REVIEW

Vol 5 No 3 Jul 1995 MITA (P) No 143/09/94

Self-enhancing Schools

Association for Supervision and Curriculum Development (Singapore)

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT

ASCD (Singapore) Review is published three times a year in March, July and November. The views expressed in this journal do not necessarily reflect the official position of ASCD (Singapore).

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Printed by Nanic Printers Pte Ltd, Blk 4006, Depot Lane #01-56, Singapore 0410.

ASCD REVIEW

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July 1995 Vol 5 No 3

FOCUS: SELF-ENHANCING SCHOOLS

OTHER TOPICS

Will they remember it after the holidays? Maintaining classroom learning

Dennis J Rose

Teachers have a problem. Even though their pupils show interest and enthusiasm for their learning, they frequently forget what they have learned or they fail to perform as expected on a later occasion. The problem is often worse after a vacation or even after a long weekend.

On the other hand, learning that occurs in the natural environment seems to be more permanent. When young children learn to walk, talk, and interact, they remember everything that they have learned. Their vocabulary expands rapidly while their syntax becomes more refined. Older learners master physical tasks such as driving a car or typing, while also learning the technical jargon and procedural rules necessary in their work. They rarely forget this learning.

This paper presents an analysis of the differences between learning in the classroom and learning in the natural environment. The paper also recommends strategies for teachers suggested by the analysis. The analysis is in four sections:

1) Events and conditions which precede the learner's actions
2) The actions of the learner
3) The result of the learner's actions
4) The milieu in which learning occurs.

Events and conditions which precede the learner's actions

Well-defined routines and tasks are a characteristic of most classrooms. Teachers give precise instructions and make clear requests, usually with consistent and grammatically correct wording. Lessons follow a pattern using structured and predictable materials. Conditions found in the natural environment are often only represented symbolically in the classroom, despite an expectation that pupils will eventually apply their learning in the natural environment. For example, pupils solve mathematics problems on paper rather than in "real" situations.

The natural environment has a loose structure and is less predictable than the classroom. A variety of people give instructions and make requests in many different forms and language patterns. There is usually quite free access to a wide range of materials and unstructured learning opportunities. Learners often choose what they will do.

Teachers and researchers have

found that well-structured teaching tends to produce high achievement (e.g., Engelmann & Carnine, 1982; Good & Grouws, 1979). Baer (1981) has suggested that teachers should make their instructions more varied once acquisition has occurred. There is also evidence that they should use a greater range of examples (Stokes & Baer, 1977) because pupils will eventually need to apply their learning to a greater variety of situations than those they encounter in the classroom.

When planning for practice, teachers should use a wide variety of examples and vary their presentation formats. The examples should reflect conditions outside the classroom and teachers should also use materials that their pupils will find in the natural environment.

Actions of the learner

Many lessons have long periods when teachers present material while their pupils remain passive. Pupils usually only practise skills briefly and they are required to make a single type of response (e.g., short answer, multiple choice). For example, a lesson about the classification of living things may require students to identify features of living things and to make a classification according to those features. The entire exercise may be in written form and may not require pupils to recognize physical features. While these pupils may be expert at the classification of words about living things, they may not be able to recognize or classify them when they are physically present.

Outside the classroom, learners are usually more active. They sometimes practise newly learned skills incessantly. They apply their learning frequently, in a broad range of situations and in a variety of different ways. For example, a child learning new vocabulary at home will use words as labels or in sentences, and will find items or perform actions when others use the words.

There is considerable evidence that learners who become very fluent at using new skills and knowledge, retain their learning and spontaneously combine it with other skills and knowledge to make new and creative connections. Johnson and Layng (1992) achieved dramatic results by having learners practice basic skills until they could perform them at a high rate. Once they could perform basic skills automatically, students were more easily able to solve abstract problems and made accelerated progress in their achievement levels. Engelmann and Carnine (1982) have suggested that teachers provide expansion activities in which learners apply a well-learned skill in a range of new situations, including games and simulations.

Teachers should require their pupils to demonstrate and practise their learning in a variety of modes. Besides classifying living things through a worksheet exercise, pupils might also classify from pictures, slides or videotape. They could "work backwards" by taking their knowledge of certain living things and creating a classification guide. The key for the teacher is to avoid having pupils make just one type of response to one type of situation. Instead, they should provide opportunities to act flexibly in a variety of contexts.

The result of the learner's actions

Classrooms provide few rewards for many pupils. Sometimes the only reason for completing work is to get it out of the way and to avoid being reprimanded for non-completion. Teachers occasionally provide praise or rewards such as stamps, stickers or points, but these are usually too infrequent. Such rewards can seem contrived and are only available when the teacher is present. They will have no influence out of the classroom.

Learners in the natural environment are dependent on naturally occurring rewards. A child who is learning to speak may receive attention for each attempt. The attention will diminish over time as the talking becomes more routine and the reward will become related to the intrinsic value of the communication. However, new and improved performances will still attract notice and so the learner will be rewarded for continuing to expand his or her repertoire.

This change from extrinsic to intrinsic rewards and from frequent to intermittent rewards is the same pattern that best produces new learning and then maintains it (e.g., Alberto & Troutman, 1982). Baer (1981) suggests that, if teachers ensure that their pupils are fluent in new skills and knowledge, their performance will be more likely to attract notice in the natural environment and is, therefore, more likely to result in naturally occurring rewards.

Wherever possible, teachers should ensure that pupils are rewarded for achievement while establishing new learning and then plan to reward them intermittently and less frequently. Teachers can reward pupils by using quick glances and smiles, praise, points, stamps and stars. Another useful way of providing rewards is to set goals and have pupils reward themselves once they have achieved the goal. Peer tutoring and cooperative learning groups also make it possible for many children to be rewarded for achievement without taking much of the teacher's

time. In the long run, success in a particular subject often becomes the natural reward but it is often necessary to use external rewards in the early stages.

The milieu in which learning occurs

Classroom learning typically occurs in an environment that remains much the same from lesson to lesson. The teacher, other pupils, the general classroom surrounds, even the times of the lesson in a particular subject, often remain constant day after day. These all have some influence on later performance. If they are absent, there is less likelihood that learners will use their new learning.

The natural environment varies continuously and unpredictably. No particular factor in the natural environment is able to acquire a strong influence over later performance.

Baer (1981) urged teachers to vary as many features in the classroom environment as possible. These include not only where and when learning occurs but also the structure of the lesson, the types of activity, and the demeanor of the teacher. Teachers should attempt to have some learning occur in groups, others individually and some during whole-class lessons.

Conclusions

An important difference between classrooms and the natural environment is the amount of control that teachers exercise in classrooms compared to the randomness of the natural environment. Teachers need to control their teaching so that pupils efficiently acquire new skills and knowledge. However, this very control limits the capacity of the learner to use the learning outside the classroom

One approach is for teachers to make their classroom programmes replicate much that is in the natural environment, especially after the acquisition of new learning and in situations where the purpose of a lesson is to provide practice and develop fluency and confidence. Wherever possible teachers should:

- vary the time of day the lesson is taught in
- use different lesson structures
- use different types of teaching material (from highly structured workbooks to general references)
- require a range of different types of pupil response (from worksheet answers to discussion or a long term project)
- have pupils work alone, in large and small cooperative groups and in competitive teams
- provide a lot of practice for basic component skills and set pupils fluency targets
- reward often in initial stages but intermittently after acquisition
- vary the rewards (e.g., points, stickers, stars, stamps, access to activities, praise)
- use different teaching styles (e.g., directive, laissez faire, democratic)
- vary their position in the room, their tone of voice, and their choice of words
- sometimes have others in the room.

It would be helpful if teachers incorporated as much variety as possible in all aspects of their teaching. This might interfere with initial learning and so teachers might need to reduce the variety early on. However, once initial learning has occurred, teachers should strive to make the learning experiences they create reflect the natural environment in which the learning will be applied.

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Working with Pupils' Parents: Some Suggestions for Teachers

Elena Lui Hah Wah

Why do teachers need to work with pupils' parents?

Parents are pupils' first teachers. Their attitudes, values and behaviours have direct influence on pupils' physical, social, emotional and intellectual behaviour in school and in their later life. With parents' cooperation, teachers can expect better results from pupils in their performance in school. Helping parents understand the implications of current educational policies, education system and curricular provisions will benefit pupils in terms of more realistic parental expectations, less pressure on them and better guidance at home. Effective communication with parents will enable teachers to gain better insight into pupils' background, needs and problems. Hence, it is important for teachers to bear in mind that teaching and guiding each pupil as a total person, not just as a child within the time frame and space of school.

Generally speaking, parent-teacher interaction takes place on occasions such as registration, orientation, parent-teacher conferences (for discussion of pupils' academic or behaviour problems), parent-teacher association meetings and functions, special group meetings, e.g. for parental education, information dissemination, interpretation of educational policies, promotion of government campaign, placement or streaming of pupils, etc. Some parents are involved at policy making levels of the school, for example, as members of the School Advisory Committee or Management Committee. When it is time for fund raising, parents may be involved either directly or indirectly.

Beyond the abovementioned occasions of parent-teacher interaction, teachers need to know whether there are any so-called "problem parents" in the classes. One of the reasons for a pupil becoming less academically inclined is the lack of parental guidance at home. Parents of these pupils are mostly from lower income groups and less educated. Teachers often have difficulties in getting them to come to school or even making appointments to visit them at home. On the other hand, there are parents who are quite well to do and highly educated. They may even wish to teach teachers how to teach their children. These parents have very high expectations of their children and pressurize them to study. Such parents do interact a lot with teachers. But "what kind of interaction is it?" and "How to change the interaction that is hostile or defensive?" These are important questions.

How to maintain good relations with pupils' parents?

The following are some guidelines for maintaining good relations with pupils' parents:

1 *Be courteous*

A teacher should not ignore parents, keep them waiting or let them wander in the school without anyone attending to their needs. He should greet them, talk to them and find out what they want. If he is not free to attend to them, he should try to get a colleague to help or find a convenient time and place to meet the parent(s) later. One should avoid delay in acknowledging or replying letters from parents. If the request, demand or complaint is hard for the teacher to handle, he can consult the principal or other colleagues and solicit their opinion or help. If the feedback from parents is of significance, the teacher has the responsibility to convey it to the authorities concerned through proper channels. When parents confide their personal problems, the teacher should not gossip about them with other teachers and must respect their right to privacy. In case he needs to refer the parents and/or the child for specialist consultation, the parents' consent should first be obtained. For upper primary and teenage pupils, the teacher should get their own consent too, after having consulted the principal.

2 *Communicate effectively*

For effective communication with parents, besides showing patience and engaging in active listening, the teacher needs to talk to parents at their level and use the language or dialect they feel most at home with. If there is a language problem, one can ask the pupils, colleagues or other people around to help interpret the conversation. Teachers need to avoid professional jargon and not complicate the matter by bringing in too much information. Observe the non-verbal aspect of communication with the parents, such as tone of voice, facial expression, gestures, etc. Try to catch the underlying message of the parents. Ask leading questions to help them express themselves freely. Never use "cross examination" because teachers are not detectives or prosecutors. Use telephone calls, circulars and bulletin boards to keep parents informed of the happenings at school. Also never put across "blaming" messages because it will only make parents become defensive and subsequently cause communication breakdown.

