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CONTENTS

CONSTRUCTING GENDER IN THE WRITING CLASSROOM

Review by
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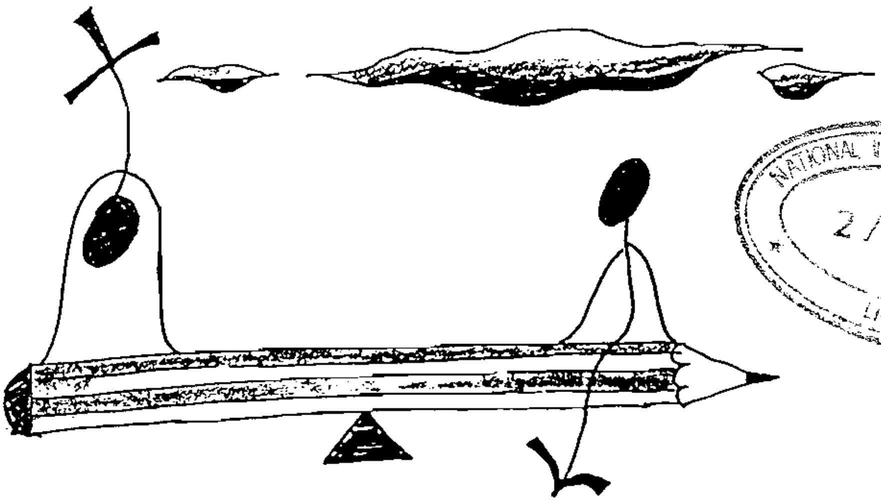

INTRODUCTION

In the last twenty-five years the dominant approach to language learning advocated in our classrooms has been one which stresses 'individual growth', 'personal expression' and 'creativity'. That this approach, whether in the form of whole-language classrooms or process-writing ones, has brought tremendous benefits - integrating language skills, humanising and personalising schooling - is without question and has been widely recognized. In fact, American pedagogues in particular have hailed it as 'empowering', since it values 'personal expression' and acknowledges students' right to their own language and ownership of their own texts. But what most assessments of the 'individual growth' approach have failed to recognize is that its persistent focus on the personal nature of language learning has blinded its advocates to the fact that language practices are socially constructed and that our pupils' access to various reading and writing practices is regulated and highly constrained by factors such as race, social class and gender. Recently, however, this lack of awareness of naturalistic and expressivist language programmes to issues of educational disadvantage has drawn extensive criticism from Australian linguists and educators (see, for example, Kalantzis and Cope, 1993). In the following, I review some of this critical research, drawing primarily on studies which have foregrounded the gendered nature of language practices. While some of these studies have focused on how classroom texts and activities contribute to the perpetuation of stereotypical norms of femininity and masculinity, others have searched for ways in which teachers can 'make strange' these norms which seem perfectly natural to us and can enable pupils to question and resist them.

SEX DIFFERENCE RESEARCH

Process writing and whole language pedagogies insist that when it comes to writing, pupils be given the freedom to choose their own topics and genres. But to what extent are their choices really personal and free? As we know, children engage with gender ideology from their earliest years, since they encounter stereotypical ideas of what it means to be a girl or boylwoman or man daily in the taken-for-granted ways of speaking and interacting in the culture, whether in the picture books they read or are read to, the television programmes they watch, or the talk and behaviour they observe and participate in at home and at school. It comes as no surprise, then, that by the time they start writing, children cannot but reproduce the gender ideology in their own texts. As studies which have examined sex differences in children's language practices have suggested, the seemingly free choice of the writing curriculum only encourages children to produce 'a narrow range of gendered meanings in their texts' (Kamler, 1993, p. 21), which is evident in their selection of both topics and generic writing patterns.

In her extensive study of children's writing in Sydney primary schools, Poynton (1985) documented consistent gender-specific choices of topics. While girls preferred writing about domestic activities, romance and fantasy worlds inhabited by fairies, witches, talking animals and other objects, boys chose to write about dangerous physical actions and fantasy worlds in which creatures from outer space, monsters, burglars and murderers figured predominantly.

When it comes to characterisation in children's stories, Kamler (1993) found that males were most frequently presented as assertive, often aggressive, acting decisively upon the world around them, whereas females were usually portrayed as recipients of other people's actions or, when not passive, as involved in pro-social, nurturing behaviours (sharing, helping, and so on). She regards these choices in character construction as neither conscious nor accidental; instead, she claims, they demonstrate how the cultural circumstances of girls' and boys' spheres of activity influence the way they represent their experience in their own texts and that this act of presentation of theirs, in turn, helps perpetuate the traditional gender order.

Apart from these obvious differences, close examinations of the structure of children's stories reveal more subtle, generic differences. For instance, Poynton (1985, p 36) observed that girls tended to structure their narratives more tightly, telling about single problems and their resolution, while boys had a preference for digressive plotlines with multiple episodes. Similarly, in Kamler's study, the boys' texts evidenced greater development of the events proper of the narrative. The girls' writing, on the other hand, concentrated more on providing descriptive details and evaluating events and characters. These differences in focus, she concluded, appeared to reflect the dualistic cultural stereotypes of males as acting upon the world and females as observing and evaluating it (Kamler, 1993, p. 25).

How can a reading of our pupils' texts from the perspective of sexdifference research be useful for us as educators? According to Gilbert, it can reveal how different, usually dualistic, the ways are in which 'girls and boys take up positions within the symbolic order' (1993, p. 23) and construct themselves as particular kinds of beings. It also enables us to determine to what extent their stories conform to these dualistic constructions of gender and to what extent they deviate from them. In addition, however, we need to understand how 'seductive' popular generic conventions and forms are and why it is so difficult for our pupils to challenge them, despite the 'free' choice of topic and form we may offer them. The work of genre researchers can help us gain such understanding.

GENRE-RESEARCH

According to recent research in genre (e.g. Kress, 1985; Threadgold, 1989). genres are no longer seen as merely formal categories but as sociohistorical ones which have social functions. According to Threadgold, genres cannot be treated 'in isolation from the social realities and processes which they contribute to maintaining (and could be used to subvert)' (1989, p. 103). Among these genres, stories play a crucial role in structuring the meanings of a culture, its value system, system of norms and acceptable modes of behaviour. Hence, through stories - the kinds of events they sequence and the functions and traits they attribute to their characters - we learn, among other things, how to be women and men, girls and boys, mothers and daughters.

The 'seductiveness' of the popular generic pattern of our pupils' stories can in large part be explained by the fact that they are not restricted to their own stories. The narrowly dualistic confines within male and female characters are allowed to be and to act are replicated in the larger narratives which permeate all aspects of our culture, whether in the form of Hollywood movies, pulp fiction, popular press stories, advertisements or others. Because of the repetitive and stable nature of such texts the values and modes of behaviour encoded in them have come to pass as almost natural, plausible and uncontentious.

Moreover, genres are also potentially gendered in structure. Cohan and Shires describe the modern romance genre as a 'feminine' narrative since it 'stmctures the meaning of gender difference through a narrative representation of female subjectivity in much the same way that masculine narratives such as the thriller and western structure the meaning of gender difference through representations of male subjectivity' (1988, p. 79). In addition, as Gilbert (1993) points out, all storylines are not equally valued. Whereas the male storylines of westerns and thrillers, which promote the values of physical power, aggressiveness and competition, become serious stories to admire and respect, the female storylines of romances, which reinforce the values of love, dependence and emotional vulnerability become marginalised stories to laugh at and bmsh off as silly.

Placing the construction of texts within this broader social framework of language practices enables us to see how genres, such as narratives, contribute to the regulation and control of social meaning, including what women and men in our culture should be. But, as Threadgold also noted above, generic conventions are not necessarily fixed once and for all but can be challenged and subverted. How we can give our pupils the tools to question existing conventions has been the concern of educators working in the tradition of critical language study.

CRITICAL LANGUAGE STUDY: ITS PEDAGOGICAL SUGGESTIONS

The aim of critical language study is to increase our awareness of linguistic features and conventions and the ways in which they convey not merely propositional content but also ideological messages. To look at language critically means denaturalising it, making strange and questioning conventions which we have come to accept as commonsensical. Apart from detailed critical analyses of texts, advocates of critical language study have also proposed a workable pedagogy that can be used in classrooms with pupils at various levels. The central objective of their educational programmes is to uncover the choices which have been made in the creation of the texts we read and write. At the macrolevel, this includes the choice of a particular genre (e.g. fairytale, detective story, romance) and, within it, the choice of a particular sequencing of events. On the microlevel, the selection of particular wordings and ways of describing characters' actions and attributes is examined. For without an understanding of the meaning and significance of textual choices and conventions it is unlikely that our pupils will move beyond the deferent stance towards texts which is of so much concern to those involved in training critical readers and writers.

More specifically, the framework offered by Kress (1985) suggest that we ask three simple questions of any text:

(1) Why is this topic being written about?
(2) How is this topic being written about?
(3) What other ways of writing about this topic are there?

