UNRAVELLING A STRAND IN AN INTRICATELY WOVEN SONGKET PIECE: 
THE ADDITIONAL SCIENCE CURRICULUM IN THE MALAYSIAN INTEGRATED 
SECONDARY SCHOOL CURRICULUM

by

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A thesis submitted in conformity with the requirements 
for the degree of Master of Arts 
Department of Curriculum, Teaching and Learning 
Ontario Institute for Studies in Education of the 
University of Toronto

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Abstract

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The rationale and mechanism for the design and development of the Additional Science curriculum in the Malaysian secondary school curriculum are examined. The contextual examination of the indigenous science curriculum syllabus through a socio-historical analysis clarifies the current status in the upper secondary school curriculum. A comparative analysis is provided for the multidisciplinary Additional Science curriculum episode with the implementation of similar primary school curriculum. Factors influencing the planning and development stage and the implementation stage are interpreted. The extent that systemic barriers and external controls imposed on the science curriculum development experience in a centralised educational system is interpreted as well. Rethinking planned curriculum change is imperative to ensure repetitions of unproductive course of actions is minimised and avoided. Such efforts would require greater co-ordination and co-operation from all levels in a country’s educational system.
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PART ONE: INTRODUCTION

CHAPTER I: THE NATURE AND PURPOSE OF THE EFFORT

The curriculum is...an important social artefact and a vital documentary source for any social history.

Goodson, *International Perspectives in Curriculum History.* 1987

Introduction

The word *songket* refers to 'the process of digging under'. The *kain songket* is a hand-woven textile of gold and silver thread combined with fine cotton or silk yarn. The *songket* is normally worn on special occasions and, in the early days, it was the attire for the aristocracy in the Malay Archipelago. *Songket* weaving is one of Malaysia's cultures that is still practised in the East Coast states in Peninsular Malaysia.

The process of *songket* weaving requires dexterity and patience. In the act, the weaver infuses his/her past experiences embedded in the design and motifs of a beautifully crafted piece. The piece is an historical, artistic and cultural artefact.

Similarly, a country's school curriculum is also an important historical document because it evolves from the tensions and negotiations between various elements in the society at a particular period of time. Just as the process of untangling a gold or silver strand from a motif on a *kain songket* reveals much about the weaver, a contextual examination of a school curriculum will reveal the nature and dynamics of the curriculum.
The Focus of the Study

To face the many challenges in the field of education and to acknowledge the crucial role of education in building the nation, the Malaysian Ministry of Education took the concrete step of spearheading and shouldering the responsibility for the development of human resources through the schooling system. The 1980s was a significant period in the Malaysian education system, beginning with the introduction of a curriculum innovation known as the New Primary School Curriculum (NPSC) or Kurikulum Baru Sekolah Rendah, KBSR, in the Malay language. In the late 1980s, after a full cycle of NPSC, the Ministry introduced the Integrated Secondary School Curriculum (ISSC) or Kurikulum Bersepadu Sekolah Menengah for the secondary level. Its acronym in the Malay language is KBSM. The planning and development of both these curriculum innovations was guided and governed by the objectives and principles of the Rukun Negara (National Ideologies) and the Falasahah Pendidikan Negara (National Education Philosophy).

The bloody racial conflict of May 13, 1969 was a watershed in Malaysian history. Both the Rukun Negara and the National Economic Policy (NEP) were formulated with the intention of addressing the racial issues that brought about this incident.

The Rukun Negara is the philosophy of life that guides the citizen towards common aims for building a united Malaysian nation with a common and shared destiny (Appendix A). It was formulated by the Department of Unity, which was set up after the 1969 incident. Its five principles have become the pillars for the attainment of these aims. The Falasahah Pendidikan Negara, formulated in 1983, defines and explicitly directs the aims and goals of education in Malaysia (Appendix B).

One of the aims of the recent economic policy, which replaces the NEP, is to make science and technology an integral element in Malaysia’s socio-economic planning and development. This would entail developing a competent workforce based on scientific knowledge and technology and promoting a science and technology conscious society towards the vision of building an industrialised and progressive country.
This study focuses on the upper secondary science education after the implementation of the ISSC in 1989. In an “effort towards further developing the potential of individuals in a holistic and an integrated manner” (Ministry of Education 1991), an elective science subject Additional Science, was introduced at the upper secondary level (equivalent to Grade 10 and 11 in North American schooling system). The science curriculum is specifically designed for able students who have an interest in science and intend to continue further studies in science and technology related courses. “In structuring and determining the content of this subject, the main consideration was on integration” (Ministry of Education 1991, 4). Firstly, the “integration [is] between the science disciplines” (Ministry of Education 1991, 5) with the content organised thematically. The second aspect is the integration of knowledge, skills and values through the teaching and learning experiences with the assumption that “a skill or value is also appropriate for other aspect of knowledge” (Ministry of Education 1991, 5).

This study focuses on the historical development of the Additional Science curriculum from its conception to the current scenario. It illustrates the interplay of factors and forces in society that might have resulted in its current status as a science subject in the secondary school curriculum in Malaysia. The study attempts to describe and explain the development of this science curriculum innovation through socio-historical analysis of related textual data from various sources in the curriculum development process and where possible, through the lenses of the participants involved. As a teacher involved with the implementation of the specified curriculum from 1986 to 1994, a former teacher educator for a couple of years and my own recollections from previous involvement in curriculum development projects will also contribute to this developmental description. From this ‘recount’ of the events, emerging issues related to the curriculum development process, in general, will be interpreted.

Finally, an attempt is made to determine patterns in the implementation of a curriculum innovation by comparing the interpretations of this study with a work previously done by another researcher in the implementation of the Man and Environment curriculum.
**The Specific Questions**

Using the case study method, this study seeks to explain and interpret from the perspective of curriculum history, the formulation and subsequent development and implementation of the *Additional Science* curriculum, which is offered in the two years of upper secondary schooling. It also describes the current scenario of the curriculum programme and ascertains the forces and factors that might have influenced and contributed to its acceptance in the schools.

The over-arching research questions is:

How was the *Additional Science* curriculum designed, developed and implemented as part of the new Integrated Secondary School Curriculum (ISSC) for the upper secondary level and to what extent did the influence of individual(s) or groups contribute to its acceptance at the implementation stage?

This complex research question can be further refined into the following:

1. What are the rationale and mechanism for the design and development of the *Additional Science* curriculum?
2. Who are the individual(s) or groups that might have affected its acceptance as a theoretical subject with a status equivalent to the other three pure science subjects in the upper secondary curriculum?
3. How and to what extent do these forces influence the implementation phase in the secondary schools?

These questions focused the investigation on the involvement and interaction of participants and events in the curriculum development project at all the levels in the change process. However, it is also recognised that these questions will only provide an initial
framework for establishing the scope of the inquiry. These questions are flexible in nature. The historical development is coupled with the grounded theory mode of data analysis allows the inquiry to respond to any emerging issues from the initial data collected. By comparing the interpreted data with existing models for the development and establishment of school subjects, other questions are generated to accommodate these emerging issues.

Inquiring into the rationale for the development of the Additional Science curriculum could reveal the underpinning philosophical assumptions of the planners and developers. The practitioners and former students of the curriculum innovation are also interviewed so as to examine opinions and views of the programme from their perspectives. Comparing the data collected from both ‘ends’ of the curriculum development process might reveal issues related to the dissemination and diffusion of the planned change.

Sharifah Maimunah and Lewin (1991, 244) have identified the existence of the “element of miscommunications concerning curriculum intentions” in the implementation of the Man and Environment curriculum innovation, which was implemented at the primary school level in 1989. Due to the similarities in the suggested approach and the emphasis in the content between the Man and Environment (Lee 1986, 17-19) and the Additional Science (Ministry of Education 1991, 4-5) curriculum innovations, the research questions in this study might assist in explaining the cause of any miscommunication between the ‘intended’ and ‘perceived’ intentions of the Additional Science curriculum innovation. In addition, the contextual examination of the curriculum development could reveal the tensions and negotiations that have resulted in the subject’s status in the secondary school curriculum.

The Objectives of the Study

The purpose of the study is to document the development of a science curriculum innovation from its initial conception. This planned change evolved from the educational reform in the secondary school curriculum during the 1980s. Through the attempt to describe
and interpret the complexity and unravel the web that surrounds this process, emerging issues from the analysis of the data will provide insights for the improvement and refinement of curriculum development practices in the future. By examining and comparing patterns in the development of the two planned change science curricula in the Malaysian education system, the study presents a perspective on the influence of situational contexts on the acceptance and establishment of a new subject in a school curriculum.

The specific objectives of this inquiry are:

1. to describe and explain the development of the Additional Science curriculum within the framework of the secondary school curriculum;
2. to compare research findings concerning the Man and Environment and Additional Science curriculum; and
3. to develop an alternative conceptual framework through an analytical interpretation for implementing a school curriculum.

The Rationale for the Study

The Curriculum Development Centre (CDC) of the Malaysian Ministry of Education has identified and adopted a cyclic model based on four phases: needs analysis, design and planning, implementation and evaluation, as the statutory procedures and essential stages in any curriculum development project (Sharifah Maimunah and Lewin 1991; Sharifah Nor 1998). However, some variations in this model occurred, as circumstances dictated. Additional steps are added to this seemingly smooth process when necessary, depending on the specific subjects concerned. In an attempt to evaluate the effectiveness of any implemented curriculum programme, the CDC is also engaged in ongoing monitoring in schools and conducts studies in the school science laboratories to investigate the
implementation phase of the curriculum project. This is especially imperative for curriculum programmes involving large numbers of students, such as the implementation of a core compulsory science subject (Curriculum Development Centre 1997).

However, the literature shows that the CDC has conducted only a very small number of studies to evaluate the implementation of the subjects in the ISSC at the secondary level. Furthermore, there are only two studies conducted by this government agency to examine the implementation of a new science elective subject at the upper secondary level (Ministry of Education On-line 1998).

The status of Additional Science as an elective science subject in the secondary school curriculum at the upper secondary level could also have contributed to this lack of interest among educators and academics in exploring and researching its development. Nevertheless, studies have been conducted to investigate students' selection trends, participation and perceptions in all the implemented elective subjects in the ISSC (Ministry of Education 1994, 1995; Molly et.al. 1996; Koay 1997). However, in the local literature, no study has been conducted explicitly for the Additional Science subject since its introduction in the secondary school curriculum reform. Moreover, there are only a limited number of studies on the historical development of a subject in the upper secondary school level, largely because the quantitative research paradigm is still highly valued in Malaysia. There are very few published qualitative studies and an historical analysis such as this could provides "an ever-changing and complex reality constructed socially" (Glesne and Peshkin 1992, 6). It could also provide illuminative insights into the reality compared to a statistical study. An analytic interpretation of the historical development of a curriculum provides insights into the forces, internal and external to the system, that might have influenced the process. An interpretive analysis could also reveal the tensions and negotiations that occurred in the acceptance process of a new elective subject in the ISSC. Furthermore, a case study of the curriculum development process of the Additional Science could also provide insights for a tentative generalisation to future planned science curriculum at this level. Hence, it could assist planners in developing alternative strategies for implementing a new curriculum at the upper secondary level.
Locally, all the above arguments led to the need to conduct a study on the *Additional Science* curriculum development. This is imperative in light of the proposed introduction of another science curriculum innovation in both the primary and secondary schools in the second phase of the nation’s planned educational reform for the next millennium (Ministry of Education On-line 1998).

Another important and interesting reason for conducting the study is to focus on the underlying assumption about the *Additional Science* curriculum made by the developers and planners in its implementation process. It was implemented as a new science subject at the upper secondary level and grouped together with Physics, Chemistry and Biology in the science elective group, thus competing for students’ and schools’ attention (Ministry of Education 1991). The assumption is that it has similar status or ‘clout’ to the other three science subjects. It would be advantageous to determine the validity of this assumption for future curriculum development projects.