3 *Accept the other person as an unique individual*

Parents come into school as individuals with their unique characteristics. Teachers should accept them as they are and respect them without any condition. If a teacher only respects parents who are rich and have high status, he is having conditional respect towards parents. If a teacher respects only parents who have shown respect to him, he is also having conditional respect for parents. A teacher should take the initiative to show respect unconditionally to parents. Respect begets respect. Parents who get respect from the teacher will normally respect the teacher more. There can be some exceptional cases such as a mother thinking she has a higher status than the teacher. When the teacher acts in a respectful way, she thinks the teacher is trying to please her. However, even though the parents are very proud and do not respect the teacher, the teacher still has to accept them and should never displease them or transfer her unpleasant feelings or anger onto her pupils. A teacher with sufficient confidence and competence will not feel threatened by parents who act disrespectfully toward him. Sometimes, some parents may behave rudely, use vulgar language, make unreasonable demands, etc. Teachers should keep calm and not build up psychological barriers in reacting to them. They should talk to them politely and listen actively to them. To take the case below as an example: this morning, Paul's father came to see Mrs Heng to explain why Paul had been absent for more than three days. He talked very loudly, in fact, it was almost like shouting. Mrs Heng at first felt quite annoyed but she quickly calmed down and tried to find the reason as to why he talked in such a manner. She recalled that in the class register, she had read the occupation of Paul's father as an engine fitter. She talked to him in a nice way and suggested to him not to talk so loudly as he would disturb other people around. He took the hint and spoke less loudly. Mrs Heng managed this situation very well. She accepted Paul's father as an unique individual and did not reject him because he talked so loudly, nor show any lack of respect because he was not an 'educated man'. She informed him of the consequences of his behaviour (talking very loudly) on other people. She did not react emotionally, for example, by shouting back at him or telling him off.

4 *Assess the relationship objectively*

Both teachers and the parents have feelings and prejudices. To maintain good relations between teachers and parents, the teacher

should first assess himself and then assess the parents. The next step is to analyse the interaction with the parents. The analysis should be done together with other teachers who are teaching similar groups of pupils in your school. Some parents relate to every teacher in the same way but some do relate differently to different teachers. By sharing information, your assessment can become more objective and accurate. For example, Mrs Wong found Tan Ah Meng's mother very cooperative and supportive. She was rather surprised to receive complaints from other teachers about Mrs Tan's indifferent attitude. After some discussion with the teachers concerned, it was discovered that the good relationship between Mrs Tan and Mrs Wong was because that she was the form teacher and also very senior in the school.

5 *Set goals for change*

For different parents or groups of parents, the teacher should set different goals for change. It is because parents have individual needs or special problems and have specific goals in mind. When a few parents have common needs or problems and are able to communicate in the same language or dialect, teachers can group them together and help meet their needs or solve problems. The purpose of these groups should be clear to the parents concerned and perceived by them as significant for their children and themselves.

For those who have never made their appearance in school and whose children need more guidance and motivation at home, teachers may set the goal at contacting them through home visits, or meet them in the evenings with the venue and time convenient to both parties and suggest to them how to support and supplement the teaching in school.

For those who usually come to school and their children have similar needs as the above, the teacher may set the goal at involving them in group projects to enhance pupil learning. For example, some Parent-Teacher Associations organized Mandarin classes for parents to enable parents to speak Mandarin and create a more conducive environment for their children to learn Chinese.

For those who are less educated and in need of more knowledge about planned parenthood, children's rights, desirable patterns of child rearing, home making, budgeting etc., the teacher can refer them to counselling and welfare services agencies, such as Students Care Service. For those children with behaviour or health problems, the teacher's aim should be to help them cope with these problems by advising them on how they themselves can help to solve their children's problems. The teacher can also advise them to seek help from professionals or specialists in the medical and social services.

For hardship cases, the school can help them solve financial problems and give some moral support. If teachers feel like ignoring such cases or look down on them, teachers need to change their own attitude towards poverty. To solve their financial problems, teachers can also advise them on community resources in the form of welfare funds and assistance from charitable organizations.

Some important points to remember in working with parents

When teachers are engaged in a working relationship with parents, they should remember the following points:

Parents are your partners in facilitating pupil learning. Teachers should invite and welcome parents' participation in pupils' learning activities.

Parents have the right for self-determination. Teachers can enlighten them on the variety of options and the pros and cons of each option. However, the decision should be the parents', not the teacher's.

Parents have the right of self-respect and privacy. Teachers need to assure parents that they can be trusted and the principle of confidentiality is observed.

Parents have feelings, so do teachers. Teachers should not allow emotions, particularly negative emotions, to control their behaviour. Teachers should try their best to be objective and have more patience and tolerance in interacting with parents.

Parents have their strengths and weaknesses. Look for their good points and show appreciation. Accept that parents do make mistakes owing to various constraints and limitations. Do not blame them for any mistake but help them to correct it.

Parents can change and teachers can help them to change. If teachers do not believe that basically every person has the ability to change, then there will not be any confidence to develop any action plan with them for the improvement of interaction between teachers and parents.

Parents are individuals with different needs. Try hard not to

generalize or have stereotyped views of parents. Even if teachers have encountered aggressive and hostile parents before, teachers should not think that all parents are similar. Do not forget that one of the basic principles of human growth is individual difference.

How to make referrals

Through daily direct contacts with and observation of pupils, with the help of surveys on their needs and problems as well as potential helpers in their study, teachers should be able to identify which of the pupils need to be referred to community organisations outside school. Teachers should also examine the resources within the school, and their own capacities, time, experience, etc. to see whether they can handle the case. For example, if a pupil always does not do his homework, the teacher first needs to find out the factors. If it is due to lack of motivation and no proper supervision from parents/ elder siblings at home, the teacher can solve the problem by giving advice and encouraging the parents/ elder siblings to provide support to the pupil. If they are unable to do so, the teacher may arrange for the pupil to get help from volunteers in the school or the vicinity. If the pupil has difficulties in word recognition, the teacher should consult reading specialists or refer the child to them. If it is a suspected cases of mental retardation then the teacher should help the pupil for psychological assessment. In the cases of child abuse, teachers should report to the Ministry of Community Development. Above all, teachers can consult the guidance officers of the Pastoral Care and Career Guidance Division, Ministry of Education, and the lecturers of Psychological Studies Division of National Institute of Education.

Before making a referral, the teacher should:

1) Discuss the case with the Principal, Vice-principal or the Guidance-Counsellor (if there is one in the school).
2) Collect more data from other teachers, pupils and family members.
3) Check the pupil's record, keep a recording of the pupil's maladjusted symptoms or problem behaviour.
4) Consult (through telephone or personal calls) specialists of the discipline concerned.

The next step is to work out helping strategies, the persons and the places from which the pupils can get help. When it is decided that a particular pupil should be referred to outside organisation(s), the teacher should not bypass the principal or proceed without the parents' consent (except when the parents are suspected as the main cause of problems like child abuse or it is impossible to contact them).

The work involved in referring a case can be rather simple or quite complicated. Teacher may need to:

1) help arrange the first interview or meeting for the pupil and the specialist.
2) write referral letter(s), summary of the case or fill in the referral form provided by the organisation concerned.
3) keep in touch with the specialist to exchange relevant information, discuss the treatment plan, and monitor the progress of the case.

It may not be necessary for the teacher to do all these, but it is inevitable that the teacher will get involved one way or another in the diagnosis and treatment of the case. While teachers are handling the case, they must remember that the data should be treated as confidential and can only be revealed to people concerned, in the interest of the pupil. This is a very important principle in the helping professions. It is based on the belief in human rights, i.e. a person's privacy must be respected. The teacher also need to have positive attitudes toward the pupil and genuine concern in the pupil's welfare and education.

An appeal to readers

Working with parents would not be effective at all if the teacher does not really care for the total development of his pupils. Good teacher-pupil relationship is a basic requirement for effective teaching and learning. Perhaps those teachers who prefer to keep to their daily routine, confine themselves within the classroom, and follow the syllabus strictly, will never consider taking on the adventure suggested in this chapter. They may not even have the interest to read it. Therefore the writer sincerely wishes that teachers who are convinced of the importance of tapping community resources and working with parents would help propagate the ideas offered here.

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Building Bridges Between School and the World of Work

Esther Tan

REVIEWING THE PAST

Futile Attempts in the Early Years

In the educational scene in Singapore, there had been, for many years, a big gap between the schools and the world of work. In the 50s and early 60s, career guidance was unheard of in Singapore schools or any kind of educational guidance, for that matter. The late 60s saw the beginning of career guidance for Singapore schools with the setting up of a Guidance Unit in the Ministry of Education. In these early years, however, career guidance was conceived mainly as the dissemination of occupational information. The main function of the Guidance Unit was to collate and publish career guidance resource materials. All the secondary schools were asked to appoint career teachers who were basically classroom teachers but had the added responsibility of disseminating career guidance materials to pupils. Every now and then, the schools received a circular from the Ministry to inform them that a certain resource booklet on a certain occupation was ready for collection. Soon after that, career teachers from the schools made an appearance at the Ministry to sign out a few copies which eventually ended up sitting on the book shelf in the school library collecting dust.

This approach in career guidance had three basic assumptions. Firstly, it assumed that obtaining occupational information was the essential first step to career exploration. Secondly, it assumed that students knew when they needed such information and where to look for it. Thirdly, it assumed that once the students had access to the information, they knew how to use it in an appropriate and meaningful manner. Soon it was discovered that such were invalid assumptions. Without proper training in the specialised field of career guidance, the career teachers felt inadequate in guiding and advising their students. Without proper guidance support from the career teachers, the students were at a loss of how to use the resource materials, especially in relating the occupational information to their own career exploration. As a result the materials were not well-used. In the early 70s, even this rudimentary form of career guidance came to an abrupt end with the closure of the Guidance Unit at the Ministry and its function of dissemination of occupational information was passed to the Ministry of Labour.

Growth of Concern and Public Awareness

Despite this setback, there was an increasing awareness amongst educationists of the need for career guidance in schools and a growing concern for the lack of it. Every year, thousands of young people left

the school system and drifted into the labour market, ignorant of their own vocational aptitudes and ill-prepared for employment. The result was poor person-job match and, in many instances, job-hopping and poor productivity, a concern shared by parents, employers and teachers.

As concern grew, the National Productivity Council formed a task force in 1984 to "focus on the issue of career guidance in schools with the view to develop better match between the future work force and jobs and ultimately improve productivity" (Sim, 1985). The first project initiated by this task force was a national survey amongst final year students from 145 secondary schools across the nation to identify needs and problems in the area of career guidance. The findings of this survey were startling. It was found that as many as 95% of the students left the school system to join the labour market without any form of career guidance. Although two-thirds of the school personnel surveyed recognised the urgent need for career guidance for their pupils, this service was sadly lacking in the schools due to lack of human and material resources. Interviews with company personnel from leading industries revealed that young job seekers were generally ignorant in occupational information, lacked job-seeking skills, had unrealistic expectations and had hardly any sense of career direction. (Khor, 1987). Another national survey conducted at around the same time amongst secondary school students across all ages levels revealed that in terms of the development of career maturity, Singapore adolescents were very much behind their American counterparts from the same age groups. Boys and girls alike lacked career self-knowledge and were hardly engaged in career exploration. For the few who made an attempt at career exploration, they sought help from parents, siblings and friends and school teachers were the last persons they would consult about their future careers. When asked to rate the usefulness of the various sources of occupational information, teachers were listed as the least helpful. (Tan, 1989a)

The Breakthrough

The turn of events came in late 1987, when the then Minister of Education Dr Tony Tan, upon his return from a study tour of selected schools in the United States and the United Kingdom, announced in a press conference his conclusion that although Singapore schools had been doing a good job in the pursuit of educational excellence in turns of academic achievement, two important areas were found wanting in Singapore schools - pupil counselling and career guidance. His observations were further supported by the official report entitled "Towards Excellence in Schools" by a group of principals who had gone on the same study tour. (Ministry of Education 1987).