Among these questions, 3 in particular is vital when we want to address the taken-for-grantedness of cenain conventions. By paying attention to what choices were made in writing about a topic and which ones were not, pupils will realise that there can be other ways of writing about men and women than the established oppositional ones.

A key strategy for this kind of critical analysis would be to construct lessons which juxtapose different texts about a topic or different realisations of a genre in order to foreground different ways of writing. Cranny-Francis (1993, p. 100), for example, suggests that one could compare and analyse a whole range of written versions of a Brothers Grimm fairytale. Feminist writers such as Angela Carter and Tanith Lee have recently reconstructed several of these, changing the roles of female so that they take their fate into their own hands rather than waiting for the traditional princely solution to it. Likewise, narratives which reconstruct the conventional male roles, be it he-man, Prince Charming, invincible hulk, and so on, could be studied, thus exposing the narrow range within which femininity and masculinity have been constructed in traditional stories. Through close analysis of these alternative texts, pupils can also see that for these writers a mere reversal of male and female roles in their stories is not sufficient to make a marked difference, since the underlying oppositional thinking and characterisation is still kept intact.

After this kind of comparative analysis, pupils could then be asked to write their own texts: texts which attempt to tell a different story and to construct male and female characters in alternative ways.

This review of the issues and debates that have proliferated in Australia over the last decade indicates how alive and dynamic writing instruction can be. By making the writing classroom a place of critical language analysis, where pupils and teachers examine the social functions of language practices, especially the ways in which these have endorsed particular, restrictive versions of femininity and masculinity, teachers can play their part in empowering their pupils as critical writers.

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DEVELOPING STRATEGIES FOR SPELLING THROUGH COMMUNICATIVE WRITING

Review by
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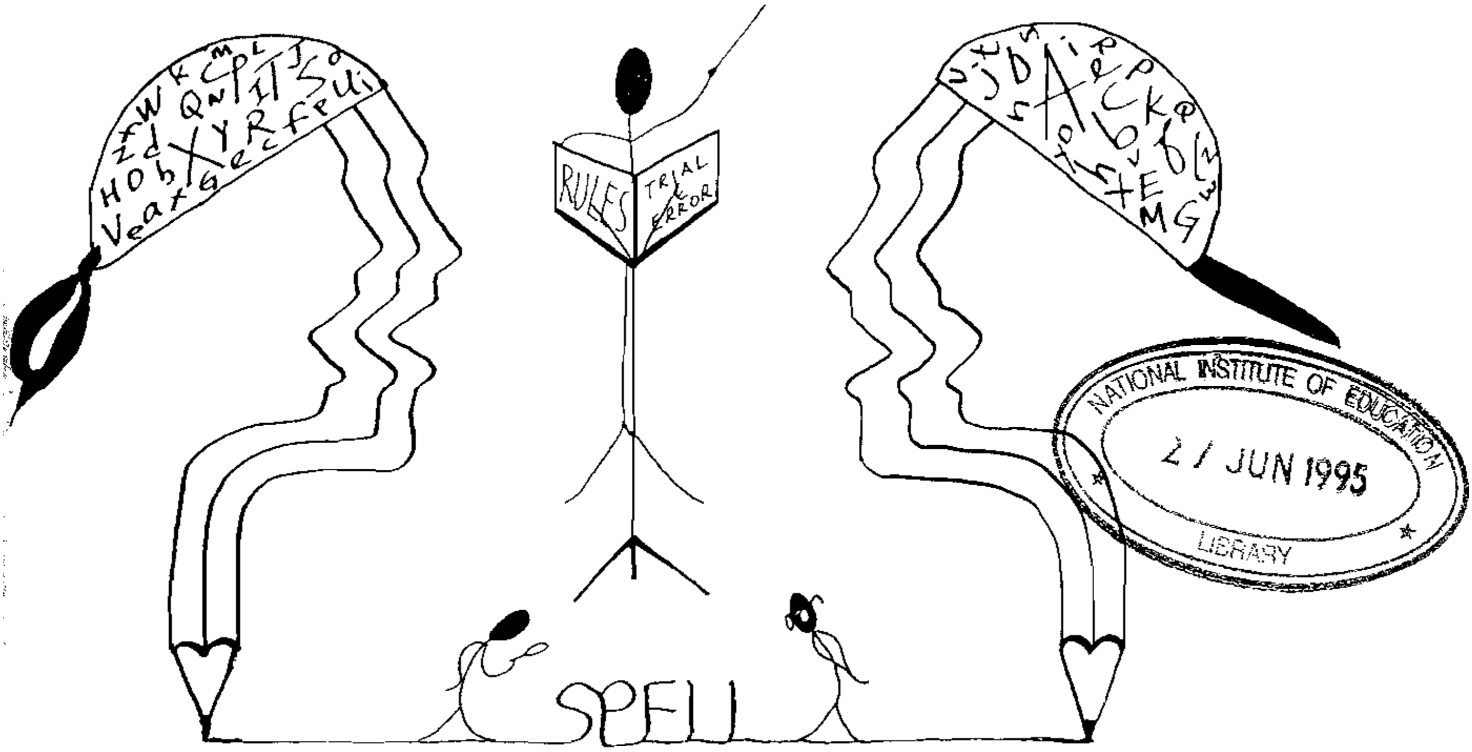

INTRODUCTION

Interactive and communicative approaches to the teaching of language arts are based upon certain beliefs about the nature of language learning and language use. Among them are the following:

Language is a vehicle for communication.

Incorporating thinking strategies into language tasks fosters intellectual growth and the development of critical skills.

Making errors is a natural part of language learning.

Language learning is organic.

Within a communication-based language arts programme, these insights about language and language learning apply to all the functions of language. Since writing is an important form of communicative language use and spelling is part of the writing system, they apply to the development of spelling as a communicative skill. An increasing body of research suggests that learning to spell is a constructive developmental process, much like the development of oral language. Meaningful learning takes places when children are encouraged to explore spelling through natural communicative writing.

STAGES OF SPELLING DEVELOPMENT

Gentry (1982) suggests that there are five developmental levels of spelling: precommunicative, semiphonetic, phonetic, transitional and correct. The precommunciative stage is that at which a child begins to use letters and letter-like symbols to represent words. At this stage, children have some knowledge of letter formation, but their knowledge of letter-sound correspondence is as yet undeveloped. At the semiphonetic stage children demonstrate some understanding of letter-sound correspondence, although one or two letters may represent an entire word. In addition, words or syllables are often represented by letters that match their letter names.

At the phonetic stage all the sounds of words are represented by the spelling and rules are developed for spelling particular types of sounds. Although children's phonetic spellings are unconventional, they do reveal children's systematic attempts to relate spelling to the sounds they hear.

At the transitional stage children demonstrate an understanding of the basic conventions of orthography, such as the need for vowels in every word, nasals before consonants, and both vowels and consonants instead of the letter name strategy. Children at this stage make increasing use of visual spelling and learned words are commonly used. Gentry (1982: pp. 1%) contrasts spellings at the phonetic and transitional stages:

phonetic	transitional	conventional
EGL	EGUL	Eagle
BAK	BANGK	bank
MOSTR	MONSTUR	monster
ATE	EIGHTEE	eighty

Invented spellings provide evidence that even preschool children's misspellings are usually sensible and reflect systematic developmental change. Busch (1990) studied the spelling bebaviour of children in a Primary 2 classroom where invented spelling was encouraged. She reports that the children actively generated hypotheses to solve their spelling problems and concludes that children who are encouraged to work through spellings of unknown words become more sensitive to conventional spellings when they encounter them in their reading.

IMPLICATIONS FOR SPELLING DEVELOPMENT IN THE CLASSROOM

If learning to spell is a developmental cognitive process that requires problem-solving and the application of a variety of strategies, classroom teachers must provide children with opportunities develop their own strategies for spelling.

1. <u>Provide frequent opportunities for purposeful writing</u>

   Children can be asked to write letters, labels, lists, signs, and newsletters in addition to stories and reports. They can also be encouraged to write to a variety of readers, including their peers, parents, public figures or favourite authors.

Distinguish between spelling for composing and spelling for proofreading

Spelling is clearly important for communication at two points in the writing process. The first is the point at which children put pencils to paper and begin to compose. The other is when they consider what they have written and make changes in surface features so that other readers will find their meaning clear.

Encourage invented spelling at the composing stage

Because children develop strategies for spelling through trial and error, emphasizing correct spelling when children are trying to get their words down on paper may actually inhibit the development of standard spelling. Invented spelling should therefore be viewed as a positive attempt to develop spelling strategies and children should be encouraged to invent spellings for words they do not know how to spell.

Help children develop proofreading skills

When children have made their written meanings clear, attention may be shifted to spelling, punctuation and grammar. At this proofreading stage of the writing process, spelling can be treated within the meaningful context of the children's own writing. Bean and Bouffler (1987) suggest that when children are unsure about the standard spelling of a word, they should be encouraged to come up with as many possible spellings as they can, choosing the one they think is best. The teacher can then give them the standard form to compare with their own versions. They may then add the correctly spelled word to their individual 'word banks' for future reference.

