

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

Introduction

This chapter is divided into three parts. The first part discusses the findings obtained from the study. The findings is discussed under the following headings:

1. Basic science concepts applied by Form Five students in their 1998 *Reka Cipta* projects,
2. Frequency of science concepts application in *Reka Cipta* lessons,
3. Students' perceptions on the importance of science concepts in *Reka Cipta* lessons,
4. Problems in application of science concepts in *Reka Cipta* projects, and
5. Ways to overcome the problems.

Conclusions will be drawn from the discussion on the findings. The second part of the chapter presents implications that arise from the discussion of the findings. The final part proposes recommendations for further studies.

Discussion of Findings

Basic Science Concepts Applied by Form Five Students in Their 1998 *Reka Cipta* Projects

The findings in this study show that the basic science concepts applied by students in the 1998 *Reka Cipta* syllabus were closely linked with the three

themes of lighting, separation and protection. The most frequently-used science concept was electricity. This was followed by electric current, kinetic energy, movement, force, light, potential energy, sound, pressure, heat, light energy, chemical energy, temperature, refraction of light, gravity, gravitational pull, dispersion of light, solar energy, inertia, pulley system, evaporation and photosynthesis.

Generally, it can be said that most of the basic science concepts applied in the themes lighting, separation and protection were closely linked to physics. Only one student used the concept of photosynthesis in biology. Basically, the main science concepts used were electricity (electricity and electric current), energy (kinetic energy, potential energy, light energy, chemical energy, solar energy and evaporation), light (light, heat, light energy, temperature and refraction of light) and force (movement, force, pressure, gravity, gravitational pull, inertia and pulley system).

Frequency of Science Concepts Application in *Reka Cipta* Lessons

The findings indicate that a large percentage of the students always used science concepts in *Reka Cipta* lessons. Very few students seldom applied science concepts. However, no student indicated that he/she never applied science concepts in *Reka Cipta* lessons. Therefore, it can be surmised that most of the students used science concepts although this aspect is not taught explicitly in *Reka Cipta* classes.

Students' Perceptions on the Importance of Science Concepts in *Reka Cipta* Lessons

A large percentage of the students applied science concepts in their *Reka*

Cipta projects. An overwhelming majority of the students also agreed that science concepts were important for *Reka Cipta*. Moreover, almost all of the students were of the opinion that they needed science concepts in their projects because science concepts helped them understand how a project functioned. Students also felt that science concepts assisted them in inventing their projects easily and successfully. Furthermore, with the assistance of science concepts, students could invent better and more interesting projects.

The study has shown that almost all of the students advocated the teaching of science concepts in *Reka Cipta* classes. Students suggested that the *Reka Cipta* teachers conducted extra lessons on *Reka Cipta* especially to teach science concepts and their applications in *Reka Cipta* projects as most projects required science concepts. Students also felt that science concepts should be taught in *Reka Cipta* classes in order to provide them with an in-depth knowledge of the concepts and their applications as well as a large repertoire of science concepts to choose from.

In conclusion, it can be said that the Form Five students in this study felt that science concepts should be taught not only in pure science classes like physics, but also in *Reka Cipta* classes. This is to help students understand science concepts and their applications better.

Problems in Application of Science Concepts in *Reka Cipta* Projects

Majority of the students faced problems in the applications of science concepts. Almost half of the students did not understand clearly a few of the science concepts used. Students were often unable to think of suitable science concepts to be used in their projects. They also found it difficult to explain some

of the science concepts used or even to apply these science concepts in their projects.

Students found that science concepts were so difficult to apply that they had to guess the science concepts that they could use in their projects. Sometimes, although students knew some of the science concepts, they were not be able to apply them. Explaining the concepts as well as how their projects functioned also posed major problems for the students. Students also did not really understand the science concepts that they had used in depth. In addition, lack of technical and professional advice and assistance also hindered the application of science concepts.

It can be surmised that these Form Five students felt that the application of science concepts was important in *Reka Cipta*. Yet, they faced various kinds of problems in the applications of these science concepts.

Ways to Overcome the Problems

Both the survey and interviews revealed that most of the students overcame their problems of science concepts application in *Reka Cipta* projects by consulting their teachers and friends. The students also did their referencing in the library. Students made modifications to their projects so that they could use easier science concepts, put their problems aside and thought of other science concepts to use as well as carried out their own experiments to test the science concepts which they could apply. Searching for information from the Internet was also one of the ways of solving the problems. Some students resorted to electrical shops to seek for technical and professional advice and assistance. Help from the laboratory assistants in school was also sought.

It can be concluded that assistance from various people was most sought after compared to other methods such as referring to books and obtaining information from the Internet. Teachers were the persons most of these students relied on for help.

