

REACT

**Review of
Educational Research
and Advances for
Classroom
Teachers**

**NATIONAL INSTITUTE OF EDUCATION
NANYANG TECHNOLOGICAL UNIVERSITY**

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ARE TRUE-FALSE TESTS USEFUL?

Review by
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True-false (TF) tests consist of items with straight forward statements that can be responded to as either true or false. They have often been criticized for trivial content, ambiguity, guessing problems and the lack of ability to discriminate. Good test items should have the essential qualities of relevance and discriminating power. Teachers need to set items to improve test relevance, i.e. to emphasize important and useful information rather than trivial **details** and to reward understanding and application rather than rote learning. Test items need to be discriminating to distinguish between the better and weaker students; the correct response must be demonstrably better than any alternative.

Several research studies have investigated the psychometric properties of TF tests as compared to multiple-choice (MC) tests. They considered reliability, validity, level of difficulty and ability to discriminate. The reliability of a test is important as tests are intended to indicate differences among students' achievement of certain instructional goals. If the differences revealed by one test are about the same as the differences revealed by a second test intended to measure the same thing, then both tests are reliable. In addition, tests need to have validity, to be able to measure what they are intended to measure.

CAN TF ITEMS YIELD RELIABLE AND VALID MEASURES OF ACHIEVEMENT?

Grosse and Wright (1985) used a model of examinee behaviour based on knowledge and random guessing to generate hypotheses about how TF scores work. One of the hypotheses was on guessing. When the answer to an item was unknown, students tended to guess. The effect of this guessing would depend on the number of alternative responses offered by the item. When the answer to a TF item was not known, there were only two possible alternatives and a 0.5 probability of answering correctly by chance. When the answer to a five-choice MC item was unknown, the probability of answering correctly by chance was 0.2. They showed that TF scores contain an error component (due to guessing) that makes the scores less reliable than those based on multiple choice items. They also found that examinee response style can invalidate the total TF score.

Other studies such as Frisbee (1973) and Green (1979) compared the reliabilities and concurrent validities of tests with TF items and MC items. Frisbee (1973) used a seventy item MC test on social studies and science and developed a TF format for these items. The tests were then administered to 1018 students in Grades 9 - 12. It was found that students responded to more TF items than MC items in a given period of time. Frisbee (1973) showed the TF item format to be of lower reliability than the MC item format, with about equal concurrent validities.

On the other hand, Green (1979) found no significant differences in the reliability and validity of the two formats when testing time was held constant. In this study, a TF form and an MC form of a midterm examination were administered to 50 undergraduates doing an introductory course in testing and measurement. Generally, TF items were found to be easier than the MC items. Green indicated that the reliability of the TF format can be as high as the reliability of a comparable three-option MC format and can be as effective in measuring classroom achievement.

HAVE TF ITEMS ANY ADVANTAGES OVER MC ITEMS?

TF items can provide a simple and direct measurement of achievement, despite its limitations. Downing (1992) pointed out that TF items discriminate less well than comparable MC items and are almost always easier than MC items. However, the strength of TF items lies in their efficiency. Content validity of a test can be enhanced with well written TF items that sample a domain of knowledge more adequately than MC items. Parallel questions can be more easily produced using TF items.

Guessing must be taken into account when setting TF items. As the probability of randomly guessing the correct answer for one TF item is 0.5, TF tests must contain a sufficient number of items to minimize the guessing problem. Thus Ebel and Frisbee (1986) pointed out that using a sufficient number of TF items would result in reliable and content valid scores.

CAN CLASSROOM TEACHERS WRITE GOOD TF ITEMS?

Ebel and Frisbee (1986) felt that there were no inherent weaknesses of the TF item type; the only requirement for writing good TF items was to adhere to basic principles of item writing. They recommended that TF items must be carefully constructed and edited to eliminate ambiguities. A requirement of writing good TF items is mastery of the subject to be tested. TF items must reflect careful thought and precise expression since they will be interpreted critically and judged in isolation. A good TF item is one that effectively tests the student's command of an important element of the subject.

Writing good, unambiguous TF items may require some training and practice. Ebel and Frisbee (1986) listed four essentials to writing good TF items:

- a Choosing a significant idea,
- a Devising a problem that will require understanding or application of the idea,
- a Wording the statement of the problem in such a way that students who lack understanding of the element to be tested will be attracted to the wrong answer, and
- a Reviewing the statement critically to make sure that the students who understand the point being tested will be able to answer it correctly.

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CAREER EXPLORATION : HOW CAN IT BENEFIT ADOLESCENT STUDENTS?

Review by
Chew Lee Chin



INTRODUCTION

One important developmental task during adolescence is *preparing for an economic career* (Havighurst, 1972) and therefore, any career guidance programme for secondary students must be based on this task to help facilitate them in their career development. This means providing opportunities and encouraging students to develop desirable *career exploration behaviours* with the aim of helping them formulate and crystallize a vocational preference.

WHAT IS CAREER EXPLORATION?

Career exploration is a *problem-solving* behaviour aimed at *eliciting* information about oneself or one's environment in order to choose, prepare for, adjust to, or progress in an occupation (Jordaan, 1963).

For good **career** decision making, accurate and sufficient information is necessary. Helwig (1984) classified this information as either external or **internal** to the decision maker. **External information** includes world of work factors outside the **individual**, such as occupational information and vocational and educational opportunities, whereas **internal information** comprises **personal** factors within an individual, such as knowledge of **aptitudes**, interests, and values.

Some possible sources for such career-related information include the family, friends, work people, media (**books/films**), careers lessons, careers teachers/other teachers, careers library, work experience, and part-time jobs.

According to many career development theorists, the secondary level is an appropriate time for enhancing the career exploratory behaviours of students as they are at a **vocationally** realistic stage of thinking. Super et al (1963) indicated that this exploratory stage is characterized by self-examination and role try-outs which can take place in the schools, leisure activities and part-time work.

WHAT IS THE SCENARIO AMONGST SINGAPORE STUDENTS?

Tan's study (1988) on the career development of secondary pupils in Singapore showed a **dearth of career guidance activities** in the schools and also **low student participation** in career guidance activities. The findings revealed that 63.8% of the sample of 1380 students drawn from 17 schools have not been exposed to career guidance activities

Analysis by grade level showed that **non-participation** ranged from 82.7% to 44.5% for students in Secondary Two to those in Junior College (JC) 2 respectively, while the rest indicated only some participation. This may mean that our adolescent students have not broadly explored possibilities for their future and that they are probably making career decisions based on limited, inadequate, or faulty information. One can also imply that their career exploratory behaviours have yet to be better developed.

WHAT DOES THE RESEARCH SAY?

Many studies have established the importance, value and contributions of career guidance activities in facilitating the career development of adolescent students. The primary objective of any typical career guidance programme is to provide **opportunities** for students to explore selves and the world of work so as to start reducing vocational alternatives.

One study (Chamberlain 1982) which assessed the "career awareness" of fifth-form students revealed differences between students who were having and those not having regular career lessons. The results showed that **students especially the less-able benefited from the regular career lessons**. They had a greater knowledge of the world of work than their peers who had no such lessons; they were less reliant on their family for career advice, and in general used a wider range of resources for career knowledge; and they were more aware of the preparations necessary for job interviews.

In a recent study by Rea-Poteat & Martin (1991), they found that a programme to encourage career awareness and exploration of non-traditional career choices **benefited adolescent girls**. The

participants reported confidence in learning about and choosing an occupation, and clearer ideas about possible occupations for themselves.

Grotevant and Cooper (1986) found that *adolescents who explore a variety of career alternatives will make career choices that are more congruent with their personality styles* than will adolescents who explore less broadly. Four aspects of the occupational information that are evaluated by adolescents in their career exploration include social prestige, substantive complexity, gender dominance and interest environments of the occupation considered. Hence, the broader the knowledge that they have about the content of the occupations from which they may choose, the better equipped they are to make a choice that is consistent with their own personality, interest styles, and abilities.

In a study by Blustein (1989), he found that the tendency for adolescents to engage in exploratory activity is linked to *internal motivational processes*. That is, individuals who had internalized goals and values were more confident in fostering an active approach to career decision making and career exploration.

Blustein (1989) also examined the role of career exploration in the career decision making of college students. An interesting finding showed that *students who were relatively committed to their career plans* tended to be engaged in exploratory activity that are environmentally focused (i.e. external information). On the other hand, *students who were in the planning phases of decision making* seemed to express the usefulness of self-exploration (i.e. internal information).

Research by Helwig (1984) revealed that students in the 10th grade (16-year olds) could be tremendously unstable and changeable in their self-perceived internal information relating to career decision making. But he indicated that *this changeability be viewed positively* as it clearly suggests the importance of career exploration for adolescent students during which they question their future, are open to new ideas and eager to explore their own interests and capabilities.

WHAT ARE THE IMPLICATIONS FOR SCHOOLS?

In summary, on the basis of the above review, schools should note the far-reaching effects of career guidance activities for their adolescent students. Such activities can help promote and enhance career exploratory behaviours in students. Hence, in planning and implementing a comprehensive career guidance programme, it is important to include the following features:

- a Start career exploratory activities for students beginning from the lower secondary years. This will enable them to develop appropriate exploratory behaviours as early as possible.