Help children develop spelling awareness

Teachers can help children develop greater awareness of spelling by encouraging them to compare and contrast words in terms of sound, structure, and meaning. Gillet and Kita (1980) recommend the use of word sort activities in which children work together to group words which are written on index cards. The children may group the words by features such as shared letters, similarity of consonant or vowel sounds, related meaning or grammatical function. In addition to providing a problem-solving approach to word study, "word sort activities allow children to demonstrate what they already know, what they are learning, and what they need to learn" about how words are related. (pp. 125)

Teach useful spelling rules

Children should be taught the rules for spelling silent letters, *ie/ei*, adding *-ing* and *-es* to words ending in y, and rules for doubling consonants. Rules for spelling homophones such as *their/they're* and *are/our* and contractions such as *it's* should also be introduced.

CONCLUSION

Learning to spell is a developmental cognitive process which requires thinking, not memorization. It should take place in writing contexts which are meaningful and purposeful. Encouraging children to invent spellings for words they do not know how to spell can help them to extend their range of spelling strategies. Teaching them useful rules for English spelling and having them compile individual 'word banks' can help them to develop the ability to proofread their own written work.

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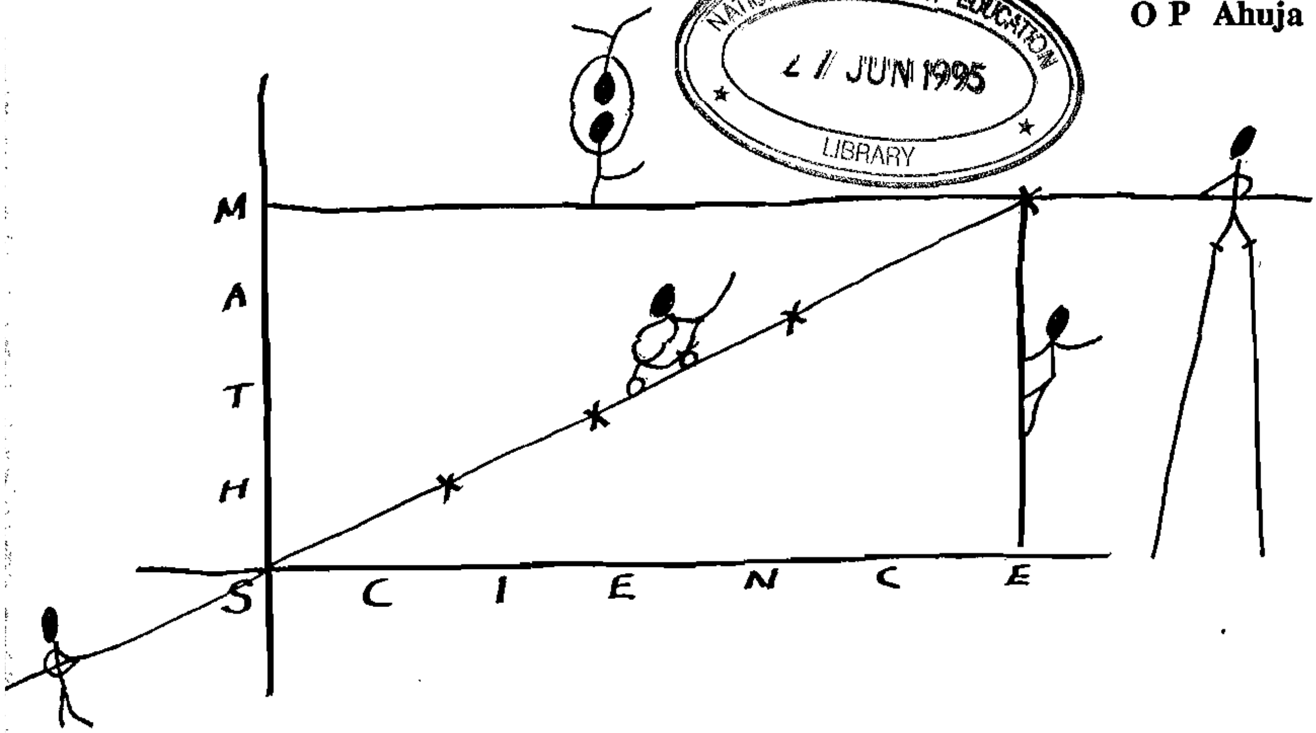
INTEGRATING MATHEMATICS AND SCIENCE TEACHING: SOME PERSPECTIVES AND IMPLICATIONS

Review by
O P Ahuja



INTRODUCTION

A new thinking that is now gaining momentum is the integration of mathematics and science teaching and learning. However, the alliance between mathematics and science is not a new idea. In 1902, Moore in his presidential address to the American Mathematical Society suggested the idea of integrating mathematics and science. A review of literature reveals several articles and books related to the integration of mathematics and science (*see* McBride & Silverman 1991, Berlin & White 1994, Lonning & DeFranco 1994). In this article, we shall briefly review the recent attempts made by some mathematics and science educators to bring about the integration of mathematics and science. Finally, we shall give implications and some recommendations for schools in Singapore.

WHY INTEGRATE MATHEMATICS AND SCIENCE?

Mathematics and science skills are traditionally taught as separate disciplines in schools. So, students generally perceive that they will hardly use the skills/concepts which they study in these subjects. Moreover, compartmentalized knowledge significantly hinders students' ability to function as effective Problem solvers because many real world problem situations require the knowledge of both mathematics and science.

It is argued by many researchers (Berlin 1994, Lehman 1994, and others) that the integration of mathematics and science will help in a more meaningful and effective learning of concepts in both disciplines. Motivation often increases when students perceive a relevancy between what they are learning and their own lives. For example, primary school children can be motivated to learn measurement skills when they conduct measurement activities in science classes such as charting the growth of plants. The activities with simple machines such as levers can engage children in multiplication and solving simple questions. Similarly, balance beam activities can provide a framework for addition, multiplication, ratio and proportion (McBride & Silverman 1991).

Researchers have found that integration improves student understanding and performance and develops realistic and positive attitudes related to both mathematics and science (Berlin & White 1994). For example, science content such as the destructive force of tornadoes can become more meaningful and fascinating to students when they are allowed to apply arithmetic to calculate the total amount of air pressure on the inside walls of a room prior to being struck by a tornado.

WHAT IS INTEGRATED MATHEMATICS AND SCIENCE?

There are a variety of interpretations of integrated mathematics and science (see Berlin 1994, Berlin & White 1994). A total integrationof mathematics and science has been found to be unsuccessful. Attempts to use either mathematics or science as the focus were found to be unsatisfactory (see Lonning & DeFranco, 1994). However, we can argue about the amount of ***intersection***, but it seems quite clear that no one is arguing that they are congruent or disjoint. Some of the "big ideas" which are common to both mathematics and science include: balance, conservation, equilibrium, measurement, models (including physical, conceptual, and mathematical), patterns (including trends, cycles, and chaos), reflection, refraction, scale (including sue, direction, speed), probability, symmetry, systems, variable, and vectors. (Berlin & White 1994). Some of the examples of the interrelationship of mathematics and science processes may include: (a) sorting and classifying, (b) measuring, (c) using spatial and time relationships, (d) interpreting data, (e) communicating, and (f) formulating and interpreting models (see Lonning & DeFranco 1994).

There are certain mathematics and science concepts that are best taught independently while others lend themselves to natural integration, that is relevant science activities utilizing meaningful mathematics skills. For example, a secondary school lesson on "specific gravity" is a lesson where both mathematics and science skills are necessary to understand the concept. Similarly, a high school lesson on "Genetic Inheritance" in biology can make use of mathematical ideas such as probability, Cartesian product, tree diagram, set notation etc.

The integration of mathematics and science education cannot be simply defined. A 3-day conference funded by the National Science Foundation (USA) in 1991 failed to reach consensus as to a definition of the integration of mathematics and science education because the definition involves a broad range of aspects. Most importantly, our primary consideration should not be "How can mathematics and science concepts be integrated?" but rather, "What is the ***best*** way to teach them?" (Lonning & DeFranco 1994).

A PROBLEM-SOLVING APPROACH TO INTEGRATE MATHEMATICS AND SCIENCE

A problem solving approach can be used to allow for the integration of mathematics and science. The choice of a particular problem or question can be driven by specific mathematics or science concepts that are included in the curriculum or come from content areas outside the mathematics or science domain. Several problems or questions can be designed and developed for all grade levels. For example:

i) Will an orange sink or ***float*** in ***the*** water? What happens when ***the*** orange is peeled? This problem can include the concepts of mass, volume, water displacement, and specific gravity. Also, it will require skills in using a balance, a graduate cylinder and the techniques involved in measuring volume by water displacement. (see Lonning & DeFranco 1994).

ii) ***What is the volwne of blood in the human body? What is the total number of red corpuscles in the human body? How much oxygen do we inhale, and how much carbon do we exhale in our life time?*** These problems can be solved by using various skills in arithmetic, algebra, geometry, and mensuration.

