

Chapter 10

CONCLUSIONS AND RECOMMENDATIONS

10.0 INTRODUCTION

This chapter provides a brief summary of some of the important findings of the study. Based on these findings some recommendations can be drawn up. With sufficient background from four consecutive studies, it should be easier to map out workable programs that can be effectively implemented. It should now be left to the relevant authorities to act on the recommendations. Without such seriousness, the benefits of studies like this would not be shared optimally.

10.1 PERCEIVED KNOWLEDGE OF S&T

Malaysians continue to perceive themselves to have poor knowledge of S&T despite efforts to encourage S&T participation at all levels. Like the findings of the earlier studies, about one third of the respondents perceived themselves as having poor knowledge of S&T. But what should be a cause for concern is that the overall mean for perceived knowledge has continued to slip from 2.34 in 1996, to 2.24 in 1998, to 2.22 in the latest study.

However, on the brighter side, one of the two new topics added in the 1998 study, namely new inventions from Malaysia continues to be rated second in term of mean knowledge among issues related to S&T. The mean score for this issue has gone up slightly to 2.41 from 2.32 previously.

The public's perceived knowledge of various general and S&T issues continued to show significant difference between the different age groups. The mean overall knowledge of the children continues to be lower (1.95) in comparison to the youth's (2.27) and the adults' (2.19). The same pattern was observed in the last study with the mean knowledge score recorded at 2.02, 2.30 and 2.25 respectively.

Children claim to be more knowledgeable in S&T issues compared to general issues like the economy and business; and the national education policy. Children also continue to claim that they're knowledgeable on applications of computer technology. If this finding can be translated into the children's commitment to S&T in later years, it will be promising for the country.

The finding over the years for the youth group has been fairly encouraging because although the overall mean knowledge of the different age groups has dropped, the youth recorded the minimum drop.

The adults' mean level of knowledge on all issues, has dropped over the years, except for new inventions from Malaysia (from 2.32 to 2.39), new technologies and inventions (2.24 to 2.25); and applications of computer technology (from 2.26 to 2.28). At the same time, the mean knowledge level in some of the issues has increased.

It has been shown that there are significant differences in perceived knowledge of S&T between respondents of different educational level. The study indicates that the overall mean knowledge for respondents with primary education, secondary education and tertiary education are 1.77, 2.22 and 2.64 respectively. In the 1998 study, the order was also the same where the overall mean knowledge level were 1.72, 2.25 and 2.64 respectively. Hence, if knowledge of S&T is to increase to more acceptable levels, it should be part of the education system.

When comparison is made between respondents of different school streams, significant differences are also seen. The study shows that respondents from different academic streams displayed different levels of average knowledge of the issues. Respondents from the science stream continue to perceive a higher average knowledge in comparison to the other streams.

Urban respondents continue to perceive that they have better knowledge in overall general and S&T issues when compared to the rural respondents. The differences are significant in all the issues. What should be a cause for concern, is that, the mean perceived knowledge level for most of the issues discussed has gone down for the rural respondents. The mean level of knowledge for eight of the issues has gone down against two, which have gone up. The performance in the urban areas is better balanced where the mean levels for five of the issues have gone up against those of four which have gone down. To check the imbalance, something needs to be done in this area too.

10.2 PERCEIVED INTEREST IN S&T

Malaysians continue to be most interested in the same S&T issues in the two recent studies, but the level of interest in almost every issue has gone down. In terms of what issue attracts most interest, environmental problems continue to rank number one followed by the applications of computer technology and new invention from Malaysia.

The issues that evoked least interest are also similar to the ones in the two previous studies. The application of nuclear technology to produce energy attracted the least interest of the S&T issues among the respondents.

The youths continue to rate themselves higher in terms of interest in all the S&T issues when compared to the children and adults. Children, on the whole, continue to rate themselves lowest in terms of interest on the level of various issues discussed when compared to the youths and adults. Something needs to be done so that the interest among the youth will not taper off as they grow older.