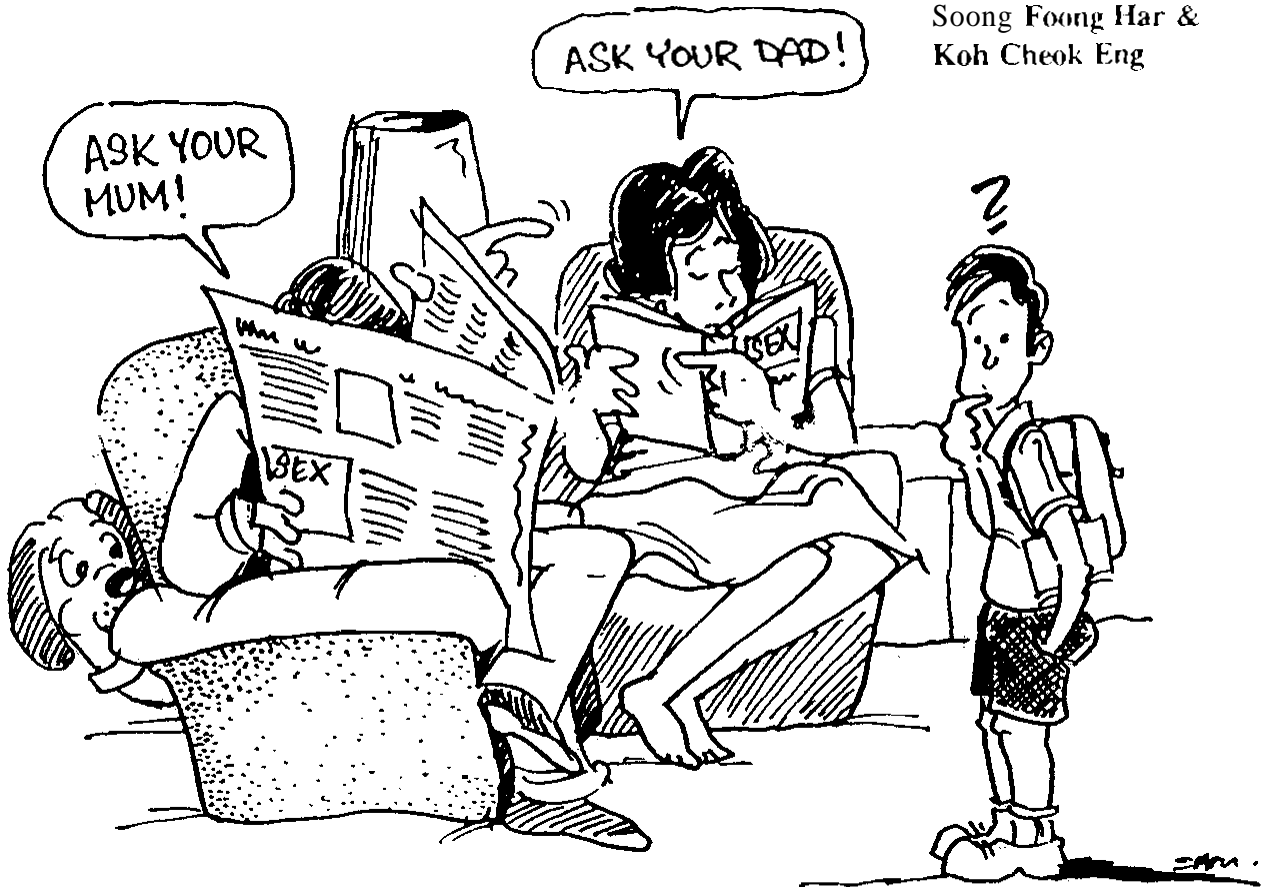
- Provide opportunities for students to explore broadly both information regarding self and the world of work. This allows students to become aware of their own strengths and weaknesses, and understand what these mean as they develop plans for school and beyond.
- Provide a wide range of resources in the career guidance activities; and encourage students to tap and use these various resources. Each source of career-related information may enlighten students with regard to one aspect or perspective about the occupation(s) considered and eventually, help them crystallize on a vocational preference.

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SEX EDUCATION IN SINGAPORE SCHOOLS

Review by
Soong Foong Har &
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Sex education in Singapore schools often takes the form of talks and workshops conducted on an ad hoc basis by organizations like the Singapore Planned Parenthood Association and Family Life Society. As such, there is no planned curriculum that covers the four or five years that a teenager spends in the secondary school. Are Singapore teenagers getting sex education from schools? If they are, is what the schools providing adequate?

In 1988, the Singapore Planned Parenthood Association conducted a survey on teenagers' sexual knowledge and experience. They found that one in six teenagers had sex before the age of seventeen. 45% of these teenagers did not use contraceptives or resorted to unreliable methods. Teenagers were generally ignorant about sexual matters and harboured many myths and misconception about sex and puberty.

This year, sex education is incorporated into Secondary One and Two science lessons, with the focus on presenting facts about physical changes, human reproduction, sexually-transmitted diseases, birth control methods, abortion and premarital sex (The Sunday Times, 1991). Thus, the focus of sex education is on providing knowledge. The underlying assumption is that such knowledge would hopefully result in more responsible behaviour.

AIMS OF SEX EDUCATION

But sex education is more than the provision of facts. Sexuality is inextricably intertwined with interpersonal relationships. What, then should be the aims of a good sex education programme?

Went (1985) defines sex education as the imparting to young people "information that will help them make the best decisions for the particular circumstances they are in at the time; develop skills enabling them to take responsibility for their own behaviour and gain understanding and insight into the emotional, social and moral factors involved in human sexuality." Therefore, a good sex education programme should have the following objectives

1. To give teenagers knowledge of physiological changes so that they can gain understanding of their own sexuality.
2. To help teenagers accept their sexuality, to enhance self-esteem and self-confidence
3. To dispel myths and misconceptions about sex, and lessen anxiety and guilt.
4. To learn and practise interpersonal relationship skills so as to relate better with the opposite sex.
5. To disseminate information on the consequences of irresponsible sexual behaviour.
6. To develop decision-making and problem-solving skills so that teenagers are able to make responsible choices.
7. To clarify values and develop a strong moral philosophy of life which would form the basis of marriage and family.
8. To give teenagers information so that they can protect themselves from exploitation and know how to cope with molestation, rape or abuse.

EFFECTS OF SEX EDUCATION PROGRAMMES

The implementation of Pastoral Care and Career Guidance programmes in secondary schools in 1988 provides an opportunity to conduct sex education. Principals and teachers are generally supportive of sex education programmes and see the need for sex education, but they are also apprehensive about the effects of such programmes. One major worry is that students' curiosity may lead to experimentation.

In Kirhy's (1984) survey of sex education programmes, findings are unanimous that sex education programmes increase knowledge. However, these findings do not indicate that there is any change in values or behaviour. This is similar to Strouse and Fabes's (1985) report that there is evidence to show that knowledge alone does not bring about the behavioural change. Allen (1987) in a study of the sex education in British schools found that while there is no guarantee of a change in behaviour, both parents and teenagers interviewed said that sex education did make teenagers aware of the consequences of sexual behaviour and more conscious of the risks of pregnancy and venereal disease.

Sex education programmes can have positive outcomes. Reid (1982) quotes several studies which showed that sex education courses could produce short-term gains although the results of retrospective surveys are not encouraging. Sex education seemed more likely to produce attitudinal rather than behavioural change. Teenagers reported increase in knowledge and more tolerant attitude towards masturbation and homosexuality but without an accompanying change in personal behaviour. In other words, teenagers are more accepting of other people's behaviours, even if (they) would not engage in such behaviours themselves. Reid also found that there is no evidence to support the view that sex education arouses curiosity and encourages teenagers to experiment, or influences contraceptive practices. Teenagers' decision to engage in sexual activity is not so much influenced by whether or not they have had sex education, but by such factors as self-esteem.

Silverstone (1989) draws the relationship between sexual behaviour, adolescent developmental tasks and self-esteem. Teenagers need to forge new relationships with parents and with others outside the family, particularly their peers. They need to achieve a sense of identity, connectedness, power and hope. However, it is increasingly difficult for teenagers to realise their needs because of the decreasing number of intact families and the increasing number of families with both parents working outside the home. As a result, the relationships established with the peer group become more significant. Silverstone's study of sexual behaviour and self-esteem indicated that for boys, there is a positive correlation between sexual intercourse and self-esteem. Sexually experienced boys tend to feel good about themselves. The reverse is true for girls – there is a positive correlation between sexual experience and diminished self-esteem. However, it is not possible to say whether it was low self-esteem that had caused the girls to seek out sexual experience in the first place, or whether it was sexual experience that caused the girls' self-esteem to diminish, or whether a third factor was responsible for both.

ROLE OF THE SCHOOL IN PROVIDING SEX EDUCATION

With the introduction of Pastoral Care and Career Guidance in schools, a sex education programme can be introduced and integrated into the pastoral curriculum as part of Personal and Social Education. Sexuality should be viewed as "an integral part of an individual's total personality and not as an isolated piece of sexual behaviour" (Went, 1985).

Kirby (1984) advocates the linkage of sex education programmes with holistic and integrated programmes that involve teenagers' emotional needs, motivation, and career awareness. In other words, sex education programmes, conducted in conjunction with pastoral care activities, have potential for success. As such, it should not be taught as an isolated subject, slotted into the time-table whenever there is a crisis or when it is convenient.

Furthermore, the school has other advantages over parents in providing sex education. The teachers are well trained in matters of educational theory and teaching methodology, and are able to upgrade their knowledge and skills by attending in-service courses or conferences on sex education. Some members of the Staff are trained in counselling skills and are thus able to help pupils with special problems. The school has access to resources and materials suitable for various age groups, and when necessary, can invite experts on the subject to conduct special sessions. The school can arrange to provide parents with the knowledge and skills needed to discuss sexual matters with their children. Both the school and the home should work hand in hand to reinforce what is taught and to complement each other.