Once a question or problem has been identified, appropriate activities that integrate mathematics and science can be selected. There are several on-going projects in USA which are being designed to connect mathematics and science. For example, Project AIMS (Activities that Integrate Mathematics and science) began as a National Science Foundation grant in 1981. The Project was designed by the AIMS Foundation in Fresno/California to motivate students by providing problems, projects, or topics that connect mathematics and science knowledge and skills. Project AIMS has produced high quality supplemental investigations, books, and resource materials. It is now enjoying tremendous success among students, teachers and administrators. AIMS investigations are implemented by teachers with varying mathematics and science backgrounds and attitudes. For more descriptions of AIMS and other similar projects *see* Deal (1994) and McBride & Silverman (1991).

HOW TO DEVELOP AND TEACH AN INTEGRATED UNIT/COURSE

Several questions need to be addressed when planning an integrated course. For instance: What does integrationof mathematics and science mean? What content should be taught in such a course? How should we develop good integrated units? How should this course be taught?

How to develop an integrated unit? Take some small steps: begin with a colleague or two from mathematics, science, and, if possible, from other related subjects as well. Identify an issue or a topic of common interest. Next, identify concepts that could be meaningfully developed and that relate to mathematics, science, and the topic. Finally, develop specific activities that allow exploration of the concepts and integration of mathematics and science.

For example, suppose a team of two or more Mathematics and Science Teachers decide on '*sharks*' as their topic of common interest for their secondary school students. Concepts related to science and 'shark' may include: classification, skeletal structures, teeth and diet relationships, food chains, and anatomy of sharks. Concepts that can be meaningfully developed and relate to mathematics and 'shark' may include: ratio and proportion, data collection, graphs, geometry, and percentages. Next, these teachers can design several activities which connect the above mentioned concepts in a manner they feel will be educationally effective. For instance: (i) What is the smallest amount of blood in a gallon of salt water a Great White shark would be able to smell? Demonstrate this to the class with one gallon of salt water and red food coloring for blood; Use this as a spring board for a lesson on ratios and proportions; (ii) Generate a computer database with information (about sharks) such as type of food each shark eats, length, weight, family, order, top speed, depth it lives at, etc; Look for relationships and patterns; Is here a relationship between weight and speed? Formulate a hypothesis about these relationships; Can you validate your hypothesis? For further details, *see* McDonald & Czerniak (1994). These authors have used a central theme of ***'sharks'*** to illustrate the process of developing an interdisciplinary unit involving mathematics, science, social studies, fine arts, and language arts.

How to teach an integrated course? Good teaching should be modelled and not lectured. The basis of integrated instruction should be hands-on, activity-centered and guided discovery methods. Such a course should be coordinated by two or more teachers from mathematics and science.

IMPLICATIONS AND RECOMMENDATIONS

While some researchers have examined several issues confronting mathematics and science education in Singapore, little research has been done on the integration of mathematics and science.

Although there is a strong rationale for the integrated mathematics and science instruction as a supplement to the traditional curriculum in both the disciplines, there might be several difficulties in implementing integrated instruction in local schools such as teacher training, classroom management, more instructional time, and relevant curriculum materials.

It is suggested that mathematics and science educators, schools, and policy makers might examine the following recommendations in their future agendas:

1. Plan, develop and implement AIMS (Activities that Integrate Mathematics and Science) in schools. Such a project should be designed as a supplement to mathematics and science. The focus of the project should be through real world experiences. The project will help students to appreciate that mathematics and science are everywhere.

2. Expose mathematics and science teachers to a large selection of AIMS activities selected for their grade levels and generic integration and management techniques. In addition, the in-service training will help teachers develop personal confidence and positive attitudes towards inquiry-based investigations.

3. Develop and introduce a 1 or 2-semester AIMS technological problem solving method course for pre-service teachers - both at primary and secondary levels. Such a course could be extremely challenging and extremely rewarding. It will help future teachers make mathematics and science teaching more meaningful and exciting to their students.

4. Develop a set of videotapes on AIMS for model lessons at various grade levels where exemplary pre-service and practicing teachers teach demonstration lessons and also provide information related to curriculum materials.

5. Establish Mathematics and Science Clubs in educational institutions. These clubs will help to create the environment and avenues for cross discipline and inquiry-based learning. This will also encourage cooperation of mathematics and science teachers in the schools.

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AN INQUIRY APPROACH TO LABORATORY TEACHING - SOCRATIC DIALOGUE INDUCING LABORATORY

Review by
Yap Kueh Chin

INTRODUCTION

The role, usefulness and effectiveness of the laboratory in physics teaching have been discussed in a number of papers (White, 1979; Moreira, 1980; Toothacker, 1983). While we may agree that tightly structured and directed laboratory experiments do not facilitate genuine inquiry, completely unstructured laboratory activities do not appear to be helpful also. Arons (1993) suggested that we need to "provide students with enough Socratic guidance to lead them into the thinking and the forming of insights but not so much as to give everything away and thus destroy the attendant intellectual experience" (p. 279). One such approach may be provided by introducing the Socratic Dialogue Inducing (SDI) laboratory (Hake, 1987 and 1992).

WHAT IS A SDI LABORATORY?

The SDI laboratory is an innovative inquiry approach to laboratory teaching. It gives emphasis to hands-on experience with simple experiments and students' interactive and intellectual engagement with materials and the teacher. It is based on the belief that concept construction and formation are best facilitated through disequilibration, discussion and Socratic dialogue. Thus such a laboratory will he characterized by (a) extensive verbal, wrinen, pictorial, diagrammatic, graphical, and mathematical analysis of experiments, (a) conceptual conflict among students, (c) repeated exposure to experiments, (d) peer discussion, and (e) Socratic dialogue with the teacher.

The SDI write-up may be necessarily long in order to provide space for student sketches and answers. It may induce students to (a) write down operational definitions of terms used, (b) predict and perform simple hands-on experiments or activities, (c) draw diagrams showing various important details, (d) discuss with other students, (e) write down answers to probing questions which require reasoning, explanations, justifications and/or sketches, and (f) engage in Socratic dialogue with the teacher if there is still any disequilibration after peer discussions.

EXAMPLES OF SDI LABORATORY EXERCISES AND QUESTIONS

A sample of SDI laboratory exercises and questions on mechanics are outlined in an abbreviated form.

(1) Operationally define "vertical" and "horizontal".

(2) Hold two permanent magnets close together but not touching.

(a) Do you think noncontact (action-at-adistance) forces exist?

(3) Hold a I-kg mass in the palm of your hand and move it

(a) vertically upwards with an increasing velocity,

(b) horizontally across the room with a **constant** velocity

(i) Is the mass in equilibrium?

(ii) Is there a horizontal force vector acting on the mass?

(iii) Is the force exerted on the mass by your hand equal and opposite to the force exerted on the mass by the Earth?
(This illustrates Newton's _____ Law.)

(iv) Is the force exerted on the mass by the Earth equal and opposite to the force exerted on the Earth by the mass?
(This illustrates Newton's _____ Law.)

(v) Is the force exerted on the mass by your hand equal and opposite to the force exerted on your hand by the mass?
(This illustrates Newton's Law.)

(4) Take a 5-25 kg dry ice block and place it on an approximately 1x2 m glass surface.

(a) Give the block a tap (impulsive force) in a horizontal direction so that it slides on the surface. While the block is sliding but not in contact with your hand:
Is the net vector force exerted on the block by the table equal and opposite to the force exerted on the block by the Earth?

(b) Predict the path and then give the block a tap (impulsive force) in a direction perpendicular to its direction of motion as it slides on the glass.

(c) Predict the path and then release the block after moving it along a curved path.

(5) Set a steel pendulum bob in motion.

(a) Show time-sequence F, v, and a diagram for the motion from the top of its path on one side of the swing to the top of its path on the other side of the swing.

(b) For the above motion, predict the path and then arrange to release the bob from its constraint when the bob is moving upward and is midway between the bottom and top of its path.

(6) Simultaneously release a light sheet of paper and a heavy steel ball from the same height above the floor with the

(a) plane of paper horizontal.

Do your observations support Aristotle's contention that heavier bodies fall faster than light bodies?
Is the above experiment in error?

(b) paper sheet crumpled into a ball.
How would you explain the nearly simultaneous impact of the paper and steel balls with the floor to an Aristotelian friend?

EVALUATIVE RESEARCH ON THE USE OF SDI LABORATORIES

There may not be an abundance of research studies involving SDI laboratories as yet. However, from the few research studies that do involve SDI laboratories, the results appear promising. In their early use of SDI laboratories, Hake and Swihart (1979) found that such laboratories were generally well received and popular with students. Later on, Hake (1987) designed a six-week noncalculus-based introductory course on mechanics using SDI laboratories as one of his primary emphases. Fifty three students completed this course. He found that the course using SDI laboratories was effective in overcoming students 'misconceptions' based on their performance on the pre-course and post-course mechanics examinations.