Implications

From the discussion above, several implications can be drawn. Firstly, since the students applied several main science concepts (Electricity, Energy, Light and Force) in the 1998 *Reka Cipta* syllabus, teachers could focus on these few main science concepts to ease the process of teaching and learning. Curriculum developers should formulate certain guidelines for teachers to concentrate on these main science concepts in the 1998 *Reka Cipta* syllabus. They could identify the main science concepts for every theme and provide guidebooks and handbooks on the concepts and their applications. With clear guidance and assistance, teachers would be able to guide their students better.

The researcher suggests that materials focusing on these few main science concepts be published so that students would have better grasp of science concepts. Gross et al. (1971) pointed out that availability of highly-motivating instructional material is vital in order to ensure a successful implementation of a new curriculum. With this regards, therefore, materials for *Reka Cipta* too should be highly-motivating and able to provide a large number of examples of how science concepts could be applied to inventions. This kind of materials would be useful to teachers and students, especially non-science students who were taking *Reka Cipta*.

This suggestion would also mean that if the curriculum developers change the themes every year as it is currently done, they would have to come up with different frequently-used main science concepts annually. Perhaps curriculum developers could consider retaining the same themes for two or three consecutive years. This would give them and publishers enough time to come up with materials for teachers and students to use. The distribution of these materials to schools also should not be delayed. Gross et al. (1971) indicated that the time factor is vital as difficulty in obtaining supplies and materials quickly enough often hinders a curriculum from operating with desired efficiency. The time factor, the researcher of this study feels, also applies to *Reka Cipta*.

This study discovered that majority of the students frequently used science concepts in their *Reka Cipta* lessons. There was no indication that science concepts were never used at all. Students agreed that science concepts were important for *Reka Cipta* and advocated the teaching of the aspect of science concepts in *Reka Cipta* lessons. Therefore, teachers should take this aspect into consideration in their lessons. Teachers could place more emphasis on science concepts and their applications in students' projects. Direct applications of these concepts in projects should be addressed. Teachers as well as curriculum developers need to be sensitive to the needs of the students and find ways to provide sufficient guidance and assistance.

The main problem that these Form Five students faced with regards to science concepts applications was that they did not understand some science concepts clearly. Some students were able to think of a few science concepts but they did not know how to apply them in actual situations. Some students were not

able to explain the science concepts used. This means that these students were well-versed with the theories they had learnt in science classes but were not able to see how these science concepts could be used in practical situations. Most of the students generally did not have a firm grasp of science concepts. The researcher feels that it cannot be assumed that once these students have learnt some science concepts in their science classes, they can and are able to apply the concepts in authentic inventions.

In general, most of the students were of the opinion that their teachers should teach them science concepts during *Reka Cipta* lessons. Extra classes devoted to the teaching of science concepts and their applications to inventions were suggested by these students. Thus, the researcher proposes that one extra period be allocated weekly for *Reka Cipta* lessons in schools. This extra period should be devoted to the teaching of relevant science concepts and their practical applications in students' inventions. With the existence of this extra period, it is hoped that problems of application of science concepts in *Reka Cipta* could be minimized.

The findings in this study also imply that teachers play the most important role in helping their students overcome problems related to science concepts application. Therefore, *Reka Cipta* teachers need to be well-versed in various science concepts and their applications. Hence, the researcher feels that *Reka Cipta* teachers should be the science optionists. Moreover, since most of the basic science concepts used in *Reka Cipta* were concepts in physics, perhaps school administrators should consider choosing physics teachers to teach *Reka Cipta*.

Currently, teachers who teach *Reka Cipta* come from various fields of discipline such as pure sciences, economics, mathematics or even economics. One wonders if these teachers themselves have any problem helping their students to overcome problems related to science concepts and their applications in *Reka Cipta* projects. If so, then these teachers need to develop the skills and acquire the knowledge required to guide their students. Gross et al. (1971) and Charlesworth (1975) pointed out that one of the reasons for minimal success in the implementation of a curriculum was teachers' lack of skills, knowledge and needed capabilities. Therefore, it is vital that guidance from qualified persons such as state *Reka Cipta* resource personnel and personnel at the Curriculum Development Centre is obtained in order to help these teachers acquire the techniques and skills needed to resolve problems in the applications of science concepts in *Reka Cipta*.

Teachers also need to be creative in their teaching approaches as *Reka Cipta* is an interdisciplinary subject which demands high level of creativity. Teachers also must be able to provide adequate examples or hold discussions on science concepts and their applications during *Reka Cipta* lessons. Teachers should emphasize not only scientific theories, but also the practical aspects of these theories. Madhavan (1988) explained that it would be difficult to implement a new curriculum successfully if teachers did not possess the necessary skills and ability. This view is also relevant to *Reka Cipta*.