IMPLICATIONS

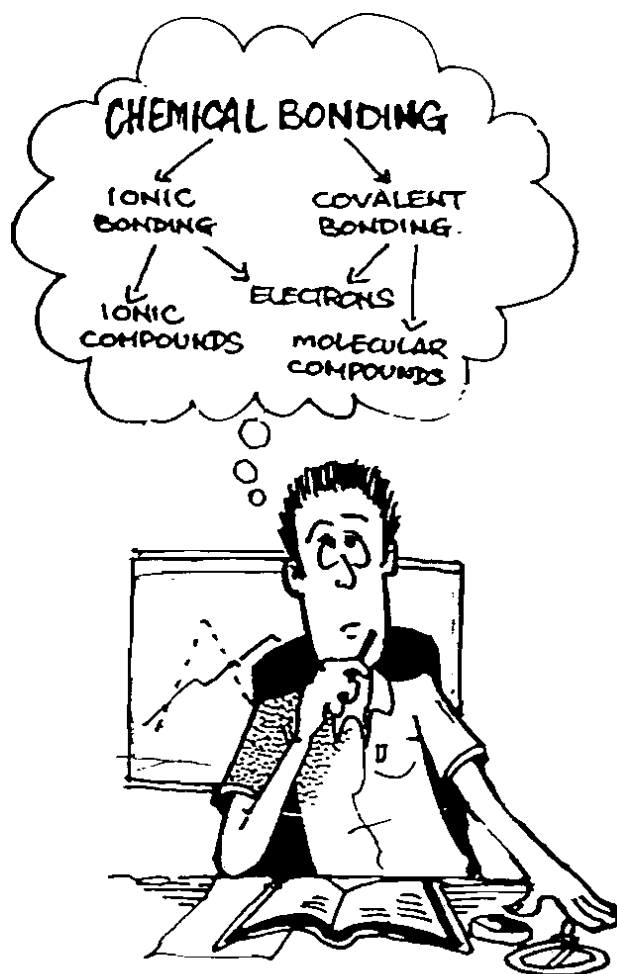
- Sex education must take place within the context of personal and social relationships
- Peers play a significant part in influencing teenage sexual behaviour. The discussion of sexual matters -- the moral and social issues -- should take place as part of group guidance activities.
- Teachers should organize the discussion of sexual relationships under such topics as self-awareness, self-esteem, decision-making and problem-solving

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CONCEPT MAPPING AND SCIENCE LEARNING

Review by
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Chia Lian Sai



INTRODUCTION

According to Ausubel (1963), meaningful learning is promoted by the understanding of hierarchical relationships and linkages between concepts. Based on this idea, Novak (1977) first attempted to represent students' conceptual knowledge as concept maps. A concept map is a two dimensional hierarchical organisation of the structure of a discipline, a unit of study, or a lesson. It is constructed from topics by ranking and arranging concepts. A concept map is drawn beginning with the most general, most inclusive concept at the top, proceeding downwards through less general concepts, and finally to more specific concepts and examples. The concept map serves as a link between what the learner already knows and the new knowledge. Novak (1977) has refined the concept map to include linking words (logical connectives) that indicate relationships between concepts. He termed this relationship between two concepts 'a proposition'. Since then, Novak's (1977) concept mapping technique has received increasing attention from science education researchers. This review aims to look at one of the specific questions: "Will training in the use of concept maps significantly affect student learning in science?"

REVIEW OF RESEARCH PAPERS

As science teachers, one of our main concerns is students' achievement. Can concept mapping improve students' achievement in science? Fraser and Edward (1985) conducted a one-shot intervention treatment to determine the effect of concept mapping on student achievement in traditional classroom tests. Their study involved instruction in concept mapping for 27 grade 9 science students who were low and medium achievers and drawn from two classes totalling 63 students. During each study unit, groups of 4 students from each class were instructed in and carried out concept mapping through both class and homework. Students in the two classes worked in self-chosen pairs. The treatment phase comprised two sections. The first was a 45-minute basic instruction section, and the second, a 4-week period during which the students produced concept maps and received remediation in the technique. After instruction in concept map construction, students were required to incorporate the technique into the classroom routine. Students' mastery of concept mapping was assessed by the **teacher/researcher** according to the correct ordering, their correct relating of concepts, and the explanatory power and clarity of propositions. Each student was given an overall mastery rating of low, medium or high. This study revealed that (1) over half of the students, who achieved a high level of concept mapping mastery, showed a significant improvement in performance on normal classroom end-of-unit achievement tests; (2) students who did not achieve a high level of concept mapping mastery showed no significant improvement in performance on the same tests. Hence, this study suggested that concept mapping should be incorporated into the ongoing classroom instruction patterns if performance gains are to be maintained.

The above-mentioned study indicates that concept mapping has a positive effect on students' science achievement. Will the technique also affect students' problem solving ability? Pankratius (1990) studied the use of concept maps in the teaching of problem solving to physics students. Six intact high school physics classes took part in this study. Two classes formed the control group and received standard instruction. Four classes received 6 weeks of concept mapping instruction prior to the unit under study. Two of these classes were the low-level treatment group which were required to submit concept maps at the end of the instruction. The other two classes of the high-level treatment groups were required to submit concept maps before and after instruction and encouraged to continuously modify their initial maps throughout the instruction. The achievement measure consisted of a set of items from the Ontario Assessment Pool which were matched to the unit objectives on the conservation of energy and momentum. The results indicated that the groups which received the concept mapping instructions scored 18% higher than those in the control group. Moreover, the achievement of the students in the high-level treatment group was 11% better than the low-level treatment group, which in turn performed 6% better than the control group. It was concluded that the time required to teach concept mapping was well worth the benefits in achievement and understanding in problem solving.

The results mentioned above are encouraging. But can concept mapping also improve science practical work? Stensvold and Wilson (1990) investigated the use of concept mapping in science laboratory instruction. In their study, seven intact classes of grade 9 students were randomly assigned to one of two groups: experimental and control. The experimental group differed from the control group in that the former received instruction in concept mapping and was asked to draw concept maps before and after a series of 6 laboratory activities related to chemical reactions. The control group completed the same laboratory activities but did not draw the concept maps. All students were **tested** using a 33-item comprehension test regarding compounds, products, reactants, ions, and ionic and

covalent bonds. The results showed no differences between the experimental and control groups. However, a regression analysis showed that the number of 'valid map links' and 'links per word' were significantly related to performance on the comprehension test. The results also showed that the students who began with lower scores on the vocabulary test achieved higher scores than the control students. Conversely, the concept mapping students who scored higher on the vocabulary test achieved lower scores than the control group. Thus, the concept maps seemed to help the students with lesser vocabulary, but hinder those with better vocabulary. The latter result may suggest that concept mapping can interfere with the students' familiar approach to learning and comprehension.

The above mentioned studies do not address the effect of concept mapping on the affective domain of science. Thus, Jegede et al (1990) studied if concept mapping can be used as a cognitive strategy to reduce anxiety and enhance achievement in biology. A total of 51 grade 10 students participated in this study. The experimental group (n=22) was taught concept mapping over a 3-week period and was required to draw concept maps for each lesson for 6 weeks of instruction. The control group (n=29) was taught by expository methods for the same time periods. In both groups, students were taught selected concepts from units on nutrition in green plants and respiration in cells. The students' anxiety levels were measured before and after instruction using a modified version of Zucherman's Affect Adjective Checklist. Science achievement was determined by using a 50-item multiple test related to the above topics. The results showed that (1) the use of concept maps reduced anxiety and improved achievement; (2) males achieved better and were less anxious than females; (3) the use of concept maps reduced anxiety and improved achievement somewhat more for males than for females. It was concluded that the use of concept maps as a metacognitive strategy was effective and worthwhile.

IMPLICATIONS

Based on the above mentioned studies, the following implications can be drawn:

1. Taken as a set, the results of the above studies reveal that concept mapping is a powerful **teaching/learning** strategy that requires students to participate in the building of their knowledge bases. The achievement gains from this strategy can help students make the transition from rote to meaningful learning. Hence, the results of these studies support the continuous use and study of concept mapping in our schools.
2. Though **the** outcomes of these studies are not completely consistent and conclusive, it appears that concept mapping can reduce students' anxiety and has a positive effect on their achievement in science content, problem solving and probably practical work. Hence, in order to enhance students' achievement in science and promote **meaningful** learning, teachers should incorporate this technique into the on-going classroom instruction.

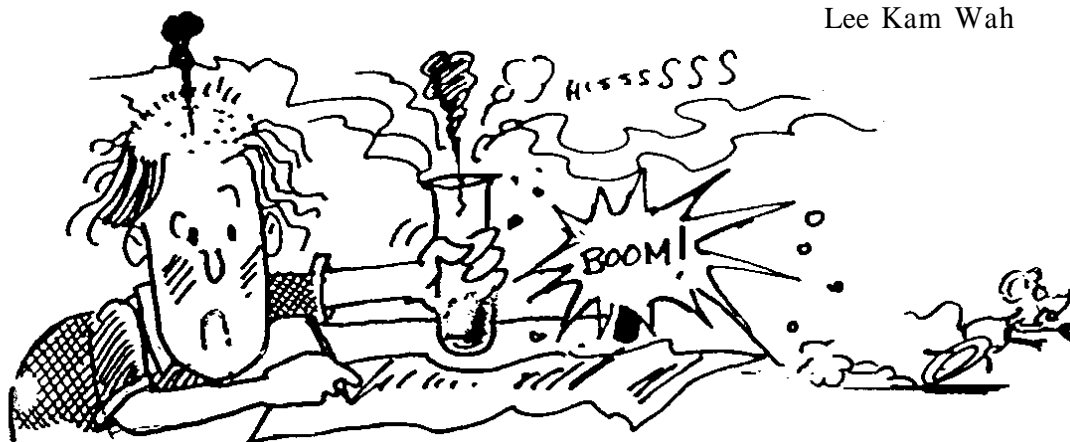
3. All the above studies showed that there is no problem of equipping students with the technique of concept mapping. However, to promote using concept mapping in the classroom, students' learning style has to be taken into consideration. Teachers should therefore encourage their students to use this technique as early as possible, preferably before grade 9 or 10 (equivalent to secondary 3 or 4).

