

A·C·E·R

NEWSLETTER

Edited by Peter Jeffery and John King

Computerized Adaptive Testing

Assessment plays an important role in the education of students because it is the means by which a teacher obtains relevant information about the educational progress of his or her students. Information gained from assessments of students' learning and performance enables the teacher to make valid decisions concerning students' needs and directions for future learning. Many forms of assessment include the use of achievement tests that can be used to identify particular weaknesses in students' learning, and to identify students who are making progress and those who are not. On the basis of the resultant test information the teacher might decide to focus his or her teaching so that more assistance is directed towards particular students who are not doing well.

In the past two decades considerable progress has been made in the development of educational assessment methods that analyse test data in terms of item response theory (IRT), sometimes called latent trait theory. In IRT the interaction between a student and the items (questions) of a test are modelled statistically to provide a link between the student's responses to the items and the theoretical constructs (latent traits) assumed to underly the test items.

The IRT model of student-item interactions that ACER's project on *computerized adaptive testing* is concerned with is known as the Rasch model, which is the simplest of a number of IRT models. A student responding to the items in a test is assigned an ability parameter whose estimate locates the student on the underlying latent scale, and each item administered to the

student is assigned a difficulty parameter whose estimate locates the item on the same underlying latent scale. That is, both persons and items are located on the one latent scale, and so valid comparisons can be made between performances of students and items. It is worth noting that in more complicated IRT models each item is characterized by parameters additional to item difficulty. However, these models do not have the attractive measurement properties of the Rasch model and are more difficult to apply to practical testing problems.

An important development in recent years has been computerized adaptive testing (CAT), which joins IRT methods with adaptive testing procedures. Moreover, the development of microcomputers and their introduction into schools has meant that CAT is now a possibility in classrooms. Adaptive testing with the Rasch model is a process of administering items that differ only in their difficulty to students on an individual basis, which capitalizes on a student's responses to previously administered items. One begins with a large item pool that is representative of an underlying latent trait or construct, then items are selected from the pool and administered to a student one at a time. After each item is administered, the student's response is scored as correct or wrong, the student's position on the latent trait scale is estimated, and a new item is selected from the pool to obtain a better estimate of the student's location in the scale. In this way, the items selected for administration to the student may be tailored to the student's level of proficiency so that the student is presented with only the number of items required to estimate the student's trait level or position on the latent trait scale to a predefined level of accuracy. Although different sets of items may be

administered to different individuals, the resulting estimates of proficiency will always be represented on the one common latent scale.

Adaptive testing is well suited to implementation on microcomputers because it requires an extensive storage facility for the item pool, an efficient means for administering the items, a reasonably powerful computational facility to score and analyse the student responses, and a reporting facility that can produce tailored reports on students quickly and efficiently. Moreover, CAT provides a worthy facility for innovation in classroom practices: it could free the teacher from having to administer tests to the class as a whole at the same time—individual students could take the test when they were ready to do so; students could be provided with instant feedback by the computer about how well they were progressing in the course; the computer could automatically update information about students' performance, and this infor-

ACER Publications

ACER Psychological Catalogue 1986-1987.

ACER Special Education Bulletin 1986.

ACER Special Education, Health, and Community Services Catalogue.

Australian Education Index, Volume 29, Number 2, June 1986, and Number 3, September 1986.

PAT Reading Manual.

Priorities in Language Education: a Survey of Community Views. Kevin Piper & Hilary Miller. ACER Research Monograph No. 28.

School Organization and the Quality of Schooling: a Study of Victorian Government Secondary Schools. John Ainley, Rodney Reed, & Hilary Miller. ACER Research Monograph No. 29.



mation could be made readily available in the form of tailored reports to teachers and school.

This ACER project has three main aims: (1) the development of a comprehensive system of microcomputer programs in the BASIC language for CAT, initially for the Apple II family of computers, which are portable and easily used in a classroom environment; (2) the development of computerized adaptive tests based on the existing paper-and-pencil ACER mathematics tests—the AM Series and the Profile Series; and (3) examination of some research problems concerning the use of CAT.

The first aim is essentially a problem of design, and provides a CAT scheme of sufficient generality that contains utility programs for storage and retrieval of test items, programs for administering, scoring, analysing and reporting the results of CAT, and a teacher's manual that describes the rationale of the scheme and how to apply it. The programs will be provided on floppy diskettes which will be inserts in the teacher's manual.

The utility programs focus on the teacher's individual data management needs for assessment and improving instruction. The data base of test items is file oriented, which allows the creation of pools of items within the one computer environment. Moreover the CAT

scheme is able to handle items with significant pictorial content, and to link items to form tests according to criteria specified by the teacher.