In another study by Tobias and Hake (1988), ten nonscience professors took the same course for three weeks. In comparing their pre-course and post-course mechanics tests, it was found that their knowledge was positively enhanced. Their post-course average increased to 71.4% from a pre-course average of 46.4%. The majority of these professors agreed that one major contributory factor for their substantial learning was the use of SDI laboratories.

Uretsky (1993) recently implemented the SDI laboratories in a community-college physics course. In his evaluation report, he noted some positive and negative aspects of using the SDI laboratories. He found that the SDI laboratories were fun to teach and required less grading time than conventional laboratories. He had no difficulty in closely coupling the laboratories to the course content. He noted that attention could be focussed on the concepts. He also found that the harmony between the classroom and laboratory work provided a more conducive learning environment. However, he warned of the amount of time needed to implement such a course. He suggested modification of existing manuals to suit the needs and levels of students one is handling. Nevertheless, he is convinced that the "conventional physics laboratory format - formalized experiment, calculations, formal report -is a pedagogical rite that is long overdue for oblivion." (p. 481)

WHAT TEACHERS CAN DO TO INCORPORATE SDI FEATURES IN LABORATORY PRACTICES

For a start, physics teachers may want to look at a few examples of SDI laboratory manuals more carefully. This will enable teachers to have a better grasp of the nature of such laboratories. They will then also have a better idea on how such SDI laboratories could be adapted for the needs and levels of their students. Teachers could locate some of the materials from the sources quoted (Hake, 1987 and 1992). However, teachers who have Internet access may be interested to locate more of the materials directly. The review writer would be glad to provide the necessary assistance.

Based on the various examples located, teachers may then identify one or more topics to implement the use of SDI laboratories. Initially it may not be a bad idea to just adopt and adapt the same topic or topics as those already designed.

Having identified one or more topics, teachers may then practise planning and designing a few SDI laboratory manuals. In planning and designing such manuals, teachers need to ensure as many of the appropriate characteristics of the SDI laboratories are incorporated. Again it may not be a bad idea to use existing materials as a starting point.

It will also be helpful if teachers draw upon the experiences, skills, resources and knowledge of various colleagues in order to integrate a wide variety of appropriate and challenging materials and questions into the planning and design of the SDI laboratories.

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STUDENTS' DIFFICULTIES IN LEARNING SECONDARY SCHOOL GEOMETRY

Review by
Lim Suat Khoh

INTRODUCTION

The van Hiele model of thinking in geometry has been the basis for much research on how children learn geometry. Besides smaller studies, three substantial van Hiele based projects, the Oregon, Brooklyn and Chicago projects were undertaken in the United States in the seventies and the eighties (see Hoffer (1983)). The model is well known for its stratification of human thought in learning geometry into a sequence of levels of thinking. The van Hieles also proposed a sequence of five phases of learning which would bring the learner from one level of thinking to the next. Van Hiele based research generally deals with the verification of the hierarchical nature of the levels, the instruments for determination of levels of the learner and the interaction between teaching and learning of geometrical concepts. This review seeks to consolidate the discussion and findings from several reports and studies in order to suggest strategies for more effective teaching and learning of geometry.

HOW CHILDREN LEARN GEOMETRY - THE VAN HIELE THEORY

According to the van Hiele model, the learner of geometrical concepts progresses through a sequence of five levels of thinking which may be described as follows:

Level 1: Learners recognise and identify figures by their global appearance and do not explicitly identify properties of the figures.

Level 2: Learners analyse properties of figures but do not order these properties nor interrelate them. They are unable to relate figures through properties.

Level 3: Learners are able to relate-figures and properties. They can logically order the properties and definitions become meaningful.

Level 4: Learners develop sequences of statements to deduce one statement from another. They understand theorems and the relationships between a network of theorems within a deductive system.

Level 5: Learners are able to analyse various deductive systems rigorously and understand the properties of deductive systems such as consistency independence and completeness of postulates.

The van Hiele theory also proposes a sequence of five phases of learning to bring the learner from one level to the next. The phases are (1) inquiry, (2) directed orientation, (3) explicating, (4) free orientation and (5) integration.

The van Hiele levels were postulated to be discrete and form a hierarchy of geometrical thought. Research has confirmed the hierarchical nature of the levels and has further shown that the learner can be at different van Hiele levels for different concepts. Furthermore, learners can be at transition between levels and here, they may in fact move back and forth between levels.

WHAT RESEARCH SAYS

Cognitive abilities and Piagetian stages

Mathematics educators have compared the van Hiele phases of learning to Dienes' learning cycle (Hoffer (1983)) and some correspondence can be drawn between the levels of thinking and Piaget's stages. According to Farrell (1987), the cognitive abilities needed by students in a secondary school geometry class are the ability to hypothesis, the ability to reason deductively, to understand the difference between definitions, postulates and theorems. All these abilities, which are at at least Level 3 of the van Hiele model, are characteristics of Piaget's formal operational stage. MacDonald (1989) also found that formal operational learners structured their geometry content more like subject experts than did the wncrete operational students. However, tests of students in geometry classes show that at least 30% of these students reason at concrete operational level with another 30 to 40% being assessed as transitional reasoners. Such students, who are able to reason inductively rather than deductively, would have difficulties with deductive proofs of theorems. If teaching of geometry occurs at the level 3 where wncepts and structures are deductively linked, there would be communication barriers between the wncrete operational students and their teachers.

Language and communication

One significant point of the van Hiele theory is that the language and mathematical communication at each level is characteristic of that level and that if the teacher and students are communicating at different levels, they are effectively using different languages and hence cannot understand each other.

As reported in Hoffer (1983) and Fuys et al (1988), the Oregon and Brooklyn projects found that due to interference from everyday language, students were impoverished or imprecise in their use of geometrical vocabulary. For example, students would use the word "straight" to mean parallel ("both lines are straight") or perpendicular ("they go straight up"). Moreover, even if students were able to make simple informal deductions, few used a logical type of language (such as "all these rectangles have . . . " or "if the shape has property X, then . . .") until they were at Level 2 or the transition between Levels 2 and 3.

Visual Perception and Misconceptions

Students' use of language also showed that they were hampered by visual perception, an indication that they were reasoning at only Level 1. The visual image that they had in their minds would override any definition which they may appear to have accepted. A large proportion of students were also influenced by the orientations of the figures e.g. opposite sides of a quadrilateral would appear to be parallel in one orientation hut not in another. The concept image which they had would often he the one in the standard textbook orientation.

Since they were not at Level 3, non-essential attributes which were culled from diagrams were mistaken as necessary attributes for the figure. For example, students would put in their descriptions of parallelograms the attribute that "it does not have a right angle because that would make it a rectangle." On the other hand, necessary conditions were converted into sufficient conditions and they would jump to the conclusion that a shape which has the property of shape Type X must be a shape of Type X.

Proof writing

Another van Hiele-based research study was the Chicago Project which, among other aspects, studied the relation between proof-writing ability and van Hiele levels. Senk (1989) reported that students' ability to write proofs correlated positively with their van Hiele levels. Students who began their high school geometry course at Level 1 had little chance of learning to write geometry proofs later in the year. In contrast, a level 2 student had a 50-50 chance while a level 3 student had an even greater chance of mastering proof writing. However, the study did not support the contention that only Level 4 and 5 students are able to write proofs.

Van Hiele Levels of Singapore Students

For his M.Ed. research, Hang (1993) used the Rasch model to investigate the van Hiele levels of geometric thought of secondary and junior college students in Singapore. The sample consisted of 362 secondary four students and 311 junior college students and they were tested on the two main concept strands of triangles and quadrilaterals. It was found that for triangles, about 72% of the students had attained at least level 3 but about 28% were at most at level 2. For quadrilaterals, the results were less satisfactory with 68% attaining at most level 2.

There was found to be no significant difference in the van Hiele levels of secondary four students as compared with the second year junior college students. As there is very little geometry instruction at the 'A' level, this indirectly supported the findings of other van Hiele research that it is carefully planned geometrical instruction rather than chronological age which promotes the progression from one van Hiele level to the next.

IMPLICATIONS

In general, the van Hiele model has revealed that there is disharmony in the teaching and learning of geometry. Students were not using geometrical language in the way that teachers and the textbooks intended, Research also supports the contention that language structure is a critical factor in movement through the van Hiele levels.

Misconceptions once learned are very persistent and increasing chronological age does not automatically result in progression to higher levels. The lack of understanding appears to be caused by limited diagrams and examples, inadequate or inappropriate explanations pitched at too high a level, improper sequencing of learning materials with little consideration for the levels of the learners and so on.

In the Singapore context, although the Elementary Mathematics syllabus does not require students to write proofs, simple deductive reasoning is necessary to apply the geometrical properties learnt. Furthermore, proofs of these theorems are often given in textbooks and problems requiring simple proofs are also included. It would thus be necessary for students to attain Level 3 by the time they complete their secondary education and yet, for quadrilaterals, the majority of secondary four students were at level 2 and below.