The *Additional Science* curriculum introduced at the upper secondary level has similar characteristics to the *Man and Environment* curriculum which, was implemented in 1983. Sharifah Maimunah (1990) has conducted an extensive case study of the *Man and Environment* curriculum, which has existed for a decade in the primary school curriculum. The *Man and Environment* subject was later replaced in 1993 by the *Primary School Science Curriculum*. Because it comprised elements of Science, Health and Physical Education, History, Geography and Civics or citizenship education, the *Man and Environment* curriculum was “envisaged [to solve] the problem of overlapping content, compartmentalization of subjects” (Sharifah Maimunah and Lewin 1991, 244) which was prevalent before the introduction of the NPSC at the primary school level. It was offered as a compulsory subject in Years 4, 5 and 6 in all the primary schools (equivalent to Grade 4, 5, 6 in North American schooling system) (Lee 1986). The *Additional Science* curriculum also offers an integrated content that is diverse and broad in scope compared with the traditional and established pure science subjects of Physics, Chemistry and Biology, (Ministry of Education 1991). Whereas the *Man and Environment* subject is a compulsory subject for the final three years of primary schooling, the *Additional Science* subject was introduced as an
elective science subject in the final two years of secondary schooling. The assumption that underpinned this implementation move is that *Additional Science* would be positively received by the school community and, eventually, would be offered to their students by *all* secondary schools.

Based on the preceding discussion on the similarity between the *Man and Environment* and the *Additional Science* curricula, an historical perspective enables one to compare the findings and predict the likely fate of *Additional Science* through a comparative analysis. This is another driving force for undertaking the study.

The interpretive analysis of the *Additional Science* curriculum initiative could also assist in formulating steps to promote it to the educational community. This is because the broad-based and integrated content of *Additional Science* assists motivation and has the potential for promoting science to upper secondary students. Eventually, it helps to mitigate the issue of low enrolment of students in optional/elective science subjects. The reported science enrolment in the secondary schools has decreased from 22.8 % (1990) to 21.3 % (1995) (The Star On Line 1996). However, a study that investigated the reception of *Additional Science* as one of the elective subjects only a year after its implementation found that it had ‘gained recognition’ with students who are eligible to choose the science stream (7.78 % compared to 0.52 % in 1992, Ministry of Education 1994, 105), but opt not to. The low enrolment in science courses is still a major concern within the science education community in Malaysia (The Star On-line October 1998).

The study will also present three perspectives on a distinct indigenous science curriculum innovation. Firstly, from the perspective of integration. While the integration of several science disciplines into a single subject is neither unique nor unusual (Ranaweara 1976; Dove 1989; James *et. al.* 1997), this curriculum is distinctive in that it is organised thematically and in such a way that it is a “relevant, up to date and high quality” curriculum (Curriculum Development Centre 1998, 8) for realising the national goals and aspirations in a developing country. Secondly, there is a strong emphasis on the integration of knowledge, skills and values (Ministry of Education 1991) through carefully designed learning experiences. More significantly, there is integration of science with ethical and spiritual
dimensions of an individual, namely, Man, Universe and the Creator since "Man is an appointed being to manage the universe responsibly" (Ministry of Education 1991, 5).

In the Malaysian context, this science curriculum innovation is considered to contribute to the process of promoting and developing an "individual's potential holistically and in an integrated manner" (Ministry of Education 1991, 1). It also has the goal of producing a science and technology-conscious, tolerant and progressive society founded on strong religious and spiritual values, culture and traditions.

Finally, the fate of the Additional Science curriculum is of personal interest to the researcher as a science educator who has been directly involved in teaching and promoting the subject in schools in a northern state in Malaysia. I was also involved as a member of the panel for setting the written and practical examination questions at the state level during the first three years of its implementation.

The Study’s Contribution to Science Education

Although there have been several studies of the implementation of the NPSC (e.g. Sharifah Maimunah 1990; Noor Azmi 1991) and the implementation of the ISSC (Shamsiah 1990; Jamil 1992; Molly et. al, 1996; Sharifah Nor 1994; Koay 1997), it is important to describe and clarify the developmental process of the Additional Science curriculum and to seek constructive implications for science education in general. Thus, this study made a conscious effort to expand experiential understanding on issues related to the curriculum development process in Malaysia.

Locally, this urgency is heightened by the announcement of the proposed second phase of Malaysia’s educational reform for the new millennium (Ministry of Education Online 1998), which sets greater emphasis on science and technology education. Understanding the strategies of the development process, the underlying assumptions for the Additional Science curriculum and recognising successes and failures will help to refine future
curriculum development projects and avoid repeating unproductive courses of action in the implementation of future planned science curriculum innovation.

Furthermore, critical interpretation of the history of the *Additional Science* curriculum development could reveal valuable insights for promoting science subjects to a greater number of students at the upper secondary level. The latest statistics showed an upward trend, from 1995 to 1997, in the number of eligible students choosing science at the upper secondary level: in Physics, a 20 % increase; Chemistry, a 1.9 % increase; Biology, a 0.6 % decrease (Malaysian Government On-line 1998). In the Malaysian context, the development of this science curriculum is unique with the intention of the Ministry to provide a more liberal science education at the upper secondary level. It is also intended for students who have an “interest in science and prefer learning science in a multidisciplinary form” (Ministry of Education 1991, 2). With its emphasis on applied science, it could augment motivation in the able students who have little interest in traditional science disciplines and, consequently, could increase student enrolment in specialised science courses at this level.

Although the research is a case study of a specific science curriculum at the upper secondary school level, it could have significant transfer value. In an education system that practises a “systematic curriculum development process” (Sharifah Nor 1998, 11), the findings could provide preliminary and exploratory data for further in-depth investigation, could identify patterns in the process and could determine the capacities of these situational factors to influence the curriculum development process. Furthermore, the interpretations of historical data supplemented by the interviews and personal recollection help to redefine the existing model for the development and implementation of a school subject in the Malaysian educational system.

Last but not least, the study also contributes to the general science education literature and promotes “educocultural support” (Fensham 1988, 17) on the experience of science education. This helps to bridge social and cultural differences by raising consciousness and awareness of the issue of context in science education. Consequently, it will bring about better understanding among educators in the field of science education from both developed and developing countries.
In a small way, it also assists in rectifying the issue of inaccessibility of literature and reports on educational issues in developing countries (Lewin and Stuart, 1991) and the problem of unavailability of resources on experiences since the 1960s in certain parts of the science education world (Fensham 1988). This is because the study presents an example of a curriculum development from a developing country in the South East Asia region and a science curriculum that is embedded in a rich cultural context, but one that is unfamiliar to most Western science educators. In so doing, it gives much-needed acknowledgement to some of the work carried out by educators and researchers in developing countries.

*The Thesis Organisation*

The purpose of the proposed study has been outlined in this first chapter. In addition, the rationale and the implications of the inquiry in terms of the Malaysian context and in the general field of science education have also been discussed. This discussion will act as the preamble to the subsequent chapters. The history of science education in Malaysia is also discussed.

Chapter II provides the essential theoretical framework for the study based on a review of literature in the Malaysian context and on science education in general.

Chapter III discusses and justifies the research methodology adopted for the study. These three chapters provide the first part and act as the introduction for the thesis.

The second part of the thesis comprises two chapters. Chapter IV presents the contextual setting for the curriculum under study. It presents an overview of the geographical and historical background of Malaysia, supported by a detailed description of the history of Malaysian educational development. In addition to the educational background, this chapter provides the social, political and economic contexts to paint an authentic ‘portrait’ of the curriculum episode under study. Chapter V presents a narrative of the *Additional Science*
curriculum syllabus, with detailed description of the development of the curriculum episode and a critical examination of the subject syllabus.

Chapter VI forms Part III of the work. It provides an analysis and interpretation of the historical development of the Additional Science curriculum presented in the previous chapter. Other emerging issues that are not covered in the previous chapters and aspects that are related to the emerging issues from the data collected are also discussed. This chapter presents some thoughts and reflections on the whole process of ‘inquiry introspective’ and ethical issues related to the study.

**Limitations**

As outlined in the previous sections, this research is limited to an account of the historical development of a specific science curriculum within the framework of the school curriculum located in the Malaysian educational context. Even though case study methods provide rich and detailed contextual data, the findings are limited in their generalizability to different social, political, economic and educational landscapes.

Furthermore, because Additional Science is an elective subject, the study has limitations when used to address issues surrounding compulsory or core subjects, which are perceived differently by students, teachers and administrators.

**Terminology**

The study relates to educational experiences at the upper secondary level of schooling. Hence, it may be helpful to clarify some terminology related to these years and to the specific
system of education in Malaysia. This will enable the reader to clearly picture the development of the curriculum as it unfolds in subsequent chapters.

Years of schooling:
The total number of years for secondary schooling is five: three years at the lower secondary level and two at upper secondary level. Compulsory secondary schooling at the lower secondary level is an extension of primary schooling, which provides a minimum of five to a maximum of seven years for completion.

Examinations:
Public examinations held at the end of lower secondary, Penilaian Menengah Rendah, PMR or Lower Secondary Assessment, guides selection for upper secondary specialisation. Another public examination for the purpose of higher education selection is also held at the end of the upper secondary level, Sijil Pelajaran Malaysia, SPM or Malaysian Certificate of Education.

Subjects Organisation:
Subjects are categorised into a core or compulsory group, an elective group and an additional group, with a total of eight, twenty-four and four subjects offered, respectively (Appendix C). The number of elective subjects offered in a specific school may vary.

Types of schools:
There are four types of government-funded specialised schools that cater for the upper secondary level: academic, vocational, technical and religious schools. These schools offer general education plus subject specialisation in certain specific areas.
Immediately after gaining independence, efforts in education were concentrated on developing a framework for a national educational system. According to Conway (1972), British education policy during the occupation period was based on “pragmatic solutions to economic problem” (Conway 1972, 71). However he concludes that the British policy did little to solve other societal problems:

British educational policy did not create the tension and inequality that besets Malaysian society but they did contribute to them; they did not repress the Malay, but they did not elevate him.

(Conway 1972, 73)

Hence, the occupation period has left a legacy of separate systems of education catering for the different racial groups in the country.

During the post-Independence period, education was seen as an agent for change, capable of perpetuating accepted societal values and behaviours while preparing society for anticipated future changes in the life of the nation (Sufean 1996). This was the Period of Restoration (Ministry of Education 1998), where the concern was on physically and psychologically rebuilding society. During this period, science education occupied a place at the periphery of the country’s educational scene. Indeed, the science curricula considered appropriate during this post-colonial period were imported from Britain, with only minor changes for local use (Lewin 1984; Tan 1991).

Finally, in 1969, the racial problem simmering from the continued separate education systems escalated into a bloody racial tension. Subsequently, recognising the importance of unity, concerted efforts were taken by every sector to restore peace and racial harmony. The
government saw education as a means of reconciliation and national integration through a common medium of instruction and a common curriculum.

During the *Period of Restructuring* (Ministry of Education On-line 1998), the goals of education were providing a foundation for unity through a national language of instruction and moral education. Efforts to diversify and expand science education were subsumed within these goals to provide science to a wider range of students than previously. Dove (1989) has identified similar patterns of curriculum development practice during the immediate post-independence period of other New Commonwealth countries. Political leaders or governing bodies set out a broad context for national development, with educational goals only somewhat later being articulated. Subsequently, policy statements and national plans that relate to these goals are formulated and eventually these are translated into overall educational goals made explicit in terms of objectives and aims for each subject in the curriculum.

During this period, science education at the upper secondary level was very concerned about academic specialisation and, consequently, curriculum differentiation was practised: students would either enter the Arts or Science stream, where the Nuffield Science course had been adopted with minor alteration (Tan 1991). The 1970s were also characterised by the production of a more *Malaysianized* science curriculum. The Nuffield Secondary School Science Curriculum was renamed Modern General Science for the Arts stream and the Nuffield ‘O’ Level Pure Science Syllabuses adopted for the Science stream were renamed Modern Physics, Modern Chemistry and Modern Biology (Cabinet Committee Report 1979). These science curricula were implemented in 1972 and, by 1978, all secondary schools were offering them (Cabinet Committee Report 1979 [Malay] 1984, 80). Similarly, at the lower secondary level, the adapted version of the Scottish Integrated Science programme was first introduced, in 1969, and renamed Malaysian Integrated Science. By 1975, all schools offered the programme at the lower secondary level (equivalent to Grade 7, 8 and 9 in North American schooling system).

Besides these curriculum activities during the 1970s, two other factors set the stage for the more wholesale curriculum reform of the 1980s. Firstly, the Curriculum Development
Centre (CDC) was established, in 1973, to co-ordinate all curriculum development efforts. Dove (1989) identifies similar practices of establishing specialised curriculum units throughout the New Commonwealth countries during this period. Secondly, the Cabinet Committee conducted a major review of the national policy on education from 1974 onwards, and its report was published in 1979. This report made several recommendations, among which was an assertion about the importance of science education for all levels of schooling. The report also recommended that the upper secondary level school curriculum should reflect general and universal education in order to provide equal educational opportunity to all students (Cabinet Committee Report 1979 [Malay] 1984). Furthermore, it recommended greater emphasis on the aesthetic aspect of education. As a result, the reform in science education in the 1980s, which evolves from this major restructuring of primary and secondary schooling, reflected the suggestions of this review report.