The computer programs for administering, scoring, analysing, and reporting the results of CAT are based on recent research findings. Although there have been many important developments in the research literature in this area, practical applications of this research are still limited and not widely implemented. Problems we are working on at present include the optimum entry level or starting point for administration of the first item, the item selection rule for succeeding items, and the termination criteria for ending a testing session. The project is examining these problems from both classical and Bayesian statistical perspectives.

The second aim of the project is the development of computerized adaptive test versions of two existing series of ACER mathematics tests. These tests are providing the item base for development and refinement of the CAT system. At the completion of the project, the two series of tests will be marketed by the ACER as alternative versions of the existing paper-and-pencil tests. Information on the use of the two versions should provide data for assessing advantages and disadvantages of the two modes of presentation and the likely ac-

ceptance by Australian teachers and students of computerized tests and computerized materials in general.

The third aim of the project is concerned with a number of research problems in the use of CAT. Specifically the project is focusing on the differences between paper-and-pencil testing and computerized testing, and the effects these differences have in the assessment of students' proficiency—available evidence suggests that there could be marked individual variation between the two conditions, and that these might influence validities more than other psychometric features such as the reliability of tests.

We are also studying the extent to which CAT improves test-taking performance (speed of initial response, time between responses, number of attempts at items, and time to complete testing sessions with individuals and groups), the extent to which computerization of tests may be expected to change the nature of a test, and the kinds of information required to assist in the interpretation of results obtained from CAT.

For further information regarding this project contact Mr George Morgan at ACER.

What is the Australian Education Index?

- Q. How do you find out about 'it'? . . .
'Your pet topic'
- Q. How do you find out about (for example) . . .
- Curriculum development in computer science education
 - Retention rates in secondary schools
 - Parent participation in reading teaching
 - Effect of classroom environment on academic achievement
 - Community involvement
 - Teaching methods
 - Environmental education
 - Multicultural education
 - Migrant education
 - Aboriginal education
 - Enrolment projections

Mathematics teaching and females
Teaching reading and writing
English as a second language
Teaching second language
Teaching science

A. Consult AEI!

The Australian Education Index covers everything from 'Ability grouping' to 'Zoning'. It is a comprehensive index to published and unpublished material relevant to Australian education

The index is published quarterly with an annual cumulation. It has been produced regularly by the ACER Library since 1957 and has been available for online searching through the Australian Information Network (AUSINET) since 1979. Material relevant to all levels and areas of Australian education is identified and indexed for retrieval by authors, institution, and subject.

Approximately 350 separate Australian periodical titles are scanned to identify relevant material for inclusion in the index. Books, reports, conference proceedings, and monograph series are also included. Material published by Australian authors or published overseas about Australia is also included.

Two specialist clearing houses contribute to the AEI. The Australian Clearing House on Library and Information Science identifies and indexes material relating to library and information science and the TAFE National Clearinghouse contributes indexed entries on vocational and career education.

Online User Courses are available (see details elsewhere in this newsletter).

PREP for Effective Family Living

ACER has arranged to stock and distribute some excellent new materials from American Guidance Services. PREP is a programme for young adults that emphasizes decision making, communication, and mutual respect in current and future relationships. The course of nine units explores issues such as self-understanding, interpersonal communication, problem solving, dating, marriage, and family life.

The programme is suitable for school or other organizations that help teenagers with living skills. PREP was reviewed for ACER by Eva Duggan, of the Education Department's Student Services at Boronia. Part of her review follows:

Preparing teenagers to cope effectively with the complexities of interpersonal relationships is PREP's generalized objective. More specifically, the aim is to develop and encourage the application of effective techniques in communication, decision making, and problem solving. An understanding of the motivations behind human behaviour, emerging from exploration and leading to progressive behavioural change, is the underlying expectation.

Both practical experience and relevant literature suggest that crises of adolescence frequently involve confusion about the self, peer and family

relationships, and uncertainty about the future. Adolescent girls are particularly vulnerable. Their experience of growing up can be one of self-doubt and emotional turbulence. Adolescent boys are faced with similar uncertainties and encounter innumerable social frustrations.

PREP focuses on concerns relevant to adolescents' day-to-day experiences. It also seeks to broaden adolescents' perspectives of their own families and provides insight into the management of future relationships.

Adler's humanistic cognitive principles provide the theoretical foundations for the programme. Accordingly, individuals are seen as socially oriented, goal seeking beings who act purposefully and can choose to behave either responsibly or irresponsibly.