This series of events served to bring career guidance to the forefront and soon things started moving. In a matter of months the Ministry of Education set up a Unit to look into the introduction of career guidance into schools and a pilot project was started involving 14 schools. Since then every years another 15 to 20 more schools were phased into the programme. By 1994 all secondary schools in Singapore had some form of career guidance programme in place implemented and monitored by a group of "Career Guidance Coordinators" with the blessing and full support from the Ministry of Education.

Since the breakthrough in 1989, there had been concerted efforts on a national level amongst practitioners in the schools, policy makers at the Ministry of Education, teacher educators from the National Institute of Education as well as potential employers from the community to build bridges and narrow the gap between the schools and the world of work. This is being done at four levels, namely, provision of systematic career guidance services in the schools, comprehensive in-service programmes to equip the career co-ordinators for their specialised roles, development of indigenous resource materials, research activities to enhance understanding of the career development of students and vocational behaviour of young job seekers and the involvement of the industries both in the training for teachers and the preparation of the students.

APPRAISING THE PRESENT

The First Bridge - Provision of Career Guidance in Schools.

Since the official introduction of pupil counselling and career guidance in 1987, the schools were given both financial and manpower (in the form of two additional staff members in some cases) to develop and implement career guidance programmes for their students. While most schools resorted to commercially produced resource materials available in the market, many schools attempted to develop their own programme and resource materials. Such career guidance activities may take place during the curriculum time and a typical curriculum is usually graded to match the developmental needs of the students. Thus in the first year of secondary school the focus may be on the development of career self-

awareness in terms of an assessment and understanding of one's own career interest, vocational aptitude and work values. The second part of the curriculum usually involves the students in searching for and the sharing of occupational information. For the older adolescents in the upper classes, the focus often shifts to hands-on activities to develop job seeking skills. So there are role-plays and mock interviews and tips on how to write application letters, usually carried out as group guidance activities.

The Second Bridge - Teacher Training to equip specialised staff

Responding to the training needs of the career coordinators, the National Institute of Education launched a specially designed 8-module in-service training programme to help equip these teachers for their career guidance roles. To meet the urgent demand of training many teachers within a short period, innovative approaches were used in the conduct of these in-service courses. There were school-based training programmes where the trainers from the Institute brought the training to the schools to ensure that the whole staff were exposed to the concept of career guidance as well as pupil counselling. There were the conventional campus-based training courses where an in-service class comprised of teachers from as many as 30 schools to share their experiences while receiving training. There was also the campus-based school-focused approach where by an in-service class comprised sizable groups of teachers from two to three schools. Meanwhile, on-going efforts were made to improve these in-service courses based on feedback from the participants themselves as well as school principals (Tan, 1994a). Workshops and seminars are organised periodically to provide opportunities for sharing amongst the career coordinators and support groups are formed to sustain their interest and motivation.

The Third Bridge - Involvement of potential employers and industries

To expose students to the world of work, many schools also implement work experience programme during the school vacation to allow students a chance to obtain first hand knowledge of what working life is like. So alumni, parents and companies in the neighbourhood are recruited to help out as mentors and provide role models. To enhance the effectiveness of the career coordinators, the Ministry of Education has, since 1992, implemented a "Teacher-in-Industry Programme" whereby career coordinators are attached to industries to have first-hand experience of these work settings.

The boldest attempt and most ambitious effort in linking the schools with the community and world of work comes in the form of a national annual career exhibition jointly organised by the Ministry of Education, professional bodies and the industries introduced since 1991. The latest of these, held over five days in March 1995, involved 230 exhibitors from nine countries, representing employers from government ministries, the private sector and more than 100 local and foreign universities, polytechnics, colleges and institutions. Since 1993, the organisers have also been holding career seminars and career talks for school leavers and job-seekers concurrently with the Career Fair. Another innovation introduced this year was on-site job interviews and recruitment. It was no wonder that Career '95 attracted 200,000 visitors during its five-day run.

The Fourth Bridge - Research and Development to increase knowledge and enhance facilities

Since the first national survey conducted in 1985, there have been many more attempts at research and development to increase knowledge and enhance facilities in career guidance. Such efforts are mostly spearheaded by the National Institute of Education. For example, research studies were conducted to look into the career guidance needs of secondary school students (Khor, 1985); the impact of parental involvement on the career maturity of teenagers (Tan, 1988); job preference of secondary school students (Tan, 1988); work values of secondary school and junior college students (Tan, 1989; 1994a); sex-stereotyping in career choice amongst adolescents (Tan, 1992; Yeo, 1994) and the effect of computer-assisted career guidance on the career self-awareness of adolescent girls (Tan 1992).

In line with the current interest in the development of information technology, the Singapore government awarded the National Institute of Education a half-million dollars research grant in 1989 to develop a computer-assisted career guidance programme for use in secondary schools. The project took five years and the end product is a computer software called "J.O.B.S." (the acronym for Jobs Orientation Backup System) which comprises a career guidance module to guide the user through the self-assessment of career interest, vocational abilities and work values and an occupational information module providing career profiles of some 200 occupations. Being the first and only attempt in the South East Asian region to develop an indigenous career guidance

computer software based on local data, this research project has attracted much attention and interest amongst fellow professionals. (Tan, 1994b). Presently the computer programme is in use in about 70 secondary schools and there are on-going research efforts at the Institute to provide an improved, updated version of the software.

LOOKING AHEAD TO THE FUTURE

Career guidance in Singapore schools has come a long way since the futile, abortive attempts in the 70s. The most rapid changes took place in the last six years and much progress has been made.

With the current national interest in career guidance, the time has come to take a full and close look at this very important aspect of education. Public awareness of the various aspects of career development has been heightened ; educators are more convinced than ever of the need for career guidance in schools; policy makers realise its importance and are forthcoming in lending support and practitioners in the field are ready to try out new ideas and innovative programmes. Riding on the tide of success, it is time to press on.

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I never attempt to teach my pupils; I only attempt to provide the condition in which they can learn.

Einstein

Low Guat Tin

After teaching for a number of years, things took a slight turn last year - I decided to use a slightly different approach in the classroom. I decided that I would "antagonize" the class, use sarcasm and also asked them to determine each lesson's agenda. "What do you want to learn today?" was a question I asked. The class tried to list a topic here and there and inevitably I would shoot them down as not worth delving into.

The participants were at their wits' end and I too was quite disappointed for I wanted to challenge them, to create the dissonance that I believe so firmly in. I believe that confusion is an important component to learning, especially where adults are concerned. I believe that when there is dissonance, the organism would consciously seek consonance; the organism wants to be in a state of equilibrium and when they come to grips with it, there will be much joy and excitement, just as those who emerged from Plato's cave (The Republic Bk VII) with such exhilaration! But for that to take place, they must seek new information, they must refocus, they must shift their paradigm a little.

Further, didn't Knowles (1970) tell us that adults learn differently? I feel that the participants in the programmes I teach need to be more reflective, to become reflective practitioners, for administrators need to reflect, to assess the values of life and education and to determine what men should be and do. Reflective thinking should be one of the goals of education.

The year passed uneventfully. It was certainly not the best year in my teaching career. It was alright but neither the participants nor I were challenged or excited. A few were inspired to read for they were welcomed to all the books in my office. But the year did not end in a high note for me.

It was thus that I looked forward to a trip to the US in June. I felt I needed to go back to visit my professors in University of Michigan and to spend time reading in the university libraries and bookshops. I needed to read about issues which concerned me. I was also enrolled for a 4-day course on *Dimensions of Learning* in Washington D.C.

I have attended so many workshops, seminars and conferences that I was wondering if I should attend the 4-day intensive,workshop at all. Anyhow, I turned up at the hotel and I was cooped up in that hotel for 5 days. (Cooped up because the hotel was in the middle of nowhere, and I did not leave the hotel at all!)

It was a timely course for on the first day we learnt about the first dimension which is *Positive attitudes and perceptions about Classroom Climate and Classroom Tasks.* It was in brief, a dimension about "Safety in the Classroom" The importance of classroom climate, the need for students to feel accepted by teacher and peers and comfort and order, i.e., structure in the classroom were discussed.

While I have always remembered to ensure that participants in my lectures/classes felt comfortable

both physically and emotionally and have always worked at establishing rapport with them, I have in my eagerness to challenge them to shift their paradigms, been quite "harsh".

How can students learn when the classroom climate is harsh? For fear of ridicule dare they question me? Dare they interact freely with me? And if they do not feel safe with me would most of the time in class not be spent protecting themselves--their fragile selves?

Yes, I believe many of us well-meaning teachers have assaulted our pupils' "fragile selves", many of us have unknowingly "asaulted" our pupils self-concept, we have unconsciously "shredded" their concepts of themselves. And this often comes from excellent, caring teachers, who may not be aware of the impact of their behaviour on their pupils.

Dimension One tells me too that there is another aspect of safety in the classroom which teachers have to address. The first as discussed above is emotional safety and the second--safety in the task. I was reminded of this in my first lesson this academic year. I had returned from the States recharged, eager to meet the participants and keen to share with them what I've been through.

I excitedly went to class and taught, talked, listened and challenged. Half way through the session, one hand went up and a voice asked "Dr Low, what are the objectives of this lesson?" I was taken aback! Yes, while they had a stimulating hour, questioning assumptions, challenging biases, examining blind spots, arguing about perceptions, in the final analysis they wanted to know what were my lesson objectives. These are heads of Depts who are so used to Specific Instructional Objectives (SIOs) who would step into a class to observe and expect to see their teacher's lesson plans with SIOs all properly written out and here I am their lecturer "caught" without SIOs!

I was puzzled for I thought it was an extremely good lesson on paradigm shift and my initial reaction was "Gee, this is a lesson on paradgim shift and you have not shifted!" My initial reaction was to say "You are now in a different situation, please shift gear and look at things differently! Wake up!"

On reflection, I realised that the topic on paradigm shift is so new to them and for people who are so used to SIOs I have not provided them with the second form of "safety" and that is, safety in the task at hand. To feel "safe", even adult learners must know what the teacher is driving at, they need to know the objectives of the lesson. Lessons must have "handles" which they can hold on to. And many adults need to have lots of notes in their hands to feel safe! "Safety" in a course is sometimes equated with quantity of handouts.

Yes, there are many teachers in our midst who go to class with very clear objectives and conduct the lesson competently but not taking into consideration the pupils emotional safety. We have heard of students who are so nervous in some lessons that they do not learn because all the time they are thinking of ways to protect themselves. Other teachers give so much emotional safety/security but lessons are so unstructured that pupils do not know what is expected of them or what they are supposed to do. Many of our pupils are not ready to handle ambiguity, they need clear guidelines.

And I find that adults also need clear guidelines. They need to know what is required of them in the course, what do lecturers look for in the assignment, and how will they be graded? The fears that children and adults have about failure is a real thing and as teachers how can we help them to overcome some of these unfounded fears? I also want to echo the words of Pullias (1975) who said and I quote in length:

> One of the greatest functions of a teacher is to give his students a "vision of greatness," which is a figurative way of saying a clear picture of their potential as human beings and of the possibility of realizing that which they can be. ...the individual cannot or will not see and take advantage of opportunity, however physically available it may be, unless he is brought to believe that he has possibilities for growth and that this opportunity is a door for him.

As teachers how can we help our pupils, how can we give them this "vision of greatness"?

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How Principals Can Build Self-Renewing Schools

Outstanding principals practice three types of behaviors that help teachers become more reflective practitioners.

Ulrich C. Reitzug and Leonard C. Burrello

What distinguishes principals in self-renewing schools from those in schools where it's business as usual? Outstanding principals go beyond merely involving teachers in decision making--they encourage teachers to continuously engage in identifying best practices. These self-renewal efforts result in the types of learning organizations described by Senge (1990), Watkins and Marsick (1993), and others.

