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Science and the Teaching of Values
What Image of Science Does It Lead To?

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INTRODUCTION

This paper reports some preliminary findings from an on-going action research study on the teaching of values in science curriculum. Generally the study had two aims, one was to help teachers in the teaching of values in their science class, and the other was to study the possibility of introducing action research as a means of in-service teacher education in the future. This introduction explains how the image or conception of science became an issue to be considered in this study too.

An action research method was chosen because it is my belief that it is people, that is teachers and not research or researchers that are the principal problem-solvers and implementors and even initiators of changes in schools. It is mainly the teachers who need to make the translation from the curriculum developers aims to the daily classroom implementation. It is felt that not enough help has been given to teachers as a whole in helping them understand and translate these goals into a workable reality in the classroom. In a study on the teaching of values in schools, Haris & Ahmad commented that teachers have misperceptions when compared to curriculum planners. The reasons given were that teachers need to be and indeed were more concerned with the "immediate enabling objectives" which they must fulfil and that the "philosophical goals as envisaged by the curriculum planners are too remote for them to give immediate priority." If this is the report of the teaching of values in the Moral Education subject, then one can envisaged that the teaching of values in a subject that has

its own agenda, teachers are going to find the teaching of these values more remote and difficult to translate into the classroom. In a study on teacher's perceived importance of these values, Siow & Choong(1992) found that teachers do favor some values over others in both desirability and the ability to actualize these values.(See later) While one can obtain teachers perceptions of these values, more importantly, given the above finding on the teaching of values, is to understand what are teachers interpretations of these values in the science classroom. How do they translate these values? How do they relate or even feel about these values in their science classroom? Briefly then the reasons for choosing action research as the method of study is that educational value of action research is the "empowerment" of individuals so that they can on their own or collectively take action to solve their problems. (Kemmis, 1989.) The human interest is emancipatory.

The aim of the study then is that it intends to raise the awareness and competence of teachers in the area of teaching values and science in the classroom. It is aimed at improving the understanding of teachers in the teaching of values in science, their practice and the context in which the practice takes place. The methodology followed in this study would be close to that suggested by Bell, Kirkwood and Pearson, in the Teaching in Science Project -(Teacher Development). (1990). Adjustments would be made where necessary to suit the local school context. Briefly it makes use of qualitative research methods within an action research framework. Descriptive data will be collected using interviews recorded on audiotapes and transcribed, field notes, and teacher self-reports. The total programme of the study should include initial understanding of teachers as to what is teaching of the sixteen values in their science lessons means to them. This would be followed by teachers developing their understanding of values in science and science education, the development of lessons incorporating the teaching of values, trying out these lessons and analyzing their own practice. Teachers will be encouraged to make suggestions as to the method and type of

data that they felt needed for further understanding of their practices. These steps of the programmes would be worked out together with the researcher from the University.

The study was initiated using the Teachers' Professional Development Day, to introduce teachers to the idea of Action Research and Teaching of Values in Science. Teachers have been practicing the teaching of values in their lessons. Thus the first step of the study was to obtain teachers interpretations of these values in their science classroom, and to also obtain volunteer teachers to be involve as participant-researcher in this study. There were fourteen science teachers in this school. Teachers were asked to discuss in groups, their understanding and methods of teaching the set of values in their science lessons. They were given a set of questions to refer to if they felt they needed it on the teaching of the values, as well as the set of values in the syllabus. The teachers decided to form groups according to the level of students and subjects they were teaching. Thus the groups comprised of teachers teaching forms four and five and in the single science subjects, those teaching forms four and five and teaching the general science subjects, and those teaching forms one to three science. (specialization occurs only in the upper secondary schools). There were between four to five teachers in one group. In this initial discussion, the teachers were given the time and the freedom, to focus and discuss what they wished to. It is hoped that this would help to find out what concerns teachers most in the teaching of values.