In addition, political and economic stability during the 1980s provided a conducive environment for increasing the government’s capacity to project a new direction for the country and to determine the nation’s aims and aspirations (Cabinet Committee Report 1979 [Malay] 1984, 11). However, Marsh and Morris (1991) remark that economic growth and the nature and quality of education are mutually supportive. Sufean (1996) goes further, and states that investment in education has a long-term positive personal and social return, and so contributes substantially to the country’s economic development. Consequently, guided and governed by the national educational policy and the national ideologies, concrete plans for the development of the science curriculum were set in place. The government had recognised the power of education for social development and economic growth, and so undertook to restructure the education system and the science curriculum along lines considered favourable for economic growth (Cabinet Committee 1979 [Malay] 1984, 7). Thus, the roles of education and societal development were reversed.

In the major educational reform of the 1980s, a more holistic and democratic science curriculum (Ministry of Education 1992) was developed in order to reflect the nation’s future need for a capable work force, skilled and capable in science and technology. Science education was seen to contribute positively to individual development and, as a result, to
enhance the contribution of individuals to national progress. Science education reform was, of course, planned within the framework of the nation's educational reform. The goals of science education within this general framework of educational reform emphasised a balance among scientific knowledge, scientific method and personal development, with an added emphasis on moral values (Ministry of Education 1992).

At the lower secondary level, Sains (KBSM Science syllabus) is a core examinable science subject. It has an integrated science content. However, an ‘option-selection’ curriculum is offered at the upper secondary level. Physics, Chemistry, Biology and Additional Science are the elective science subjects, whereas Sains Teras (KBSM Science syllabus) is a compulsory examinable subject for students who are not taking any combination of three elective science subjects. Thus, the current science curriculum at the upper secondary level is a compromise between providing basic science education to a greater number of students and providing for the specialised manpower needs for the country. In the curriculum materials distributed to all teachers, the aims of this new science curriculum are stated as:

"This science education provides opportunities to students to acquire and understand basic science principles through the core science subject to produce a literate and innovative Malaysian citizen. It also provides a more specialised science curriculum aim for the more able students who have an interest in science in order to produce scientists and technocrats for national development"  
(Ministry of Education 1991, 1).

The American educator, J. M. Rice (1893, quoted in Bybee and DeBoer 1994, 363) proposed a new approach to education with the aim “in a word, to develop the child naturally in all his faculties, intellectual, moral and physical”. However, science education reform in Malaysia during the 1980s took Rice’s proposal one step further by including an element
considered equally important with regard to the individual socio-cultural context: the spiritual dimension of the individual. The restructured science curricula for both the primary and secondary level reflected the commitment to develop each individual student's potential holistically and in an integrated manner, intellectually, spiritually, emotionally and physically (Ministry of Education 1992).

**Conclusion and Remarks**

The story of how and why a curriculum development faced difficulties can be as educative and instructive as a success story, perhaps even more so. Moreover, examination of the interplay between the factors affecting a subject's acceptance in a school curriculum is also illuminating for planners responsible for policy-making decisions.

An historical account of a curriculum development provides invaluable insights because:

"[Curriculum history] ...can be a source of useful data for understanding where we have been, where we are, and where we ought to be"

(Bullough Jr. 1989, 28).
Chapter II: REVIEW OF RELATED LITERATURE

I believe that the study of science is educational in so far as it brings out the materials and processes which make social life what it is.

Dewey, My Pedagogic Creed, 1897

Introduction

Disentangling the web of gold thread in a songket piece will need a conceptual framework that acknowledges the complexity of the effort to weave it. In addition, reminding us not to undermine the role of the weaver and the context for producing the elaborate and magnificent piece.

This chapter discusses some of the literature related to curriculum, planned change and the concept of integration in science education. Including a discussion of planned change is imperative in the context of curriculum development activity in a developing country. This is because of the centralised nature of curriculum administration in those countries. This chapter reviews related literature on changing trends in the goals and aims of science education, in general, and in the context of developing countries in particular. The assumption is that the literature originating in Britain and the United States reflects the predominant global pattern.
Curriculum, Change and Innovation

Curriculum?

In the written literature, there are wide variations in the definition and interpretation of curriculum, giving rise to several models, approaches, and strategies for its development. The practical everyday meaning of curriculum that is provided by the Collins dictionary is: all the courses of study or a course of study in one subject offered in the school. In the Education Dictionary, curriculum is defined as a group of courses and planned experience for students under the guidance of school (Good 1959) and according to Taba (1962), curriculum is a plan for learning. However, in his definition, Hirst (1974) has also included the expected learning outcomes of these planned activities.

These definitions have identified some of the elements that constitute a curriculum: content, planned learning experiences or method, and objectives or outcomes. They constitute the ‘intended’, ‘prescribed’ or ‘explicit’ curriculum. In other words, learning experiences are ‘planned activities’ with ‘expected’ learning outcomes. Those seeking for a fuller definition of curriculum might ask: What about unplanned experiences that will always occur in the learning process? Defining curriculum only in terms of planned activities narrows the scope of the learning experience. This is because students acquire knowledge and skills not only from the planned activities, but also through the process of socialising in the school environment. This ‘implicit’ curriculum is as important as the ‘intended’ or ‘explicit’ curriculum, and sometimes more important.

When Marsh and Stafford (1988, 7, as quoted in Marsh and Morris 1991) refer to curriculum as the “interrelated set of plans and experiences which a student completes under the guidance of the school”, their definition includes the element of interaction between the ‘intended’ and ‘implicit’ curriculum in the learning process. Furthermore, Connelly and Clandinin (1988, 6) define curriculum as “something experienced in situations”, which necessarily encompasses both the learner and the learning milieu in which the interactions
occur at a particular time. However, this study will only concern the ‘intended’ or ‘explicit’ curriculum.

Hence, the essential elements in a definition of curriculum are the curriculum plans, students, teachers and the ‘educational context’. The ‘educational context’ refers not only to the students’ physical environment, but also to their cognitive environment. In addition, a dynamic two-way interaction occurs between the planned curriculum and the learner in a locus area, resulting in the “individual student’s curriculum”, sometimes referred to as the ‘learned’ curriculum (Cuban 1992, 222). It is clear that the context influences and affects the students’ ‘learned’ curriculum, often in idiosyncratic ways.

School is a unit in society with its own sub-culture; it promotes a certain way of socialising. As Connelly and Clandinin (1988, 124) say, “our schools are in dynamic relationship with society”. Consequently, the students’ ‘educational context’ expands outwards from the immediate classroom: first, to the school environment, and subsequently, to the wider society. One of the strands linking and mediating these levels of expansion is, of course, the curriculum plan. People, each of whom has a distinctive social location, plan a curriculum. As many curriculum historians tells us, curriculum development should be viewed from a perspective that connects it to culture and the society in which it is located (Williams 1961; Connell 1985, as quoted in Goodson 1987). In other words, the curriculum development process is embedded in the social and cultural context. It follows that not only do curriculum definitions vary, depending on the individual’s theoretical views on the nature of curriculum, but also curricula carry value-laden assumptions concerning schools and education that are a consequence of socio cultural forces. This has important consequences for rational and systematic planning for curriculum development.

In the Malaysian context, the school curriculum has an official documented definition. It refers to the prescribed education programme, which includes the knowledge, skills, accepted values and elements of culture and beliefs that will help to develop individual students holistically. It encompasses the subject syllabus and the extra curricular activities in the school (Cabinet Committee Report 1979 [Malay] 1984), and is referred to as the National Curriculum (Education Act 1996). The change introduced by the Cabinet Committee in the
definition of curriculum replaces the one that has existed since the 1950s (Sufean 1996). This revision acknowledges the new emphasis on the individual learner’s personal growth and his/her contributions towards social developments. Subsequently, the Malaysian government decided to implement a *planned change* to restructure the Malaysian educational system during the early 1980s (Cabinet Committee Report 1979 [Malay] 1984).

*Planned Change or Innovation?*

As everyday life testifies, planning and introducing a change is a formidable endeavour, beset by all manners of internal and external constraints. The process of planned change for a system is both complex and dynamic (Gross *et al.* 1971; Eslane 1972, as quoted in Bolam 1975). When introducing and implementing planned change, interactions between the innovation and the variables in the system can sometimes create conflicts within the system (Connelly and Clandinin 1988). As such, in any effort of educational innovation, careful attention must be paid to the multiple, interrelated and interdependant variables associated with the system and the innovation. Consideration of the “systemic nature of [the] innovation” could improve the probability of success for the activity (Bolam 1975, 279).

What are these systemic barriers? What are the accommodations needed? These are some relevant questions when planning an innovation. One of the essential characteristics of any innovation, and the one that has considerable implications on the life span of the innovation, is its relevance to the users in the system (Bolam 1975; Hoyle 1975; Meyer 1997). What are its advantages? Does it improve the current situation? This other set of questions is significant to the users of any innovation. In addition, the characteristics of newness or goodness, in terms of the innovation’s practicality as perceived by the user, are also important determinants. Of course, these factors are subjective to the perceptions of the particular individuals involved in the activity; they are not value free (Bolam 1975). Furthermore, the capabilities and the capacities of the system to adopt, accommodate and support the innovation are also important considerations for sustaining the change (Nisbett
1975; James 1981; Dove 1989; Prophet 1990). It almost goes without saying that some organisational structures are more conducive for change than others.

Planned change is either initiated by individuals within the system, who recognise the need for improvement, or it is imposed on the system by external forces that have ascertained this need. The evidence from a number of UNESCO studies (Havelock and Hubermann 1977, Dove 1989) suggest that the demands for change in developing countries are often initiated by political pressures and the need to attain economic independence. In some developing countries, education has always been seen as the vehicle for a nation's social development and economic growth (Havelock and Hubermann 1977; Brophy and Pillay 1986; Abdalla Uba Ama 1991; Yat-Ming 1991; Ayas et. al. 1993). Subsequently, this view is translated into concrete goals and objectives in the school curriculum that are then aligned to support and complement the national goals for development and modernisation. However, Bacchus (1991) has warned against over-emphasising the significance of education and in particular, the role of curriculum in social transformation. He stressed that “[it] can only play a supporting role” and needed prior “changes in the social, economic and political situation” in the society if it is to make a lasting contribution (Bacchus 1991, 22). Hence, for some countries, the goals and aims of a school curriculum development are seen as part of the larger framework for the goals of national development (Commonwealth Secretariat 5:1990; Tan 1991; Khoon 1991). For example, Swaziland’s Second Development Plan, 1973-1978, projected the equal opportunity goal of education and the development of manpower (Dove 1989). In comparison, in China, any change in the curriculum has been associated with political movements, for example, in meeting national defence or political security (Yat-Ming 1991; Wang 1997).

Bennis, Benne and Chin (1969) refer to the strategy used by decision-making bodies in a system for imposing planned change as ‘power-coercive’. Change is achieved through the introduction and implementation of policies or legislatures that acknowledge the needs and aspirations of the nation (Commonwealth Secretariat 1990; Tan 1991). This strategy is usually used in a centralised system, where the decision-makers are located at the upper levels in the educational hierarchy. Whether this approach is successful in achieving the
nation's aspirations and goals is dependent on several factors: the planners' perceptions of the system, the nature of the planned change and the consideration given to the interplay between the variables involved (Havelock and Hubermann 1977; Marsh and Morris 1991; Hall 1992).

Planned change that is initiated by internal forces is normally at a smaller scale, and addresses specific area concerns. It results in a more incremental rather than revolutionary change. These changes are often localised and focused on the day-to-day activities of teachers. Cuban (1992) refers to them as 'first-order' changes.

*Kesepaduan?*

In the Malay language, the term *bersepadu* means integrate and *kesepaduan* means integration. The notion of integration conjures up an image of complexity, subjectivity and enormity associated with the task of combining pieces to produce a unifying whole. Science educators have suggested a number of different ways for achieving integration.

For practical purposes, the content from several science disciplines could be integrated through common themes or issues and approaches. Indeed, Blum (1994) has suggested this is one of the rationales for integrating the teaching of science for practical purposes. If the emphasis of integration is the knowledge, method and skills for content selection, then the underlying assumption is that the skills and methods are transferable across the disciplines' boundary. However, Hodson (1992) argues that this assumption is not valid from the perspective of the philosophy and sociology of science and, instead, proposes the goal of 'critical scientific literacy' as the means for integrating and unifying science education along common issues.