We studied 13 principals from 13 school districts in the Midwest, Southwest, and Southeast. Outstanding principals had been recommended to us by school administrators and university colleagues in each geographic region of the United States. Our sample included urban and suburban as well as male and female principals. We observed the principals; interviewed them, their teachers, and other staff members; and analyzed school documents for evidence of empowering and self-renewing leadership behavior.

We found that these principals do three things to help teachers become more reflective practitioners. Specifically, they:

- provide a "supportive environment" that encourages teachers to examine and reflect upon their teaching and on school practice;
- use specific behaviors to "facilitate reflective practice"; and,
- make it "possible" for teachers to implement ideas and programs that result from reflective practice.

Providing a supportive environment

How do principals develop a supportive environment for reflective practice? They use several strategies.

Outstanding principals go beyond merely involving teachers in decision making ...they encourage teachers to continuously engage in identifying best practices

1. Encouraging justification of practice

Many of the teachers we interviewed commented that principals allow them to teach in the manner they feel is most appropriate. Autonomy, however, does not come without responsibility. Teachers have to justify why they are using specific methodologies.

In one school, a group of teachers went to the principal because some of them wanted to use a phonetic approach while others preferred a whole language approach to reading. The principal replied, "Each of you needs to be able to justify what you're doing. You don't all need to be doing the same thing." What was important to him was not which approach they use but that they do their own thinking and that students learn. Other principals had similar philosophies. The implication is that teaching cannot be standardized--it is individual and context-specific. Teachers must study their own practice and learn from it as much as from formal research.

2. Providing alternative instructional frameworks

Principals also help teachers develop other perspectives through creative use of staff development opportunities. For example, one principal scheduled an in-house workshop in the morning with a repeat session in the afternoon. This permitted half the teachers to attend each session, with enough aides and special area teachers available for classroom coverage. Other principals also manipulate school schedules to provide more staff development opportunities for their teachers. In addition, they share professional articles at meetings and by placing them in teachers' mailboxes, generally with a personal note.

Perhaps the most extensive way in which principals provide alternative frameworks is by framing ideas as possibilities: "Maybe you could try this way; give it a thought." One teacher whose principal periodically attends their team meetings commented, "He jumps right in and makes suggestions. Now whether we do it or not is our choice. It's not like, 'Because I'm here and said this, you have to do it.'"

3. Encouraging risk-taking

Many of the principals in our study encourage teachers to take risks. For example, one principal fulfills teacher resource requests not "to be nice to them, to get them what they want," but to encourage them "to start making more decisions for themselves." Outstanding principals view unsuccessful tries as learning opportunities. When risks don't work out, this principal remarked, "I'll sit down with the person, and we'll talk about what we're going to do next and why."

Another teacher observed that a favorite saying of his principal was, "We're not working on a project; we're working on improving ourselves."

4. Creating teaming structures for collective responsibility

Many of the principals create organizational structures that reduce isolation and increase teaming. Teaming leads to a sense of collective responsibility for one another and for students and provides an emotional and instructional support network. One teacher observed that when she had tried everything she could think of with a student, simply having team

members with whom she could share these frustrations helped. Her colleague summed it up this way:

> "One person doesn't own a child. You may be able to work well with a child in one area of his or her life, and somebody else needs to give you some ideas to work with in another area.... It's not only team teaching, but it is collaborative consultation."

Thus, teaming provides teachers with a support group that recognizes individual limits. Simultaneously, teaming expands individual limits by providing opportunities for teachers to share ideas, strategies, and students.

Facilitating reflective practice

Whereas "providing a supportive environment" requires changing organizational characteristics, principals "facilitate reflective practice" in ways that more proactively stimulate teachers to study their teaching. Here are three strategies that we observed.

1. Asking questions

Principals ask challenging questions that prompt teachers to reflect on their practice. One teacher noted that sometimes a simple "Why?" from her principal is enough: "If I haven't done any research, I'm not going to be able to present a valid argument."

Principals also ask questions to help resolve issues of school policy and practice. In one school, for example, several teachers were involved in a scheduling dispute. The principal called them all together and asked each individually, "Did you get exactly what you wanted last year? What other time is good if you can't get this time?" Rather than imposing a solution on teachers, this approach places the responsibility for developing solutions and resolving conflicts upon those involved.

2. Critiquing by wandering around

Peters and Waterman (1982) popularized the concept of "management by wandering around" (p. 67). If principals are to ask questions that facilitate reflective practice, they need to know what is occurring in teachers' classrooms. "Wandering around" helped our principals stay informed. One teacher commented that her principal was "everywhere," using his visibility to interact with teachers. "He really picks our brains," she said.

The principals in our study also use their time in classrooms and hallways to relearn the local context, which increases both their opportunities to ask questions and their knowledge of what questions to ask. While Weick (1982) has argued that the purpose of management by wandering around is to "remind people of central visions and to assist them in applying them to their own activities," our principals' questions, by contrast, helped teachers clarify personal visions, which ultimately strengthens the organizational vision.

While in some contexts the frequent presence of the principal in classrooms might make teachers uncomfortable, this was not the case in the schools we observed. Teachers interpreted the principals' presence as a sign of support rather than as an intrusion. As one teacher commented, "That shows me he's interested in what's going on in my classroom ... in what I'm doing with the kids."

The most extensive way in which principals provide alternative frameworks is by framing ideas as possibilities: "Maybe you could try this way; give it a thought"

Teaming expands individual limits by providing opportunities for teachers to share ideas, strategies, and students

3. Challenging program regularities

Knowledge of local context also makes it possible for principals to go beyond questioning to challenging program regularities. For example, after observing two reading classes--one ability-grouped and the other for learning disabled students--a principal initiated a conversation with teachers about tracking and then issued a challenge: "We're working in the same place. Why don't we bring two teachers down [to join the two LD teachers], keep these kids on task all of the time, and we'll get a lot further than we are." The result for students was the alleviation of an exclusionary tracking relationship, which has been found to undermine social aspirations and feelings of self-worth (Oakes 1985).

In another instance, the principal's actions went beyond challenging a program regularity. When the principal came to the school, she found a culture that embraced corporal punishment. She responded by prohibiting it:

> "Now that I look back on it, I took the one piece of power they had. The teachers said the best thing about paddling in the hall was that everybody down the hall heard it.... It was significant when I asked them to put the paddles away, because they had no idea what they could do to motivate kids in a positive way. They had no alternative."

While the tendency might be to criticize the principal's autocratic decision, when core values are at stake, principals (or teachers) may not have a choice other than to respond in a manner compatible with their core beliefs. In this case, teachers responded by developing a more humane discipline policy.

Enhancing possibility

Another type of behavior through which principals promote self-renewal is giving teachers the opportunity to implement ideas and programs. Principals in this study enhance possibility by "providing resources" in the form of money, materials, time, and opportunity.

Teachers and principals have an explicit understanding of the relationship between resources and self-renewal. As one principal observed, "When I believe that teachers know how to teach, then I believe I need to provide them what they need to teach with." Teachers noted that rather than issuing a flat "no" when money was not available, the principal worked with them to identify potential resources. "It forces you to sit down together to talk about programs that you might want to do if you could dream," explained one teacher.

According to teachers, funding was frequently obtained through grant writing. When they were unsuccessful in obtaining grants, schools would "find the money somewhere." Many schools regularly look for funding from local businesses and state incentives, or they creatively administer the regular school budget.

The "possibility thinking" stimulated by grant-writing appeared to be something that principals consciously promote. One teacher indicated that in her selection interview, the principal had asked her, "If I gave you $500 to spend in the next 10 minutes, what would you buy?" After giving the teacher an opportunity to reply, the principal had asked, "Now I'm telling you I don't have the money; how are you going to get it anyway?"

One principal used a teaching slot to which the school was entitled

to restructure two elementary teachers' roles. As a result, they could more extensively share their special interest and expertise in science and language arts by working with students throughout the school, while the new teacher taught half-time in each of their classrooms.

A focus on teachers and their practice

Traditionally, principals have been placed in hierarchical domination over teachers, the assumption being that hierarchical superiority equals expertise (Sergiovanni 1992). It logically followed that it was the principal's responsibility to tell teachers how to teach.

By contrast, principal behavior in the self-renewing schools we studied motivates teachers to examine their teaching in order to determine which practices are appropriate. Dominant sources of teaching expertise in these schools shifted from principals and formal research to teachers and their practice. The role of principals changed from dispensing information to facilitating processes in which teachers could discover knowledge.

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Principals promote self-renewal by giving teachers the opportunity to implement ideas and programs

Explaining Right, Left or Whole: A Dimension to Learner Analysis

Yeap Lay Leng

Identifying learner characteristics is a major consideration in most instructional design models. The common learner considerations are age, grade level, socio-economic background and entry competencies. Currently one learner characteristic considered crucial for pedagogical decisions is that of learning styles or preferences. The construct of learning style is a combination of environmental, emotional, sociological, physical and psychological factors (Dunn & Dunn, 1992a, 1992b). The psychological domain of the construct can be termed cognition which is related to the roots of learning behaviour. Cognitive variabilities among learners can inhibit or optimise their learning. The learning style construct can be manifested as an individual's habitual, preferred and stable patterns of behaviour in relation to mental functioning like perception and processing, organisation, transformation, classification, drawing inferences, and interaction of information in the learning environment. The emphasis is on how students learn (processes) and not on what they learn (products). Studying individuals' diversified mind qualities, referred to as cognitive diversity, is a non traditional approach of individuality. Contrary to the traditional cognitive measurement by intelligence quotient (IQ), there exists a horizontal dimension of learner analysis which focuses on cognitive dominance. This refers to individuals' preferred mode of learning and knowing when faced with the need to solve a problem or select a learning experience. It reflects the relative efficiency and predominance rather than an absolute difference of a "better or worse" dichotomy.

'Right, left, or whole" is about the brain. Referred to as hemisphericity and confirmed by the science of neuropsychology, individuals are able to process information in two distinct complementary modes. Many of our specific mental abilities are

> '....carried out, supported, and coordinated predominantly in one hemisphere of our dual brain or the other. Speaking, reading, writing, and thinking with numbers are now known to be carried out mostly in the left hemisphere...while spatial perception, geometry, mental map-making and our ability to rotate shapes in our mind are performed predominantly in the right hemisphere' (Herrmann, 1990, 11).

Psychologists began to redefine and reconceptualise the hemispheric differences in terms of the processing of information rather than in terms of the types of tasks. The left hemisphere's strategy in dealing with incoming information is best characterised as analytic, while the right hemisphere process information in a holistic manner. This analytic-holistic distinction has been the most influential in moving thinking about hemispehric differences away from the verbal-nonverbal dichotomy (Levy, 1982; Springer & Deutsch, 1985).

Perhaps the most well-known idea that may benefit educators is that of hemisphericity which is the tendency of a person to use one side of the brain to perceive and function more than the other. Brain research on brain-damaged and split-brain

patients has enabled the prediction of normal brain function. It also confirms the existence of two interacting systems, the right and left hemispheres, each having its own processing approach. Such research is possible when split-brain patients can respond to the senses of one hemisphere at a time after a surgical operation called commissurotomy. Normal human brain processes information simultaneously as a whole brain. This is made possible by a interconnector fibre called the corpus callosum between the two undamaged hemispheres of the brain. Experiments, psychological tests and other forms of measurement data from observable behaviour in normal human brains matched the picture of hemispheric differences that emerged from studies of brain-damaged and split-brain patients.

Local Studies on Hemisphericity

Several Singapore research studies related to hemisphericity were carried out (Yeap, 1986, 1989; Lau & Yeap, 1993; Lee, 1994).

