract and difficult concepts. Key subject teachers should be able to pass on their skills to other teachers in schools.

Objective Three: Specially trained subject teachers should be trained to use the computers to improve pupils' reasoning skills through programming.

Levels of Computer Education

The above three objectives became the guidelines in the design and implementation of IE's computer education programme. These levels of training apply to both pre - service and in-service teacher education. For the first three years, in-service teacher education is confined to the secondary schools in support of the Ministry of Education's emphasis.

Level I

Basic knowledge of parts of a computer and its peripherals and their respective functions.

Computer as a **tool** for wordprocessing, data processing, record keeping, graphic design for preparation of teaching materials, for assessment and administration.

Basic understanding of networking systems and skills in using multi- systems for retrieval, communication, and storage of information.

Level II -

Exposure to a variety of computer assisted learning (CAL) or computer assisted instruction (CAI) programmes that make use of the computer in the tutor mode in selected subject areas.

Evaluation, selection, and utilization of CAL and CAI programmes for subject teaching

Using applications software to integrate or create materials for subject teaching

Level III-

Learning computer languages, programming and authoring languages such as BASIC, LOGO, SUPER PILOT to a level of competence that will enable one to create CAL programmes in the subject areas, i.e., the incorporation of the use of the computer as a **tutee.**

Current IE Computer Education Courses

With the adoption of the rationale mentioned, every computer course conducted by the Institute of Education has, as far as it is posssible, incorporated the three features. This is to ensure that teachers are not only familiar with the use of computers, and the users and producers of this technology, but they are also able to educate pupils who reflect the same awareness and understanding of the symbiotic partnership of man and computer.

To ensure that individual needs of the teachers are met, a three-level computer education programme with different kinds of courses has been proposed. The first level focuses on using the computer and computer software as a tool. In a role - related term, the user is a consumer, a worker or a citizen using computers to access, retrieve, communicate and store information. The second level looks at the tutor mode. The computer is used as an instrument to acquire knowledge and skills in specific subject areas or as a tutor to supplement teachiang. Selection, evaluation and utilization of the available coursewares are of great concern. The third level incorporates the tutee mode of the computer, that is programming and research in relations to computer education.

An example of the Level I course is the 30 hour pre-service Information Technology in Education course for all Diploma in Education (Dip Ed) and Certificate in Education (Cert Ed) students. The student teachers are expected to acquire skills to operate and use the computer and a local area network for all subjects across the curriculum. They are expected also to learn to use applications software packages to do wordprocessing, create tables, graphs and charts, and databases for information storage. They also enjoy some hands-on experience in using the computer as a tutor when they try out and evaluate courseware in different subject areas on different machines e.g. IBM JX, IBM PC, Apple 2E, Acorn- BBC computers.

Results from a study evaluating the computer knowledge of Dip Ed students after taking the course (1986/87) shows that all the 354 students passed the course after mastering the required skills in wordprocessing, spreadsheet, database management and LOGO graphics. In a post-course questionnaire 75% of them agreed that wordprocessing was important to their pupils and 59% of them felt that it was important to themselves. 67% felt that computer assisted instruciton was important to their pupils but only 23 % felt that CAI was important to themselves. While 81% of the Dip Ed students indicated that spreadsheets and databases were useful for their own personal management. Consistently , the maths and science students indicated that computer applications were more important or useful to them than the arts and social science students (Koh & Harper, 1987). This disciplinary difference was more marked than gender difference as male students in the 1986/87 batch made up only 18.36 % of the total population.

At Level II, the first such example is the Innovating An Educational Computing Project in School course for in-service teachers. It aims at exposing the participants to a range of applications software and computer assisted learning programmes that have been developed on a firm scientific basis. These include individually and commercially produced programmes as well as locally created information and educational databases such as the School and Home Interactive Network Exchange (SHINE)

well as locally created information and educational databases such as the School and Home Interactive Network Exchange (SHINE) of the Singapore Press Holdings. The participants also created their own programmes by using software packages (e.g. a word - processor and a spreadsheet) and/or a lanaguage (BASIC or LOGO).

As a requirement of the course, the participants shared their knowledge and skills with the teaching faculty in schools by applying the most workable diffusion of innovation principles in conducting school-based workshops for their colleagues. Of the two participating schools, one-third of the entire teaching population learned word processing and more than half were exposed to a variety of computer assisted instruction packages. One school was exposed to the SHINE database. In fact, the participating school principal himself designed a math programme for SHINE. Other teachers in the school have also indicated interest to design programmes that explain difficult concepts with the assistance of SHINE.

Future Direction

In view of the high tech contexts of Singapore and her trading partners, schools and teachers will not only be demonstrating their reliance upon computers and computer systems to improve the quality of administration and instruction, they will have to prove their efficiency in employing high tech resources as well as to become the nurturing grounds for producing prototypic learning and teaching materials.

The Institute of Education, being the one and only teacher education in Singapore, has to play an increasing leadership role in training and developing such teachers for the high technology generations ahead. The computer education programme described is only the beginning of more comprehensive teacher education in the use of computers. There is provision for further development and expansion in step with technological and social developments in the future.

References

Culbertson, Jack. (1986). Whither Computer Literacy. Microcomputers and Education. 85th Yearbook of the National Society for the Study of Education. Chicago: University of Chicago Press.

Kemeny, John. (1983). The Case for Computer Literacy. Daedalus 112, Spring 1983, p.218.

Koh, Peter Y.H. & Harper, Dennis. (1987). An Analysis of A Mass Computer Education Course for Secondary Preservice Teachers, a paper presented at the annual meeting of the Educational Research Association, Singapore, September 1987.

Lockheed, M.E. & Mandinah E.B. (1986). Trends in Educational Computing: Decreasing Interest and the Changing Focus of Instruction. Information Technology and Education. Vol 15 No 5, May 1986.

Loh Kon. Interview with the Assistant Director, Computer Education Section, CDIS, 28 September 1987.

Noble, Douglas. (1984). Computer Literacy and Ideology. Teachers College Record 85. Summer 1984, p. 602-614.

Seah J. C. et al (1986). Report on Computer Education: A Review and Proposals for New Objectives and Strategies. Ministry of Eudcation, Singapore.