After their initial small group discussion and an open discussion with the researcher, principals and supervisors, it was suggested that we should find out what the students think. The students have been exposed to the teaching of these sixteen values in their moral education classes as well as in all subjects since their primary school days. Do students interpretations reflect those of their teachers? It was decided that groups of students would be encouraged to discuss these values. That was

initially tried out with the science class. The teachers suggested that the researcher be the one to obtain the students view points as they felt they would influence the students. The students group discussion was however, not very successful. The researcher was present at the discussions by students as observer. After a while, she approached the students, and discussed with them, helping them along. The students then suggested that perhaps this was better as it helped them to think and discuss the values, rather then they on their own. A semi-structured discussion by students with the researcher was used to obtain the students views. The students declined individual interviews. Sixteen groups of five students in each group were interviewed. These were audio-taped and transcribed. One teacher of the five volunteers decided that he would obtained the students views himself. He decided to group the students into groups of three to four, and asked them to write within ten minutes what values they learned in the science class.

It is from this stage in the study, the teachers interpretations and the ensuing interviews with students that the conception of science and the teaching of the sixteen "noble values" became of interest to the researcher. In the initial study of the curriculum syllabus it was expected that these values would help and encourage the learning of science and that the suggested implementation from the in-service courses and school textbooks recommended would leave serious gaps in translating the values into the classroom. From this study so far, that appears to be realized. In addition, it appears that the teachers interpretation of these values, and the students perceptions of these values in their science lessons raises some questions for discussion on the image and nature of science that also may have implications for teaching of science.

BACKGROUND TO SCIENCE AND VALUES TEACHING IN MALAYSIA

The teaching of values has been given an important place in Malaysian Schools. A set of sixteen values has been identified and is taught in a

special subject call Moral Education. However, each of the school subjects has now to translate these sixteen values into their syllabus, be it Science, English, Mathematics, History Geography. The sixteen values, all of which are considered equally important are Compassion, Self-reliance, Humility, Respect, Love, Justice, Freedom, Courage, Cleanliness (both Physical and Mental), Honesty, Diligence, Cooperation, Moderation, Thankfulness, Rational, Civic -Mindedness or Public Spiritedness. These values are considered desirable qualities for a student to have. They are developed from the national philosophy of education which aims to develop a rounded individual in all aspects, that is intellectually, spiritually, physically and emotionally.

The Science Curriculum sees science as representing a field of knowledge that is the product of man's efforts to find a rational explanation of the phenomena of the world. This explanation brings understanding about the orderly existence and specific laws, arranged or orderly procedures or methods, and relationships that exists in the creation of nature. Curriculum developers focussed on fostering the development of these noble values from the view that man must play their role as responsible and intelligent human beings in the management of the environment. In addition, these values also represents those values that the developers felt could be instilled through the teaching and learning of science.

Thus the translation of the sixteen values into the science syllabus as a set of attitudes and values to be encouraged in the teaching of science are as follows:

1. possessing the spirit of curiosity, of wanting to know and will act with diligence to investigate matters and events that occur in the environment with boldness/daring and productive.

2. Be honest and objective in attitude in work of collecting and compiling and report the results of scientific investigations.

3. Be open-minded and ready to receive alternative ideas or views and to change your own views when evidence that are more

reliable are obtained.

4. to work cooperatively and take a positive attitude towards safety in the laboratory.

5. To value science as an empirical study about the various things and phenomena that can be observed and measured.

6. To be aware that Science represents only one of the ways of understanding the environment.

7. To value and practice living that is clean and healthy.

8. To value all kinds of living things, and the interrelationship, and interdependence and needs of all living things for the continuation of live in this world.

9. To be responsible in the use of natural resources and energy and to value the joint efforts of man to manage the earth or environment.

10. To value the beauty of the natural environment, and to care for its cleanliness for a peaceful and prosperous living.

11. To be cooperative and to possess the spirit of togetherness in our efforts to manage and care for the balance of nature.

