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**A REPORT ON RESEARCH AND DEVELOPMENT PROJECTS
CONCERNING MINIMISING OF INVESTMENT AND MAXIMISING
OF ACHIEVEMENT IN MATHEMATICS EDUCATION
IN SINGAPORE**

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A report on "Research and Development Projects concerning minimising of Investment and maximising of Achievement in Mathematics Education" in Singapore.

by
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Synopsis:

In Singapore research and development projects concerning minimizing of investment and maximising of achievement in mathematics education have been mooted and are on-going in two main areas:

- * computer-based learning (CBL) since 1984
- * primary pupil profiling (PPP) since 1991.

CBL Projects

Computer-based learning (CBL) has been carried out in a pilot school where CBL was integrated into the Mathematics curriculum (CDIS, 1990) over a 3-year period (1986 -1988). It was found that CBL pupils outperformed the pupils from the control group in the Mathematics General Achievement Tests (MGATs). The CBL group also performed increasingly better each year than the non-CBL group. In particular, the pupils with lower aptitude for mathematics benefitted more from the CBL programme. Both teachers and pupils demonstrated favourable attitudes towards learning with the computer.

In 1986, the Computer-assisted remediation (CAR) programme in the Learning of Mathematics (CDIS, 1989) was piloted in a primary school. In 1986, the focus was on primary four pupils with extremely weak performance in Mathematics. From 1987, however, the focus was switched to primary four pupils who obtained borderline passes in the subject. Each year, about 12 pupils took part in the programme. The evaluation results collected each year indicated that both pupil achievement and attitude towards Mathematics improved after the programme.

Ms Yeo Hong Mui, the Project director of CBL confirmed that it has been researched and documented in one of the papers on CBL at the ministerial level that the computer could do the equivalent of 2.3 teachers per unit time in terms of individualised instruction, marking and analysis of students work.

PPP Project

The overall objective of the Primary Pupil Profiling project is to develop a prototype pupil profiling system that would be meaningful and useful to schools, as well as teachers, pupils and their parents, in making decisions regarding placement and other arrangements for effective learning after Primary 3.

Specifically, the project aims to:

- (a) develop and validate tests in basic literacy and numeracy;
- (b) apply item response theory to analyse the data;
- (c) explore the development of Learning Abilities and other cognitive or non-cognitive measurements which could be included in pupil profiling portfolios

The Mathematics component will focus on the development and validation of tests for topic domains of Number, Measurement, and Geometry at the Primary 3 and Primary 5 levels.

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In Singapore research and development projects concerning minimizing of investment and maximising of achievement in mathematics education have been mooted and are on-going in two main areas:

- * computer-based learning (CBL) since 1984
- * primary pupil profiling (PPP) since 1991.

CBL Projects

In 1983, a project team was formed by the Curriculum Development Institute of Singapore (CDIS) to look into the feasibility of introducing computer-based learning into Singapore schools. In march 1984, the strategy "Buy, Learn and Develop" was proposed for the implementation of the CBL project which was to be carried out in three phases:

Phase 1 (1984-1988): Buy a system and pilot it to determine the effectiveness of using the computer for learning; develop prototype courseware for implementation

Phase 2 (1989-1992): Design and develop more courseware; train teachers and extend CBL to more schools

Phase 3 (1993 onwards): Implement CBL full-scale

Phase 1 programme has been carried out in a pilot school where CBL was integrated into the mathematics curriculum (CDIS, 1990).

The objectives of phase I of the project were to

- * study the effectiveness of using the computer for mathematics learning;
- * develop prototype courseware for implementation.

The project involved a 3-year longitudinal study (1986-1988) to evaluate the effectiveness of using computers to aid mathematics learning. The evaluation was undertaken jointly by the Monitoring and Evaluation Branch of the Ministry of Education (Singapore) and CDIS. A quasi-experimental design was used. It involved more than 2500 pupils from Primary 3 to 5, from 6 different schools. Pupils from each experimental cohort received between 1 to 3 years of computer-based instruction.

Mathematics General Achievement Tests (MGATs) and questionnaires were administered at the end of each year. The results of the evaluation were positive and the main findings are summarised below :

The results showed that CBL pupils outperformed the pupils from the control group in the MGATs. The CBL group also performed increasingly better each year than the non-CBL group. In particular, the pupils with lower aptitude for mathematics benefitted more from the CBL programme.

Teachers' and pupils' attitude towards CBL were surveyed. Both teachers and pupils demonstrated favourable attitudes towards learning with the computer.

Computer-assisted remediation refers to the use of the computer as an instructional tool in remedial teaching. Remediation, one of the important aspects in the teaching of Mathematics, requires proper diagnosis and to a large extent a degree of individualisation to cater to different learning needs. Such as undertaking usually involves the handling of a fair amount of data. The computer-assisted remediation (CAR) programme harnesses the capability of the computer in data-management and analysis, and in providing individualised instruction.