As in the previous studies, the issue of environmental problems attracted the most interest among respondents of different age groups, and various educational levels. It can clearly be observed that the higher the education level of the respondent, the higher is their level of interest.

The study shows that urban respondents perceive themselves to have a higher interest in overall issues presented when compared to the rural respondents. The level of interest among urban respondents continues to slip in almost every issue except in new invention from Malaysia and new discoveries in the medical field. For example, the mean level of interest for environmental problems has slipped from 3.32 in 1996 to 3.01 in 1998 and to 2.9 in the current study. However, although there is a significant difference in terms of interest level between the urban and the rural respondents, their ranking of preferred issues of interest are almost identical.

10.3 ATTITUDES TOWARD S&T

Malaysians continue to view science and technology positively even though their perceived knowledge of S&T is still poor. When asked to assess the role of S&T in their lives majority responded positively on eight out of the eleven questions. For example, the majority (82.1%) of the respondents claimed that scientific research is necessary.

While the public has generally positive views of S&T, they hold mixed views of research that causes pain to animals and of the quality of science education.

Youths continued to demonstrate the highest optimistic views towards S&T, followed by the children and adults. Respondents across all the age group did not subscribe to the notion that science education is satisfactory. They also disagree that people are becoming too dependent on science and this may suggest that while they do recognize the importance of S&T, they could maintain an objective view.

Respondents with tertiary education are more positive on the benefits of S&T. They outscored those with secondary education in eight out of eleven questions. However, they are more cautious in areas relating to the impact of technology on employment and the human's sense of independence. These findings are very similar to those of the previous study. The response of those with primary education was generally less positive which could be due to their minimum knowledge on the subject matter.

Similar to the earlier studies, comparison between urban and rural population shows no significant difference in the attitudes towards S&T. Comparison between male and female respondents also shows no significant difference in the attitudes towards S&T.

Another reflection of their positive attitude is that almost half of the respondents agree that the economic growth in Malaysia is closely related to scientific research. Most Malaysians agree that scientific research has a positive impact on the economy particularly in sectors such as the agriculture, education, industry and business. This augurs well for more science activities. The majority of the respondents continue to believe that S&T has enhanced working conditions and raised the standard of living.

However, Malaysians' appreciation of and confidence in the impact of S&T on their lives have decreased slightly compared to 1998's findings. At the same time, not that many Malaysians feel that advances in S&T has a positive impact on the cost of living, world peace and environment. On the other hand, Malaysians across all age groups generally subscribe to the notion that S&T has a positive impact on the quality of life.

Difference in opinions were more pronounced between people of different educational levels, especially on topics relating to world peace, enjoyment of life and working conditions. Those with tertiary education are most optimistic on the roles of S&T in improving working conditions, standard of living and enjoyment of life. However, about a third feel that S&T has brought a positive impact to world peace, the environment and the cost of living.

The urban and rural population shows no significant differences in their opinions of the impact of S&T on the quality of life. At the same time, less than half of the public believe that the benefits of scientific research outweighed any present or potential drawbacks.

Malaysians on the average are getting more familiar with the concepts of genetic engineering and cloning. The present study has shown a marked improvement in their understanding of these concepts. The majority who has heard about these concepts is able to provide examples of each, such as cloning of animals, cloning of human beings, cloning of plants, and a combination of engineering technologies.

Malaysians' knowledge on the MSC is still minimal with less than a third of the respondents knowing about the MSC project. Only a small proportion was able to provide at least one application of MSC: such as smart school, electronic government, telemedicine and national multipurpose card. What the study shows is that Malaysians have heard of MSC but are not familiar with the applications.

Something which should be of concern is that, a large number of the public are of the opinion that the government has not done enough to reduce pollution and this finding concurs with the 1998 result. Slightly more than 40% of the respondents agree that the government had also not done enough on the improvement of public health and quality of education.