Another important element in the rationale for integration that might have been overlooked is the social and cultural context. In a society where the main aim of education is to guide the *insan* (individual) to know his/her Creator better and to attain peace with oneself and neighbours, another dimension is added towards the perspective of integration. The *insan*
refers to Man, who possesses cognitive, physical and affective attributes and, as such, a science curriculum that holds this view of education will necessarily encompass this concept of integration in its aims and goals. This concept of integration creates another perspective for understanding holistic education. Abd Raof (1987, 7) refers to holistic education as “the combination between ilmu (knowledge) and life, the congruence between teaching and the development of ummah (the worldwide Muslim community), the relationship between Man and his intrinsic attributes in order to create a balance between the spiritual and physical … that is manifested as a process to foster in the individual moral and ethical values based on the knowledge gained”.

From this perspective, the integration for science teaching is also an integration between science and the spiritual and ethical dimension of the individual learner. This highlights the point that arguments for integration in science education are also value-laden, and profoundly influenced by the cultural context. Miller (1988) has also stated the centrality of the relationship between the individual learner and his/her milieu in the concept of holistic curriculum:

The focus of holistic curriculum education is on relationships- the relationship between linear thinking and intuition, the relationship between mind and body, the relationship between various domains of knowledge, the relationship between the individual and community, and the relationship between self and Self. In the holistic curriculum the student examines these relationships so that he/she gains both an awareness of them and skills necessary to transform the relationships where it is appropriate

(Miller 1988, 3)

Witz (1996, 603), for example, has argued for a re-orientation of science to provide a greater emphasis on the goal of “oneness of the scientific attitude and vision with the higher
inner forces of the soul” in science education. The integration of science and the spiritual and ethical dimension of an individual is manifested in an explicit emphasis in the statement of the goals and aims of the science curriculum, and is inculcated through the learning experiences provided in the classrooms. These explicit and implicit “beliefs and values need to be treated and exemplified in subject areas” (Poole 1990, 72). This perspective on integration contributed significantly to the aim of developing “the individual’s potential holistically and in an integrated manner”, as stated in the Malaysian philosophy on education (Education Act 1996).

Curriculum Development Process

As a complex process, curriculum development involves consideration of the various tensions and negotiation of the several variables at different stages in the process. The published examples of implementing planned within diverse cultural, political and economic backgrounds exemplify the difficulties encountered in the process. Furthermore, they also show the efforts taken to resolve these issues within the capacities and constraints in each specific educational system (Lewin and Stuart 1991; Marsh and Morris 1991).

Schools can be seen as a mediator between the developers and practitioners in a curriculum development process. They can act to oppose or to facilitate an attempt at imposing a curriculum, depending on the school ‘climate’ and the characteristics of the individuals. By examining the curriculum development process from a ‘bottom-up’ view, the implementation of a subject curriculum in schools can be seen to consist of two phases. Initially, during the orientation period, the subject is being evaluated on its worth. During this phase, “response to change may be accommodating, tactical, or voluntary” (Bybee and DeBoer 1994, 218). In phase two, a subject is accepted and achieves an established status in the school curriculum, or it is rejected.

During the implementation stage, the support given by individuals such as teachers, schools administrators, students and parents may differ. However, they collectively influence
decisions about the subject’s worth in the school curriculum, and determine its acceptability. Two fairly recent studies in science curriculum history have shown the importance of these individuals as determinants of a subject’s status and have illustrated how alliances form to accommodate changing context influences during the development of a school subject (Rowell and Gaskell 1987; Smith 1987).

Factors such as the relevancy and practicality of the content, the validity of the knowledge and the ‘official status’ of the subject can have considerable implications for the support given to any subject and its claims for inclusion in the school curriculum. Brown (1977) and Black (1986) (both quoted in Woolnough 1988) illustrate that the lack of a convincing rationale or the absence of a concrete curriculum content can contribute significantly to the failure to gather sufficient support for a given subject to ensure its inclusion in the curriculum. In a Chinese study, Wang (1997) has shown that the shift in the importance of Physics during the late 1970s was directly attributable to its being perceived as the “fundamental and most difficult subject” (Wang 1977, 338). In addition, one of the conclusions arising from the case studies on subject integration conducted by the Organization for Economic Cooperation and Development (OECD) is that teachers and students ‘must have grounds for confidence in the change situation’ (James et al. 1997, 479).

In an educational system that offers the ‘option selection’ curriculum, where the status of a subject as either elective or core is associated with its examination status, a subject’s status is crucial. Goodson (1987) contends that amongst the three traditions of curriculum design, academic, utilitarian and pedagogic, the connection between examination and academic subjects is influential in obtaining increased time allotment and resources for academic subjects.

The individuals at the actual site for implementing the planned curriculum shape the worth of a subject and its importance. Subsequently, they determine its future life span in the school curriculum. Thus, insufficient attention by developers to this stage of implementation could jeopardise and retard any attempt to establish the subject in the school curriculum. Hodson (1987) has also reminded us of the crucial role of the cultural context of any proposed curriculum innovation in determining its acceptance and institutionalisation. In
other words, these groups of individuals, with their political, cultural, social and economic ‘baggage’, form an influential part of the cultural context for any implemented curriculum innovation in the schools, and are ignored at the developers’ peril.

There is an abundant literature available concerning stages on the ‘other side’ of the school in the curriculum development process. Some authors have suggested that multiple strategies and approaches to implement planned change can improve its success rate (Hoyle 1975; Hall 1992). The ready availability of diverse models and strategies of implementing and managing curriculum development assist this suggestion. Perhaps, the most cited and influential model derives from the work of Benne, Bennis and Chin (1969), who describe the process of innovation in terms of four distinct stages: initiation, development, implementation and evaluation. However, by using system analysis, Havelock and Hubermann (1977) have emphasised the linkages between the components in an organisational system during the process of educational innovation. This model also provides a framework for the dissemination and diffusion of educational knowledge associated with the innovation. For example, in the Malaysian context, all educational innovations are disseminated to the school community (the user system) through in-services courses conducted by key personnel (linkage agent) trained by the Curriculum Development Centre (resource system). These courses are organised by the State or District Education offices (linkage institution) to provide the teachers (user system) with the subject’s syllabus and other support materials.

Lewin (1991) has suggested that educational systems employ a variety of approaches to initiate change; imposition by bureaucratic means; scientific problem-solving; argument and diffusion; innovation by charismatic individuals. These approaches differ in terms of the determinants for instigating the change and the aims of the change. In a centralised system of education such as Malaysia’s, a bureaucratic approach to implement change has often been adopted. Strategies have been adopted in which the goals of innovation are determined at the system level. However, in a more centralised system, the crucial role of the human element in curriculum development has sometimes been overlooked and underestimated. While Fullan (1972) stresses the users’ role in all phases of the curriculum development in order to ensure
its success, Marsh and Morris (1991) suggest that the users’ participation at a particular stage in a curriculum development depends on the type and structure of the system. Consequently, in their role as the end-user of a school curriculum, teachers could either be the implementers of the prescribed curriculum document or an active and significant contributor to the curriculum development process (Fraser-Abder 1989; Thomas 1991; Aziz et al. 1991; Toh et al. 1996). In the Malaysian educational system, the decision-making body or the policy makers refer to the central government officers and administrators who hold key positions at the upper level in the system’s hierarchy. In this system, all essential details of an innovation are decided upon and announced by these officials. Teachers’ participation in the decision-making stage or the ‘initiation’ stage is normally very strictly limited (Marsh and Morris, 1991).

Connelly and Clandinin’s (1988) argument that teachers’ personal practical knowledge and experience influence their curriculum planning in the classroom is also applicable to the macroscopic level. The decision-making body acts as a link between schools and societies and, consequently, it should be aware of the contextual factors influencing curriculum planning and implementation. At the initial planning stage, where economic and political contexts of the process are dominant, decisions on “what counts as science education” (Roberts 1988) determine the aims and goals of the curriculum. These decisions also set the agenda and define the conceptual framework within which alternatives are discussed (Dove 1989; Commonwealth Secretariat 1990; Marsh and Morris 1991; Lewin and Stuart 1991). Countless historical reviews of the progress of science education have identified that any factors affecting decisions about the goals of science education will subsequently influence its structure and function (Bybee and DeBoer, 1994). Ultimately, any tensions and negotiations between these factors will affect the ‘intended’ subject curriculum for the classrooms and will have an impact on the daily life of science teachers.

Taba (1962) has suggested that in the designing and planning stage or the ‘development’ stage, the knowledge base for a rational curriculum development should include considerations of the learner, the processes of learning, the cultural and societal needs and the fundamental content of the disciplines. She has also suggested the inclusion of
values and underlying philosophies. The concern with values and philosophies adds another important dimension to views about science education, providing a platform for discussing a deeper aesthetics orientation with regard to the emphasis and priorities of the curriculum goals (Witz 1996). Ahmad Idris (1990) carried out a conceptual analysis on the aims and content of the Islamic Education, which is an elective subject in the Integrated Secondary School Curriculum, ISSC, for the Malaysian secondary schools. He concluded that the justifications of the syllabus, its intended clientele, its content and the method of its implementation should be considered when developing the aims of a curriculum. Unquestionably, a clear and comprehensive set of objectives will assist in the selection and organisation of the content and the learning experiences (Taba 1962; Hirst 1974; Marsh and Morris 1991).

A number of authors have suggested the participation of the curriculum users at this stage, in order to alleviate the issue of conflicting proximate aims between the ‘intended’ and ‘taught’ curriculum (Taba 1962; Connelly 1972; Fullan 1972; Marsh and Morris 1991) or between policy and practice (Hall 1992). Teachers’ participation in the activities at this stage bridges the gap between the components in the educational system and acts as effective ‘linkages’ in disseminating curriculum information. The effort could also increase teachers’ sense of ‘ownership’ and further assist its establishment in the school curriculum. This is a reasonable suggestion, given the experience during the 1970s of the implementation of the ‘adopted’ science curricula in developing countries (Maddock 1983; Brophy and Pillay, 1986; Dove 1989; Tan 1991; Ayas et. al. 1993). Furthermore, this suggestion is also supported by research conducted in some developed countries (James et.al. 1997).

At the microscopic level, the issue of conflicting aims arises from the differences between the ‘intended’ and ‘perceived’ intentions of a curriculum document during its implementation in the classrooms. In Malaysia, this mismatch issue has been identified in several studies of the implementation of the science curriculum in the ISSC (Abu Bakar 1985; Shamsiah 1990; Sharifah Maimunah 1990; Jamil 1992). However, in interpreting the findings of these studies, it is important to note the following; teachers’ expertise and experience; how well and also how long they have been using the curriculum innovation in
their classroom (Hall et. al 1979, quoted in Marsh and Morris 1991; James 1981). Several studies have shown that the barriers to successful curriculum innovation in developing countries include the neglect of the users' psychological and cultural attributes (James et. al. 1997; Toh et. al. 1996; Havelock and Hubermann 1977) and the inability of the existing organisational structure to provide support for the implemented innovation (Havelock and Hubermann 1977; Lewin 1984; Dove 1989; Siow and Wong 1983; Aziz et. al. 1991; Hall 1992). Overcoming these barriers will partly contribute to the promotion and establishment of a specific subject in the school. A positive and supportive environment with adequate physical infrastructures, human resources and ample time for implementation, is imperative for an innovation to be “more than a passing novelty” (Nisbett 1975, 9).

*Development of Science Education*

“What are the goals for science education?” ‘What constitutes a relevant science education?’ ‘Who decides what is relevant?’ These are some fundamental and crucial questions in an attempt to develop a science curriculum. Analysis of the changes in goals and concerns of science education provides a framework for determining of what is considered as the relevant and appropriate content of the science curriculum at any particular time period. Fensham (1988) has suggested that in finding a new direction for science education, science educators should face up to the changing societal realities and seek to minimise conflicts arising from diverse intentions and realities. Recent review literature in science curriculum history indicates that, in general, three important goals have been prevalent in science education: acquisition of scientific knowledge, acquisition and application of scientific method and the promotion of personal-social development (Bybee and DeBoer, 1994). In addition, the identified goals have come in “various configurations ...[that] underlie all science programs” (Bybee and DeBoer 1994, 357). The understanding of scientific principles has often been the primary element in the goals of science education (Bybee and
De Boer 1994). It is seen as associated with the cognitive development of a learner. While the science method generally refers to the skills needed for doing science, it has been taught as a way of developing problem solving skills and a means of acquiring scientific knowledge. However, scholars in the philosophy and sociology of science have, in recent years, dismissed the notion that there is a method for doing science.