Some suggested strategies for teachers

Van Hiele-based research has thrown much light on student difficulties in learning geometry and has also suggested strategies for improving the teaching and learning of geometry. It is for teachers to use these findings to improve the effectiveness of their geometry teaching.

1. Teachers should be aware that students could be at a level lower than the expected one. The examples, text materials, language and explanations used by the teacher should be adjusted accordingly.

2. Students should be helped to fill in their understanding at level I, teachers being alert to possible misconceptions due to limited examples of standard orientations. (See Lim (1992)).

3. Students could be encouraged to progress to level two by discussing and testing properties, perhaps with the help of computer software such as the Geometric Supposer.

4. Students should be encouraged to communicate, to describe and explain, their geometrical reasoning at all levels. This allows the teacher to correct misconceptions, to ask "why" questions so as to encourage deductive thinking, etc.

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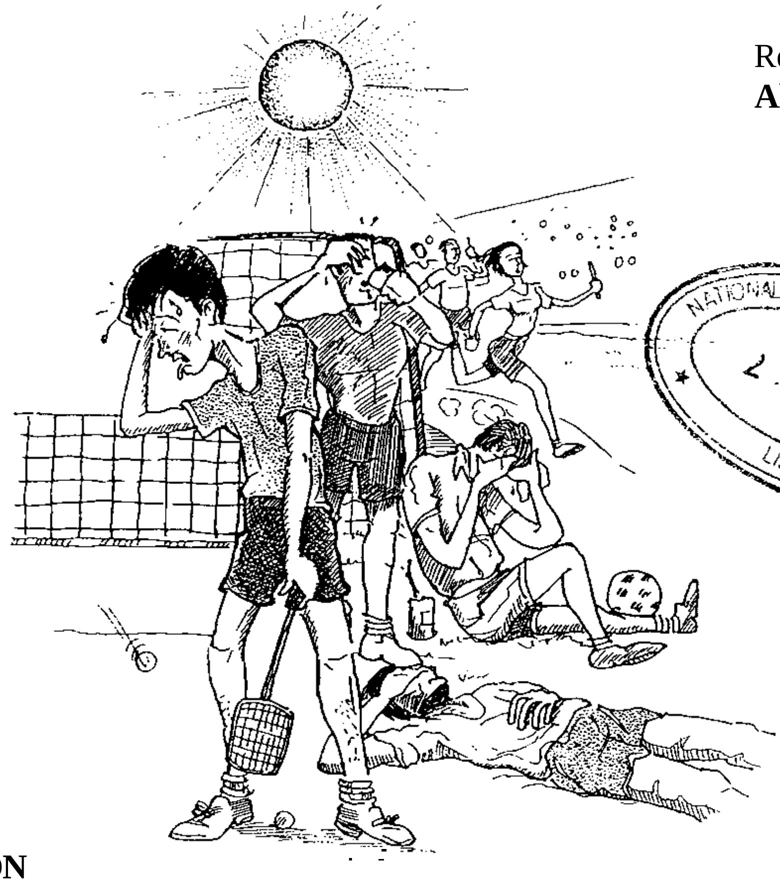
HEAT-RELATED ILLNESSES AND THERMOREGULATION IN CHILDREN

Review by
Alan Ch'ng T H



INTRODUCTION

In our tropical climate, which is hot and humid, the body produces large quantities of sweat during exercise in an attempt to achieve thermal balance. The rate of water loss through sweat may reach two litres per hour (Brouns, 1991) in order to eliminate the excess heat produced by the active muscles. However, because of the high humidity, much of the sweat produced is not evaporated and hence an important avenue of heat dissipation from the body is not maximised when exercising in our climate. As a result of the reduced cooling of the body, the temperature within the body (core temperature) rises and there is also progressive dehydration of the person. This could lead to heat-related illnesses if dehydration and rising core temperature is left unchecked. This paper will discuss the type of heat-related illnesses, thermoregulation in children and how schools could minimise the risk of heat-related illnesses to their students.

HEAT-RELATED ILLNESSES

Heat-related illnesses are sometimes called "heat disorders" or "heat injuries". They are pathological conditions arising from exposure to heat either at rest or during exercise (Bar-Or, 1983). These conditions are preventable, only if precautions and appropriate actions are taken when exercising in the heat.

Heat cramps are the most common of heat-related illnesses. They are characterised by painful and involuntary spasm of active muscles, eg.the calf muscles of the legs. They are mainly caused by prolonged exercise in the heat with excessive loss of water and possibly salt through sweat from the body. They are generally not serious and the student should recover by resting in a cool shade, drinking adequate amounts of cold water and gently stretching and massaging the affected muscles.

Heat exhaustion *(heat* fatigue) results from a physiological breakdown of the body's thermoregulating mechanism. This happens when there is excessive exposure to heat and generation of body heat from the muscles during intense physical exertion. Students affected by heat exhaustion show signs of headaches, dizziness, exhaustion, muscle cramps and flushed skin. In extreme cases loss of consciousness may occur. The affected student should be rested in the shade with any tight clothing loosened. Sponging with water helps and if conscious, a generous amount of water should be consumed. Where possible, a light electrolyte sports drink should be administered.

Heat stroke is the most severe of heat-related illnesses and is considered a medical emergency. There is a breakdown of the body's thermoregulating mechanism. The affected student will have a very high body temperature and dry skin. Loss of consciousness often follows complaints of headaches and signs of confusion. The presence of sweat on an unconscious student does not exclude heat stroke. All first aid procedures mentioned above should be taken and medical assistance must be called for immediately.

RESEARCH ON CHILDREN AND THERMOREGULATION

In general, children are not able to thermoregulate as efficiently as adults (Baily & Martin, 1988; Bar-Or, 1983). Although children have a larger surface area per unit body mass than adults which favours them in situations where heat loss is preferred, other factors may put them at a disadvantage in hot and humid environments.

(I) Children have a lower sweating rate (Bar-Or, 1983), ie. they sweat less over a period of time. Therefore, their evaporative capacity of sweat is much less. This reduced sweat rate is due to the lower output of the sweat glands compared to those of adults (Baily & Martin, 1988). The decreased capacity to lose heat from the body by evaporative means could increase skin temperature and subsequently causes the core temperature to rise during exercise.

(2) Children expend more energy per unit body mass when performing the same task than adults do (Bar-Or, 1983). A large part of the chemical energy used to do work is converted into heat. Hence, children produce a greater amount of heat per unit of body mass during exercise. This larger heat load will place their physiological system at higher stress.

(3) Children pump out less blood per minute (cardiac output) at a given exercise intensity. This may result in insufficient blood flow to the internal organs and also to the skin during intense exercise. This situation can also arise when the child has been exercising for a long time without replenishing lost water. With less blood flowing to these two areas, any increase in core temperature cannot be dissipated away from the skin (Bar-Or, 1983). Core temperature could then increase further with risk to heat injuries.

IMPLICATIONS FOR SCHOOLS

Even though children have a lower sweating rate, they still lose a lot of their body water through sweating during exercise. This is especially pronounced in tropical climates. Therefore a primary concern for the students' health and physical performance during exercise is to ensure that there are adequate drinks before, during and after their physical activities and training. When the students are hydrated adequately, the body is able to perform it's thermoregulatory function efficiently. To meet this end, schools can ensure that:

(1) there are sufficient water-coolers around the school compound so that water is easily accessible to any student.

(2) students are encouraged to drink before and after their physical education lessons and ECA training. When the lesson is conducted over two periods, a short water break may be useful. All students training during ECA hours should be encouraged to drink regularly. While water is easily available and cheap, schools wuld examine the possibility of providing electrolyte drinks (eg.100 plus, Gatorade) to their ECA sports groups when training or competition are conducted over a long period of time or in the heat. Electrolyte drinks have been shown to be more efficient in rehydrating the athlete than water alone (Nose et al., 1988).

(3) all teachers teaching PE and conducting ECAs need to be aware of the risk of heat-related illnesses when exercising in our climate. Teachers should allow regular drinking before, during and after a training session. It must be noted that drinking enough water to satisfy the thirst is usually not enough (Nose et al., 1988) and students should be encouraged to drink beyond this amount to properly rehydrate themselves after a long training session.

(4) where possible, ECA trainings should be conducted at a time of day when the temperature is lower, eg. early morning or late afternoon.

(5) students should wear light and loose clothing during training or PE lessons. Tight clothing restricts air movement between the clothing and skin and thus reduces heat loss by evaporation and convection.

The importance of drinking enough during exercise can never be understated. Our tropical climate with it's high humidity and temperature is not conducive for prolonged exercise without adequate hydration. However, if proper precautions are taken and students as well as teachers are aware of the importance of drinking adequately and wearing the right clothing for exercise, then the risk to heat-related illnesses can be minimised.