Many teachers will already be familiar with Adlerian principles and will have fruitfully incorporated these into their teaching styles. Most teachers would have encountered in-service programmes and activities that have used strategies similar to those employed by PREP.

Programme packages based on the same theoretical orientations include STET (Systematic Training for Effective Teaching), STEP (Systematic Training for Effective Parenting) and DUSO (Developing Understanding of Self and Others). These have

been readily available to schools and teachers for many years.

PREP lends itself to a variety of applications in school settings. Maximum benefit would be gained from its inclusion in core curriculum. Given that schools already have excessive demands on their course provision and teacher resources, other forms of application may, however, be more practical. PREP units are capable of adaptation and may be used as supplementary or enrichment materials in humanities, health and human relations, or general studies. Given the diversity of the Australian educational system, it is difficult to pinpoint how individual schools would utilize PREP.

Undoubtedly, schools that offer comprehensive education would experience fewer difficulties in conducting a personal relationship programme than schools organized along traditional academic lines. Victorian secondary education is progressing towards broader curriculum frameworks, and in this climate there will be increasing opportunities to teach students to relate effectively and to gain greater personal fulfilment in future relationships.

PREP For Effective Family Living, published by American Guidance Services, is available in kit form from ACER for \$172.60. Write to John King for a free information pack on Social and Emotional Development Resources available from ACER.

Education Abstract

ACER has been appointed distributor for the superb abstracting publication produced by the Queensland Department of Education, *Education Abstract*. This small but powerful publication brings to a dispersed group of educators throughout Australia information from a large amount of literature that is not easily obtainable and certainly not easily or quickly read!

Education Abstract is published ten times each year (February to November) and until now was only available to educational administrators in Queensland Government schools.

ACER has offered its assistance and marketing expertise to make this information service available to many other people so that we can all benefit from the work of the Queensland team.

Each month, the international and Australian educational literature is scanned for items of significance to educators in Australian schools. These items are then summarized and organized into sections of *Education Abstract*—Education Overseas, Education Australia, and Professional Reading. Since the reading and writing up of *Education Abstract* is a continuous process, readers are assured of a painless professional update ten times per annum.

ACER will distribute *Education Abstract* on a subscription basis commencing with the first issue in 1987. Anyone other than Queensland Government schools who wishes to get *Education Abstract* will need to subscribe through ACER.

A free sample copy of *Education Abstract* is available on request from ACER to allow prospective subscribers to assess the publication.

Normal subscription within Australia is \$25.00 for ten issues in 1987; overseas subscriptions are \$35 (air mail delivery). Introductory offer for Australian subscriptions: \$20.00 for 1987 if the subscription is received before 19 December, 1986.

Courses for Parent Educators

In the second half of 1986, ACER introduced two courses in leadership skills for parent educators. Courses in 'STEP for Professionals', and 'Responsive Parenting for Professionals' were designed to acquaint participants with the programme content while at the same time teaching group leadership skills. Similar courses will be offered in 1987. In addition, ACER will run a course to acquaint educators with a new programme, 'Strengthening Stepfamilies'.

The Australian replacement cassettes for the STEP/Teen (set of five) are now available from ACER.

Inquiries concerning these courses or the STEP/Teen tapes should be directed to Joanna Goldsworthy at ACER, 9 Frederick Street, Hawthorn, 3122; Phone 819 1400 in Melbourne, or (008) 33 8402 elsewhere.



ACER Consultant Services Division operates a Resource Centre to support the staff in providing professional advice to psychologists, teachers, and other clients. Mrs Anne Lowry (right) is assisting two psychologists with materials for particular applications. The Resource Centre is accessible by mail to people located out of Melbourne but in all cases registration of qualifications at ACER is a necessary prerequisite to access.

Optical Mark Reading Services

What the Service Can Do for You

The service can save you time, worry, and a lot of tedious work by:

- reading students' responses
- scoring a test
- producing a variety of reports and analyses

The Service Can Provide for Published or School Based Tests

- alphabetical listings
- summary of statistics
- group responses
- rank ordering
- standard norms, percentiles or stanines
- plus other analyses on request

Answer Sheets

Specially designed answer sheets must be used. These are then fed through the Optical Mark Reader (OMR), which reads the information from the answer sheets and converts it into data that the computer can translate for scoring tests.

Optical Based Tests or Questionnaires

ACER standard answer sheets are available for your own tests or questionnaires. These can be read by computer

and reports and analyses produced to your specifications. You can develop your own school based studies.

Costing

The cost structure varies depending on the number of students and the type of test.