12. To be responsible when making plans and conclusions and to take into consideration its effects towards society and nature.

The suggested method for teaching was that teachers looked for incidences outside of the science classroom, a social situation, that these values learned in science could be applied. It is clear, that the approach taken by the curriculum developers, was that science lessons would be a means, vehicle for teaching of values, as is defined in the moral education classes. Infant, except for the General Science syllabus, the syllabus of the other three science disciplines, physics, chemistry and biology, clearly stated that one of the aims of the curriculum, was also to foster the development of the noble values in students.

Science is taught as a General Science subject which comprises all three areas of physics, chemistry and biology, as well as the three individual subjects called the pure sciences. The physics, chemistry and biology subjects are taken in the last two years of secondary schools, whereas the general science subject is taken through the five years of secondary schools. Students taking the pure sciences need to take the first three years of the general science syllabus and need to qualify, by examination results to enter the pure science stream. The subject matter of science is also planned such that through the learning of science, students thinking become more matured and open and that it will also developed an individual that is creative and productive for national development.

TEACHERS AND STUDENTS INTERPRETATIONS OF VALUES - FINDINGS AND DISCUSSIONS.

The following interpretations of teachers and students on the meaning of these noble values in the science class is based on the descriptions and examples and the context in which they have described these values.

The values that teachers in their discussion focused on and discussed were honesty, objectivity, curiosity, responsibility, awareness and appreciation of nature, cleanliness(physical), civic-mindedness, co-operativeness, gratitude(thankfulness), hardworking. All, the three groups of teachers mentioned these values, and cited examples of how they teach it. In their discussions teachers did not discuss the values as stated in the science syllabus given to them, instead, often, when the is a word, or meaning that is similar to that found in the moral education class, that became the value discussed. Despite the fact that they were also asked in the discussion, to think of their role as science teachers, what are their responsibilities, and what is science, these questions never really came up for discussion. Instead, the discussion

focussed mainly on the four values that they considered that they have taught.

Values are taught mainly by "lecture method". This is telling students what not to do and what to do. Or by citing examples or reasons for not doing certain things, or behaving in a certain way. Some teachers mentioned that the actual value being taught for with the example given, while most teachers do not mention any value explicitly. It is mainly the lower secondary school teacher, in forms 1 and 2 that would mention the exact value to be taught for the lesson. However, with the upper secondary science teachers, the technique is not to mention the value at all. They expect that the examples or "advise" that they give to the students that concerns values will be "caught" by the students and practiced after the lesson and even after they leave school rather than that they are taught explicitly. Teachers have also claimed that students would laugh if they mentioned the values explicitly. Two values are taught more through student activities, these are honesty and cooperation.

The values identified by students in their science lessons can be grouped under the following headings - co-operation(working together), honesty, curiosity, open-mindedness, cleanliness and values that could be considered under the general heading of love and appreciation of the earth. The examples cited by students in these last value could belong to any of the last four items in the science syllabus.

The reaction of students and teachers also differ when they were initially asked to discuss the teaching and learning of values in the science class. Teachers were skeptical, fairly antagonistic(but there are more than just teaching of these values that give rise to this), and could be said to treat it as not that important. Students' reactions on the other hand were varied. The forms one and two students were serious

and ready to discuss whereas, the forms four and five students seem to find it incredulous and at times a joke. Definitely they all started by giving the researcher broad smiles and giggles. But that, it appears, is more of the reaction to learning values in their moral education class in general. Infant, they all begin by saying that they did not learn any of the noble values in their science lesson, however, after being given a list of the values, agreed that they have been taught these values. It could be that the students began to interpret the science classroom with the values they understand from their moral education class.

Generally it can be said the teachers interpretation and focus of values in teaching science, were more in line with the values as stated in the "moral Education" syllabus than that of the science syllabus. The number of values that were discussed were limited. The values inherent in science, the values that would be indirectly taught as students learn science was not considered at all. In addition, teachers asserted that these values were not something new. They have been teaching these values all the while, and it is a case of someone now "putting it into words".