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SOME DIFFICULTIES ASSOCIATED WITH THE TEACHING AND LEARNING OF PROBLEM SOLVING IN SCIENCE

Review by
Lee Kam Wah



Problem solving has an important place in children's learning of science in schools. However, problem solving is still a continuing area of difficulty as far as classroom instruction for effective learning is concerned. Common teaching methods used by instructors or textbooks to teach scientific problem solving skills, rely predominantly on presenting information, showing prototypical examples of worked-out problems, and providing students with practice in solving similar kinds of problems. Less emphasis has been placed on the more important aspects such as the systematic organisation of the thinking process required for problem solving. Students should be specifically taught how to start, where to start, how to analyze and how to proceed with the solution. The purpose of this article is to identify some common difficulties in the teaching and learning of problem solving in science. Some implications of effective teaching of problem solving will also be discussed.

COMMON DIFFICULTIES OF TEACHING AND LEARNING PROBLEM SOLVING

Problem solving in this article is defined as a form of discovery learning that bridges the gap between the learner's existing knowledge and the solution to the problem. The term "problem" refers to a question to which a given individual cannot give an immediate answer. Otherwise the question would be called "an exercise" instead of "a problem".

Reif (1983) reports on the observations of the naturally occurring problem solving behaviour of novice students and experts. The information of problem solving behaviour was collected in the form of protocols. A protocol is a think-aloud exercise while writing out the solutions for the problems. Such protocols provide much more useful and detailed information than those would be obtained by test results, questionnaires or other similar gross measures. His observations indicate that novice students possess conceptual structures derived from prior experience and from informal cultural transmission. Unfortunately, these conceptual structures are often ambiguous, vague, inconsistent, and not accurately predictive. In contrast, experts possess knowledge which is remarkably large and well-organised. Much of this knowledge is tacit, i.e. used automatically without any conscious awareness. ~~Yet~~ this tacit knowledge is essential to good problem solving performance and sometimes quite subtle.

According to Reif (1983), novice students usually r... assemble problem solutions by proceeding, in linear sequential fashion, to piece together various mathematical formulas. By contrast, experts often approach problems by using qualitative arguments and seemingly vague language. These plans are later refined into more mathematical language. The observations show that the experts' superior performance is not merely due to their large store of accumulated knowledge, but also to problem solving procedures more effective than those used by students. Reif (1983) suggests that problem solving involves some general problem solving procedures used in conjunction with a knowledge base containing particular knowledge about a specific domain. The problem solving procedures include three stages:

- (a) Initial problem description
- (b) Synthesis of a solution
- (c) Assessment and improvement of solution.

Two steps of initial problem description are described. The first step aims to generate a "basic description" of a problem into a form where it is readily understandable to the problem solver. The basic description summarizes the information specified and to be found, introduces useful symbols, and expresses available information in various useful symbolic forms, e.g. the use of diagrams. The next step of the problem description is more complex. It aims to redescribe the problem in terms of the special concepts provided by the knowledge base for the relevant knowledge domain. The resulting problem description greatly facilitates the subsequent search for a problem solution since all principles in the knowledge base are expressed in terms of these special concepts and thus become readily accessible.

Once a problem has been translated, one can turn to the task of constructing its solution. The task is difficult because the search for a solution requires decisions among many possible alternatives, only a few of which lead to the desired goal. Once a problem solution has been obtained, it is important to assess whether it is correct so that suitable improvement can be made.

The comparative studies of successful and unsuccessful problem solvers in their problem solving were also reviewed by Woods (1988/89). He finds that unsuccessful problem solvers fail to know where to apply general theory and when to apply specific subsets of the general theory that seem to apply. Unsuccessful problem solvers place more emphasis on collecting sample solutions and working examples than on understanding the fundamentals. They do not memorize experience or tacit knowledge. Successful problem solvers can rapidly and accurately identify knowledge useful in solving a problem. He considers three components that contribute to successful problem solving. These are:

- (a) possession of problem solving skills,
- (b) a knowledge structure of the laws, concepts and "textbook" knowledge in a subject discipline;
- (c) embedded components of tacit (or experience) knowledge - the discipline-specific knowledge that is implied but rarely stated in textbooks.

A study of teachers' teaching of problem solving in classes was carried out by Lee (1986). Case studies were undertaken to examine teachers' behaviour in teaching problem solving and to infer from classroom observations the students' experiences of learning about solving chemistry problems. Four teachers from four different schools (1 boys', 1 girls' and 2 co-ed schools) in Melbourne were involved. The case studies involved classroom observations and recordings of these teachers while they were teaching problem solving in electrochemistry at the HSC level. Among the four cases, the number of visits ranged from three to five lessons. For each lesson, the researcher sat at the back of the classroom to observe the activities occurring during the teaching. The blackboard and/or overhead projector presentations and the teachers' verbal instructions including their dialogues with the students were written

down by the researcher. The teachers' oral presentations were taped during the lessons with the permission of the teachers. These data were qualitatively explored and analyzed. Some important results that relate to classroom learning and teaching of problem solving emerge from these case studies.

In terms of the students' potential learning experiences of problem solving, it was found that the students were mainly witnessing their teachers' demonstrations of using rules or algorithms for solutions to problems. The repeated practice of solving the sorts of problems that occur in examinations was also included as part of the learning experience. The students were not exposed to a range of strategies that could possibly be used to solve the same problems. There was no explicit teaching of important problem solving skills such as translation skills (comprehending, analysing, interpreting, and defining a given problem) and linkage skills (concept relatedness between two concepts or using cues from the problem statements to associate ideas, concepts, diagrams, etc. from memory). When teachers solve problems, they use, in general, several strategies to solve the same class of problems and they are very careful and explicit about translating problem statements, making relevant linkages and checking. (This finding is derived from the protocols (think-aloud) of these four teachers in solving four problems given by the researcher outside the classroom.) These absences in the teachers' teaching of problem solving and hence in the students' range of learning experiences are particularly interesting because they are part of the teachers' own repertoire of skills. In the light of the above reviews, some common difficulties in teaching and learning solving problems are identified and summarised as follows:

1. Students lack knowledge pertaining to the problems.
2. Students lack an organized, hierarchical knowledge structure which can be easily remembered and appropriately retrieved in complex contexts.
3. Students lack problem solving skills such as translation and linkage skills. They have difficulties in translating the problems into meanings and in setting goals or subgoals for the problems, especially for the unfamiliar ones. They also have difficulty in linking the appropriate knowledge from their minds to the novel problem situations.
4. Students do not seem to know any problem solving strategy or procedure with which they can apply to their problem solving. It is not a surprise to see some problems unattempted by many students when the problems are the unfamiliar ones.
5. Students lack experience and confidence in problem solving.

Teachers do not explicitly teach the processes of problem solving but emphasize the strategy which directly uses rules or algorithms for solving the problems. Their sense of strategy in fact was more than a strategy of using rules or algorithms for a typical type of problems. The evidence for this can be drawn from the way they perceive the problems, the way they pull the information together, also from the way they check their solution.

IMPLICATIONS

Based on the preceding literature reviews, students' failure in problem solving could possibly be attributed to the fact that they do not receive a wide range of learning experiences in the problem solving lessons. It is necessary to improve the methods of teaching problem solving if we want to strengthen our students' problem solving ability and skills. Some suggestions stated below may be useful for this purpose.

1. Develop the structure of the knowledge
It is important not only to teach the concepts, principles and rules as individual knowledge or

facts but also to deliberately the organization of this information. Information can be easily linked and retrieved in complex contexts (such as solving problems) only when it is effectively organized. The technique of concept mapping (Cliburn, 1990) can be used as a tool to enhance the development of an organized and hierarchical cognitive structure.

7. Develop students' problem solving skills

Two important problem solving skills - linkage and translation skills - are likely to be neglected in the teaching of problem solving. The learning of linkage skills can be enhanced through word association (Gunstone, 1980), idea association (Lee, 1993) and concept mapping. Teachers can arrange activities for students to practise word association by responding to the same word with various single words which come to their minds. Idea association is quite similar to word association. Key words from the problem statements are given to students who in turn are required to respond to these key words with words, phrases, equations, diagrams, or anything that comes to their minds. The teacher can then discuss with the students which of these responses are correct and relevant to solving a particular problem.

The learning of translation skills could be considerably emphasized by teachers dwelling on the significance of the problem statements and their component parts. For instance, what important information can be selected from the problem statements, what are the possible meanings of the statements and what are the goals that can be pursued. The practice of problem translation through class activities or home exercises can be organized as part of teaching strategies.

3. Teach overall problem solving strategy

Students should have a sense of an overall strategy that will solve science problems. Teachers could incorporate problem solving strategies such as Reif's problem solving procedures in their teaching of problem solving in science by emphasizing the important stages or processes involved.

4. Teach think-aloud strategy

The protocol approach mentioned earlier is a good technique for tapping the thinking in people's minds. Accordingly it may be useful in classrooms, if teachers and students attempt to solve aloud unfamiliar problems. Through this kind of exercise in the overall teaching approach, strengths and weaknesses of students' problem solving strategies could be revealed and hence the necessary steps for rectifying errors or undesired behaviour in problem solving can be followed.

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PRACTICE TEACHING: HOW CAN A COOPERATING TEACHER HELP?