Tests Now Available for Machine Scoring

General School Use

Otis Lennon School Ability Test (OLSAT) Intermediate Test—Form R
 Otis Lennon School Ability Test (OLSAT) Advanced Test—Form R
 ACER Paragraph Reading Test
 Progressive Achievement Tests: Mathematics
 Progressive Achievement Tests: Vocabulary and Comprehension Forms A or B
 ACER Primary Reading Survey Tests (Levels A-D)
 Cooperative Reading Comprehension Test—Forms L or M
 English Skills Assessment
 ACER Tests of Learning Ability, TOLA 4 and TOLA 6

Careers Teachers

Career Development Inventory
 Work Aspect Preference Scale

Restricted—Psychologists and Counsellors

Mechanical Comprehension
 Mechanical Reasoning
 Standard Progressive Matrices

Further Information

For more details contact Carol Ford at ACER (OMR Services); telephone (03) 819 1400.

ACER International Seminar on Intelligence

Put this in your planning diary now: ACER International Seminar on Intelligence, 24–26 August 1988, in Melbourne.

The aim of this seminar is to analyse, integrate, and disseminate some of the most promising recent findings and approaches resulting from research related to intelligence and its improvement.

Dr Helga A. H. Rowe, Chief Research Officer, ACER, is the Chairperson of the Planning Committee. Further inquiries should be directed to Mrs Yvonne Allen, the secretary of the Committee on (03) 819 1400.

Australian Education Review

Australia's International Relations in Education—P. Jones

This issue of the Australian Education Review explores the international dimensions of Australian education.

The past five to 10 years have seen steady increases in the prominence of such issues as the arrival of students from overseas, the role of education in the Australian overseas aid program, and Australian participation in such international organizations as UNESCO. In a period of increasing stringency in general government financing, questions inevitably arise about how best to balance domestic and international concerns, and how to ensure best results from funds. In particular, the years 1983–85 saw a flurry of activity, es-

pecially at the national level, designed to balance these interests and achieve coherence in public policy. At the same time, there is a rapidly growing range of international contacts experienced by Australian educators in their work, with a myriad of programs currently being developed.

Universities, CAEs, government departments, and research organizations are all explored in this review in a systematic attempt to describe current patterns in the international exchange of educational ideas, materials, and personnel. Some international issues have emerged in ways that open up fundamental domestic issues, especially at the post-secondary level, and the overseas marketing of Australian education is prominent among them. Other emerging issues include the promotion by Australia of the English language in the neighbouring region, and fostering Australian studies around the world. The author argues the need for a more

explicit and coherent alignment of our policies on international education with broader national goals, and here the interaction of Australian culture, identity, nationalism, and internationalism becomes significant.

The whole range of international issues in Australian education is brought together for the first time in this review. It will be of considerable interest to those working in national and state government departments and organizations, particularly in those with policy interests in international and educational areas. It will be of equal interest to members of educational institutions at all levels who are concerned with current trends in the area, as well as to students of international relations, educational and social policy, Asian studies, and current affairs.

Australian Education Review No. 23 is available from ACER for \$8.95 plus \$3 handling charge.

Stanford-Binet: Fourth Edition

A major development in psychological testing has occurred with the publication in 1986, by Riverside Publishing Company, New York, of a completely new edition of the Stanford-Binet test of intelligence. The authors, Robert L. Thorndike, Elizabeth P. Hagen, and Jerome M. Sattler, are all well known in the fields of psychometrics and intelligence.

The fourth edition of the Stanford-Binet maintains historical continuity with previous editions by retaining the most useful item types from the 1937 and 1960 editions. At the same time, many changes have been introduced to incorporate advances in psychometric theory, to take account of contemporary views of the nature of intelligence, to make use of adaptive testing concepts, and to improve ease of administration and scoring. The test has been completely restandardized on samples totalling over 5000 individuals.

ACER recently signed an agreement with Riverside to distribute the new Stanford-Binet to psychologists in Australia. The set of test materials and manual is available for \$578.00.

Australian Education Index: User Courses

The ACER library announced the introduction of user courses for the *Australian Education Index* (AEI) in a separate brochure mailed with the March *ACER Newsletter*. The first full day course was held in Melbourne on 17 July. Where sufficient interest is shown in other capital cities it is planned to hold courses there. The first course outside Melbourne was held on 15 September at the Bardon Professional Development Centre in Brisbane. It is hoped that courses will next be offered in Adelaide, Canberra, and Sydney.

The course is aimed at current or potential users of the *Australian Edu-*

cation Index. It is designed to enhance data base search strategies and describes the scope and contents of the machine readable file and associated printed products. Attendees have an opportunity for hands on experience at online searching and receive a new data base user's manual.