The following paragraphs will discussed the interpretations of some of the values and its possible implications.

Honesty is a value that is tied to laboratory classes, and to the recording of observations made during experiments. Honesty is that students should record exactly what readings or results they obtained. There is no mentioned made recording experimental procedures followed during experiments. A general discussion on honesty is as follows:

T2: you see, they(the students) know the answer first, they know the results from books, their tuition teacher. During the experiments, they don't get the results, what I teach is you must write the results, you cannot bluff the results, so this is honest, and objective. We discuss the results in the perbincangan (discussion session), and it is not easy to get the results sometimes, even for us, it is because of the apparatus, or the skills, like the in chemistry, the reagents(is not pure)

even we ourselves also cannot get the results, we must guide them not to bluff the results, and then if you get it wrong it is alright, depending on how we discuss.

T3: The thing is if they write the wrong results, later when they refer to it, this is what I get.

T1: What I think Francis is trying to say is like this, if you write down the results like in you conclusion that time, okay, you can put in, this type of result is obtained because of the .....things possibly happen, like if these things are rightly done you would get another set of results, like the students write down their own results first, then in your discussion, if we have done it this way, or if the apparatus were more accurate, the following results would be obtained.

T4: It is the way it is being done you know. Like the melting of naphthalene, your instructions is that they heat it slowly, if you heat it strongly, the melting is so fast you cannot get the plateau in the graph.

Despite being aware of the need to relate results to experimental methods, teachers do not ask students to record accurately their procedures. A discussion follows after the experiment, where students with "wrong" results may repeat the experiment or obtained a set of "correct" results from other groups in the class. And what ultimately appears in the students' laboratory record books is a "record of "correct/acceptable results", and the right conclusions drawn.

For students honesty is also a value that is to be found in the laboratory and in recording of experimental observations. There are two instantances where students say they need to be honest. When they get the wrong results or observations in an experiment, and when they break something in the laboratory. Generally the students' interpretations agrees with that of the teacher. What they finally record as results of experiments really has nothing to do with being honest or not. They know, the teacher knows, that they have not got the accurate results. We don't want red ink all over our books and besides they would need the correct information to study for their examinations are reasons cited for changing their reading.

Honesty should be translated as integrity when it comes to teaching of science and not as "not lying" which seems to be the simple translation by teachers and students. It would be a value that would give wider interpretation to the science classroom, especially the laboratory. And this would include all the elements of science, its assumptions, methodology, approximations, questions it asks, the social significance and effects of its results too can be considered as part of the scientist work, especially if it is going to have adverse effect. It is perhaps, the non-teaching of values, in the science classroom, that has lead to the misuse of science that has led to the focus on its results. This teaching of what is honest has helped focussed the teaching away from science skills, and what should actually be happening in the laboratory. The way honesty is being interpreted by teachers, and the curriculum also sees the emphases on results and that would certainly help promote the "exact image" nature of science. That there is a clear cut right and wrong. It makes the numbers in science "hard" and to mean exactly what it says.

Another mentioned value is that students must be objective. Again this is mention in connection with laboratory work of students, in the recording of results. One teacher, gave this explanation, being objective is "being able to accept your wrong answers, but after discussion, one is being rational, not bias, being able to accept other answers that are right."
Students' interpretation of a similar situation is that they were being "open-minded". They were referring to another value. The teacher"s interpretation is again much from the point of a personal moral value, not to be bias.

It is interesting that students have much to say about learning this value in their science lessons, but the teachers do not even mention it in their discussions. To some students open-minded means being able to

> "accept new findings or results from the experiments when it conflicts with what we expect. And when the results is the other way around, we have to be able to be open-minded about it to accept that new results."