Yeap (1989) looked into the five dimensions of learning of 284 Secondary Two students categorised into three achievement groups, namely the high, average, and low. The five dimensions were environmental, emotional, sociological, physical, and psychological that could affect individuals' academic achievement. Of the five categories of learning factors, the psychological domain in terms of hemisphericity was the one factor that distinctly distinguished the three achievement groups of fourteen-year old Singapore students. The high achievers were very balanced or whole in their processing of information in contrast to the low achievers where there was a great difference between the right and left brain tasks performances. In short, with increasing achievement, there was a smaller difference in the task performances between the right and left brain, vice versa. In short high achievers, unlike the low achievers, were balanced in both the right and left brain tasks performances.

The continued interest of educational research on instructional processes has now taken a new turn. When students cannot learn the way we teach them, then we must teach them the way they learn. The new orientation of individuality has been towards matching teaching styles to students' learning styles.

The study by Lau & Yeap (1993) was such a research. It was based on an eclectic approach in brain theories, applied psychology and media research. More specifically, the experimental study was concerned with how media might be used and managed in a manner to produce desirable outcomes in the learning of literature of a Shakespearean drama text.

Apart from finding that cognitive matching of teaching and learning styles resulted in increased achievement, the study was more concerned with the effects of cognitive matching at the three levels of cognition, namely recall, interpretation, and application. Cognitive matching was not crucial for rote learning at the recall stage. A match was crucial at the higher levels of cognitive processing, namely at the interpretation and application stages. A cognitive match at these two levels saw a significant diffference in students' achievement in terms of students' abilities to extract contextual information based on the content of the text; receiving what was being communicated to them; understanding the meaning of characters' utterances; arriving at an interpretation of characters' intentions; and the ability to use abstractions, rules, principles, and ideas.

One of the objectives of Lee's study (1994) was the cognitive profiling of 407 thirteen to fourteen year old adolescent mathematics achievers. The study aimed to determine if there were distinct differences or similarities in hemispheric patterns of fourteen year old mathematics achievers. The findings identified the less observable dimensions of individual differences to explain why certain students achieved highly in mathematics, and why some were having cognitive obstacles in the learning of mathematics.

The "fear of mathematics" exhibited by students, the high attrition rates in mathematics, and the growing concern to increase mathematics achievement were some reasons that prompted this study. The findings would enable teachers to provide instruction around the students' actual cognitive learning processes appropriate to mathematical concepts.

The results showed that high mathematics achievers, compared to the low achievers, were significantly,

- more abstract than concrete in perceiving information,
- more reflective in processing information,
- more left-brained dominant.

The findings showed a decreasing right-brained dominance with increasing mathematics achievement. This could be expected because mathematical problems at secondary school level require students to extract meaning from the written question, then reason analytically on how the information can be transformed into an equation to solve the problem through mathematical symbols. These functions are characteristics of the

With low achievers, there might be a need to deliberately create a learning environment where teaching styles match students' learning styles in terms of their cerebral dominance

left hemisphere which is superior in extracting meaning and hence surpass the right hemisphere in the derivation of meaning. Furthermore, the left hemisphere is specialised for understanding language communication such as words, while the right hemisphere is most adept at nonverbal understanding such as drawing. So more left brained dominant students should do better in mathematics because language cannot be separated from mathematics in problem solving.

These evidences strongly disputed the misconception that normal brain students process information with only one side of the brain. Rather, a normal brain has a different arousal of the two hemispheres. Integration of the two hemispheres does not mean equality. As tasks change, the relative importance of the two hemispheres changes with the left being more activated when verbal response is required, and with the right being activated when visual or spatial response is required.

Implications

This newest element of the learning style construct have great potential to our understanding of educational processes. Research in neuroscience can provide new analogies, generate educational research in this field, suggest new hypotheses and revise old theories. Over speculation should be avoided as educational problems may not be evident in neurological research.

Studies, local or otherwise have clearly demonstrated differential information processing characteristics among individual learners of different age groups, subjects and abilities. Individuals have their preferred and typical modes of perceiving, organising, reacting, remembering and processing information within their memory structure, technically termed "cognitive styles".

Learner analysis highlights important pedagogic principles that must be taken into consideration in future curriculum design. Yet diagnosing styles remain problematic. This, in turn, can be the main stumbling block to the widespread practice of style diagnosis. The problem remains related to instrumentation. However well the instruments are validated, each style instrument is only as reliable as the purpose it is designed to serve.

Instrumentation is a hindrance for the following reasons:

- instruments are normed on non local samples;
- some do not allow for self scoring;
- scoring by the company takes time because of the geographical distance;
- they can be costly;
- immediate diagnosis for early intervention is not possible; and
- they are not easily made available because of copyright laws.

In the light of problems encountered with commercially available instruments, self-perceived diagnosis of learning styles may have a place in the diagnostic process. In certain respects, there may be some disagreement between self-perceived and measured learning styles. When findings are generated for development purposes, self-perceived styles can provide valuable insights where inferences from commercial instruments are not available. The unstable personality traits at the early stages of an individual's life would increase the importance of the individual's ability to diagnose his own style (Yeap & Wong, 1992).

Mahlios (1981) remarked that teachers' behavioural specifics were related to the cognitive orientation of teachers who also have a preferred way of perceiving and processing information. It is then reasonable to believe that teachers will communicate subject matter to students in ways that are most compatible with their own cognitive styles. Kuchinskas (1979) revealed the significant impact teachers' styles have on everything and everybody. If we recognise the key role teachers play in the learning process, then their cognitive styles need to be closely examined in order to determine the effects they have on classroom activities which in turn are influenced by curriculum, instruction, interactions and, in particular, the individuals' own perception of how they process information.

If a teacher instructs and evaluates by his dominant style, this will only benefit those students who prefer to learn in that mode. To avoid shortchanging students and to enable them to succeed, teachers should expand their repertoire of instruction to include a variety of cognitive modes. The essence of designing appropriate instructional intervention hinges on teachers' innovation to diversify students' style preferences to one of style flexibility in order to cope with certain stylistic characteristics that are consistently successful with school learning tasks.

Teachers need to be aware and be deliberately educated to detect information processing styles in order to gain better insight into the varied psychological types of information processing. Teachers need to adjust to learner characteristics to avoid conflicts between the teachers' instructional modes and the students' learning modes. Acquisition of knowledge about cognition may enable teachers to be sensitive to the cognitive styles of others and avoid bull-dozing students with their own teaching styles. Instead, they should support opportunities to develop and utilise activities that will broaden students learning styles and to develop specific learning activities and instructional materials that can reinforce each modality. The degree to which teachers are able to develop such activities, materials and strategies may be crucial to the ultimate success of the learning style movement.

Conclusion

Cognitive testing gives a qualitative picture of the cognitive profile of a person's strengths, weaknesses, and preferences. Instead of the traditional vertical dimension of who is worse on a performance test, a horizontal dimension of the relative performance between the two information process tasks is available for comparison. Neither the left nor the right hemispheres can be claimed to be better or less able than the other. Neither can one conclude that a left brain dominant student is more intelligent than a right brain dominant student and vice versa. They only differ in functions as they are differently aroused by the types of incoming information. As people do not process tasks in the same way, there is a need to recognise and accept the fact that there are two equally valid methods of acting upon, processing, perceiving and storing information.

In short, not all students process information in the same way. Average achievers, but more so the high achievers, would do well academically regardless of the ways learning tasks were introduced to them as they were found to be more balanced in the functioning of both sides of the brain (Yeap, 1989). With low achievers, there might be a need to deliberately create a learning environment where teaching styles match students' learning styles in terms of their cerebral dominance (Lau & Yeap, 1993).

Some possible and realistic problems can be encountered. The findings of local research studies provide a substantive framework for educators to appreciate learning styles as a non traditional approach to look at learning, instruction and classroom activities related to learners' characteristics and preferences. The findings of research in the literature can be utilised in terms of,

1) attempting to identify sets of variables such as environmental, sociological, emotional, physical and psychological factors that may determine whether students find a lesson exciting or boring.
2) placing students in their preferred learning environment.
3) removing obstacles that may inhibit or demotivate learners.
4) developing matching methodologies and curricula that will support, reinforce, and complement students' learning style preferences.
5) recognising and realising the fact that there is a horizontal dimension instead of the traditional vertical dimension to compare the relative performance of students.

Learning style is not another educational quest. Rather it is a potential key to educational improvement in that it provides teachers, educators, textbook writers, curriculum developers, publishers, instructional designers and educational administrators with a "new look" at another dimension of individuality, learning processes,

classroom activities and curriculum materials in relation to individuals' cognitive dominance, learning characteristics and preferences.

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Why Textbooks Can Baffle Students--and How to Help

Isabel L. Beck and Margaret G. McKeown

If you have trouble making sense of the events described in the following passage, you can begin to understand how it feels to be a fifth grader reading a social studies text:

> "In 1367 Marain and the settlements ended a seven-year war with the Langurians and Pitoks. As a result of this war Languria was driven out of East Bacol. Marain would now rule Laman and other lands that had belonged to Languria. This brought peace to the Bacolian settlements. The settlers no longer had to fear attacks from Laman. The Bacolians were happy to be a part of Marain in 1367. Yet a dozen years later, these same people would be fighting the Marish for independence, or freedom from United Marain's rule."

The above text was developed by taking the following passage from a fifth-grade social studies textbook and replacing the agents and locations with pseudonyms:

> "In 1763 Britain and the colonies ended a seven-year war with the French and Indians. As a result of this war France was driven out of North America. Britain would now rule Canada and other lands that had belonged to France. This brought peace to the American colonies. The colonists no longer had to fear attacks from Canada. The Americans were happy to be a part of Britain in 1763. Yet a dozen years later, these same people would be fighting the British for independence, or freedom from Great Britain's rule."

In the course of our research on comprehension and learning from text, especially elementary social studies textbooks, we presented the second passage to hundreds of fifth-grade students. Reading the transcripts of students' recalls of the passage revealed that many students had enormous difficulty holding the pieces together. Even though they had studied the exploration and early colonization of North America, their familiarity with terms such as "French," "Indians," and "Canada" was not enough to hold together a sparse, poorly connected historical account.

Thus, for some students, "French," "British," "Canada," and "Great Britain" are no more helpful than "Langurians," "Marish," "Laman," and "United Marain."

The extent of students' confusion about a seemingly mundane issue -- the names of agents and places -- was striking. Our observation is but

Recent research in reading reveals that a reader must interact, or engage, with text information in order to truly comprehend it

one example of how different a text can appear to a mature reader and to a young learner. Competent adult readers construct meaning from texts by filling in background knowledge, making inferences, and elaborating statements to make them meaningful. This interaction usually proceeds so smoothly that a skilled reader is barely aware that certain information is not in the text and does not realize the work it takes to put that missing information where it belongs.

Recent research in reading reveals that a reader must interact, or engage, with text information in order to truly comprehend it; meaning does not simply come forth from the text. When readers engage with a text, they draw inferences and use knowledge to go beyond the words and mentally create a model of the situation being portrayed.

For the most part, students in our studies found it difficult to engage with the textbook passages. Consider a paragraph from the text that is meant to convey the harshness of the regulations that the British imposed on the colonists after the Boston Tea Party:

> "The British were very angry! Within a few months, they passed what the colonists called the Intolerable Acts. Intolerable means 'unbearable.' These acts were meant to punish the people of Boston. The port of Boston was closed. No self-government was allowed in Massachusetts. British troops had to be housed by the Massachusetts colonists."

Many students' recalls of this terse passage suggested that they did not engage with the material, but only picked up some isolated pieces of information. Matthew is such an example. When asked to summarize the passage, he simply said, "It's about people from Great Britain [who] were very angry. . . .There was this new thing called the intolerable act, and they didn't like it. Then people from Massachusetts put them in houses or something."

A few students, however, demonstrated quite remarkable engagement by elaborating on key ideas, adding complexity, and going beyond the information given. Consider, for example, Becky, who recalled the forced housing of British troops in this way: "But this is the really stinky part: The soldiers had to live with the poor people who weren't even getting any more food; they had to like give up their bed, give up some of their food, and still keep the house warm."