The personal-social development goal connects science education directly with societal issues and is well exemplified in the science-technology and society movement (STS) (Yager 1993). This goal also supports the importance of social, cultural, economic and political contexts in science education, and raises the issues of ethics in doing science and the effects of science on society and the environment. These are some of the major societal concerns about science affecting the relative emphasis of the goals of science education and influencing its structure and function (Tkach 1977; Bybee and DeBoer, 1994). Tkach (1997) notes that the content of school science curriculum in Alberta was influenced by these contexts largely through the educational and philosophical stances of the individuals involved in curriculum decision making.

Any shift in emphasis among the goals of science education can be related to changes in societal concerns that trigger the change at that particular period. For instance, during the 1970s, American science education was strongly influenced by social issues in the aftermath of the Vietnam War and also considerable consciousness raising about women’s participation in science education. In the 1990s, environmental issues have begun to dominate the debate, coupled with concern about the performance and ‘competitive edge’ of America in the global economy (Bybee and DeBoer 1994). Consequently, these changes become the justification for the content and approach that is considered appropriate in science teaching in the classroom. For example, the process approach is prescribed primarily with the intention of developing students’ problem solving skills through investigation by using the scientific method. It is assumed that these skills will have direct benefit to the economy.

What is perceived as an appropriate school science curriculum is determined by the forces in society at any particular period and “represent[s] a particular view of science, of science activity and of society” (Hodson 1987, 537). Clearly, different societies have
different concerns and priorities, which influence the type of science practised and the goals of science education considered appropriate (Dove 1989). These societal concerns also affect the relative emphasis given to the three intended goals of science education identified above in the history of science education. For example, the emphasis on a process approach to develop students' problem solving skills through scientific investigation in the hope of transferring these skills to the solving of everyday problems.

Thus, international emphases in the goals of science education reflect the global societal concerns about the impact of science on society and the underlying assumptions about the science enterprise at any given period of time. In many instances, although the goals and rationales of science education do not necessarily represent actual practices, they help to provide structure and direction for the school science curriculum. They at least influence the curriculum, even if they do not determine it.

In spite of the effects of these societal forces on the goals of science education, what is actually taught in a science classroom, and the realities of school science, still rests in the hands of the teachers (Hodson 1985, Roberts 1988). Teachers sometimes maintain their own beliefs, views and values in spite of attempts at planned curriculum change, and it is sometimes difficult to discern any significant overall change. Cuban (1992) remarks on teachers' role in maintaining stability in the face of attempted changes. Schools, he notes, sometimes seem indifferent to social change.

Reforms in science education can also be interpreted in terms of the relative emphasis given to the goals identified above. Riding on the first wave of reforms that started in the 1960s was the importance of 'Being a Scientist' (Hodson and Reid 1988) and its emphasis on conceptual learning. Prime examples were courses developed by the Nuffield Foundation, National Science Foundation and Schools Council. Strongly influenced by Bruner's "The Process of Education", science curriculum during this period looked only at the structure of science. To become a scientist, students were expected to learn science as scientists do. Moreover, it was assumed that students could unerringly acquire scientific knowledge by discovery learning methods. As Bybee and DeBoer (1994, 375) say, "Structural knowledge
was the end, scientific inquiry was the means and personal-social development was largely ignored.

During the second wave of reform in the 1980s, sociological issues became important factors in determining what is considered the "knowledge of worth" in science education (Fensham 1988, 21). The nature of science, multiculturalism in science education and the relation between science, technology and society are some of the concerns identified in the recent reform. How does scientific knowledge develop? What is the meaning of scientific method? What is the meaning of facts, theories, and principles? If emphasis among the goals of science education is on the acquisition of scientific knowledge by employing the scientific method, then it is important for students to understand the meaning of these questions. Many science educators have argued for the inclusion of the nature of science (history, philosophy and sociology of science) in any science curriculum aimed for scientific literacy (Elkana 1970; Smolicz and Nunan 1975; Hodson, 1985; Brush 1989; Allchin 1995; Matthews 1998). Several studies have shown that science students have wrong ideas about the development of scientific theory and a negative image of scientist (Schibeci 1986; Duveen, Scott & Solomon 1993). It is widely argued that the inclusion of the nature of science enables the science curriculum to project the 'correct' image of science and scientist.

What is the meaning of scientific truth? Who determines it? Following the arguments about the inclusion of the nature of science in science education, some educators have also proposed a global view of science (Hodson 1992; Stanley and Brickhouse 1994). These authors claim that taking multiple perspectives on science provides a strategy for teaching and learning science in a diverse cultural and ethnic setting. It also raises the students' awareness of racism within science and empowers them to formulate and take actions on any scientific issue.

Proponents of the current STS movement argue that the reform during the 1960s had failed to acknowledge and address societal and relevancy issues appropriately and effectively (Fensham 1988; Cheek 1992, Jenkins 1992; Yager 1993). Science-technology-society (STS) has been described both as a "megatrend in science education" (Roy 1984) and as "a paradigm shift for the field of science education" (Hart and Robottom 1990, both quoted in
Furthermore, STS is regarded as a reform in the school science curriculum and as "an approach to teaching" (Yager 1993, 146), where the process of learning starts with a problem that is relevant to a learner and uses appropriate scientific concepts and processes to solve it. In other words, teaching methods are embedded in and determined by the content.

Some concerned science educators have also called for the reconstruction of the school science curriculum to ensure that ‘basic’ science education is available to every child (Hodson and Reid 1988; Jenkins 1992; Hodson 1992). Clearly, a universal and democratic science education is the main agenda for the ‘Science for All’ movement. The movement seems to support a commitment to the goals of personal and social development in science education. However, in the quest for scientific literacy, what is considered as ‘basic’ science education is socially constructed, value-laden and varies with the social, economic and political capacities of the educational system. What is often absent in this view of science education is consideration of the spiritual dimension in the personal development of the learner. This, of course, is that is a significant issue in some countries, including Malaysia.

Science Education and Developing Countries

Research literature on the development of science education in several developing countries shows similarities in the patterns, trends and relative emphases of reform as these countries set about developing a more ‘localised’ curriculum, something that was only just getting underway in the 1970s (Fensham 1988). Understandably, in the 1960s, some of these countries were still busy ‘licking their wounds’ from the colonial era. Furthermore, after gaining political independence, the main priority in the political agenda of these countries was to rebuild the country physically and psychologically (Thomas 1991; Tan 1991). Education reforms were initiated and became crucial only when they were seen as relevant to nation building and development (Dove 1989).
Reports from the Commonwealth Secretariat (1990) show that the formulation of some form of national education policies based on the national goals augmented and promoted curriculum development activities, for example, in Malaysia, Indonesia and Swaziland. Agencies and international bodies such as UNESCO, APEID and the World Bank were also active in promoting and supporting curriculum development that was more relevant to the local physical and social environments. These bodies have provided a platform for better and greater co-operation between the member countries (APEID-UNESCO, 1980, 1980, 1981, 1982). They also provided financial and technical support, which justify for the flurry of enthusiastic curriculum development activities in this region.

The science projects developed in the 1960s in the United States and Britain ‘hit’ some of the developing countries a decade later. These projects created major problems because of the assumptions about the universality and generality of science, which was used to justify “the transferability of science curricula across national boundaries” (Fenshiam 1988, 5). Incompatibilities in cultural background (Maddock 1983; Dove 1989; Ayas et. al 1993), in the language of instruction (Brophy and Pillay 1986; Prophet 1990; Tan 1991), and also psychological barriers due to cognitive incompatibility (Brophy and Pillay 1986) and spiritual conflict (Ayas et.al. 1993), were only subsequently identified. Another problem that cropped up was the inability within the existing system in these countries to provide sufficient and necessary support. The APEID-UNESCO reports (1980, 1980, 1981, 1982) have identified some common emerging problems in member countries in implementing science curriculum innovations, including support systems, equipment and skilled human resources. Dove (1989) has identified that gaps in the transmission channel for curriculum development information have also created problems in many New Commonwealth countries.

Thus, the strategies used in these countries have often failed to pay sufficient attention to the social, political, economic and cultural context. These significant factors were overlooked in the first attempt at curriculum reform. The effects of the ‘divorce’ of the science curriculum from the situational context provides the justification for another wave of reform in many of these countries during the 1980s (Dove 1989; Shinohara 1991; Tan 1991;
This new ‘breath of life’ in science education was intended to address immediate local needs for economic growth and the demand for producing a more capable work force (APEID-UNESCO 1980, Commonwealth Secretariat 1990:5 & 6). This latest attempt at science curriculum development was accomplished either by revolutionising and restructuring the whole educational system (Tan 1991, Thomas 1991; Commonwealth Secretariat 1990:6) or by evolutionary reform within the existing framework (Prophet 1990; Commonwealth Secretariat 1990:5).

In some of the ASEAN countries, Brunei Darussalam, Singapore and Indonesia, the formation and establishment of curriculum development units and centres have also helped to promote and provide structure for curriculum development activities. In Indonesia, a unit for managing curriculum development activities was established in mid 1970s that resulted in the introduction of curriculum plans in 1975 and 1984 (Thomas 1991). Although the Curriculum Development Institute of Singapore (CDIS), which was formed in 1980, develops instructional materials and also trains teachers on their use, the Curriculum Planning Division within the Ministry of Education is the agent that has the final say on curriculum decisions. The current emphasis in education is on personal development for “economic survival by exploiting the full potential of each pupil” (Khoon 1991, 159). After two years of full independence, in October 1986, the Bruneian Ministry of Education was independently formed and, within it, the Curriculum Development Department (CDD) was established. The CDD’s primary task is to produce a common curriculum for all schools, except for those under the jurisdiction of the Ministry of Religious Affairs, which is ‘localised’ and socially relevant, in accordance with the nation’s over-arching educational policy.

Besides the dominant political and economic demands, cultural and social backgrounds have sometimes been influential in affecting the science curriculum. In those countries where religion (especially Islam) has a strong influence in society, in Indonesia, Malaysia and Brunei Darussalam, it is recognised that the goals of science education should be closely aligned to the religious percepts, with greater emphasis on moral values (Commonwealth Secretariat 1990: 5; Thomas 1991; Tan 1991). In a report at a conference of
the Commonwealth Education Ministers in Barbados on improving the quality of basic education, the Bruneian Ministry of Education pointed out that:

"It is the intention of the Ministry to foster the all-round development of each individual from the physical, mental and spiritual points of view, and in terms of aesthetic disposition, in order to make him or her into a Bruneian citizen who will uphold the aspirations of the nation"

(Commonwealth Secretariat 1990:5, BRU 5)

In spite of these recent curriculum development activities, and due largely to demographic, economic and psychological barriers, there are still traces of the residue from the earlier 'adoption' policy in some of the reformed curriculum. Some of the earlier theories of learning are still valued, especially the instructional and process approach and discovery learning. Although the content was grounded locally, the importance given to examination results in some of these societies ensures that the curriculum content is still highly academic and conceptual.

The diverse cultural, political and economic background of these developing countries contributed to produce differences in almost every aspect of science curriculum reform: the scope of the reform, the intensity of the effort and the appropriate time to initiate it (APEID-UNESCO, 1980, 1980, 1981). As Marsh and Morris (1991, 255) remark, the "cultural context and prevailing political priorities in each country exert powerful influences on curricular issues and their resolution". However, within this diversity there are some similarities. It can be argued that, historically, most of the developing countries were a colony at one time or another. Case studies of countries in East Asia have shown that the historical background of the countries in this region has also shaped the curriculum reforms through the political and economic context (Marsh and Morris 1991). A common legacy of the colonial era is a centralised education system and similarity among the external forces impacting on curriculum reforms. In addition, Dove (1989) points out that there were
common trends in some developing countries in the prescriptive integration of the science curriculum at the junior or lower secondary level, although this is not the general case. This finding has also been supported by the APEID-UNESCO reports on several of its member countries (APEID-UNESCO 1980, 1980, 1981).