It is also being able to accept that they are wrong. This "open-mindedness" is also to be found in their discussions of questions during "revision" for examinations. There is a need to be able to accept that their friends answers or way of answering a question may be better, and this requires being open-minded. As one of them said, being open-minded means being able to

> "go back and look at our thinking, because something has conflict with the way we feel and think and that we do not like it or feel comfortable about it."

I think this clearly shows the "affective" or "emotional" dimension of any argument in the classroom. That learning science is not a totally cognitive process, and the emotional part is crucial when ideas conflict with what students expect or have understood. This interpretation of the value of being open-mindedness is perhaps significant for understanding the processes of the scientific enterprise.

Students also bring, this value further to their conflict in learning between what is outside the schools and what is from science. It raises the question of their position of scientific knowledge when it conflicts with "common sense" or the norm of situations. As one group of students explained in their learning of AIDS from their biology lesson. They were told that AIDS could not spread through touching and even sharing the same cup. Now in the case of hepatitis B they have been taught differently. This according to them, conflicts what is the norm about the spread of contagious disease. Isolation wards, etc, is the norm when someone gets a contagious disease or rather a serious disease that can cause epidemics. And AIDS has been in the

press in the form of threatened epidemics. They believed their biology lesson not because of the teacher or science. But because they were convince by the arguments provided by science. That AIDS was spread by a virus. And they have learned the characteristics of virus, that it could not exist outside the cell or human body. And therefore, it could not survive on the coffee cup or outside the human body, and therefore could not be spread by the normal means of contact. They felt that they needed to be open-minded and objective on their part in order to believe, and accept this explanation which runs so contradictory to what they hear outside, and their own common sense.

While teachers have not stressed on this value, students' interpretations gives a good start to their learning and participation in the progress of science. Here, science, is seen as being open-minded could build an image of science open, changing and moving. That students can bring out this value better than their teachers, or are aware of this value better than their teachers is a result I think from their moral education class. They could be transferring what they have learned to the science lessons, despite it not being taught or highlighted by teachers.

Another value which is highlighted by teachers is that of "cooperation". All teachers in this school mentioned that they teach students to be cooperative. And all instances cited for doing this is again in the laboratory work. In the school science laboratory class, experiments are usually carried out in groups of six or more students due to insufficient apparatus and large classes. This often becomes a "habit". Groups are formed informally by students choosing to sit on the same bench in the science laboratory. Thus groups are already made up of friends. Teachers feel that since students are working in groups in the laboratory, and that there are no squabbles, with experiments running, for that to happen students have learned to be cooperative, or are practicing the value of being cooperative. They are therefore being taught indirectly.

In their answers, students also describe the same situation for being cooperative. It is the sharing out the work involved in doing experiments. Some of us get the apparatus, some run the experiments and others clean up. However, what is obvious here that group work is not a formal intended arrangement planned by the teacher specifically for the day. It depends on the initiative of individual students, thus it is not surprising to find some students playing the role of observers of experiments only. Thus it is more of is more a having to work together, making the best of a situation, rather than the fact that if they do not cooperate and do their part, fulfilling their responsibility in terms of work and timing, the experiment would not get done. It leaves out the excitement and teamwork and responsibility of a scientific venture. As one student puts it:

> "what do we do if we do not cooperate? fight? naturally we must cooperate."

Working cooperatively can come to mean agreeing in silence. Indeed some students, especially the younger ones, give examples such as listening quietly to the teachers even if it is boring, or obeying the rules and regulations in the laboratory for safety sake, as instances of being cooperative.

Two values or attitudes that get mentioned together is curiosity and interest. Teachers feel the students' interest or curiosity could be aroused by their teaching or the subject matter itself. However, it ends there. There is often no follow-up as to what happens to the curiosity or interest, other than questions by students. Although the curriculum wants to see interest tied in with continued investigation, and the instilling of the spirit of investigation, this is not highlighted by teachers. Interest and curiosity are considered the same.