Review by
Steven Wright



THE ROLE OF PRACTICE TEACHING

A major component of teacher education, and the preparation of **teachers** throughout the world, is that of student or practice teaching. Many noted educators have called practice teaching "the most universally approved education course" (Guyton and McIntyre, 1990, p.514).

Teachers themselves have repeatedly identified practice teaching as the single most beneficial aspect of their teacher education programme (Lortie, 1975). All teachers, regardless of their specific experiences and memories of practice teaching (whether of sheer terror, joy, or most probably somewhere in between), were certainly affected by the phenomenon.

Many researchers today look at the **role** of **practice** teaching as part of what they **call** a student's socialisation into teaching. This professional **socialisation** is a process by which the student acquires the knowledge, skills and values inherent in the teaching profession. Certain aspects of this process **are** addressed **must** **effectively** in a **teaching/learning** environment. Hence the **notion** that the **apprenticeship** or **practising** of **teaching** in a **realistic** school environment, is **invaluable** for the **person** who **begins** his or her training with the **status** of a **student**, and **ends** with the **status** of a **teacher**.

STAGES OF PRACTICE TEACHING

There has been a great deal of inquiry and research into the practice teaching experience in terms of what exactly happens to the participants. Are there similarities in events that individuals seem to share? Several researchers believe that most individuals do go through similar stages. Lacey (1977) found that her subjects went through four distinct stages. The initial stage was called the Honeymoon stage where practising teachers were eased into the system and things appeared to be fine. The Methods and Materials stage followed, just before the Crisis stage struck. The culminating phase she called the Learning to Get By or Failure stage.

Although it has been determined that teaching practice is important and necessary, it also appears to be quite difficult. Who are the major players in the practice teaching equation. What are their roles, and how can they ease the burden placed on the neophyte teacher?

SIGNIFICANT OTHERS

If practice teaching is viewed as part of the socialisation process, then the main socialising agents are the students, the cooperating teacher at the school, and the supervisor from the university. Of those three, the two that offer the most in the way of support are the cooperating teacher and the supervisor. Throughout the world, this triad of individuals combine in a working relationship with the goal of helping the practising teacher adjust to the demands of teaching. Research shows that the cooperating teacher appears to have more influence in the practising teacher's experience as they have far more contact with the student teacher, compared to that of the supervisor (Guyton and McIntyre, 1990).

PROBLEM AREAS

Anyone who has experienced practice teaching to a group of 40 students will be aware of the plethora of challenges involved. Let us not concern ourselves with all the factors that are intrinsic to the student teaching, such as content knowledge, organisation and discipline. Instead, let us focus on the dynamics of the triad and how that relationship can either help or hinder the experience of the student teacher. What are some of the problems related to such a relationship? ⁱ

Research has shown that several problems seem to permeate this relationship. Beswick and colleagues (1980), Yates (1981) and Southall (1984) found similar problems in Australia, England, and the US respectively, pertaining to a lack of communication between the university (and its supervisors) and the cooperating teachers in the schools. There was a problem of cooperating teachers being unclear as to what their role of supervision should be, and the fact that their expectations of the student teacher were often different from that of the supervisor. Lack of time and lack of training in supervisory roles also created problems for the cooperating teacher.

SUGGESTIONS

It appears that the problems of lack of communication between university personnel and cooperating teachers are and have been universal, and are present here in Singapore. Efforts should be made by both the cooperating teacher and the supervisor of a student teacher to meet and discuss the relationship, roles and expectations that each member of the triad should embrace. The principal of the school should also be made aware of the expectations of the cooperating teacher so that conflicts do not arise at the local school level, pertaining to timetable conflicts. Supervisors could provide more guidance to the cooperating teacher in terms of what to look for in a lesson and how to help facilitate a reflective discussion with the student teacher. As stated earlier, the cooperating

teacher has far greater opportunities to interact and observe the practising teacher, compared to the supervisor who struggles to see a student teacher three times in seven or eight weeks.

Experienced teachers have a wealth of information and experience in the field of teaching, and possess very specific knowledge about individual students they have been teaching. A crucial element of "cooperating" is devoting time to the process of observing student teachers and offering constructive and supportive feedback. Students need the opportunity to "get their feet wet" and experience teaching firsthand, but they most definitely need guidance, help and reassurance on a regular and dependable basis.

GENERAL OBSERVATIONS

There are certain things that an observer of a lesson can look for in the teacher/student relationship, regardless of the subject taught.

Planning stage: Are there clear learning objectives? Does the lesson fit in to the overall unit plan? Are the tasks required of the students appropriate? Is the learning environment appropriately prepared and equipped?

Class management: How much time is spent on managing tasks? (Time spent here takes away from student learning time). Is discipline a problem? If so, why? How is it handled? Is there monitoring of on task behaviour?

Communication: Are there concise explanations and demonstrations given? Is the teacher enthusiastic and encouraging? Is there good rapport with the class? Does the teacher provide specific and relevant feedback relative to student performance?

Development of the lesson: Are there plenty of opportunities for students to perform the tasks given? Are they progressive, appropriate and challenging? Does the pace maintain interest yet provide for quality of thought and performance? Are there smooth and efficient transitions from one activity to another? Does the opening provide for a revision of past learning and is there a conclusion that summarises main points and successes?

REFLECTIVE PRACTICE

Wright (1992) found that one of the techniques that proved to be very successful in helping practising teachers from a cooperating/supervising role was to provide opportunities for students to reflect on a lesson just taught. Cooperating teachers could start a review session with questions such as: How did you feel about the lesson? What were the successes you had? What problems did you encounter? Depending on the answers given, other questions could be asked, such as: How else could you have handled that situation? How much time do you think you spent talking? How long were students actively involved on a challenging task?

These questions give the students opportunities to reflect on what happened in their class in a way that still gives them ownership and responsibility for the planning, implementing and evaluating of activities in their classes. The cooperating teacher, as the facilitator of their learning, can provide specific feedback on what was actually happening from an observer's point of view, and offer suggestions and information as an experienced and knowledgeable teacher.

This concept of reflective practice is one of the latest techniques being used in the U.S. Advocates of this approach believe that professionals being trained to perform a wide variety of tasks will do best if they are given the opportunity to learn by doing with an experienced "coach" to guide them through the process. Within this context, Schon (1991, p. 17) states: "The student cannot be taught what he needs to know, but he can be coached. He has to see on his own behalf and in his own way the relations between means and methods employed and results achieved. Nobody else can see for him, and he can't see just by being "told", although the right kind of telling may guide his seeing and thus help him see what he needs to see"

In other words, the student teacher needs to have the freedom to do the teaching, in every aspect from planning to evaluation, but the presence of a coach to help make connections and offer an experienced perspective, is most important.

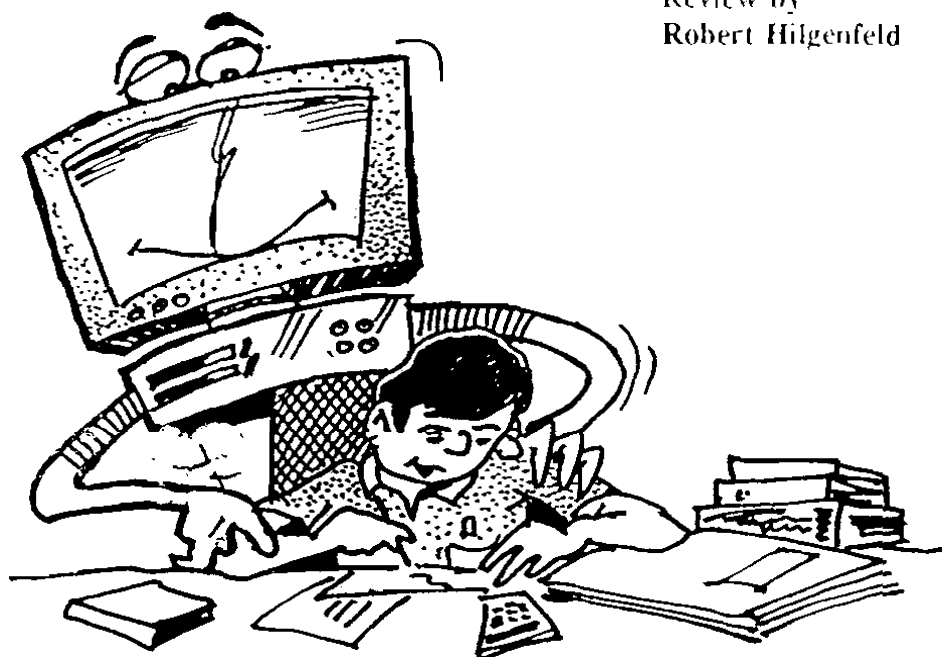
In conclusion, the practice teaching experience is a most meaningful, yet difficult enterprise. This experience can be made even more difficult if the two people available to lend support to the student teacher, the cooperating teacher and the supervisor, do not communicate expectations and role definitions. Every effort should be made to ensure understanding and open communication on these issues. Cooperating teachers can also help facilitate the student teacher's learning experience by spending the time to observe lessons being taught and to engage in a reflective discussion on what has occurred in class.

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DEVELOPING THE EMPATHETIC COMPUTER

Review by
Robert Hilgenfeld



INTRODUCTION

It has been said that the computer is such an important invention that it has the potential of transforming the process as well as the way in which we as a society view education. The computer is now a part of the classroom scene around the world, from the primary grades through tertiary education. With the development of this technology has come a deliberate effort by educators to define, refine, and delineate the role of this remarkable tool. It has the capability of tireless performance for mundane tasks. At the same time, it has the capacity to provide a rich medium for simulation, exploratory learning, skill practice, and assessment in a wide variety of educational settings. This presents a challenging task for the educator of today – to make use of this tool which has become such a necessary part of our lives.