Thus, reforms in developing countries showed the influence of changes in societal needs on the goals of science education. For example, the emphasis often shifted from nation building to personal development for producing an adequate and capable human work force for the nation's economic growth. This shift is normally guided by national policies and is implemented by force of central government decree. The societal development goal has always been predominant. Within a framework of the national education, science education is seen as the vehicle for modernisation and economic independence.

**Conclusion and Remarks**

Literature on *songket* weaving provides some colourful pictures and elucidates the structure of the process. However, it 'decontextualises' the art of weaving. What is the method of *songket*? What are the different types of *songket*? What is the historical background of this piece of artefact? These questions guide the reader-inquirer to delve into this art which originated in the Sultanate days. Similarly, examining the literature on the development of science education could identify shifts in the relative emphasis of its goals. A school science curriculum often reflects these shifts and prevailing social perceptions of science and science education. A curriculum history could also provides insights into the negotiated change that has taken place and the professional initiatives of the developers. Furthermore, it provides residual evidence of the last reform, consequently taken as an historical artefact.
CHAPTER III: METHODOLOGY

To know a rose by its Latin name and yet to miss its fragrance is to miss much of the rose’s meaning

Eisner, 1981

Introduction

One of the best known types of songket is called the kain limar. Kain limar is made from silk cloth and it is among the softest and finest cloth in the Malay peninsula. What is the method of producing this songket piece?

In order to describe and understand the process of songket weaving, we have to decide on the nature and characteristics of the information needed. This decision determines the most appropriate approach for understanding the process. Perhaps, one of the common approaches is by gathering all the available textual information on the process. Similarly, to study the development of the Additional Science curriculum, the decision on the most appropriate research methodology starts with the initial questions formulated and the objectives of the study. Hence, the starting point is in determining the type of information needed and how best to obtain it, in order to achieve the objectives of the study.

Nevertheless, the word songket is related to sungkit or weft wrapping. Bamboo sticks are inserted through the wrap according to the plotted pattern and are lifted in a set of sequence. Threads are woven in and out at right angles to the wrap, called the weft. Shuttles are used to interweave the weft threads. The process of riding the weft threads over some wrap threads creates patterns on the cloth. This insight indicates a possible starting point for studying the development of Additional Science.
Research Design

Rationalistic over Naturalistic?

Although my own prior professional training and disciplinary background is, perhaps, more suited to the quantitative research approach, I have adopted a procedure that emphasises "holistic and qualitative information and... interpretive approaches (Verstehen)" (Husen 1988, 17). Consequently, the development of the Additional Science curriculum was studied in its cultural setting. In the early part of this chapter, I will attempt to explain why I have employed naturalistic inquiry for the study when the prevalent research methodology in science education in Malaysia is rationalistic inquiry?

Firstly, the aims of the study are to describe and explain the development of the Additional Science curriculum at the upper secondary level. In the process, the study also intends to illustrate the interplay of factors that influence the acceptance of the curriculum as a science subject in secondary schools in Malaysia. Hence, in view of the complexity of the development and implementation of a curriculum innovation and the desire to study this complex educational episode in its natural setting, I have employed an historical case study design, with qualitative research strategies. Denzin and Lincoln (1994) provide a generic definition for qualitative research:

Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. ... qualitative researchers study things in their natural setting, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. ... involves the studied use and collection of a variety of empirical materials - case study, personal experience, introspective, life story, interview,
observational, historical, interactional, and visual texts — that
describe routine and problematic moments and meanings in
individuals’ lives.

(Denzin and Lincoln 1994, 2)

However, Guba and Lincoln (1988, 81) point out that “the naturalistic paradigm ... is
often referred to (mistakenly) as the case study or qualitative paradigm”. Nevertheless, the
qualitative research tradition provides appropriate and flexible strategies for illuminating the
inner dynamics of the development process of the Additional Science curriculum. The
qualitative research tradition, or naturalistic inquiry, is also compatible with the efforts
towards the attainment of the objectives of the study.

Secondly, the characteristics of qualitative research support the decision for adopting
a naturalistic inquiry in preference to the rationalistic inquiry. Bogdan and Biklen (1992)
have defined five features of qualitative research:

1. Qualitative research has the natural setting as the direct
source of data and the researcher is the key instrument.
2. Qualitative research is descriptive.
3. Qualitative researchers are concerned with process rather
than simply with outcomes or products.
4. Qualitative researchers tend to analyze their data inductively.
5. ‘Meaning’ is of essential concern to the qualitative approach.

(Bogdan and Biklen 1992, 29-32)

Any attempts to objectively explain and clarify a curriculum development process
have to consider the educational experience as embedded in its natural setting. Consideration
on the cultural context of the development process of the Additional Science curriculum is
important because this will provide a vivid picture for the backdrop of the process.
Furthermore, it is crucial to ‘paint a landscape portrait’ of the background because “everything
has [a] potential of being a clue that might unlock a more comprehensive understanding of what is being studied" (Bogdan and Biklen 1992, 31).

In addition, a holistic treatment of the curriculum development process also provides insights to justify its current status in the secondary school curriculum. Thus, qualitative approaches provide experiential understanding of the complex interrelated variables involved in the curriculum development process through detailed description, without necessarily searching for causal explanations. Trumbull and Stake (1982, quoted in Stake 1995) have proposed that a study should maximise the opportunity for experiential learning or ‘naturalistic generalisation’ to occur for the readers.

To facilitate this process of experiential understanding of the educational episode, I have assumed several roles during the conduct of this study. In my role as a facilitator for understanding the development process of the Additional Science curriculum, I have interpreted the meanings given to the educational experience from the perspectives of the individuals associated with it. Erikson (1986, as quoted in Stake 1995) remarks on the centrality of interpretation as the primary characteristic of a qualitative research. However, since I was also the main instrument for gathering data in this study, I am aware that my personal views could influence the interpretations of these meanings. My previous involvement with curriculum development projects in my capacity as a science educator in the Malaysian education system could affect my interpretations of the Additional Science curriculum development process. In addition, I am also aware that I brought into the study socially constructed premises on the research problem, process and strategies. Denzin and Lincoln (1992) remark: “These beliefs shape how the qualitative researcher sees the world and acts in it” (Guba and Lincoln 1994, 13). They also refer to them as a ‘basic set of beliefs that guide actions’ (Guba and Lincoln 1994, 13).

The nature of the naturalistic report has also influenced my decision on the research approach to be adopted. A qualitative inquiry report has a more descriptive quality; it is ‘anecdotal’ (Bogdan and Biklen 1992, 30). Such reports “often contain quotations and try to describe what a particular situation or view of the world is like in narrative form” (Bogdan and Biklen 1992, 30). These qualities in a report would appeal to a wider audience
in the educational community and, consequently, act as a means of presenting the study to a greater number of concerned parties. Lofland (1974, quoted in Bogdan and Biklen 1992, 193) points out that: “Qualitative researchers are blessed in not having a single, conventionalized mode of presenting findings”. As Bogdan and Biklen (1992) succinctly remark, “Diversity, however, reigns” (Bogdan and Biklen 1992, 193). Furthermore, the various forms of presentation available in the qualitative research approach empower me to write more creatively and fluidly in a language not of my own.

Finally, the flexibility of research design afforded by qualitative research strategies was an important consideration in deciding on the approach. According to Vulliamy (1990): “Qualitative researchers generally recommended very much more open-ended research designs” (Vulliamy 1990, 85). However, Guba and Lincoln (1988, 83) have suggested that although research design in a naturalistic inquiry need only be specified in the broadest sense, “the naturalist is well-advised to specify as much in advance as possible”. This was sound advice in view of the anticipated time constraints for collecting data for the study, coupled with the initial uncertainty and tensions concerning what data to collect and how best to do so. Moreover, these early considerations of the data collection procedure were crucial because of the distance of the site for data collection.

Furthermore, Vulliamy (1990, 25) has suggested that conducting research within the qualitative research tradition is especially appropriate and beneficial in developing countries because of the “considerable potential for contributing to educational theory, policy and practice in developing countries”. Moreover, framing the research as a curriculum history study can provide a valuable link between past curriculum episodes and plans for the future.

A further consideration is that naturalistic inquiry is rarely employed in the field of science education in Malaysia, which traditionally has a more positivistic stance. Thus, my study may help to legitimise an alternative research paradigm. However, Sharifah Maimunah (1990) has voiced reservations about conducting a naturalistic inquiry in Malaysia, after employing the case study approach in her own study of a curriculum innovation at the primary level. She remarks that the mode of gathering data and the language of report are the two factors that could influence acceptance of naturalistic inquiry amongst the local
community of educators, and not always favourably. I anticipate that this study will broaden the perspective of the local educational research community still further, especially in science education, through its historical orientation.

The 'I's and Multiple Meanings

Stake (1995) remarks: "How case study researchers should contribute to reader experiences depends on their notion of knowledge and reality" (Stake 1995, 100). A researcher undertaking a quantitative research assumes and searches for a single tangible reality that comprises variables and processes (Guba and Lincoln 1988). However, employing a naturalistic inquiry has enabled me to assume the existence of 'intangible realities' constructed by individuals. In other words, as Guba and Lincoln (1988) point out, a reality can be recognised as having multiple meanings and interpretations constructed by individuals. Therefore, in an attempt to understand the development process of the Additional Science curriculum, and to convey to the readers the meanings given by the various individuals involved with the process, I assumed multiple roles.

I acted as the mediator for understanding the development process, as an instrument for gathering data to facilitate this understanding and, most importantly, as an interpreter of the meanings given to the curriculum development process by the individuals involved. Stake (1995) stresses the importance of this last role in a case study: "of all the roles, the role of interpreter, and gatherer of interpretations, is central" (Stake 1995, 99). Closely related to the role of an interpreter of the meanings, say Bogdan and Biklen (1992), is the essential concern with capturing the accurate meaning of the participants. In other words, a concern with the faithfulness of the meaning attributed to informants is essential to good qualitative case study research.

As a responsible investigator in all of these roles, I have tried to ensure that the "standards of trustworthiness" (Guba and Lincoln 1988, 84) were maintained. If, say Guba and Lincoln (1988), quantitative researchers are concerned about validity, reliability and
objectivity, qualitative researchers are concerned about the analogous notion of credibility, plausibility and, the like.

I have employed the triangulation technique to ensure the credibility of the data gathered and the meanings given to the development processes of the Additional Science curriculum. The data collected from various sources were in the form of reflective field notes, transcripts from taped interviews, official documents and official statistics obtained through informal conversation, interviews, related documents and textual materials. This multi-method for collecting data through triangulation also increases its validity and reliability (Patton 1990) by cross checking them. According to Stake (1995): “With multiple approaches within a single study, we are likely to illuminate or nullify some extraneous influence” (Stake 1995, 114). Adopting a multi-method approach enabled me to collect data on site from a variety of sources in a relatively short time period. However, due to the unexpected time constraint in the process of data collection, the study relied heavily on textual data in reconstructing the chronological development of the Additional Science curriculum.

Because I have maintained good rapport with the science educators in the Science and Technology Unit of the Curriculum Development Centre (CDC) in Malaysia, I was able to spend a substantial amount of time in the CDC during the data collection period. During these visits, the time was spent talking informally with the developers and observing how they work. These activities helped to overcome my own initial biases and misconceptions about the CDC in my role as an instrument for gathering data.

Beside the credibility check, Guba and Lincoln (1988) have also proposed transferability as a ‘standard for trustworthiness’ for a naturalistic inquiry. According to them: “Transferability is the equivalent to generalizability to the extent that there are similarities between sending and receiving contexts” (Guba and Lincoln 1988, 84). As the interpreter of the multiple meanings given to the development process of the Additional Science curriculum or the ‘multiple realities’ constructed by the individuals involved, I have also ensured that the information collected provides a detailed description of the process to facilitate the readers’ experiential understanding. However, I made no attempt for
generalizability. Rather I empower the readers to contemplate on the transferability nature of the study, based on the detailed description provided in the study. There were two phases for collecting this information: the initial phase in the data collection period was conducted in Malaysia; and the later phase in Canada, using computer technologies.

Guba and Lincoln (1988) also propose the use of purposive sampling as a technique to ensure transferability. To provide the detailed description needed in the study, I have considered the perspectives of the developers in the CDC, the teachers who formally taught the Additional Science curriculum in the secondary schools, school administrators, educators and former students who have taken the subject. In addition, the sampling technique employed has also contributed towards gaining insights into the multiple meanings given to the curriculum development episode.