For students the value of curiosity is also synonymous to interest. This occurs during an experiment or before an experiment. It involves their experiencing the feeling of interest, of wanting to know, of not knowing what to expect. Besides experiencing these feelings of interest in their laboratory lessons, students also suggest that novel, unexplained or strange phenomena or things do build their curiosity in their theory lesson. How things work, why it exists, why are certain theories like that are among questions raised by one group of fifth form students. But the follow-up steps to investigate as mentioned in the syllabus is not mentioned by students. Their actions that follow is much dependent on the teacher, asking the teacher is the most likely next step to take. Further, despite the mention of interest in theories, the new and unexplained phenomena given as examples refer to "concrete" experiences that students could relate to, and not to theories and models. Thus action of bacteria vitamins that is good or bad, chemical reactions that they can see in the laboratory, how a car works, are new and of interest, but theory of gravitation while new, is not of interest. In the case of theories and models most students do not feel that they have learned anything new. According to one student "the apple still falls with or without the theory." And that we already know.

The focus of teaching here is again very much on results. Thus students feel curious rather than learn to be curious. They are stimulated by the new things that are introduced in the science lessons, but they themselves do initiate questions. This aspect of the value is not brought up or taught. Even when teachers teach, they think in terms of how to interest the students, to teach curiosity, is to create interest for the moment. But not to form the habit of asking questions, of wondering, of explanations. It appears perhaps that there are different aspects or levels to the value of curiosity, and the curriculum developers have rightly includes the aspects of follow-up investigative steps. However, the translation of that value into teaching lies with the interpretation of interest. Developing the value of curiosity for science

education must include the aspect of learning how to ask questions. And they should not be questions of any level, but questions at the meta-cognitive level.

The limited interpretation of curiosity with interest does not provide students with possible long term interest in studying science, or even how to study science. For an important element for the working scientist, is the ability to ask questions, different kinds of questions but those that are at the meta-cognitive level, at the level of theories and models. Questions that students ask out of interest tend to be those about technology rather than science. This then introduces a limited image of science. That the science programme has not emphasized sufficiently the modelling and theoretical aspects of science, and that inventions and creations are not only technological, and that discoveries are not only of things. They see science as very "concrete" as study of the environment and phenomena, the explanation, but not the theories.

The value of responsibility will extensive in science is again limited to caring for apparatus and instruments, during and after experiments. It means that students would clean and put away equipments in a proper manner. Responsibility is also cited as a value learned when students do their assigned homework. Students did not mention this value in their discussion.

For values such as cleanliness, civic-mindedness, appreciation of the beauty of nature and the interdependency of living things teachers cite the following examples. Similarly the students refer to these examples in their descriptions.

> Using water, we tell them not to waste, or pollute water. Do not leave the tap running when not in use. You should be thankful that you stay in Penang and you can get clean fresh water easily as compared to the village.
>
> Pets, if you want to have pets you must take care of them or else don't have them. animals should be cared for and there should not be unnecessary killing.

> Do not be wasteful. In the laboratory student are asked to be careful and not wasteful when using chemicals. Do not take more, take only the required amount.
>
> You should appreciate the beauty of your natural surroundings and do not spoil them, pollute them.
> Cleanliness means not polluting the earth too.
>
> You should not only take care of your things but other people's things too.

Most of these examples are cited during the appropriate lessons. It is an "add on" to the content that is being taught for the lesson. Lessons are not planned around issues that would highlight these values. This is perhaps the way that teachers see best for teaching values.

SOME STUDENTS' IMAGE OF SCIENCE AND SCIENTIST

Besides students interpretation of values, it was also decided to find out about what students understand about science ad what kind of values they think a scientist possess. Students were asked to describe the character they think a scientist have, what a scientist does, and what is science, and also asked to explained how they reached their conclusions.

The image of a scientist and science is very positive. And one sees that students may have transferred some of the values they have learned and identified in their moral education class to the science class. Students readily answered these questions, and without reference to the set of science values. They were asked these questions before the discussion of values began.