THE COMPUTER AS EXPERT TUTOR

Initial uses of the computer in the educational environment were extremely simple. The computer would present information on a particular subject. After sufficient information was given, questions were asked of the student. Based on common algorithms and other programming techniques, the responses of the students were assessed. Feedback was given on the correctness of cursory and succinct answers. Yes, if the answer was a correct response or, no, the answer is . . .

With the advent of the systems referred to by several acronyms including: CBL (Computer Based Learning), and CAI (Computer Assisted Instruction), an increased emphasis was placed upon the value of psychological research in the study of the process of learning (Atkinson, 1974). Within the past decade, even more progress has taken place as research in the area of cognitive science has fuelled extensive use of the computer-based tutors (Schmitt, 1990). *The Handbook of Artificial Intelligence* (Barr and Feigenbaum, 1982) describes Intelligent Tutoring Systems (ITS), also referred to as Intelligent

Computer-Assisted Instruction (CAI) The term Interactive Learning System (ILS) is used extensively in the literature which deals with the broad range of systems now in focus. ILS can be used in a wide range of learning situations in which various types of knowledge or information exchange take place between two learning system partners. These intelligent systems are characterized by three components: an expert, which is capable of solving the problems presented to the students; a diagnostic component or student model builder which is capable of diagnosing a student's misconceptions and erroneous responses; and mapping discrepancies between the student's knowledge and learning strategies and those of an expert in the area, and a tutor, who makes decisions about the appropriate directions and guidance which is given to the student. They, many times, are multi-centred (involving many participants), multi-modal (involving a variety of physical, perceptual and conceptual modalities), and multi-media (involving many communication channels or devices).

In any technology based system, the process depends extensively upon the interaction(s) that take place between the learner population and the various learning technologies used in the support learning environment. However, even with the overwhelming need for computer programs which demonstrate the level of our expertise in the area of diagnostic capabilities and applied research findings, generally, the tutor module in most computer-based systems is lacking in depth and ability. Limited information and even less research has been levelled at the principles which form the foundation for the rules which a tutor uses to interact with a student. Most information is based upon the cognitive, rather than the motivational and social aspects of the computer-based tutoring process. Tutoring strategies cannot be developed only from the cognitive approach. Motivational components form the other half of the formula. It is imperative that instruction must be individualized along motivational and cognitive dimensions (Lepper and Malone, 1987). There is substantial reason to address the need for computer tutors to display "empathy" and "intelligence" as they interact with students.

The preliminary observations suggest that motivational components of the tutoring process are extremely important. It appears that many decisions which are made by human tutors are based upon the tutor's sense of the feelings of the student, as on the assessment of the student's knowledge of the subject. Questions are then raised. What implications does this have for the design of interactive tutoring systems? Is it important that a computer tutor "empathize" with a student? Can the sophistication of modern tutoring systems be tailored to interest and motivate instruction? It is reasonable to ask what motivational strategies and principles are needed to develop the computer as a tutor with a "personality" which augments, enhances, and complements the learning performance of the student.

HOW DO HUMAN TUTORS EMPATHIZE WITH THEIR STUDENTS?

The key characteristic which is evident with human tutors is their ability to empathize with students' feelings. They are able to detect nonverbal clues as to the students' comfort level as through the learning process. The tutors are able to place themselves in the same situation and understand the problems the student is facing. Their observation of the student and their intuition tend to provide the basis for the decisions which govern their intervention. The problem then becomes one of identifying the components which might better guide the student and provide the student with a more effective tutoring system.

Several areas for which characteristics or rules could be developed for computer tutoring systems which would meet the needs of the student's affective motivational needs might be as follows (Lepper and Chabay, 1988):

A. General Social Knowledge

1. The intelligent tutor should understand that special congratulations should be in order if a student completes an especially complex or arduous task after much time and effort.
2. The computer tutor should recognize that a measure of sympathy and encouragement should be a part of the response if a student has worked hard and performed well while still falling just short of the final goal.
3. The expert system should, likewise, have the ability to challenge a student with a parallel problem which would reinforce a student's confidence after the successful completion of a similar task.

B. Specific Background Knowledge

1. The tutor should be armed with background information about the individual students who are working with it. This information is what a teacher who works with the students regularly would know, i.e. Aptitude tests and motivational measurement scales could be available to the computer so that it would know that one student likes to work out problems for herself while another needs to have constant encouragement and help to master the subject. The tutor could be aware that one student enjoys a particular subject while another's interests extend beyond to a range of subjects. This information should help determine attitude-treatment and attitude-treatment interactions in learning.

C. Students' Choices and Responses

1. The computer tutor should ask periodically whether or not the student desires help with the task at hand. It should also ask whether difficult or easier problems should be presented – whether cooperative or competitive situations should be presented as well as other situational parameters to which the student may respond.
2. The intelligent system could possibly create a diagnostic model of the student along motivational dimensions. This could create a tutor capable of identifying the best techniques available for use with each unique student learning situation.

WHERE FROM HERE?

Two major obstacles face the development of the above model of expert tutor feedback and guidance in the area of motivation and the affective domain. There is little research which deals with the affective aspects of the process of tutoring. We know much about what tutors do, but little about how effective their procedures and practices are. Also, we have much knowledge to acquire concerning the translation of these procedures and practices to the computer tutor in order for it to make the appropriate judgments and assessments of students.

However, if we view these limitations in a positive fashion, as new ground to be developed, explored and tested, then much research is still needed. As is generally known, it is extremely difficult to control and vary human tutor behaviour. The consistency of the computer can be viewed as a positive research factor. As new computer courseware becomes available, teachers need to examine it for content, approve of that content in the context in which it is to be presented, and then observe it in the instructional setting. As the courseware is used, the motivational aspects need to be observed and recorded with special treatment given to the positive differences and assessment scores which may occur as a direct result of the elevated interest level shown by the learner.

The overall question remains whether this approach in the development of the computer tutor would make a significant difference in the facility for students to learn. The above dialogue constitutes compelling evidence to suggest that further study must be forthcoming. Exploration of the affective component presents exciting and stimulating possibilities.

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HIGH-TECH SUPPORT SERVICES FOR TEACHERS OF PHYSICAL EDUCATION



Review by
Ian R. Haslam

Over the past fifteen or so years a fascinating revolutionary movement has been evident in professional physical education across the world. Changes in the structure and organization of the subject matter, new patterns of staff utilisation and department organization, new instructional materials and techniques have been evident across international frontiers. In like manner there is a philosophical move towards the individualisation of instruction through attempts to personalize and humanize the educational systems of the world. These global events have occurred so rapidly that the normal evolutionary rate of change has been discarded. The burden of change on many school systems has caused an unusual amount of curriculum planning confusion and has complicated the planning process which must be undertaken by primary and secondary physical education teachers.

The physical education teacher is confronted by dual expectancies. On the one hand, he/she is expected to organise and present units of instruction with imagination and authority; on the other, he/she is urged to individualise instruction in such a way as to assure the best development of all the special talents of each student. Too often, neither of these expectancies is achieved because the teacher does not have the time or access to the resources to plan.

The purpose of this short paper, therefore, is to review the research literature on computer-based planning and to introduce the concept of computer-based support services for professional teachers of physical education.

RESEARCH LITERATURE

The computer-based curriculum planning in physical education (CBCP-PE) program is based on the pioneer work on interactive resource units for teachers developed at the Centre for Curriculum Planning at the State University of New York in the mid 1960's. The program began in 1963 on main frame computers but is now utilising both micro and mainframe, and is extensively employed by school boards in the western New York area.

The early research data on the impact of computer-based resource units on teachers and students was very encouraging. Harnack (1976) notes much greater professional involvement in the teaching process by teachers who use the computer-based ideas as well as enriched learning environments for children involved with those teachers. Holden (1966) reports that teachers who use computer-based materials became increasingly aware of a greater range of educational ideas and instructional materials. Fields (1977) states that the designing of instructional resource units by teachers resulted in an increased involvement with students in planning, an increased sense of professional competency and an enlightened awareness of the possibilities of integrated work. Goldberg (1966) witnessed an increase in the variety and depth of teacher decision making across all

aspects of the curriculum unit Hicken's (1965) research demonstrated an increase in student participation in instructional design and student independence in instructional decision making through the use of computer-based interactive resource units. On the basis of these findings, it seems reasonable to conclude that

- (1) a teacher's sense of professionalism and overall professional control is enhanced through the use of a computer-based support system,
- (2) students experienced more relevant and interesting lessons that motivated them to further study,
- (3) the curriculum could be organised to reflect not only grade level differences (as is typically the case) but also individual differences,
- (4) relevant research findings have a much greater chance of reaching the teacher and the student, and
- (5) student-teacher planning in physical education could become a reality.

PURPOSE OF THE CBCP-PE PROGRAM

The purpose of the CBCP-PE program is to provide teachers with instant access to the most up-to-date and proven resource materials in the area of physical and health education. The computer will empower teachers with content and pedagogical knowledge in physical education which will help to achieve the goal of daily quality physical education for all Singaporeans. The exciting part about this program is that it is not only confined to the pre-planning work of teachers but that it could also be used to facilitate student-teacher planning and in turn student self-directed learning. The planning of an instructional unit or module could be undertaken by teachers and students in the classroom each working on computers to help define the parameters of the curriculum. Thus, the educational goals of the computer-based curriculum planning programme in physical education are teacher empowerment and student self-direction in active living settings.