QUESTIONING THE AUTHOR

Encouraging students to draw on their own resources to engage with what they read can greatly enrich their interactions with textbooks. Successful instructional efforts that have taken this route have focused on teaching specific reading strategies, such as predicting, rereading, and self-questioning--the kinds of text interactions that mature readers rely on to keep their comprehension on track.

We have recently embarked on a new approach that aims to encourage students' engagement with text. Rather than identifying explicit strategies and having students practice using each of them individually, we set up a reading situation designed to bring forth readers' natural tendency to search for meaning.

The essence of our approach, which we call *Questioning the Author*, is to let students know that what appears in a text is simply someone's ideas written down, and that "sometimes what someone is

Encouraging students to draw on their own resources to engage with what they read can greatly enrich their interactions with textbooks

thinking doesn't come across clearly in the writing of it." So we ask students to consider what ideas the author is trying to convey: "What is the author trying to say there?" "Is that said clearly?" "Why is the author telling us that?" "How does that connect?" Using these questions, the teacher initiates discussions, then elicits student contributions and extends the conversation as needed.

In classroom implementation of *Questioning the Author*, talk about text has changed from traditional recitations of direct questions and brief responses to cycles of conversations in which student comments build on each other to construct meaning. Although the teacher still plays the role of discussion leader, the students' participation has changed dramatically.

Their contributions show the formulation and elaboration of ideas; their comments frequently challenge the text and other students; and they have a greater tendency to initiate and questions bring up issues that interest or puzzle them.

One example of a student-initiated issue emerged out of a discussion about the first settlers in Hawaii. Students had just read a textbook passage stating that these early settlers brought food with them and planted some of what they brought. This idea prompted Charles to wonder, given his prior knowledge of what grows in Hawaii, why it was necessary to bring food:

Charles: *They'll still have food, because they have coconuts.*

Students consider Charles' comment and join in with their own ideas in the following exchange:

Antonio: *But Charles, they might not know that you can eat that.*

Darleen: *I think they knew to eat the coconuts, but because every human being eats so much food, they would need more.*

Brandy: *I think the reason they brought the food and the plants is maybe they didn't know what was on the island.*

By asking students to give texts a critical eye, *Questioning the Author* offers students a concrete way to experience the key to successful comprehension, transforming an author's ideas into a reader's ideas.

Having students read to determine whether or not ideas are clearly presented is a potentially powerful tool for encouraging engagement with text.

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This article is reprinted, with permission, from the Newsletter of the National Research Center on Student Learning (Fall 1993, Vol. 1 No. 1).

Where in the World are the World-Class Standards?

Countries known for their outstanding students have several practices in common; clear, consistent, demanding public education standards head the list

Lauren Resnick and Kate Nolan

A current television ad portrays a neatly dressed young girl walking into a middle school classroom, a pile of books cradled in her arms. With a pleasant voice, the teacher calls roll. The scene is genial and familiar, until we notice that there is only one long row of chairs, and that the names being called are the names of countries: "Taiwan, Korea, Switzerland...." As the girl takes her place in the very last seat, the teacher intones ominously, "the United States of America."

The ad expresses our national concern over how well U.S. students are doing in school. Readers of an article on international standards typically expect a similarly gloomy perspective, buttressed with handy charts comparing students from around the world. Because the international standing of U.S. children is well-known, we will spare you another such chart. Instead, we want to look at countries known for producing high-performing students to discover why these school systems look so good on the honor roll of nations.

Documents don't tell the story

At a recent forum on 21st century education, a co-panelist asked us to send him a copy of the world-class standards in education. We had to chuckle; would that it were so easy! If world-class standards were defined and available in the local library's reference section, researchers and policymakers alike would make frequent use of it. Unfortunately, no such volume exists.

In 1993, when the New Standards Project at the University of Pittsburgh began its international benchmarking efforts, we hoped to collect and analyze the standards documents of other countries. We began by concentrating on mathematics, thinking it might suffer less from cultural differences than do other areas.

The countries that interested us fell into the following categories:

- those whose students perform well on international tests (for

example, France),

- those whose education systems enjoy international esteem (for example, the Netherlands),
- those with a federal structure much like our own (for example, Germany), and
- those representing major economic competitors of the United States (for example, Japan).

We quickly discovered that standards are not in neat volumes on the shelves of education ministries, but instead arise out of a complex interaction of curriculums, textbooks, exams, classroom practice, and student work.

Moreover, when we sought to compile a library of materials, teachers, both at home and abroad, warned us that documents alone cannot tell the whole standards story. After all, teachers do not teach all and only what is in a textbook. They advised us to (1) find out what happens to kids who do NOT meet the standards, and (2) look at student work, which is where one really finds out what is expected of students.

We realized we had to answer six important questions to get a clear picture of world-class performance:

- What is the structure of the education systems in other countries?
- What are students expected to know and be able to do at key junctures in their schooling careers?
- What kinds of performances are used to demonstrate competence?
- What counts as "good enough" in these performances?
- What percentage of the students is meeting the standards?
- What reform efforts are under way or on the horizon?

The answers to these questions were often fascinating, and, at times, startling. For example, students in France, Japan, and the Netherlands have traditionally done very well on international mathematics tests (Educational Testing Service 1993, McKnight et al. 1987). In addition, international experts hold these systems in high esteem. At first glance, these systems differ dramatically from one another, but a closer look yields two important lessons:

- There is more than one way to help students achieve excellence.
- To successfully serve a large number and variety of students, schools must work as systems whose parts are focused on coherent, consistent, publicly articulated goals.

Let's look at mathematics education in Japan, France, and the Netherlands.

Tracking: Results are mixed

Historically, U.S. schools were among the first to provide secondary schooling for all students. Many argue that this is why the United States fares poorly in international comparisons: while we are committed to the education of all children, other countries practice strict ability tracking that creams off the best students. Hence, our average students are compared with their best students.

In fact, our research shows that things are no longer that simple. Other developed nations have caught up with and even surpassed us in terms of retaining students throughout the years of secondary schooling (Centre for Educational Research and Innovation 1993). Further, tracking practices do not correlate in any straightforward way with high performance internationally. In such comparisons, tracking and achievement appear to be independent of one another.

In practice, U.S. students are often tracked into classes for the gifted and talented, vocational education, and the like. On the other hand, those systems in which students outperform ours include both highly tracked and highly untracked systems.

Tracking is common in the Netherlands, where secondary school students elect one of four levels of study based on both their career goals and their past experience in school. French students are untracked through age 13; thereafter, about 85 percent of students are in a single track. In Japan, there is no tracking throughout the years of compulsory

Setting clear, consistent, demanding, public standards helps students perform well

schooling.

In other words, tracking and education's availability to the whole populace cannot by themselves explain away the poor performance of U.S. students on international tests. We have, however, learned some important lessons while examining tracking.

JAPAN. Japanese schools prefer heterogeneous grouping because it seems to produce higher performance all around: High performing students actually learn more, it is argued, by serving as tutors to their classmates. Further, a central focus of Japanese schools is to help form the moral and cultural character of students. High performance is valued because it contributes to the well-being of the group. In school, this means that students see their own excellence as compromised by another student's failure! One of the standards for all Japanese students, then, is to be a contributing member of an effective work group.(1)

THE NETHERLANDS. Tracking in the Netherlands is not determined by achievement tests, which are a predominant means of sorting students in the United States. In fact, achievement tests are not used in the Netherlands. Instead, secondary students, in consultation with parents, teachers, and--sometimes--school administrators, choose the track that is most appropriate for them.

The major factor in the student's choice of track is his or her career goals, because each of the four tracks in Dutch secondary schools leads to a broad set of careers and levels of specialization. Further, throughout the first two years of secondary school, and in some cases beyond that, students may switch tracks if their goals change. Early on, then, Dutch students have a clear sense that their studies are directly connected with life after school.

A defining characteristic of tracking in Dutch schools is that ALL students are expected to perform well. Mathematics exams at the conclusion of high school are a case in point: Although students who intend to go on to a university are asked to perform at a more sophisticated level than those who wish to enter the work force, the latter group faces very difficult exams. These exams involve complex applications of algebra and geometry. Students are also expected to show how they arrived at their answers; there is more than one right way. Dutch educators have been developing a mathematics program geared to helping all students perform well.

The Dutch approach contrasts sharply with that used in the United States today, where educators are hotly debating the relationship between tracking and achievement. Some argue that tracking results in a weak curriculum for students whose work has been weak in the past; others argue that a failure to track means holding back highly motivated students, forcing them into heterogeneous groups with a dumbed-down curriculum.

Curriculums: Common goals are crucial

Many countries whose schools have achieved academic excellence have a national curriculum. Many educators maintain that a single curriculum naturally leads to high performance, but the fact that the United States values local control of schools precludes such a national curriculum. This argument would have us throw in the towel regarding raising achievement.

Our research has shown that national curriculums are a diverse

Exams that call for complex, demanding tasks can be given to a wide range of students, perhaps to all students

group of documents. Some express the educational philosophy or traditions of the country, while others concentrate on prevailing cultural needs. Some describe teaching strategies or content considered important. Most are very sketchy. They do not detail lesson plans that mandate uniform classroom practice throughout the country.

In Japan, for example, the curriculum includes brief objectives for each grade and content level, and a few specific items that should be mastered. Teachers must and do go far beyond the guidelines. The same is true in France and in the Netherlands.

Still, a centrally articulated set of goals, even if vaguely stated, plays important roles: It organizes the development of exams and curriculums, informs textbook writing, and determines the direction of teacher training. As a result, high-stakes exams, texts, curriculums, and lesson plans do not work at cross-purposes. When all parties involved in these diverse activities have their eyes on the same set of goals, students get a consistent message about what they should know to be well educated.

FRANCE. France offers the clearest example of this convergence of goals. In texts and exams, the influence of the national curriculum is obvious. For example, a French math text for 16-year-olds begins by spelling out the national curriculum for the year so that all 16-year-olds know what they are expected to study. The book's similar table of contents shows that the text developers referred to the curriculum. Moreover, the text makes frequent references to math exams the regional school districts have given in the past. Students practice on these exams to help them prepare for the exam they will face; they know where to concentrate to meet the standard.

One could draw a tempting but fallacious inference from these examples. Can simply having a coherent system of curriculums, texts, and exams produce excellent student performance? In fact, coherence is not enough; Sweden offers the counter-example.

SWEDEN. As in France, the Swedish national curriculum strongly influences texts and exams, giving students a clear message about what is expected. Still, the mathematics exam for Swedish 16-year-olds shows that a clear message, too, can set a low standard. Unlike its Dutch counterpart, the Swedish exam does not ask for complex mathematical reasoning, but focuses instead on relatively low-skill computation. The lesson here: Unless coherent schooling elements set high academic standards, we can't expect student achievement to rise.

Exams: Upholding standards

To understand how certain systems produce excellence, we also must find out how students demonstrate what they know and can do. Many countries give an exam at the end of compulsory schooling, at about age 16, and that exam often is the last measure we have of how ALL students are performing. After this point, not all students are expected to work to high standards.

FRANCE. In France, virtually all students attempt to qualify for the BREVET certificate at the end of middle school, and more than 75 percent succeed. This qualification is awarded on two bases: final exams in several subjects, and classroom teachers' continuous assessment during the last two years. The exams differ among the country's 27 regional school districts, but multiple choice is virtually unknown. Students must write essays, argue for positions, and solve problems while giving evidence of their reasoning. Texts and curriculums support these practices. This means that students can prepare for the BREVET, because it reflects the very same skills and knowledge they have been honing in school.