Scientist turn out to be people who are patient, determined, never give up or lose spirit, willing to take risk, brave in trying out experiments they do not know, hardworking, skillful, careful, not afraid of failure, not good at mixing with people, funny, spend all their time in the laboratory, intelligent,

creative and inventive, open-minded, truthful, independent and confident, scientist always introduce new things, curious, sensitive to the environment, helps improve society, brain is more active, what they do is think, invent and create all the time.

Where do students get these ideas from. It is hard to pinpoint exactly where students get these ideas from. Students themselves also felt that they get these ideas from a multitude of influences, such as reading of reference books, history books, scientist being cite as (good)examples in their moral education class, from their own experiences in the classroom. Among reasons some group of students give for coming to their conclusions were,

> scientist have to be sensitive to the environment because they observe what happens, and do research and try to find out about it
>
> they must be patient to do experiments, as they have to repeat many times, and they also must be determined and not give up easily
>
> the scientist must be willing to take risk when working in the laboratory because they do not know what will happen and it could be dangerous.
>
> truthful, if scientist did not have the evidence they would not say it.

These are some of the reasons students give, and they admit that in those given above, it was their experience in the science class that help them make up these ideas about scientist. The students in forms one and two, gave the more simple answers of hard working and intelligent. It is the forms four and five science classes, students who do the three science disciplines, and have been learning science for four continuous years that gave the more elaborate answers. It was from one group of the form five science students who said

> Before learning science, we think a scientist must be intelligent, after learning science, a scientist must also be sensitive, curious, not give up.'

They felt that they have to be more aware of their surroundings, sensitive and more

"active" when they are learning science as compared to the other subjects. They felt that science is a "live" and open subject, sometimes very strange. "You have to be creative in learning science," is what one student said. That the science classes certainly does influence the image of science and scientist is obvious.

CONCLUDING COMMENTS

Although this interpretations are from one school, and the group of students are girls studying in a city, I think that much of what they say can be found throughout science classes in the country. It is also possible that students may have transferred some of the values they have learned and identified in their moral education class to the science class.

There has been many suggestions on how values should be linked to science or has implications for science. Bronoswki, in his book Science and Human Values, suggest that the values needed for the practice of science are independence of thought and observations, leading to originality, and freedom, which would allow for dissent, a native activity of science. Baez, in his recommendations for teaching of science in the less developing countries suggest that the four values of curiosity, creativity, competence and compassion be also taught with science. Science should teach this four values, but how it should be done is mentioned. Curiosity and Creativity must be supported by patience and steadfastness. Competence must be a natural requirement of the scientist. In suggesting the teaching of compassion, Baez, suggest that this is the one value that would make the change to a "ecological mode" or the "being" mode. Thus in opposition to the "industrial mode" or the "having" mode the ecological mode would promote values that would lead to a better quality of life that is based on better environment, personal growth and interactions based on cooperation and meaningful activity. It would also suggest individual responsibility and promote fellow-

feeling, something that the world needs.

All the values are present in the set of noble values. But the teachers' interpretations of these values in the school classroom is what is significant. The strong emphases on "results" of experiments, on correct answers, a situation that is directly linked to the overwhelming importance of examination results in the country is proving to be one factor that may limit the meaning of all these values in the science classroom. In one national study conducted by Maznah et. al(1989) teachers have ranked disciplined and well-mannered, hardworking and keen to learn pupils, good-teacher pupil relationship, pupils understand what teacher teachers, and success in examinations as the top five outcomes of an effective teacher. In the study by Siow & Choong, cited earlier, the first five values that teachers desire are safety, gratitude, cooperation, cleanliness and thrift. The least desired values are justice/rationality, courage, creativity, moderation and freedom. Given such findings and the limited interpretations of these values by this group of science teachers which this study seem to indicate, there must be a concerted effort to help teachers reinterpret the set of noble values in the science class.

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