Urban respondents maintain similar attitude on their evaluations of four issues: support scientific research, improve public health, improve quality of education and reduce pollution. However, they improved slightly on their perceptions on the remaining issues: the government had not done enough to strengthen the country's defence and to support the aerospace industry.

10.4 UNDERSTANDING OF S&T

There have been some improvements in the level of understanding of both S&T and basic environmental terms and concepts among the Malaysian public during the 1996-2000 period.

Youths continue to demonstrate a greater understanding of S&T compared to adults. This finding could be due to the greater percentage of youths with tertiary and secondary education who are respondents in the research. This study also shows slight but continuous improvements in S&T understanding during the 1996-2000 period among adults, youths and children.

The level of formal education dictates Malaysian understanding of S&T and environmental terms and concepts. Respondents with tertiary education continue to score high on the understanding of S&T followed by those with secondary and primary education. However, scores by all the three groups for environmental knowledge are very much lower (29.6%, 16.4% and 6.2% respectively).

Individuals with a science stream background tend to report a higher level of understanding of S&T and environmental terms and concepts compared to their non-science counterparts. Overall, there has been a considerable increase in S&T understanding and environmental knowledge for all respondents across those disciplines during the 1996-2000 period.

As in the two earlier studies, the urban population is shown to have a better knowledge of S&T and environmental terms and concepts than their rural counterparts. However, the study also observes that during the 1996-2000 period, the urban and rural populations have demonstrated an increase in their understanding of S&T and environmental terms and concepts.

10.5 SOURCES OF INFORMATION

Television (followed by the newspapers and the radio) continues to be the most frequently used information source among selected sources. On the other hand, the public's level of trust is higher towards S&T publications. While the trust level for S&T publications has increased to 77.3%, the trust level has decreased significantly to 58.5% for the TV, and 49.7% for the newspapers.

While the news continues to be the most-watched program on TV, entertainment programs also continue to be the second most-watched program. Among the various age groups, the news is the most-watched program among adults but the children and youths prefer entertainment programs.

The study continues to indicate that program preferences between urban and rural populations are almost the same in most cases. Among the three age groups, youths continue to record the highest media consumption. As in the previous studies, a slightly higher rate of media consumption is recorded among youths in all the media.

Although media consumption continues to be higher in the urban areas, the difference continues to be minimal. Again as in the previous studies, a higher consumption of a media in the rural areas compared to the urban areas is only recorded in radio listening.

The frequency of newspaper readership among the public has declined steadily over the years from 54.2% to 44.1% currently. Readership by area (urban and rural) also dropped significantly with 49.3% of the urban respondents claiming that they read newspapers daily against 39.8% of the rural respondents who do.

By locality, respondents who read the newspaper daily continue to be higher (49.3%) among the urban public compared to those in rural areas (39.8%). The most-read items in the foreign newspaper have shifted to entertainment (22.0%), followed by sports (21.6%) and politics (18.4%). Children and youths record a higher preference for entertainment (33.6% and 33.8% respectively), followed by sports (33.6% and 25.7% respectively).

Entertainment programs continue to be the most-listened to program on the radio (76.1%), followed far behind by the news (11.3%). By locality, entertainment continues to be the favorite program of both the urban and rural respondents (78.7% urban and 73.8% rural).

Among magazine readers, local entertainment magazines continue to rank highest (39.5%). Also the public continues to prefer visiting the museum and the zoo to places like the science center and planetarium.

10.6 REACTIONS TO PUBLIC POLICIES/ISSUES

Only one out of every ten respondents admit to being knowledgeable about the government education policy regarding S&T while about five in every ten plead ignorance or are unsure. Public knowledge of the government's steps to increase the level of public awareness in S&T has declined to 23.6%. The rest remain either unaware (35.0%) or are not sure (41.4%) of the steps taken. 35.4% of the respondents who claimed to be aware of the steps taken maintained that the steps are effective while the majority (57.7%) said that they are moderately effective.

Among respondents who know about government programs to increase public awareness of S&T, a majority (63.7%) claimed that their level of awareness has only increased moderately. About one-third suggested that the Government should step up its campaign on S&T awareness.