Curriculum models

A curriculum model is based on a conceptual framework which delineates the organization of knowledge in a particular area of study. They are especially useful in teaching physical education in the absence of standardized student textbooks and teacher's guides for curriculum development. Curriculum frameworks are themselves reliant on an identifiable theory that supports the organizational framework. In the case of the CBCP-PE programme, the humanistic and third force psychologists' theories which support student self-determination and teacher empowerment is a central feature of the program.

The particular curriculum framework upon which the CBCP-PE program is based comes from the work of Jewett and Mullan (1977) and their Purpose-Process Curriculum Framework. The three main purposes of physical education are fitness development and maintenance, personal skill development and refinement, and interpersonal development. These areas are defined in terms of major concepts and further specified as key elements or purposes. These key concepts can be used by teachers to give their units of study as well as entire grade level curriculum a particular orientation or balance. If many of the units of study focus on fitness elements (regardless of the activity) then the curriculum is said to have a fitness orientation or is balanced in favour of the fitness goal. Throughout different grades these orientations can shift according to the perceived needs of the students.

Activity media

The selection of activity media will reflect a balanced programme which will expose students to the various forms of games, dance, gymnastics, aquatics and outdoor education activities that are popular in Singapore. Within the selection of content (basketball, track, etc.) by curriculum level (secondary 2, 3 or 4) professional teachers can develop curriculum orientations (fitness, skill or social development goals) based on students' needs at different stages of development. For example, a teacher might wish to emphasize the fundamental skills of the game of basketball in one unit and then in another unit perhaps basketball fitness becomes the orientation. This is not to say that in each lesson skill development and fitness and social learning will not be taking place but that the content knowledge to be achieved will be designated in one or the other areas.

Resource unit

A resource unit is a dump of ideas for teaching and learning which is organized around five essential components related to each instructional objective; namely, learning outcomes, content, learning activities, resource materials and evaluation devices. Teachers and students will be able to move from those learning outcomes that they would like to achieve to the content of a particular outcome, to learning activities, to additional reaching aids and then to selected evaluation strategies.

Levels of student entry

Three levels of student entry into an activity have been designated (namely, introductory, intermediate and advanced) and are based upon their previous education in the activity, their experience and their ability to take responsibility for their own learning in the area. It should be pointed out that levels of student entry do not coincide in any way with a student's age or grade level. That is today in some sports, students could be 19 years of age and have no experience or knowledge of the sport and are therefore not ready to assume self-responsibility for their own learning. On the other hand, one might expect students in grade 9 to have had some experience in the culturally predominant sports and might not necessarily be considered to be beginners.

The three levels of student entry are the beginner level - no knowledge or experience in the activity; intermediate level - some rudimentary knowledge and experience in the activity; advanced level - a good grounding in the activity with extended experience and education thus enabling them to assume self-responsibility for further learning.

The process aspect of the Purpose Process Curriculum Framework by Jewett and Mullan (1977) is the basis for the development of the learning outcomes in this program. Their seven level taxonomy is considered the most comprehensive model in the psychomotor domain and has been used in the 1992 revisions to the Coaching Association of Canada's national coaching certification theory program

Content

This section of the resource unit offers a summary of the relevant aspects of the learning outcome or objective. If the objective were skill oriented, then the information might include a definition of the skill, how the skill is used in the activity, under what different performance conditions such as when bumping in volleyball you might not always be standing still with the ball hitting the outstretched platform of the arms - you might have to move back or forward or to the side or even hump and roll or bump and dive.

Learning activities

Learning activities are suggested activities that should be developed or modified or even changed as required by the teacher. Suggestions are broken down in terms of individual, partner, small group and large group possibilities. Creative teachers can take these ideas and turn them into even more relevant and exciting activities.

Resource materials

Resource materials are additional items which might be of interest to the teacher or the student and are organized in terms of print and non-print materials. Non-print materials might include additional software for the computer or video tapes and film loops, perhaps even guest speakers. The print material might include wall charts, articles, pictures, books, student manuals, etc.

Evaluation devices

The final section of the CBCP-PE resource dump involves evaluation procedures and includes suggested activities for measuring learning outcomes in each of the cognitive, psychomotor and affective domains.

SUMMARY

Access to content-pedagogical information in the area of health and well-being through physical activity is essential for all teachers in Singapore. In the absence of detailed textbooks for children and teachers on health and physical activity, curriculum support by the Ministry of Education and the School of Physical Education is essential for the improvement and development of physical education in schools. In-service education is seen as a worthy priority and many innovative courses and programmes exist in physical education. These programmes can be augmented by school-based innovations such as the CBCP-PE facility. The potential for achieving the goal of a physically educated population with a strong desire for excellent physical health is beckoning - I hope we have the foresight to do all that we can to help our children achieve their physical potential in life.

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NOTABLE NEWS ABOUT NOTE TAKING

Review by
Barry Sponder



One of the basic tasks for students to master is the practice of note taking. Students routinely take notes when attending a lecture, during a classroom presentation, or even when reading a course text. Although note taking is a common activity, few teachers spend the time to review students' notes for either thoroughness or accuracy. Wittrock (1974) and Mayer (1987), among others, provide empirical evidence that effective note taking is a complex mental process involving the reconstruction, classification and personalization of knowledge by the learner. Hopefully, the activity of taking notes will help students to remember facts and ideas that are vital for understanding difficult and sophisticated concepts. But does that really happen? Are there forms of note taking that are particularly effective for specific learning tasks? If there are, how can teachers modify their presentations to encourage students to use suitable note taking techniques?

WHAT DOES THE RESEARCH SAY?

Nickerson (1985) summarizes several research studies that provide convincing evidence that *although most students can produce correct answers on tests, they often have only an incomplete understanding of the concepts that are being tested.* In fact, many educators believe that it is counterproductive to overemphasize test performance instead of concentrating on the development of students' conceptual knowledge. Unfortunately, it is difficult to assess higher levels of understanding

solely on the basis of standard course examinations. Nickerson (1985) observed that "to conclude that one understands something well on the basis of a single test may, in general, be a risky practice." Significantly, there is growing evidence to suggest that when students learn specific note taking strategies they can generally improve their factual recall and enhance their understanding of difficult concepts.

Kiewra et al (1988) conducted a study based upon the premise that students are usually "notoriously poor note takers" but they can be trained to improve their note taking skills. The researchers also wanted to learn how teachers can present information in a format that facilitates good note taking behaviour. The research team arranged for four groups of students to attend a standard lecture. Later they provided each group with a different set of notes to review:

1. The first group was given a verbatim set of lecture notes.
2. The second group was given an outline of the lecture notes.
3. The third group was given a set of notes organized in a matrix (tabular) format, using rows and columns to sort the information under major topics.
4. The fourth group was not given notes but students were encouraged to write down and study what they could recall from the lesson.

After studying the notes the students were tested using three types of questions: cued recall, factual recognition and concept transfer. Not surprisingly, the first three groups scored well in factual recall and easily outperformed students who did not use prepared notes. More significantly, however, students who used matrix notes outperformed all other groups on the test for conceptual transfer of information.

Is it possible to increase information retention and concept development by teaching students how to use matrix notes? A follow-up study by DuBois et al (1988) tried to answer that question by training students to use the matrix strategy in different subject areas. The training was found to be both feasible and effective. The research findings indicated that "students whose notes were in a matrix framework recalled more information and were better synthesizers than those whose notes were linear". They also found that using a matrix for lesson planning helped teachers to design presentations that made it easier for students to take their own notes.

WHAT ARE MATRIX NOTES AND HOW DO THEY WORK?

A matrix is a rectangular array of rows and columns. Notes taken in a matrix format permit the easy identification, categorization and comparison of information. The tabular structure is particularly appropriate when several target concepts have one or more characteristics that are compared and contrasted for similarities or differences.

Kiewra (1989) gives an example of using matrix notes as part of a secondary school lesson about insects. The teacher wanted to differentiate between two species of insects that are easy to confuse, moths and butterflies. At the beginning of the lecture students were given a blank matrix sheet for taking notes (see Figure 1.).

Characteristics	Moths	Butterflies
Similarities		
Development		
Wings		
Differences		
Antennae		
Rest		
Cocoon		

Figure 1. An empty matrix for 'taking notes

The presentation concentrated on the common attributes of both species and also highlighted their unique characteristics. Instead of taking random or verbatim notes the students were encouraged to use the matrix to record information that compared the basic similarities and differences of each species. The completed matrices were similar to Figure 2.

Characteristics	Moths	Butterflies
Similarities		
Development	4 stages	4 stages
Wings	2 sets	2 sets
Differences		
Antennae	feathery	long and thin with knobs
Rest	wings over hody	wings outstretched
Cocoon	fuzzy	smooth

Figure 2. A filled in matrix after the lecture

The rationale for matrix notes comes from psychological research indicating that as learning takes place we store information in meaningful mental networks that depend, in large part, upon our previous experiences and our existing ideas. It then follows that we can help students to create appropriate mental structures by presenting information in ways that helps them to organize data within suitable contexts, and in formats that facilitate the synthesis and connection of ideas.

WHAT ARE SOME ADVANTAGES OF MATRIX NOTES?

Notes taken in a matrix format have some advantages over non-systematic note taking:

1. Matrix notes produce well-organized information, whether or not the original presentation is organized. It is generally easier to study and learn from organized materials than from information presented in a linear format.
2. The tabular configuration reinforces the integration of ideas between and across categories, an important function for higher-order concept development.
3. Using a matrix makes it easier to recognize if critical information is missing from a presentation.

WHAT ARE THE IMPLICATIONS FOR SINGAPORE TEACHERS?

Both teachers and students can profit from using matrix notes in appropriate circumstances because the system tends to support the development of students' higher order thinking skills.