THE NETHERLANDS. In the Netherlands, all students take high school leaving exams. The final grade is the average of the exam's two parts: one generated nationally, the other compiled by the school. Dutch schools have four tracks and give four corresponding national exams in most subjects. As in France, multiple-choice and short-answer questions are rare.

U.S. teachers often marvel at these exams that require a lot of writing. "How are they graded?" they want to know. Obviously, with few exceptions, machine grading is impossible. By and large, teachers do it. If selected as graders, they are either freed from other duties for a time, paid a stipend, or both. To be sure grades are given fairly across regions, all scorers receive scoring guides, and auditors check a random sample of scores.

GERMANY. In Hessen, Germany, however, teachers both compile and grade the exam for their own students. When questioned about the possibility of teachers artificially inflating grades or helping their students cheat, one university professor seemed puzzled. "Why would they cheat," she asked us, "when they are professionals who care about their work?" This trust in and respect for teachers as

professionals is common in countries whose students are noted for excellence.

What we've learned

These shared practices and common threads among apparently very different approaches to education teach important lessons:

- Setting clear, consistent, demanding, public standards helps students perform well.
- Tracking and grouping practices must make sense in the culture of the school and for both the student's and community's future goals.
- Exams should test what students have been asked to learn, preferably in the same ways they must perform in class.
- Exams that call for complex, demanding tasks can be given to a wide range of students, perhaps to all students.
- As the front-line professionals in the education process, teachers should have much to say about what goes into exams and how they are graded.

None of these results is surprising. They represent what good teachers in good programs with hard-working students have always done. For the New Standards Project, the good news from international comparisons is that it is possible to set high standards and expect all students to work to achieve them.

One caveat is in order: The route to high performance is not necessarily to simply implement the good practices of other countries. When we aim for world-class standards, we are not aiming at a target that is standing still and waiting for us. Far from it.

Concerns about preparing students for the challenges of work and community in the 21st century are not unique to the United States. The Netherlands continues to stress the development of improved mathematics curriculums as a national priority. Around the world, schools are seeking to improve the technological abilities of all students.

Sweden and France are piloting creative means for teaching children of immigrants. All over the world, in fact, educators are working to improve school services to traditionally marginalized groups, including children from low-income families and girls of all economic classes. Issues of equity, or the performance of language, racial, and ethnic minorities are not unique to the United States.

The challenge for the United States is to create a national agenda of excellence that can raise the performance of all students without creating a national exam or curriculum. Each community must adapt the agenda in unique ways that nonetheless work in unison.

The image of a symphony comes to mind: each instrument has its own score, its own qualities, its own goals, but the scores must harmonize if a satisfying performance is to result. Just so with state and local reforms: they must and will vary in ways that make sense to local schools and communities. But they must also share a common vision of the high performance we must expect from all students.

(1) For more on Japanese attitudes toward ability, effort, and grouping, see H. W. Stevenson and J. W. Stigler, (1992), *The Learning Gap* (New York: Summit Books); K. Okamoto, (1992), *Education of the Rising Sun*, (Tokyo: Monbusho); H. W. Stevenson, C. Chen, and S. Lee, (1993), "Motivation and Achievement of Gifted Children in East Asia and the United States," *Journal for the Education of the Gifted* 16, 3: 223-250.

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Transforming Ideas for Teaching and Learning Mathematics

Office of Educational Research & Improvement

Background

"State of the art" is a goal that every school mathematics program in the United States would say it strives for. It is a goal owed our children and it is attainable. State of the art depends upon curriculum reform. In the current national curriculum reform movement, initiated by the National Council of Teachers of Mathematics and supported at all levels by those involved with mathematics education, it is particularly exciting to be engaged in transforming mathematics teaching and learning to reach the state of the art.

Major curriculum reform is not new in the field of school mathematics. The last such reform was the "new math" of the late 1950s and 1960s which emphasized the unifying mathematical concepts of logic and set theory. For a variety of reasons the new math did not receive widespread acceptance. Specifically, it did not pay close attention to how students learn and what they are capable of learning at different ages. It also did not address what teachers know about mathematics and pedagogy or how they can best enhance their own knowledge.

The new math was followed by the "back to basics" movement which emphasized rote memorization of arithmetic facts and the learning of paper-and-pencil algorithms. The current reform movement grew out of the inability of the back to basics movement to address key issues, including

- Neglect of higher order thinking and problem-solving skills;
- Disquieting findings about American students in recent international studies on mathematics achievement, despite the return to basics;
- Changing mathematical skills needed in the work force;
- New research findings on teaching and learning mathematics; and
- The mushrooming of inexpensive calculators and computers.

In an effort to systematically address these issues the National Council of Teachers of Mathematics (NCTM) established in 1986 the Commission on Standards for School Mathematics. This commission comprised a cross section of mathematics educators, including classroom teachers, supervisors, educational researchers, teacher educators, university mathematicians, and PTA representatives. Over the next three years, the commission developed a document, Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989), which incorporates the suggestions of the mathematics community and is now accepted as the world class standards for mathematics. By a similar process, NCTM also developed the Professional Standards for Teaching Mathematics (NCTM, 1991). Both sets of standards have been endorsed by groups representing the mathematics community from kindergarten through graduate school, as well as by many other groups with a stake

in mathematics education. The new standards imply fundamental shifts in the teaching and learning of mathematics toward a classroom environment that promotes the development of every student's capability. To create such an environment, the NCTM recommends five major shifts:

- toward classrooms as mathematical communities--away from classrooms as simply a collection of individuals;
- toward logic and mathematical evidence as verification--away from the teacher as the sole authority for right answers;
- toward mathematical reasoning--away from merely memorizing procedures;
- toward conjecturing, inventing, and problem solving--away from an emphasis on mechanistic answer-finding; and
- toward connecting mathematics, its ideas, and its applications--away from treating mathematics as a body of isolated concepts and procedures.

(National Council of Teachers of Mathematics 1991, p. 3.)

In addition, NCTM recommends a shift in the early years away from emphasis on the formal, abstract representation of concepts toward their introduction via manipulatives, experiments, and computer simulation.

These shifts make it essential for teachers to acquire new mathematical and pedagogical knowledge. But at a more fundamental level they require changes in many teachers' and parents' beliefs about the nature of mathematics and how it can best be taught and learned. The U.S. Department of Education has identified 10 ideas for transforming mathematics teaching and learning that are backed up by research or by promising practical experience. These ideas are intended to be useful to teachers--the key agents in the transformation process--for making the fundamental changes needed to help every student realize his or her mathematical potential.

This document is also addressed to parents and school administrators who share with teachers the common goal of educating children for excellence. Toward this end they can and must support teachers in their endeavors to transform the teaching and learning of mathematics to state of the art.

All students can and must learn mathematics, which should serve as a "pump," not a "filter."

Myth: Learning mathematics requires special ability, which most students do not have.

> Reality: Only in the United States do people believe that learning mathematics depends on special ability. In other countries, students, parents, and teachers all expect that most students can master mathematics if only they work hard enough. The record of accomplishment in these countries--and in some intervention programs in the United States--shows that most students can learn much more mathematics than is commonly assumed in this country.
>
> *(Mathematical Sciences Education Board 1989,p. 10)*

The idea that all students can and must learn mathematics means that the study of mathematics, by serving as a pump--an access to success--can transform the learning of the general population.

All students must have the opportunity to learn mathematics.

In the past it was assumed that problem-solving ability was tied to the ability to perform paper-and-pencil calculations. Years of teachers' and students' time were spent trying to remediate children who lacked this ability. The emphasis on remediation was based on the premise that mathematics is linear andhierarchical and must be taught in a prescribed order--rote skills first, problem solving later. But research shows that repeating the same uninteresting tasks in the same unimaginative way is not effective. Students learn best when they areintellectually challenged so that they are motivated to fill in mathematical gaps when necessary. The teacher's role is to provide stimulating problems and environment to motivate mathematical learning. In fact, research points out that certain teaching strategies can help all students develop "mathematical power." Providing students with real-life problems to investigate is just one strategy for helping them develop an understanding of the mathematical concepts that underlie a variety of problems.

Tracking, on the other hand, when it is used to filter students out of mathematics, is antithetical to the development of mathematical power: little learning is expected of students in lower tracks and, as a result, they produce little and lose the opportunity to work in mathematics-related occupations; teachers of these tracks often feel like second-class citizens too and lose their enthusiasm and creativity over the years; tracking fosters an elitism that contributes to the underrepresentation of women and non-Asian minorities in mathematics fields and careers that rely

Just as the printing press made calligraphy obsolete as a common writing tool while, at the same time, it increased the need for people to read and write, so too technology is making pen-and-pencil calculations obsolete while, at the same time, increasing the need for people to model and solve complex problems

on a solid mathematics background; and tracking is a poor substitute for implementing a wide variety of the enrichment activities at the pre-high school level and of mathematics courses at the high school level, including advanced placement courses, that can stimulate the quickest students to greater achievement.

All school mathematics courses should be of high quality and challenge all students to high achievement. Parents and students must be shown that achievement in mathematics does not depend on an accident of birth such as innate talent, but that it is attainable through hard work--the same way all skills are successfully accessed.

Teachers need to listen to students and to incorporate into their instruction what they learn from listening.

> The first several years of teaching I really was into "This is the section of the book that we're doing today, and here's the practice problems, and now we'll go over homework, and then I'll teach you how to do it, then you'll practice, and then you'll have some to try before you go home," and that kind of thing. I teach very differently now.
>
> *(Middle school teacher Becky Wickham as quoted in Philipp et al. 1992, p. 30)*

Teachers who listen to students, and who plan instruction based on what they learn from listening, transform student learning. For example, two children may arrive at the same solution of a problem but with different strategies. These strategies may reflect different levels of understanding and suggest different follow-up activities. Moreover, teachers who listen carefully to students' mathematical explanations often find that their students know a great deal of mathematics at an informal level. By building upon this informal knowledge, teachers can help their students construct more sophisticated concepts.

Effective teachers listen carefully to how students go about solving problems. They know their students' mathematical strengths and weaknesses and they can develop a teaching strategy based on this understanding. Research shows that when teachers act upon their knowledge of student thinking, their beliefs about learning and instruction, their classroom practices and, most importantly, their students' learning and beliefs can be affected profoundly.

Students learn mathematics best when they construct their own mathematical understanding.

Ms. M.: *"The African Elephant ate 37 peanuts. The Indian elephant ate 43 peanuts. How many fewer peanuts did the African elephant eat than the Indian Elephant?"*
Ms. M.: *"Got it? How many fewer did the African elephant Eat..?"*
Ubank: *"Six."*
Ms. M.: *"Does everyone agree with that? . . . How did you figure it out, Ubank?"*
Ubank: *"Well, I had 43 here (pushing out 4 stacks of ten cubes and 3 additional cubes joined together), and I had 37 here (pushing out 3 stacks of ten cubes and a stack of 7). I put 30 on top of these 30. I took 3, and I put them here. There were 4 left, so I took 4 off, and there were 6 left. . ."*
Ms. M.: *"Did he do it a good way? . . . Did anyone do it a different*

way?"

Marci: *"I took 37, and I needed 43. So I counted up 3 more. That was 40. Then I took 3 more to 43."*

Ms. M.: *"Good. Does her way work well? . . . It sure does. Did anybody do it differently?"*

(Carpenter and Fennema 1992, pp. 462-463)

Students who construct their own mathematical understanding transform their mathematical potential. It takes courage to begin using the "constructivist" approach in the classroom, but the rewards can be great. Teachers often start with an experiment--a somewhat ill-defined but interesting mathematical problem or application for students to solve. They resist pleas to solve the problem for their students. They often find that their best students resist the change in teaching and learning at first--after all, the best students have succeeded in the old mode, even if they found the mathematics boring. The teachers give the experiment time to succeed.