10.7 RECOMMENDATIONS

The Ministry of Science, Technology and the Environment has initiated and implemented various programs and awards to increase the awareness of S&T in the nation. These were organized with the co-operations of the state governments, Ministry of Education, research institutions and universities, private sector and non-governmental organizations at the national, state and school levels. Included under the human resource development programs are the S&T HRD Training Program, National Science Fellowship (NSF), Science & Mathematics Teachers conducted by the Ministry of Education, Post Graduate and Post Doctoral Program, Short Course/Attachment and Consultancy. Some of the significant awards implemented under various categories are the National Science Awards, National Inventor Awards, MOSTE Awards and Science Quizzes. In addition various other S&T activities have also been implemented such as camps, quizzes, seminars, workshops and exhibitions.

Taking note of the excellent programs embarked by the Ministry, this research is proposing that the Ministry commission an independent study to scrutinize the effectiveness of the various programs implemented so far.

In conjunction with the recommendation proposed in the studies carried out in 1996 and 1998, this research likewise proposes the following recommendations which are grouped into broad categories namely *i) Popularizing And Improvement of Science Education, ii) Collaboration Effort In Popularizing Science Education, iii) Special Initiative For Women In S&T, iii) Outreach Program In Disseminating Research Findings and iv) General Recommendations.*

i) Popularizing And Improvement of Science Education

This research indicated that youth and adults who were educated in the science stream have higher interest in and understanding of S&T. It is imperative that for greater awareness of S&T and for the preparation towards industrialization, Malaysia needs more of its population to be educated in S&T.

The effort to encourage its citizen to participate in science education started in the 1960s. However, the government's objective in ensuring an enrolment of 60% in science stream in secondary school and tertiary education has not been achieved. A policy of having a 60:40 ratio of science against non-science enrolment in school that has been in existence since 1960 declined to 31:69 in the mid 80's. In the mid 90's, the ratio dropped further to 22:78 (Designing Science Education for Competitiveness - Academy of Science Malaysia, 1998).

The above paper by Academy of Science Malaysia discusses the declining interest in science education among secondary school children and it proposes comprehensive remedies to overcome this grave problem. It covers general policy decisions and recommendations and specific practices in the conduct and delivery of science education. The objective is to eliminate the perception or even the phobia that science subjects are difficult and to plan for long-term strategy to bring science to all, especially to rural areas and to women.

High-powered independent Council - This paper proposes a high powered independent think-tank responsible for overseeing the science and technology agenda in education. Adopting the practice common to developed countries, it is proposed that the council will be drawing the following educational standards and overseeing their implementation:

1. Standards for science teaching;
2. Standards for Professional Development and Science Teachers;
3. Standards for Assessment in Science Education;
4. Standards for Science Content and to relate to the National IT agenda;
5. Standards for Science Education Programs;
6. Standards for Science Education Systems

In addition to the above recommendations, this report would propose the following:

- Apart from suggesting reform for teachers' professional development, it is proposed that the income level of teachers, especially science teachers, should be improved. This can be achieved by implementing in-service training on a modular basis to allow the teachers to obtain Masters' degrees or equivalent qualifications.

- To improve the infrastructure of S&T teaching in school and higher institutions. It is suggested that a portion of the levy contributed to the Human Resource Development Fund (established to upgrade skills of workers) be used for improving infrastructure of S & T teaching. At the same time this levy will allow the development of more smart schools especially in the rural areas. Use of ICT should become an integral part of science teaching. Good quality interactive software can make the study of science appealing to all students.

- Reward should be awarded to schools or institutions that maintain a high enrolment and produce good grades in S & T subjects.

- In collaboration with the employers and professional bodies, higher learning institutions should develop more courses to cater to science stream students that are directly relevant to employment. Emerging fields in science must be introduced in higher learning institutions. Courses like Prosthetics and Orthotics, Environment Measurement, Air Quality, Optics, Science Instrumentation and Acoustics are among the courses to be popularized in the higher institutions.