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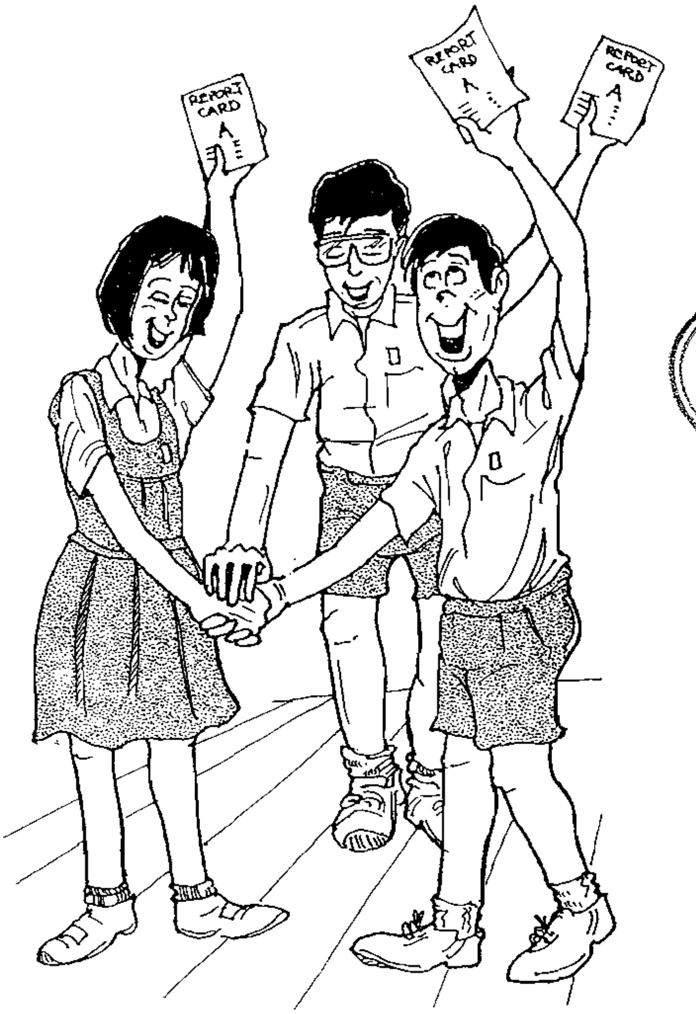
IMPLICATIONS OF GROUPWORK FOR ASSESSING STUDENTS



Review by
Jessica Ball

INTRODUCTION

Teachers in Singapore are becoming increasingly adept in using task-focussed group work to promote students' learning, communication skills, and selfdirection. However, teachers who have embraced the goals and methods of group work very frequently find themselves on uncertain ground when it comes to evaluating students during or after working in groups. Indeed, compared to the literature on how to implement groupwork, there has been little discussion about how to assess individual students when group work is used. This paper presents guidelines derived from a review of available research.

REVIEW OF RESEARCH

Available evidence provides a strong argument that the positive effects of shared learning tasks upon all group members depend in part upon evaluation that is shared by all group members (e.g., Johnson, Johnson, & Holubec, 1993; Sharan & Hertz-Lazarowitz, 1980). For example, in a review of 41 studies, Slavin concluded that, in general, the presence or absence of specific group rewards based on members' learning clearly discriminates approaches to group work that increase Student achievement from approaches to group work that has no greater effect on learning than traditional learning activities in which students work on their own (Slavin, 1983). Similarly, studies have shown that when students work in "traditional" groups, in which they are ***encouraged*** to work together but are given few ***incentives*** to do ***so,*** there are no significant benefits of group work over individual work on learning tasks (Slavin, 1990).

In Singapore, most students are familiar with, expect, and may initially prefer to be assessed using individual assignments and tests designed and marked by the teacher. However, based on a review of studies, Johnson et al. (1993) conclude that once students have actually been in a well-structured cooperative learning group characterized by individual accountability and goal interdependence, they tend to perceive a single group score as the fairest method of evaluation.

In addition to the benefits of group rewards on group cohesion and productivity, some investigators have drawn attention to the dimension of heterogeneity among group members in determining the choice of assessment strategy. When group members are heterogeneous with respect to academic proficiency, learning speed, or collaborative skills, studies suggest that a weighted combination of assessments of individual and group performance yield the highest validity and reliability (Slavin, 1990).

STRATEGIES OF COMBINED ASSESSMENT

Several specific alternatives for combining individual and collective assessments are suggested by Kagan (1991), Johnson et al. (1993), and Slavin (1990). These may be categorized into two main approaches described below.

(1) Combining assessment of individual and collective academic performance. One approach that has been well documented by Slavin (1990) and his colleagues combines a measure of a student's individual learning gains and a measure of learning among all group members. First, students work together in their cooperative learning groups and prepare each other for a test. Group members take the test individually and receive an individual score. All group members also receive a second score, reflecting the performance of all group members. There are several ways to derive the second score, including: the average of all members' scores; the total of all members' scores; whether all members achieved up to a criterion; or whether the group members' combined score showed a certain amount of improvement over the group's performance on a previous test.

(2) Combining assessment of individual academic performance and group collaboration process. Another widely used approach combines assessment of individual member's academic progress and assessment of the quality of collaboration among group members (Johnson et al., 1993). Assessment of "processing" skills shown by individuals or by the group may be based upon a variety of dimensions, such as: fulfilment of role responsibilities by individual members; frequency of interpersonal encouragement; evidence of turn-taking; and the group's ability to resolve conflicts or to reach consensus. Kohn (1993) and others have presented evidence supporting the use of self- and peer-evaluation of interpersonal dimensions with reference to each group member and to the group as a whole.

CHOOSING AMONG ASSESSMENT STRATEGIES

Beyond these guidelines gleaned from current research, several other considerations will affect a teacher's choice of assessment strategy when students work in groups.

(1) Objectives for students' learning. The relative importance placed upon academic learning or social skill development will affect that relative weighting assigned to our evaluation of students' academic proficiency and their social skills.

(2) Compatibility with the aims of cooperative group work. If we intend to develop students' capacities to work productively in groups, our assessment strategy should further include cooperative learning processes and goals (Johnson et al., 1993). For example, when students are asked

evaluate their own and others' contributions to a group task, they are likely to feel more accountable for the quantity and quality of their contributions and are likely to become more aware of their own and others' behaviours that enhance or detract from a group's ability to function effectively.

(3) Views about **the** roles of students in assessment. Assessment strategies vary with respect to the amount of input from teachers and students. Some investigators report positive effects of increasing student participation in assessment of group work (Kohn, 1993). For example, students may be asked to contribute questions for a test of material that they have studied in groups (Collison, 1993) or to develop criteria for evaluating their group process or product (Kagan, 1991).

(4) Objectives **of** the evaluation. The choice of assessment strategy will depend upon whether we are using it primarily to give constructive, ongoing feedback, as we do in formative evaluation, or to evaluate students' achievement at the end of a unit of instruction, as we do in summative evaluation. The former may he less formal, shorter, more frequent, and involve more student input. The latter may be more formal and involve more input from the teacher about the content and structure of the evaluation.

STRUCTURING GROUP WORK TO WARRANT COLLECTIVE ASSESSMENT

When group members share all or a portion of their assessment, the teacher must provide sufficient structure and guidance for the group work and students' understanding of how they will be assessed. On the basis of research, Johnson et al. (1993) have concluded that collective evaluation is more likely to be valid and perceived by students as fair if teachers take the four steps described below.

(1) Ensure individual **accountahility.** Individual group members must be held accountable for contributing and learning what the teacher intends (Slavin, 1990). This helps to encourage participation by all group members.

(2) Structure goal or reward interdependence among members. Students must be made aware that the group's goal can be achieved only if all members leam what the teacher intends students to learn through the group activity (Johnson et al., 1993).

(3) Facilitate productive group interaction. The teacher must prepare students with the skills they need to work effectively in groups (Webb & Farivar, 1994). The teacher must monitor interaction within groups to help students deal successfully with difficulties, such as inability to agree on a plan for task completion, social loafing or over-control by one or two group members.

(4) Ensure that students understand in advance the **assessment** criteria and **procedures.**

CONCLUSIONS

Effective teachers are versatile and exploit the advantages of a range of assessment strategies in order to develop valid, reliable, and comprehensive portrayals of students' progress and learning needs. Research indicates that when students are engaged in group work, they benefit most from assessment strategies that combine collective evaluation of work done in groups and individual assessment of academic gains and/or collaborative skills. When group members share a common fate, the teacher must provide a clearly communicated, cooperative learning group structure and assessment scheme.

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TEACHER INVOLVEMENT AND ATTENTION DEFICIT DISORDERS

Review by
Diana M Nomanbhoy

INTRODUCTION

Attention Deficit Disorder (ADD) is a multi-symptom medical disorder in which the individual experiences varying degrees of inattentiveness, hyperactivity and impulsivity. These characteristics, if left undiagnosed and untreated can lead to a cycle of failure in school and at work, which may in turn be manifested in other psychiatric conditions. It is also now acknowledged that ADD is not outgrown in adulthood (Wender, 1987). While some of the hyperactivity may diminish, the impulsivity, particularly verbal outbursts, and inattentiveness continue. For the minority of ADD adults who continue to experience relatively severe symptoms, there is a high probability in engaging in criminal hehaviour (Farrington, 1990).