One of the most difficult shifts for teachers is to relinquish their role of keeper of "the right answer." As students grapple with constructing their own knowledge, they may ask questions that the teacher cannot answer. They may go down mathematical paths that their teacher had not trod. They may devise algorithms that are unknown to their teacher. Teachers too need to construct their own mathematical and pedagogical knowledge. As teachers become learners they model the mathematical behavior they expect of their students.

Teachers must assume a new role if students are to construct their own mathematical understanding. Rather than just being the information givers--pouring mathematical knowledge into the student's head--teachers must provide stimulating mathematical problem situations that encourage mathematical learning. Students must change from being passive recipients to becoming active seekers of knowledge. Students must also learn to verify their own mathematical knowledge.

Students need to learn more and different types of mathematics.

> It is now possible to execute almost all of the mathematical techniques taught from kindergarten through the first two years of college on hand-held calculators.
>
> *(Mathematical Sciences Education Board 1990, p. 2)*

The need for a work force equipped with more and different mathematical concepts is transforming the mathematics curriculum. Nonroutine problems rarely involve ideas from just one part of mathematics. Just as the printing press made calligraphy obsolete as a common writing tool while, at the same time, it increased the need for people to read and write, so too technology is making pen-and-pencil calculations obsolete while, at the same time, increasing the need for people to model and solve complex problems. Thus the curriculum at all grade levels needs to include geometry and measurement, probability and statistics, pre-algebra or algebra, patterns, relations, functions, and discrete mathematics.

This suggested curricular reform is not as radical as it first appears. Many countries have used an integrated curriculum successfully for years, and teachers across the United States have already begun to develop instructional units based on problem situations that involve a variety of mathematical content areas and that may take two to five weeks to investigate.

Some teachers worry that teaching more and different types of mathematics will crowd the mathematics curriculum. Constructing one's own mathematical understanding and solving complex mathematical problems and applications are very time consuming. It may not be possible to cover the same ground using this approach as one would using the lecture method. Yet research indicates that the mathematical understanding students construct themselves is deep and enduring--that students taught this way can score as well as their peers on low-level mathematics skill items and better on problem-solving and conceptual items. Orchestrating the major mathematical concepts that students should understand and eliminating from deep coverage those items of less importance are difficult new roles for teachers.

Mathematical discussion should be a daily part of classroom activity.

> If a child asks you if this answer is right, and you say yes, you've robbed him of the real learning. It's a question of when you say good, not if you say it. Once you've probed for understanding, and you're sure that the child knows, then to say, "You've convinced me, that's terrific, what you said really made sense to me. Why don't you share it with the rest of the class?" But I'd wait until the last moment when I'm really sure that the child really knows it.
>
> *(Ball and Wilcox 1989, p. 15)*

Mathematical discourse transforms student learning. In

offering praise too quickly teachers sometimes lose the opportunity for productive mathematical discussions, a key ingredient for building mathematical power. The lecture mode of instruction also discourages mathematical discourse in the classroom. Recent research shows that classrooms where students engage in a rich mathematical dialog with their peers as well as with their teachers are effective learning environments. Students need to be actively involved in questioning, conjecturing, defining, and explaining.

Teachers can shape the classroom environment to encourage mathematical discussion. They can encourage the participation of all students by valuing each student's contribution, by reducing the risk of ridicule for being wrong, by encouraging honest disagreement, and by making sure that all students are included in the discussion. Mathematical discussion that is rigorous but open minded should be a regular and valued part of classroom activity.

When teachers openly discuss their own mathematical thinking and demonstrate the process by which they solved a problem, they encourage this active mathematical behavior in their students. Teachers cannot expect students to tackle difficult mathematical problems, to discuss, question, define, and conjecture if they do not do so themselves. They cannot expect students to be curious and excited about mathematics unless they are.

Teachers need to become "informed guides" to the learner.

> Within the short space of these few minutes of classroom time, I faced a series of issues: how to get and maintain all my students' engagement, how to make sense of what Sean and Riba [students] were thinking, how to help them move toward appropriate and connected understandings of fractions. From moment to moment I was having to consider whether to praise, explain, solicit others' ideas, let an issue grow, or even stir up trouble in order to press on a crucial mathematical point. Day after day in my classroom, students say things I had never considered. Day after day they have trouble with ideas I used to think were simple. And day after day, these eight-year-olds catch me off guard with what captures their interest and what they reach for.
>
> *(Ball 1992, pp. 14-15)*

Teachers who "guide" rather than "tell" transform student learning. The role of informed guide is much more difficult to assume than that of the lecturer. As teachers focus more on guiding their students' learning they need to know more mathematics. According to the Mathematical Association of America's *A Call for Change*.

> Teachers need to recognize the relationship between what they teach and what is taught at other levels of school mathematics. They need, for example, to understand the close parallel among the development of integer arithmetic in the elementary grades, the algebra of polynomials in the middle and early high school curriculum, and the ideas of number systems explored later in high school. . . . They should explore the relationships between geometry and algebra and the use of one to investigate the other.
>
> *(Leitzel 1991, p.3)*

Case studies indicate that teachers who have a good background in mathematics also add a richness to their lessons, involve students extensively in mathematical dialog, and capitalize on students' questions and discussions to weave and extend mathematical relationships. Such teachers guide their students to discover mathematical concepts and procedures. They do not list definitions and step-by-step procedures for students to memorize without understanding their meaning and function. Research indicates that classroom behavior is affected by an interplay among teachers' general and content-specific knowledge of mathematics, their understanding of how children think about mathematics, and their beliefs about mathematics and about how children learn it.

Calculators, computers, and related technology can be effective tools in the teaching and learning of mathematics.

> Failure to introduce and to use calculators and computers in school creates a needless barrier between what is happening in students' everyday lives and what they are being taught in school... For mathematics education to remain viable in the future, it must include a major role for the computer now.
>
> *(Shane and Tabler 1981, p. 107)*

Calculators, computers, and related technology used as tools in the teaching and learning of mathematics transform the learner from calculator to critical thinker.

Technology implies a shift from using brain power for computational tasks to using brain power to think critically, to communicate clearly, to solve mathematical problems, and to apply mathematics to complex scientific and social problems. Research shows that the proper use of calculators and computers can in fact enhance mathematics learning at all stages. Calculators and computers can take the drudgery out of mathematics by handling routine arithmetic and algebraic calculations, freeing the learner to concentrate on the problem that requires such calculations. Calculators and computers can be used to illustrate mathematical concepts graphically and this kind of visual representation can help understanding. Computers can simulate a variety of modeling options, freeing the learner to determine the most appropriate model to use in a given application.

The continual development of new technology--graphing calculators; computer-based exploratory tools such as spreadsheets, LOGO, the Geometric Supposer, and the Geometers' Sketch Pad; and hypermedia-requires teachers to continually enhance their technological skills. Professional mathematics and computer science education journals and inservice workshops can help provide this enhancement for more effective mathematics teaching and learning.

Students need shared learning experiences

Steven Kirsner [interviewer]: *What's that been like to work in groups instead of what you're used to?*

Penelope [sophomore, special education student, referring to her first opportunity to study meaningful mathematics]: *Well, first of all, when I worked in, when I didn't work in groups, it was harder to get to know people. It was hard to do math because the people who know how to do it we could learn from each other's ideas. But we didn't do it over there. We just worked separate and we actually didn't learn practically anything but what we learned from the teacher. Here we learn from everybody. We learn how they do it, how they understand it and we share our ideas with each other.*

(Kirsner and Bethell 1992, pp. 17-18)

Cooperative learning transforms the teaching and learning of mathematics to model the work force environment. In the work force, teams of people collaborate to solve difficult problems. The expertise of each team member adds a dimension to the solution process. Students need to learn to work cooperatively, too. Students working together help each other learn. Together, students can often tackle challenging situations that would be beyond the capacities of the individuals who comprise the group. The group situation can motivate students and stimulate mathematical discussion, thus helping each student realize her or his own potential.

In order for this group process to work effectively, the teacher must carefully prepare the learning environment. Problems presented to the group should be too difficult or too complex for one child to solve alone. The problems should also pique the group's interest and curiosity. The teacher must ensure that all children participate in the group work and learn cooperative skills. Teachers themselves may need inservice education in using cooperative learning strategies so they can successfully implement them in the classroom.

Research indicates several positive effects of cooperative learning in mathematics education. When coupled with individual accountability, cooperative learning leads to greater academic achievement. Cooperative learning also can increase the self-esteem and self-confidence of the learners and lead to positive intergroup relations--including cross-racial and cross-cultural friendships and social acceptance of mainstreamed children--and greater ability to use social skills.

Curricular and pedagogical change in mathematics cannot occur without accompanying change in student assessment.

> Through assessment, a better understanding should be obtained of how students are relating mathematical ideas to each other and if they are building an integrated notion of mathematics ... Making sure that assessment is integral to instruction should mean that the information obtained is directly useful for guiding instruction. In short, good assessment is good instruction.
>
> *(Webb and Briars 1990, p. 117)*

Curricular and pedagogical changes in mathematics must transform how students are assessed. As mathematics curricula and pedagogy are changed, the instruments for measuring student achievement must also be changed. It is not fair to students, teachers, or school districts to be measured by outdated standards.

The majority of standardized tests our children take are still overly reliant on multiple choice items that measure predominantly low-level mathematics skills. Although they

are beginning to reflect the changes in mathematics teaching and learning, these tests include few types of questions that require higher order problem-solving skills. School districts should analyze standardized tests and use the test that most closely assesses meaningful standards that are in place, such as the NCTM standards.

Researchers are developing alternative assessment tools that both measure student achievement and promote learning. Performance assessment, student interviews, group project reports, and portfolios are a few in the wide range of new assessment tools that researchers are investigating and teachers are beginning to use.

Lasting change takes broad support

> It costs state legislators and bureaucrats relatively little to fashion a new instructional policy that calls for novel sorts of classroom work. These officials can easily ignore the pedagogical past, for they do not work in classrooms, and they bear little direct responsibility for what is done in localities--even if it is done partly at their insistence. However, teachers and students cannot ignore the pedagogical past, because it is their past. If instructional changes are to be made, they must make them. And changing one's teaching is not like changing one's socks. Teachers construct their practices gradually, out of their experience as students, their professional education, and their previous encounters with policies designed to change their practice. Teaching is less a set of garments that can be changed at will than a way of knowing, of seeing, and of being.
>
> *(Cohen and Ball 1990, p. 163)*

Broad support from the educational community is needed to advance the reform effort and transform it to state of the art. Teachers willing to risk making the recommended shifts in classroom practices are at the forefront of the reform in teaching and learning mathematics. Yet systematic change cannot occur unless the members of the learning team--students, parents, school administrators, and policymakers--are also key participants in the process. Past reform efforts have died out because the whole learning team was not involved. The rationale for changing mathematics teaching and learning and plans for implementing the changes should be disseminated to all of these groups. The learning team needs to be involved in the construction of the new school mathematics environment.

Although research on the current reform movement in mathematics is ongoing and as yet incomplete, several components of the reform's success have emerged. It is evident that teachers cannot accomplish it alone. A coordinated school-based reform effort guided by world class standards in mathematics is necessary to transform the mathematics curriculum, teaching methods, and student assessment. The reform's success will also depend on the availability of greater opportunities for all students to learn mathematics and to use new technology. In addition, since the reform movement asks much of teachers, extensive and continuous staff development is needed. This includes courses in content to develop new and deeper knowledge of mathematics, in skills for facilitating learning, in new assessment methods, in implementing cooperative learning, and in working with diverse student populations.

In the end, the appropriate organizational structures must be in place to support the professional cooperation, planning, and school governance that in turn promote risk taking and reform and lead to a new state of the art in mathematics.

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ISSN 0218-2491