- One area that could be expanded is the indirect involvement of non science or to be specific, arts students, into technology-based employment through courses, like graphic design and industrial design in which artistic talents are combined with the high usage of computer software.

ii) Collaboration Effort in Popularizing Science Education

From the perspective of collaboration and partnership, the proposed National Council should identify a list of specific needs so that different organizations including those from the private sector can help in addressing the particular need.

Example

Company or organization A may support the program in preparing new teachers and the professional developments of those already in service.

Company B may devote their commitment to programs such as "Making Science Make Sense" i.e. a program that is hands-on in its approach and also other programs and public education campaigns in promoting science literacy.

Organization X may award grants or prizes for best practices in science teaching.

Company Y may sponsor S&T week activities.

Company Z may devote their support to activities that capture the imagination of eight-to-twelve year olds, and girls especially in the rural areas.

Informal Science

Based on a model practiced in Texas, USA, this report proposes a formal organization to link up existing resources in the country like museums, parks, nature centers, science centers, research institutions like FRIM, RRI, PORIM and MARDI, botanical centers, public television stations, zoological parks, aquarium, planetarium and other free-device learning institutions. The proposed organization would provide unique learning environments that would increase the appreciation and understanding of science, mathematics, technology and their applications through voluntary efforts from individuals of all ages and backgrounds. The experience in Texas indicated that informal science education networks in collaboration with other institutions and community organizations increase the potential for significant improvement in science, mathematics and technology education.

iii) Special Initiative for Women in S&T

This research reported that there is a slight difference in the level of awareness and understanding of S&T between male and female population. In the past S&T is always associated with the male's world. Mothers and grandmothers often lack interest and knowledge in these areas and indeed often express fear and ignorance. Inevitably this will affect the rate of taking up science among female groups. To start with, the way the text and curriculum are designed should not be gender-biased. At the same time women scientists and technologies must be highlighted as role models. It is necessary that the government should earmark funds for special initiatives to improve women's understanding of science and technology.

iv) Outreach Program In Disseminating Research Findings

The activities of making the general public or non-expert understand scientific matters should be encouraged as separate and recognized activities among the scientific communities. Those who excel in these outreach activities should be rewarded accordingly, albeit perhaps not as much as the reward accorded to scientific discoveries themselves.

Scientists must be made aware of how important the impact of their work is and its possible applications on society and public opinion. They should see themselves as 'civil scientists' (Dr. Neal Lowe - in Home of Lords Science - Technology Third Report 2000).

Consequently the scope of work and hence the budget allocation of any research grant must also contain a portion devoted to activities of the dissemination of the scientific results to the general public. House of Lords-Science and Technology - Third Report, 2000 proposed that for any research grant to be approved it must have some of the following items in the checklist in the scope of work:

- Grant-holders has to supply project summary in plain English
- Grant applicants are questioned about approach to outreach activities
- Grant-holders have to develop dissemination strategy
- Annual or periodical reports must cover outreach activities
- Final report must cover outreach activities
- Grant-holders requested for extra funds for outreach activities
- Grant-holders requested for media and communication training

Hence it is recommended the research grants agencies in Malaysia should adopt the above approach in granting research funds.

Universities must also take initiatives to train research students in communication, in particular training in dealing with the media. The training should be broadened to include an awareness of the social context of their research and its application.

v) **General Recommendation to Increase Awareness of S&T**

A few practical actions to popularize S&T in the country could include the following: S&T month, Children's Science Congress, Rakan Muda Sains - a natural science movement for youth, dialogue session with scientists, propaganda of science through music, science debate, Roda Impian science/wheel of fortune program based on science, expanding science in the cyberworld, science museums/science centers at regional /state/district level, science tourism, S&T trade show and popular S&T publication.

Finally, it is recommended that at the governmental level, MOSTE could popularize S&T at the international level by taking the initiative in launching an ASEAN Science Festival to encourage wider involvement in S&T related activities.

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