As seen in any curriculum implementation, the teacher is the key person who ensures a successful implementation of curriculum (Siti Hawa, 1986; Madhavan, 1988; Crabtree, 1989; Ahmad, 1994). Noraini and Rahimah (1988),

Lynch and Saifellslam (1989) as well as Ahmad (1994) were of the opinion that effective implementation of a curriculum could be achieved if teachers were adequately prepared. As such, in the case of *Reka Cipta*, the researcher feels that teachers need to be given sufficient orientation, training, in-service courses as well as staff development courses to ensure the successful implementation of the *Reka Cipta* curriculum in schools in Malaysia. Without much exposure to such courses, these teachers may not be able to develop the capabilities needed to perform in accordance with the requirement of the *Reka Cipta* curriculum. In view of the importance of such exposure to the development of teachers, the researcher of this study also recommends that in-service courses be an on-going activity. These courses should be held from time to time so that teachers could hold regular discussions, workshops and seminars among themselves and with resource personnel in order to promptly resolve the teaching and learning problems that they face in *Reka Cipta* lessons. Regular discussions and workshops would also help teachers share and broaden their knowledge and experience towards identifying and adopting effective techniques to teach science concepts and their applications in *Reka Cipta* projects. Feedback could be obtained from these regular meetings and actions could be taken to resolve the problems that teachers and students face during *Reka Cipta* lessons.

Another important way of overcoming problems in science concepts application is referring to books. It is sad to say that text books for *Reka Cipta* subject are not available to students and teachers. This study discovered that Form Five students resorted to their pure science text books, especially physics in order to overcome problems they had faced concerning application of science

concepts in *Reka Cipta*. This would put non-science students at a great disadvantage.

On the other hand, teachers have to refer to science magazines and journals however, these material are limited. Besides that, international materials are not cheap. In East Malaysia like Sabah, these resources are even harder to come by. Gross et al. (1971) cited that inavailability of instructional materials poses a major barrier to curriculum implementation. With this regards, the researcher of this study suggests that schools resource centres and libraries be provided with a large reserve of reference books and other related literature which *Reka Cipta* teachers and students could make use of.

Charlesworth's study (1975) has shown the need for adequate teaching materials and resources for effective implementation of a new curriculum. *Reka Cipta* lessons should incorporate a wide variety of teaching and learning methods due to its inter-disciplinary nature. Therefore, the researcher feels that *Reka Cipta* teachers should have at their disposal, a broad spectrum of resources and means to facilitate the teaching and learning process. As such, it is recommended that Teachers' Activities Centres or *Pusat Kegiatan Guru* play more active roles in developing teaching aids, materials and other resources for use in the *Reka Cipta* classrooms.

This study also found that there was lack of technical and professional advice and assistance. Some students in the study approached electricians and technicians outside their schools on their own initiatives. Thus, this matter should be looked into by teachers, school administrators as well as curriculum developers so that problems of science concepts application in *Reka Cipta* could be resolved.

Probably, teachers and the school administrators could foster better ties with governmental and non-governmental professional bodies as well as private companies. This is important as these bodies and companies could render assistance in the technical and professional aspects which students are not able to obtain from their teachers or laboratory assistants in schools. Participation and assistance of private sectors and non-governmental bodies could help solve some problems related to the applications of science concepts. These bodies could provide technical assistance or advice in students' invention of scientific and technological products. The researcher suggests that schools offering *Reka Cipta* look into this direction in order to minimize problems relating to applications of science concepts. These organizations may also be able to assist in financial matters pertaining to invention of more technical, scientific and sophisticated projects. Field trips to the private companies and factories may be beneficial for students in order to gain more knowledge on the applications of science concepts in everyday life.

Last but not least, *Reka Cipta* students should be exposed to various Invention and Designs competitions and exhibitions at state and national levels so that they could gain better insights into applications of science concepts in inventions. The Malaysian Invention and Design Society (MINDS) and Standard Industrial Research Institute of Malaysia (SIRIM) could also play more active roles in encouraging inventions and innovations at school level.

Recommendations for Further Studies

Among the various aspects that can be considered for further studies are:

1. to ascertain the problems and difficulties *Reka Cipta* teachers face with regards to science concepts application during *Reka Cipta* lessons and ways to resolve the problems;
2. to ascertain the problems and difficulties *Reka Cipta* teachers from non-science options (such as economic, arts or mathematics) face with regards to science concepts application during *Reka Cipta* lessons and ways to resolve the problems;
3. to ascertain the problems and difficulties *Reka Cipta* students from non-science stream face with regards to science concepts application in their *Reka Cipta* projects and ways to resolve the problems;
4. to ascertain the problems and difficulties *Reka Cipta* students at lower secondary and primary levels face with regards to science concepts application in their *Reka Cipta* projects and ways to resolve the problems;
5. to evaluate the implementation of the whole *Reka Cipta* curriculum, taking into consideration teachers' concerns, preparations and needs; students' difficulties; facilities; finance; teaching and learning activities; instructional strategies as well as ways to resolve the problems encountered at three different levels i.e. primary, lower secondary and upper secondary.

In conclusion, it is hoped that this study will provide insights for other researchers to carry out more future studies of the same nature.