The AEI will be introduced and demonstrated in a workshop session at the AARE Conference to be held in Melbourne from 18–21 November 1986 and also at the Online Conference to be held in Sydney at the Hilton Hotel from 27–29 January, 1987.

For further details on the AEI and user courses please contact Elizabeth Oley or Elspeth Miller at ACER; telephone (03) 819 1400.

ACER in Third ACSPRI Summer Programme

The third ACSPRI Summer Programme in Quantitative Social Science Methods will be held at the Australian National University from 31 January to 13 February 1987. There will be three courses: an introductory course in social science data analysis SPSS-X, which spans the entire programme, and two shorter courses of one week's duration, back-to-back, covering specific and more advanced data analysis techniques.

Dr Trevor Williams, Assistant Director of ACER, will conduct the course at the Intermediate and Advanced Levels in Structural Equation Models.

A booklet containing short descriptions of the courses and application details is available from:

Dr Roger Jones,
Social Science Data Archives,
The Australian National University,
GPO Box 4,
Canberra, ACT 2601.
Telephone (062) 49 4400.

Teaching and Learning of Mathematics

Previous issues of the *ACER Newsletter* have included interviews with Dr Sid Bourke about his comprehensive study with teachers and students during mathematics classes.

These reports are now available from ACER. They present some of the results of a major study of teaching practices during Year 5 mathematics lessons. Seventy-five teachers made the study possible by allowing an observer to record all their interactions with their classes and with individual students over a school term.

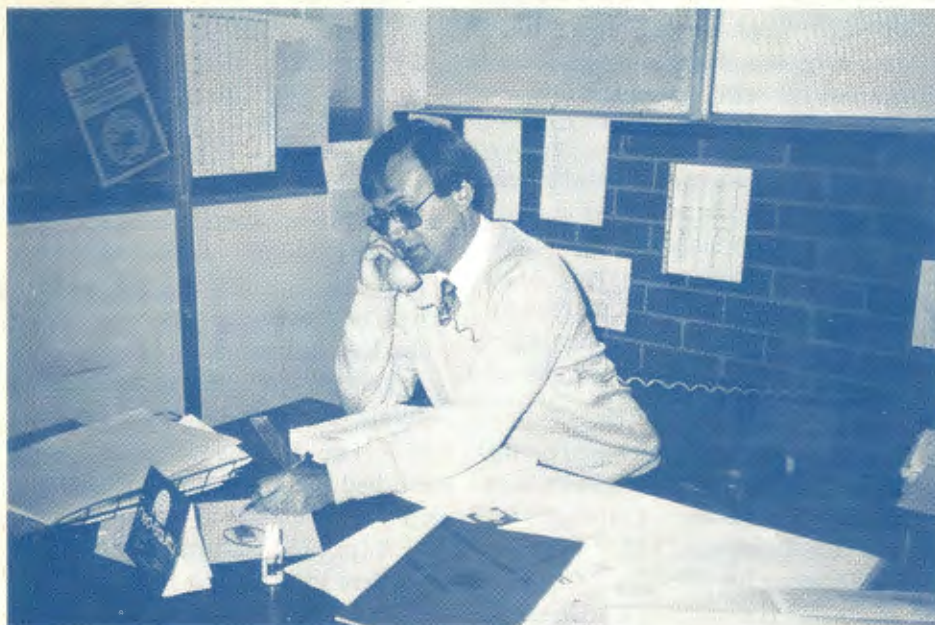
The teachers also completed detailed questions about their teaching, their students, and their educational ideas and preferences. The students completed questionnaires about their home background, their teachers, and their attitudes to mathematics. Arithmetic tests were also given. The major interest of the study was the extent to which any changes in mathematics achievement or attitude of the students could be attributed to the teaching practices used by their teachers.

The results that are reported in this collection have been chosen because they deal with one or more of the areas that teachers can influence directly, on

their own initiative. The papers in the collection are:

- Classes of Questions: Question of Classes
- Student Input to Lessons
- Responsibility for Teaching: Some International Comparisons
- Teacher use of Material and Assessment
- Comparing High and Low Performing Classes
- Teaching Smaller Classes
- Teaching Primary Mathematics

To purchase the collection, telephone or write to ACER. The cost of the collection is \$10 plus \$3 handling charge, including postage.



Ian Kendall, Senior Psychologist, has joined the staff of Consultant Services Division. Ian is developing the provision of services and products to meet the needs of ACER's clients concerned with personnel selection and careers guidance. A brochure giving details of the staff and activities of the Consultant Services Division is available free from ACER on request to Mrs Carolyn Wilkins.