Guba and Lincoln (1988) have this final word on the 'standards of trustworthiness', "It is generally understood that the use of even all these [propose] techniques cannot guarantee the trustworthiness of a naturalistic inquiry but can only contribute greatly to persuading a consumer of its meaningfulness" (Guba and Lincoln 1988, 85). Nevertheless, I took every effort in the course of conducting this study to maintain a high standard of trustworthiness and to provide a vicarious experience for readers of the development process of the Additional Science curriculum. I trust that my efforts enable the readers not only to know the rose in Latin, but also to experience the rose's fragrance (Eisner 1981).

Research Strategies

Strategies in Motion

A case study method with historical perspective has been adopted for interpreting the development process of the Additional Science curriculum process in its cultural context. The
techniques employed for data gathering complemented and supplemented each other. Several techniques for collecting data were employed, including:

1. Document Analysis
2. Intrinsic curriculum material analysis
3. Semi-structured interviews
4. Informal discussions
5. Structured Interviews
6. Reflection on my own experience as a teacher and teacher educator participating in in-service courses and curriculum development projects.

Unfortunately, a major unanticipated time constraint was imposed on the initial phase of the data collection period and the study had to rely largely on textual data to describe the development of the Additional Science curriculum. The allocated period in Malaysia had to be shortened because data collection coincided with Christmas and New Year celebrations and with the major celebration of Eid-Fitr for Muslims.

The document analysis phase included all primary and several selected secondary sources and all official documents related to the design and development of the Additional Science curriculum published by any government agencies and departments, whether printed on paper or electronically. These include circulars, curriculum documents, documents related to policies and brochures. Syllabus specifications, teachers’ guides and other supporting materials for the curriculum were studied to clarify the aims and goals of the Additional Science curriculum from the perspective of the policy makers and developers. In addition, samples of teachers’ record books were also considered to help describe the curriculum episode from the practitioners’ perspective. Information related to the economic, political, social and cultural contexts of the Additional Science curriculum were also collected from the National Archives, the National Library and from other related Ministries within the government.

In the case where primary sources were unavailable, data was collected from secondary sources available locally and, in particular, from textbooks, related published
educational books and unpublished theses on the national curriculum from local universities and abroad. In the Malaysian educational system, each university determines the minimum grade required for enrolment in its diploma and matriculation programmes. These requirements are published in their annual prospectus. Thus, prospectuses of several local universities were also collected as a secondary source of data to provide the views held by these institutions on the importance and the status of *Additional Science* as an ‘entry subject’. The requirements needed for all the programmes related to science and technology in the prospectus were considered in the analysis.

I have assumed that all the official government documents carry the views and opinions of the developers and reflect those of the respective decision-making bodies. I have considered these documents as empirical data because of the fact that they represent the perspectives of the various individuals or organisations that propose them. Thus, this data contributed to my interpretation of the multiple meanings given to the development of the *Additional Science* curriculum by the individuals or organisations involved in the decision-making stage.

These materials were analysed to identify any recurring patterns and to locate other sources of data related to the historical study. However, as a credibility check, I triangulated the document analysis with interviews and informal discussions with the participants. Conducting the interviews and engaging in informal conversation on the site revealed the intentions and feelings of the individuals, which could not have been captured from the documents alone. The educational officers involved in the *Additional Science* project from the CDC were chosen to represent the views of the policy makers because of CDC’s role as a secretariat for the decision making committee pertaining to any and every curriculum project in the country. They include members of the initial project team and the current officer in-charge of the *Additional Science* curriculum. The teachers’ and students’ perspectives are crucial because they provide meaningful insights into the question: What are the realities in schools? This purposive sampling technique was also to ensure data transferability in the study.

When on-going professional contacts with the respondents existed, data were also
collected from the planners, developers and practitioners involved in the project by means of informal conversations. For other respondents, prepared interview guidelines were constructed. These educators were chosen because of their role in the curriculum development projects and the assumption that the “perspectives of others is meaningful, knowable and able to be made explicit” (Patton 1990, 278) in reconstructing and describing the curriculum development process.

Prior to the interviews, an official letter of introduction was sent to the appropriate head of department of the respondents concerned. Letters of consent were also prepared to clearly inform the interviewees of the purpose of the study and to clarify the issue of confidentiality of the information collected. In the second phase of the data collection period, respondents were contacted and informed through e-mails.

The semi-structured interview was used during the onsite data collection period to increase the chances of in-depth and solid information from the respondents. However, in anticipation of difficulties and loss of meaning in translation, the questions were asked in both English and the Malay language and respondents were given the opportunity to answer the questions in the language that they felt most comfortable with. Consequently, this necessitated the inclusion of some initial questions, rather than only general topics as suggested in the methodology literatures. Further additional questions that were relevant to the issues that emerged during the interviews were generated from this initial set of questions and also from respondents’ responses. These complementary spontaneous questions maintained flexibility in the interviewing process. Interestingly, the interviews were conducted in English and, with one respondent, in a mix of English and Malay. This is despite the fact that both the interviewer and interviewees are not native speakers and English is not the medium of instruction in the local universities. One possible reason might be that many of the science educators from the CDC have an overseas tertiary education background. In addition, English has always been perceived and acknowledged as the international language for academic studies in the country. All interviews and informal discussion with the teachers and administrators either personally or electronically were conducted in Malay.
In addition, an interview guide provides a flexible guide for the novice interviewer and alleviates some anxieties during the interviewing process. Most importantly, it "establishes the purpose and focus of the interview" (Seidman 1991, 59). It enabled the interviewer to focus on the interviewees’ experience and to explore the meaning of the Additional Science curriculum experience from their perspectives. Finally, the interview guide also helped to structure the method for collecting information from the participants by "delimiting in advance the issues to be explored" (Patton 1990, 283), thus saving some valuable time. All these interviews were recorded and later transcribed. However, handwritten notes were also taken to supplement the tapes in these sessions, and also in one case where a respondent wished not to be taped-recorded.

These interviews were initially conducted in a face-to-face situation on site in Malaysia, but were later conducted from Canada through computer technology. Due to time constraints and time difference, only structured interviews were conducted by means of computer technology. Questions for the structured interviews were designed for the respondents in relation to the status and role of the particular respondent; teachers who have taught the subject and students who have taken the subject. Although the initial phase of the data collection period was planned for a two-month period from December 1998 to January 1999, it was actually conducted within a period of one month in Malaysia because of the constraints discussed above.

The Course of Making Sense

Bogdan and Biklen (1992, 153) refer to analysis as "working with data, organising them, breaking them into manageable units, synthesising them, seeking for patterns, discovering what is important and what is to learned, and deciding what you will tell others". Thus, to undertake the seemingly overwhelming task of making sense of the mass of information collected about the development of the Additional Science curriculum, a two-
The stage method of data analysis procedure was employed: an on-site continuous and concurrent analysis, coupled with a final and comprehensive data analysis. While the more comprehensive and full-fledged analysis was only done after all the data has been collected, data were also analysed while on-site in Malaysia in order to guide the collection of other relevant information. As data were interpreted, the need for further and different data was revealed.

This initial step enabled both the process of data analysis and the activity of data collection to occur simultaneously, while in Malaysia. This two step procedure also helped to refine plans and to determine with greater insight the subjects to be interviewed and the questions to be included in the interview guide, together with the type of documents and materials needed to provide a detailed description of the curriculum development process. Data collected from the informal discussions conducted on-site were also analysed and provided an additional focus for the first phase of the data collection period in Malaysia. All the analytical activities that occurred on-site during this initial phase assisted in the formulation of the questions for the structured interviews conducted with participants using computer technology during the second phase of the data collection period.

The final stage of the data analysis procedure was performed after all the information and responses from the respondents have been collected. In this comprehensive analysis, all the data collected were coded into coding categories that represent the chronological development process of the *Additional Science* curriculum. The 'process code' (Bogdan and Biklen 1992, 169) employed in the data analysis procedure divides the data into events and processes that occurred before and after the *Additional Science* curriculum reached the schools. The stage 'before reaching the school' includes the planning and development process at the federal level and the implementation of the curriculum at the state and district levels. All the data that contributed to the factors that influence the acceptance or rejection of the implemented *Additional Science* curriculum as a science subject in the upper secondary level of schooling were categorised into the 'after reaching the school' stage. These particular coding categories have also facilitated the interpretation of the curriculum development process from the perspectives of the individuals involved through these two stages.
Conclusion and Remarks

In deciding on a research project, questions abound: rationalistic or naturalistic inquiry? Qualitative or quantitative research methodology? The decision to employ one type of research method rather than another depends on considerations of how best to achieve the aims and objectives of the study. It seemed that the detailed description of the method for producing a *songket* piece would be improved by collecting data using a multi-method approach that includes document analysis and observation. The study has adopted the naturalistic inquiry because it gives the researcher 'room to manoeuvre'. Its multi-method approaches provide a vicarious experience of the development process of the *Additional Science* curriculum to the readers. Finally, in choosing the naturalistic inquiry, it is a personal challenge to try a research methodology that is contrary to the prevalent research practices in Malaysia. According to Glesne and Peshkin (1992, 8): "Our preferred research method reflect personal choices; they are, however, embedded in our cultural and historical contexts".
PART TWO: THE CURRICULUM PIECE
CHAPTER IV: THE LANDSCAPE

We recognized then as we do now that education is never static, for society changes and we change with the times.


Introduction

In the effort to understand recent curriculum development, it is necessary to take a backward look at Malaysia's rich and varied history. In addition, treading through the changes in formal education, curriculum development practices and school structures since Malaysia attained political independence helps to provide experiential understanding of the current educational climate in Malaysia.

This exercise is imperative because it provides the historical context for the direction and the pace of the continuing process of educational change in the country. As Postlethwaite and Thomas (1980, xiii) say, "political events in Southeast Asia will continue to exert a strong influence on educational affairs".
**Geographical Setting**

**The Land**

Malaysia is a small developing country that straddles the South China Sea and lies seven degrees north of the equator in the heart of the Southeast Asian region. It has a total area of 330,000 square kilometres and comprises of two distinct regions: Peninsular Malaysia and East Malaysia. Peninsular Malaysia is at the tip of the Southeast Asia mainland and is bordered by Thailand and Singapore to the north and south, respectively. While East Malaysia, which comprises of the states of Sabah and Sarawak, are on the island of Borneo. 531 kilometres of South China Sea divides these two regions of Malaysia.

Kuala Lumpur, the nation’s capital city, is located in the West Coast of the Peninsula. Due to its location, Malaysia has a warm and humid climate with a relative humidity of about 80 % all year round. The temperature ranges from 21°C to 32°C. Malaysia’s climate is governed by the two tropical winds: the northeast and southeast monsoons that blow alternately during the course of the year.

**The People**

Malaysia has a plural society with diverse cultural, religious and language traditions, creating a distinctively unique Malaysian culture. The population of about 20 million people is comprised of Malays and other indigenous people (Bumiputera) (58.6 %), Chinese (32.1 %) and Indians (8.6 %) (Government of Malaysia On-line 1998). Other ethnic groups account for about 0.7 % of the population. About 82.1 % of Malaysia’s population are in the Peninsula, with a greater concentration in the western coastal area. Sabah and Sarawak have 8.1 % and 9.8 % of the total population, respectively. The economic and political factors
before and during colonisation were influential in determining the development of the area and have contributed to this uneven distribution of population.

The national religion is Islam; however, the Constitution protects worship within other religions. *Bahasa Malaysia* is the national and also the official language. It is the medium of instruction in all government funded national primary schools and secondary schools and also in institutes of higher learning. Nevertheless, English is widely used and is both a compulsory and an examinable subject in schools.

*The Economy*

The Malaysian economy expanded rapidly during the 1980s, with strong output recorded in the manufacturing, services and construction sectors. Since 1987, the manufacturing sector has become the lead growth sector in the economy with a contribution to the GDP surpassing the agricultural sector. In 1996, the Malaysian economy registered a growth rate of 8.2 %, with much of the impetus for this growth coming from the manufacturing sector. The share of manufactured goods in the total exports of the nation is estimated to have increased to 81 % in 1996, up from 79.7 % in 1995 (MAS 1997, 108).

However, due to the economic crisis that has swept the Asian region since the middle of 1997, the contribution of the construction and manufacturing sectors has recently declined. The services sector has expanded, albeit slowly, during this period (Ministry of Finance 1998). In the economic report for 1998/99, the Finance Minister I states that:

...1998 is a difficult and challenging year ... the country's development for nearly a decade has been affected ... the value of *ringgit* has depreciated considerably ... and the *BSKL* has sustained a loss of two third ... equivalent to 186 percent of the GDP or two years of the country's income ... the government revenue has been affected ....