In 1986, the CAR programme in the Learning of Mathematics (CDIS, 1989) was piloted in a primary school. The programme covered the 3 core topics in the Primary Mathematics Syllabus, namely,

- * Whole Numbers
- * Fractions
- * Decimals

The CAR programme comprised of 3 components, namely,

- * Diagnosis
- * Remediation
- * Evaluation

The school piloted conducted a series of tests to select the target group for the remediation. In 1986, the focus was on primary four pupils with extremely weak performance in Mathematics. From 1987, however, the focus was switched to primary four pupils who obtained borderline passes in the subject. Each year, about 12 pupils took part in the programme.

The feasibility and effectiveness of the CAR programme were evaluated quantitatively by means of the pre/post-tests as well as qualitatively through attitude surveys. The evaluation results collected each year indicated that both pupil achievement and attitude towards Mathematics improved after the programme. The CAR lessons were also well received by both pupils and teachers.

Ms Yeo Hong Mui, the Project director of CBL confirmed that it has been researched and documented in one of the papers on CBL at the ministerial level that the computer could do the equivalent of 2.3 teachers per unit time in terms of individualised instruction, marking and analysis of students work.

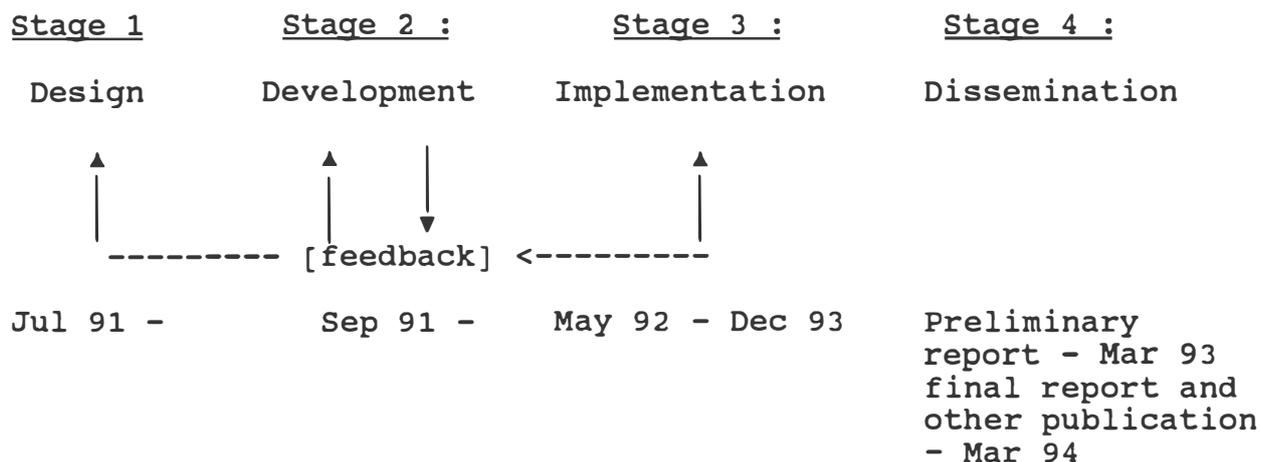
PPP Project

One important feature in the proposed improvements to primary education in Singapore implemented this year (1992) is the introduction of a school-based preliminary assessment at the end of Primary 3 (Yip et al., 1991). In order to assist school personnel, as well as pupils and their parents, in making the best decisions, not only in the placement of pupils in the three streams during the Orientation stage (Primary 5 - Primary 6), but also in monitoring and optimising learning, a study (Sim, 1991) has been undertaken by the Centre for Applied Research in Education (CARE) at the National Institute of Education, Singapore to develop an effective primary pupil profiling system.

The overall objective of the study is to develop a prototype pupil profiling system that would be meaningful and useful to schools, as well as teachers, pupils and their parents, in making decisions regarding placement and other arrangements for effective learning after Primary 3. Specifically, the project aims to:

- (a) develop and validate tests in basic literacy and numeracy in English language, and the Mother tongue (with sub-tests in listening, speech, reading and writing skills) and Mathematics (with sub-tests in Number Work, Measurement and Geometry) for possible use in Primary 3 and Primary 5 school-based assessment;
- (b) apply item response theory to analyse data and to present, or represent, results in different ways that are meaningful to pupils, their parents, teachers and the school as a whole; and
- (c) explore the development of Learning Abilities and Dispositions instruments, including a Bilingual Aptitude and Attitude Test (Chinese-English version), and other cognitive and non-cognitive measures which could be included in the pupil profiling portfolio.

The study is divided into four main stages, together with a feedback loop, as shown below



The Mathematics sub-team comprising of 3 members (Dr Khoo Phon Sai, Dr Foong Pui Yee, Ms Berinderjeet Kaur) at the National Institute of Education in the Division of Mathematics are currently developing test items in the areas of Number, Geometry and Measurement for the Primary 3 and Primary 5 levels based on the primary school mathematics syllabus as part of the primary pupil profiling project.

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