Early diagnosis and intervention are thus imperative to reduce some of these risks. Since many of the symptoms become noticeable in the highly structured classroom situation, the teacher is often the first to realise the significance of these symptoms and is thus in a good position to aid in its early diagnosis and management. However, in order for teachers to effectively cater to the needs of these children, they need to develop an understanding of its definitional and developmental characteristics, its complexities, and knowledge of their responsibilities as members of the diagnostic and intervention team.

CHARACTERISTICS OF ATTENTION DEFICIT DISORDERS

Two main subtypes of ADD are recognised: Attention Deficit Hyperactivity Disorder (ADHD) and Undifferentiated Attention Deficit Disorder without Hyperactivity (ADD-H).

ADHD has been characterised by the Diagnostic and Statistical Manual of Mental Disorders, Third Edition - Revised (DSM-III-R) as 'developmentally inappropriate levels of inattention, impulsiveness, and hyperactivity." The condition must be present before age seven and be chronic (persistent for six months or more). At least eight of the following characteristics are necessary for diagnosis:

1. often fidgets with hands or feet or squirms in seat
2. has difficulty remaining seated when required to do so
3. is easily distracted by extraneous stimuli
4. often blurts out answers to questions before they have been completed
5. has difficulty awaiting turn in games or group situations
6. has difficulty following through on instruction from others (not due to oppositional behaviour or failure of comprehension)
7. has difficulty sustaining attention in tasks or play activities
8. often shifts from one uncompleted activity to another
9. has difficulty playing quietly
10. often talks excessively
11. often interrupts or intrudes on others
12. often does not seem to listen to what is being said to him of her
13. often engages in physically dangerous activities without considering possible consequences
14. often loses things necessary for tasks.

While the characteristics of ADHD are inclusive of hyperactivity and impulsivity that may occur at either the verbal or motor levels, the main characteristic of ADD-H is inattentiveness; hyperactivity is not present. Children with ADD-H continue to have problems with organisation and distractibility. They tend to be quiet and passive in nature and they often appear to be confused and lethargic. It is likely that this subtype of ADD is often underdiagnosed since these children are not overtly disruptive. Parker (1992) suggests that these children may he at higher risk for academic failure because they seem to go unnoticed and fall through the cracks of many educational systems. Thus, it is all the more imperative that these children are not overlooked.

Often, in school settings, the above mentioned ADD symptoms manifest themselves as poor and inconsistent school performance, disorganisation, disruptions in class, low motivation, poor social relations and/or low frustration. These behaviours are not unusual since paying attention is a prerequisite to learning. Rooney (1993) reports that attentional problems result in gaps in learning, different processing styles, and behaviours that interfere with learning and academic performance. Additionally, in the primary school, where children are required to follow rules and routines, their difficulties with rule-governed behaviour become more evident.

COMPLEXITIES IN THE DIAGNOSIS OF ADD

Although the diagnostic criterion calls for symptoms before the age of seven, diagnosis is often made retrospectively after entry into school. There are several factors that complicate the early diagnosis of ADD but teachers can be key players in its early differential diagnosis if they keep the following points in mind.

First, the diagnosis of ADD is based on the severity of behavioural characteristics; and identifying these behaviours as problematic can be subjective depending on the tolerance level of the persons involved in the diagnostic process. For example, parents are sometimes more flexible, tolerant and accepting of the typical early childhood ADD symptoms than classroom teachers who need to maintain a highly structured and well-managed classroom; any disruptions to routines will be less well tolerated by the teacher. Teachers tend to be more sensitive to the symptoms and initiate early intervention. Barkley (1990) reports that many of the ADD symptoms do in fact go unnoticed in 60 to 70% of ADD children prior to school entry and that it is often teachers who first initiate referral.

The inconsistency in performance and the influences of cognitive ability, environment, and task demands on the behaviours of the ADD child also complicate the identification process. With the exceptionally bright ADD children, for example, the first few grades proceed quite smoothly. Symptoms go unnoticed because they are able to master the rote materials despite their inability to devote their full attention to the curriculum. In higher grades, when the curriculum shifts from memorisation to the application of principles in new situations and as the amount of independent work increases, the ADD symptoms become more pronounced (Barkley, 1990). Teachers who are sensitive to such subtleties of the symptoms will be more likely to initiate early referral.

Finally, many of the symptoms of ADD are shared by other psychiatric disorders and a child may be initially misdiagnosed or vice-versa. Popper (1991) recommends that a child suspected of having ADD be carefully evaluated to rule out 'look-alike" disorders such as depression, anxiety, bipolar disorders, sleep disorders, and malfunction of thyroid gland. Physicians, psychologists, educators and parents need to work together and conduct a multidisciplinary evaluation of the child. This evaluation should include medical studies, psychological and educational testing, speech and language assessment, neurological evaluation, and behavioural rating scales for both the home and school environments (Barkley, 1990).

TEACHER INVOLVEMENT IN THE DIAGNOSTIC PROCESS

Undoubtedly, teachers are in a particularly advantageous position to assist in the diagnosis of the disorder because:

1. The majority of the characteristic behaviours are most pronounced in the highly structured classroom situation.

2. Teachers are often second to parents in the amount of time that they spend with the children

3. Teachers often have a better sense of what "normal" behaviour is since they have a pool of children to compare such behaviours.

4. Teachers are able to note systematically the chronicity of specific behaviours in different school situations and at different times of the day.

5. The novelty effect of the physician's or psychologist's office, which reduces the likelihood of noting the characteristic behaviours, is not an issue in the classroom. (Physicians and psychologists tend to rely heavily on teacher observations to counter the novelty effect in order to make an accurate diagnosis.)

The contribution of the classroom teacher in the diagnostic process is critical. They have access to a wide variety of information necessary for an accurate diagnosis. The teacher can report on systematic behavioural observations that are data-based and include time interval sampling with comparisons to typical peers; teachers can make observations in multiple school situations and at various times of the day; and finally, teachers can provide relevant information such as current academic performance of the child, academic history, and behaviour management strategies that have been tried (Barkley, 1990). It should always be borne in mind, however, that it is only in conjunction with other members of the multi-disciplinary team that a final diagnosis can be made.

TEACHER INVOLVEMENT IN INTERVENTION AND MANAGEMENT

Intervention, too, will necessitate a multi-modal approach involving a treatment team made up of parents, teachers, physicians, and behavioural and mental health professionals (Barkley. 1990). **A** concerted effort by each team player is necessary because of the complexity of this multi-symptom medical disorder that impacts rule-governed behaviour, academic learning as well as social interaction.

One of the most common methods of intervention in the **U.S.** is medication (Barkley, 1990). Many **U.S.** studies, have demonstrated positive short-term effects with stimulant medication: enhancement of behaviour, academic and social functioning (Barkley, 1990). Although medication can only be Prescribed by physicians, physicians are often in a disadvantageous position because they are unable to observe and monitor many of the problematic behavioural symptoms of the child in a typical brief "doctor's visit". Thus, physicians need to rely on a reliable source for feedback on the effectiveness of medication and teachers have been found to serve as this reliable source for the primary reason that the child spends a fair amount of his/her waking time in the classroom. Teachers can report on the child's drug response to various dosages and any medication-induced changes on behaviour and academic Performance using prescribed behavioural checklists.

Medication in itself, however, does not teach ADD children to overcome their deficits in organisation, study-skills, self-monitoring, social skills, and other processing deficits. Additionally, medication has not been demonstrated to lead to long lasting positive changes after it is stopped. Thus, Barkley (1990) stresses that medication should not be the sole method employed. Lerner and Lerner (1991) summarise three other general areas where teachers, in particular, can intervene that either directly or indirectly address the deficits mentioned above and enhance self-esteem and a sense of competence:

1. Behaviour management using contingency management techniques such as contingent teacher attention, classroom token economies (eg. some sort of tangible reward), peer-mediated intervention, and time out from positive reinforcement serve to reduce classroom disruptiveness and improve on-task behaviour and academic achievement.

2. Modifying the environment and the task by reducing the number of auditory and visual distractions, and providing greater task structure. Both of these allow the child to better cope with task requirements and also provide the child with opportunity to experience success in the classroom.

3. Meta-cognitive training such as teaching study-skills, self-monitoring and self-reinforcement strategies so that the child can learn to work independently and learn to control some of the impulsivity.

CONCLUSION

The diagnosis and intervention of **ADD** are complex and require a multi-modal approach. However, teachers can contribute significantly as members of a multidisciplinary team in piecing together the diagnosis and management strategies. Since many of the **ADD** symptoms go unnoticed until entry into school, teachers play a critical role in early intervention and minimisation of some of the future risks. Teachers must therefore become knowledgeable of this complex disorder so that their contributions may be of value.

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