1. Students can be trained to take matrix notes.
2. Teachers can supply more information to students in this manner.
3. Teachers can provide students with blank matrices and encourage them to complete the cells during a lecture, presentation, or while reading course material.

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BURNOUT: OCCUPATIONAL HAZARD FOR TEACHERS

Review by
Jessica Ball



WHAT IS BURNOUT?

Burnout is...

- * Most common among people in the helping professions
- * Shown in cynical, dehumanizing attitudes towards students
- * Caused by frustration and emotional overload at work
- * A major contributor to decreasing job performance and increasing staff turnover
- * Increasingly recognized and extensively researched
- * Preventable and treatable.

Burnout is a negative change in attitudes and behaviours in reaction to work situations that place high demands on one's capacity to work directly with and care for other people. It is not surprising, then, that epidemiological studies have shown the highest prevalence of burnout among people in the helping professions, especially teachers, social workers, and health care practitioners.

Teachers, as well as their students, co-workers, and society as a whole suffer the negative consequences of educator burnout. Hence, substantial effort has been made to understand and alleviate burnout. This discussion highlights findings about characteristics of burnout, what causes it, and what can be done to prevent it.

In Singapore, it is not uncommon to hear teachers say that they are "burned out". Research is needed to determine whether the feelings and behaviours that Singaporean teachers are referring to a similar set of emotional and behavioural symptoms as are found among Western professionals who show the classic symptoms of the burnout syndrome. Studies cited in this review were conducted mainly in the United States.

THE BURNOUT SYNDROME: THREE MAIN COMPONENTS

Researchers have reliably identified three components that characterize the burnout syndrome and distinguish this response to stress from other responses (Maslach & Jackson, 1986)

- (1) Depersonalization (extreme lack of empathic response to others)
- (2) Emotional exhaustion
- (3) Loss of a sense of personal accomplishment.

Most investigators have emphasized as primary the depersonalization component of the burnout syndrome. They have focused on the apparent emotional coldness, alienation, or estrangement of teachers from students, co-workers, and the school (Maslach, 1976). For example, teachers with burnout tend to treat students in a detached, rigid, formulaic fashion, and to use derogatory labels to distance themselves psychologically from students (e.g., "they're all animals", "gone cases," "a garbage class"). Some investigators have emphasized declining motivation to perform one's job well, and the loss of idealism and enthusiasm for one's job. What was formerly a "calling" or a "mission" becomes "just a job," or even a "curse" (Cherniss, 1980).

Researchers have noted that the pattern or symptoms, as well as their intensity and duration, varies from one individual to another (e.g., Cherniss, 1980; Maslach & Jackson, 1986). Teachers' awareness of their burnout status also varies. Teachers who show severe signs of burnout may deny completely that their attitudes, feelings, and behaviours have deteriorated, while other teachers may be acutely aware that they suffer from burnout.

ORGANIZATIONAL SYMPTOMS OF BURNOUT

Signs of widespread burnout among teachers in a school include:

- low staff morale
- decrements in the quality of teaching and other aspects of job performance
- negative rapport among teachers, students, and administrators
- increased sick leave, tardiness, and absenteeism from meetings
- high staff turnover
- personal and departmental "turfism" involving distrustful and competitive relationships between teachers in different departments
- increased polarization between administrators and teachers
- rigid, stereotyped and emotionally cold interactions among staff.

WHAT BURNOUT IS NOT

Burnout is not synonymous with stress. Burnout is a reaction to chronic, high stress on the job. Factors that cause stress are also precursors of burnout. However, not everyone who experiences high stress develops burnout. Empirical and conceptual support for distinguishing between stress and burnout has been documented by Farber (1983). In particular, many teachers under stress do not resort to the coping strategy of depersonalization that is characteristic of burnout.

Burnout is not malingering or complaining too much. The symptoms of burnout are real, often severe, and in the worst cases can lead to mental breakdown, family dissolution, and even life-threatening diseases. Several studies have shown that burnout is more likely to occur among more dedicated teachers (e.g. Cherniss, 1980).

Burnout is not manipulative. People with burnout should not be dismissed as simply manoeuvring for lighter work loads, fewer hours, or higher pay. Freudemberger (1975), the first researcher to conceptualize burnout, described people most at risk for burnout as those who idealize and are over-committed to their jobs, work long hours for minimal financial compensation, and deny

themselves a social life. After they develop burnout symptoms, they often work even harder, though not as effectively, and tend to deny any personal problems or need for help.

Burnout is not just being "worn out". People with burnout tend to cling to high self-esteem, and to persevere like martyrs in their work, at least during the initial stages. In contrast, people who feel simply "worn out" tend to suffer lowered self-esteem, show reduced energy in their work, and do not show the cognitive symptom of depersonalization.

WHAT CAUSES BURNOUT!

Personal characteristics. The only predisposing personal characteristic that has been shown in research to date is high motivation in work contexts which allow for only moderate levels of success. Age has been shown to be a significant predictor of the Emotional Exhaustion component of burnout, with younger teachers being more prone to Emotional Exhaustion than older teachers (e.g. Anderson & Iwanicki, 1984).

Role characteristics. Excessive demands to respond in supportive, empathic, tangibly helpful ways to those whom the institution serves is one of the most important immediate causes of burnout, setting in motion the first stage of burnout: emotional exhaustion. Maslach and Jackson (1984) found high indications of burnout among public service workers who were expected to show personal care and concern for more than 40 people each day. Helping professionals whose jobs require them to spend at least part of their day in administration or training shows lower incidence of burnout than people whose entire-day is spent on the front-lines, in direct service delivery. Hence, it could be expected that, among positions in a school, the regular classroom teacher is most subject to the conditions that cause burnout.

Another stimulus for development of burnout is when the teacher perceives a disjunction between what she is supposed to do and students' needs; that is, the perception that students are simply not helped, and may even be harmed, by things the teacher is expected to do, or by the approaches and programmes that the school offers or does not offer.

Finally, secondary school teachers have been found to suffer more from the Loss of Personal Accomplishment component of burnout compared to primary school teachers (Maslach and Jackson, 1986).

Institutional characteristics. Pioneers in research on burnout share the view that a central role in precipitating burnout is played by environmental factors, especially the lack of organizational support for staff (e.g. Freudenberger, 1975; Maslach, 1976). Some major precipitating job factors are:

- (1) Substantial amounts of time spent with students;
- (2) Little sense of autonomy
- (3) Little sense of control
- (4) Little feedback of any kind
- (5) Little sense of success
- (6) Role ambiguity
- (7) Role conflict.

There is no doubt that many school situations are frustrating, stressful, and tiring. However, aversive working conditions alone are not sufficient to cause burnout, since many teachers working in extraordinarily difficult situations do not develop burnout. Institutional and psychological factors interact to produce burnout. Thus, efforts to ameliorate burnout must involve both alleviating

debilitating organizational factors and bolstering personal factors that reduce the risk of burnout

HOW CAN TEACHERS PREVENT OR RECOVER FROM BURNOUT:!

Systems change slowly. Individual teachers at risk for burnout need help urgently and are not good candidates for taking on the burdens and incumbent frustrations of becoming active advocates of school-wide or system-wide change. Hence, educational researchers and practitioners have identified several practical steps that can be taken personally by teachers to increase their psychological immunity to burnout, at least in the short-term. A particularly lucid presentation of the steps mentioned below is provided by Pines and Aronson (1981).

- (1) Develop **effective social** support systems in school.
- (2) Slick with the winners: Avoid negative colleagues.
- (3) Cultivate an enjoyable, need-fulfilling social life.
- (4) Recognize and avoid situations that are likely to trigger intense emotional reactions.
- (5) Acknowledge personal limitations and set realistic goals.
- (6) Prioritize **responsibilities**.
- (7) Compartmentalize - leave your work at work.
- (8) Develop a capacity for humane but detached **concern**.

The steps outlined here urge teachers to re-evaluate personal choices, re-direct energies into areas that are likely to be most rewarding, and maximize the buffering effects of social support against the potential for emotional exhaustion in teaching.

The prevalence of burnout among Singapore teachers and the generalizability of research findings to the Singapore context remain questions for future research. Nevertheless, there is a growing body of evidence that moderate to high levels of stress are experienced by teachers across national boundaries and different school systems. Since burnout is one of the most personally debilitating and socially costly responses to stress, it would seem that teachers in Singapore, as elsewhere, could benefit from exploring in more detail the preventive steps outlined here. Reports of burnout prevention programmes for teachers have indicated that taking responsibility for preventing or recuperating from burnout can lead to reduced stress overall, personal growth, and greater job satisfaction (Pines et al., 1981).

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INTRODUCING *REACT*

REACT (standing for Review of Educational Advances and Research for Classroom Teachers) continues the task of keeping teachers, senior school personnel and principals abreast of advances and research in education.

Instead of single-study abstracts as provided in the former version of *REACT*, there are now *reviews* of areas of interest to teachers and others. Each review covers two or more research studies related to a particular topic. The review writer also teases out significant implications for practice. It is this attempt to *link* research to practice which constitutes the *thrust* of *REACT*.

REACT is addressed to a wide readership of practitioners in education. In the interest of communicating with this wider audience, technical details of research and the jargon that goes with the subject will be reduced to a minimum consistent with the integrity of the data. Readers who want to know more of the details are referred to the original research reports and studies cited under *Sources* in each review.

In this issue, the ten reviews discuss research findings on a good range of topics, including sex education in Singapore, the properties of true-false test items, teaching practice, uses of the computer in the classroom, and concept mapping in the learning of science.

Send contributions and comments to: The *React* Editorial, c/o Nanyang Technological University, National Institute of Education, 469 Bukit Timah Road, Singapore 1025, Republic of Singapore.