(Finance Minister I, October 23, 1998)
The country’s GNP showed the first decline since 1985, with falls of 2.8 % and 6.8 % during the first and the second half, respectively, of 1998 (Ministry of Finance 1998). Electrical and electronic products contributed RM 152,074 million, whereas palm oil and palm based products contributed RM 22,669 million towards the country’s major export in 1998 (Government of Malaysia On-line 1998). The unemployment rate in 1998 was 3.2 % of the labour force.

The Politics

Malaysia has an elective constitutional monarchy. At five yearly intervals, the Supreme Head of State, the Yang Di Pertuan Agong, and the Deputy Supreme Head of State are selected from amongst the nine hereditary Malay rulers by the Council of Rulers. However, executive power is invested in the Cabinet, which is led by the Prime Minister from the political party with the majority of votes in the parliamentary election.

The Parliament consists of a Senate and a House of Representatives. All members of the Senate are appointed for a six-year term, whereas members of the House of Representatives are elected for a five-year term. Legislative power is divided between the Federal and State legislatures.

Historical Background

The Orang Asli (the aboriginal people of Malaysia) first arrived in the Malay Peninsular some 10,000 years ago. The Proto-Malays, who were the forefathers of the Malay population, joined them later. However, only at the start of the Christian era did Indian and Chinese traders begin trading in the Peninsula.
The first entrance in the *Sejarah Melayu* (Malay Annals) was recorded in the 16th century. A *Sumateran* prince founded Malacca in 1403, and by the 15th century, Malacca had flourished into a wealthy and powerful kingdom because of its strategic location on the waterways that connect the east and west. Its location in a land that is abundant with natural resources, such as gold, tin and spices, has also contributed to its fame and prosperity.

This abundance of natural wealth would later become the cause of Malacca’s downfall. In the next few centuries, Malacca was invaded and conquered by several European invaders. The Portuguese came in 1511, followed by the Dutch in 1641 and, finally, the British arrived in 1876 through the invasion of Penang. The Malay Peninsula was under British rule until the attainment of self-government and independence, except for those years between 1942 and 1945 when the Japanese held power.

During the British occupation era, the states in the Malay Peninsula were divided into three administrative groups: the *Straits Settlements* (Penang, Malacca and Singapore), the *Federated Malay States* and the *Unfederated Malay States*. Clearly, the British had employed the ‘divide and conquer’ strategy to maintain power during those years. Meanwhile, in the island of Borneo, James Brooke, known as the White Rajah, ruled British Borneo Territories of Sarawak and the British North Borneo Company owned Sabah (British North Borneo).

British plans for the formation of the Malayan Union after WWII was confronted with fierce Malay nationalist movements, which resulted in the establishment of the Federation of Malaya in 1948. However, through peaceful negotiations these acts of nationalism later culminated with the Malayan Federation gaining independence for the states in West Malaysia in August 31, 1957.

In September 1963, the political entity named Malaysia was born from the amalgamation of the British colonies: the Federation of Malaya, Sabah, Sarawak and Singapore. However, disagreement on the direction of this new nation between the Malayan and Singaporean leaders led to the separation of Singapore two years after its conception.
Historical Evolution of Education

Conflict of Interest (Pre-independence)

Two important factors shaped the early educational system in the Malay Peninsula during the pre-independence period. Firstly, its strategic location at the tip of the Southeast Asia mainland and in the centre of the trading crossroad between the east and west. Secondly, its abundance of natural resources, especially tin and rubber, which was largely responsible for attracting a large proportion of Chinese and Indian immigrants during this period. This influx of traders and immigrants to the area produced the multi-racial character of the populace with its diverse ethnic, religious and social background.

The school structure during this period evolved from the geographical segregation of the populace. It reflects the socio-economic compartmentalisation of the ethnic groups, which accentuated the language barriers between them. A differentiated system of education existed: vernacular schools (Malay, Chinese or Tamil) and English schools established either by the British or by missionary groups (Wong and Ee 1971; Chang 1973; Sufian 1996) (Appendix H). This segmented vernacular structure of schooling has been a significant feature of Malaysian education since the 1920s (Bokhorst 1993). For example, there were a total of 90,436 Malay medium; 86,289 Chinese medium; 22,641 Indian medium and 57,615 English medium students in the schools in Malaya in 1938 (Report of Education Committee 1956).

In exploiting the Malay Peninsula for economic gain, the British also implicitly contributed to this multiple system of education and, thereby, created a much-segmented populace with divided loyalty and allegiance (Conway 1972). A remark by an official reflects the British stance on education during this period:

The aim of the Government is not to turn out a few well educated youths, nor yet numbers of less well-educated boys;
rather, it is to improve the bulk of the people and to make the son of the fisherman or peasant a more intelligent fisherman or peasant than his father had been, and a man whose education will enable him to understand how his own lot in life fits in with the scheme of life around him.

(Quoted from P. Loh 1975)

The multiple system of education reflects the socio-economic and political scenario during this period. Chang (1973) suggested that three factors led to its development: the multiracial structure of the society, the efforts by various voluntary groups to promote education and the lack of any definite national objectives. The first attempt to formulate a definite educational policy prior to independence was through the Education Ordinance 1952. The main thrust of this Ordinance was the provision of two types of national schools with Malay and English medium of instruction. However, “the implementation of the Ordinance met with many obstacles” (Chang 1973, 45), mainly due to financial constraint and an insufficient number of teachers capable of teaching in these languages.

Three historic events that marked the end of this early period in the nation’s political development have contributed to define the emphasis of the goals on education for the nation: the formation of the Malayan Union (1945 to 1948), the establishment of the Federation of Malaya (1948 to 1956) and the attainment of Independence (1957). One important question springs to mind: Does the effects of the educational structure during this early period continue to permeate and influence the socio-political objectives of the nation in subsequent years?

*Laying the Foundation (1960-1970)*

The recommendations from two educational reports were crucial during the period of post-Independence. A national educational policy also emerged from these two reports and
laid the foundation for achieving a national system of education. The Razak Report (1956) and the Rahman Talib Report (1960) were also the basis for the formulation of two important legislatures: the Education Ordinance 1957 and the Education Act 1961. These reports provided the foundation for the aims of education and the administrative structure of the Ministry of Education.

In preparation for independence, the Alliance Government made planning for education its main political agenda when it took office in 1955. The then Minister of Education, after whom the commission was named, headed the fifteen members of the legislative council. Its responsibility was as follows:

To examine present education policy of the Federation of Malaya and to recommend any alterations or adaptations that are necessary with a view of establishing a national system of education acceptable to the people of the Federation as a whole which will satisfy their needs and promote their cultural, social, economic and political development as a nation, having regard to the intention of making Malay as the national language of the country whilst preserving and sustaining the growth of the languages and culture of other communities living in the country.

(Report of Education Committee 1956, 1)

The Federal Legislative Council accepted the report from this committee, which is also known as the Razak Report (1956). The recommendations from the report were incorporated in the formulation of a new national education policy through the Education Ordinance of 1957, which rescinded all previous policies. The report also states its main emphasis as follows:
We cannot overemphasize our conviction that the introduction of syllabuses common to all schools in the Federation is the crucial requirement of educational policy in Malaya .... Once all schools are working to a common content syllabus, irrespective of the language medium of instruction, we consider the country will have taken the most important step towards establishing a national system of education which will satisfy the needs of the people and promote their cultural, social, and political development as a nation.

(Report of Education Committee 1956, 18)

The committee recommended the conversion of the existing primary schools to standard schools with Malay medium of instruction and standard-type schools with Chinese, Tamil or English medium of instruction. It also recommended the establishment of one type of national secondary school and the introduction of the Lower Certificate and the Federation of Malaya Certificate of Education examinations.

Another important feature of the report was its emphasis on the reorganisation and development of vocational and technical education to meet the country’s growing manpower needs. This was spurred by the effort for the Malayanization of the public services immediately after independence. The report recommended that:

Technical Colleges should be institutions of post secondary education providing full-time courses for those who have completed a full secondary education. We consider that Technical Institutes should provide for pupils who have completed three years of secondary education. The course should be of three years’ duration and provide for those who seek employment as technicians either with Government
Departments or in private employment. We recommend that the present Junior Technical (Trade) Schools should become Technical Institutes. We consider that Trade Schools should provide for pupils who have completed a full primary school course. The course should be for two years.

(Report of the Education Committee 1956, 15)

The provision for a specialised trade, vocational and technical secondary education was later legislated in the Education Act 1961 and further supported by the establishment of the Technical Education Division within the Ministry in 1964.

During this Period of Rebuilding (Ministry of Education On-line 1998), the emphasis on the goal of education was to unify the diverse populace through the education system. Forging unity through a national system of education with a common content syllabus that reflects local needs and a common medium of instruction was acknowledged by the interim government as a vital step in rectifying the disparities between ethnic groups, caused largely by the separate schooling system.


The educational policy of the Federation originally declared in the Education Ordinance, 1957, is to establish a national system of education which will satisfy the needs of the nation
and promote its cultural, social, economic and political development

(Education Act 1961, 1)

At the primary level, the Sekolah Kebangsaan (national) and Sekolah Jenis Kebangsaan (national-type) schools that follow a common content syllabus replaced the previous standard and standard-type schools. In order to provide secondary schooling for students from the Malay vernacular primary schools which was not available previously, the medium of instruction of the existing national-type secondary schools (English or Chinese medium of instruction) was converted to Malay and English. This new bipartite secondary school system renamed as the national and the national-type secondary schools, with the medium of instruction of Malay and English, respectively. In addition, specialisation at the upper secondary level differentiated the secondary schools into three different orientations: academic, trade and technical and vocational schools (Education Act 1961) (Appendix I).

In the previous system, only about 30 to 35 % of the Standard Six (equivalent to grade 6 in North American schooling system) pupils from the primary schools were selected for admission to Form One (equivalent to grade 7 in North American schooling system) in secondary schools (Wong and Ee 1971, 100). The abolishment of the Malayan Secondary Entrance Examination (MSEE), in 1965, saw a dramatic increase in enrolment to secondary schools. Student enrolment in government-funded English schools increased from 48,235, in 1957, to 420,054 in 1975 and in the Malay medium secondary schools from 2,315 (1957) and 294,832 (1975) (Chai 1977, 42). This automatic promotion through the pupils’ primary and lower secondary school year was the initial step towards providing equal educational opportunity for all children as recommended by the Rahman Talib Report (1960). It extended schooling year for every child from 6 to 9 years.

Based on the recommendations from the Rahman Talib Report (1960), the Education Act 1961 also made legislative provision concerning moral and religious education. It states that:
The managers or governors or other persons responsible for the management of a school in receipt of grant-in-aid, as the case may be, may provide for the instruction of the pupils of the school, or any of them, in a religion other than the Islamic religion.

(Education Act 1961, 21)

The Education Act 1961 also showed an increased centralised control on the educational system. The Ministry of Education was given greater control on all policies pertaining to education and has authority over all educational matters relating to schools. The Act established a four-tier administrative structure: federal, state, district and local educational authority and it solidified the government's political agenda by formulating a national policy on education. At the federal level, the Ministry is counsel by professional and administrative arms in the ministry (Appendix S).

During this period, there were two main educational challenges facing the government in its effort to forge national unity through education. First, the provision for greater educational opportunities through the assurance of universal free primary education and the expansion of the secondary education (Education Act 1961) demanded greater expenditure in education. In the early 1960s, the number of pupils in the government assisted primary schools increased from 933, 151 (1957) to 1, 147, 856 (1963). Whereas, in the government assisted secondary schools, the number increased from 81, 042 (1957) to 155, 143 (1963) (Educational Statistics of Malaysia 1938 to 1967). However, by 1975, 714, 886 students were enrolled in all government-funded secondary schools (English and Malay medium of instructions) (Chai 1977, 42).

The second educational challenge facing the government was formulating a common curriculum for fostering national unity through a common medium of instruction. During this transition period, a separate system of education still existed, both at the primary and secondary levels: vernacular primary schools and the bipartite secondary school system with Malay and English medium of instruction. Although the Razak Report (1956) and the
Rahman Talib Report (1960) reformed the educational structure in the Federation, language remained the key factor. The Education Ordinance 1957 stated that Malay was to be a compulsory subject in all schools and a required subject for admission to any secondary schools supported by public funds. However, English was also to be a compulsory subject because of its utilitarian values. Chinese and Tamil would be taught to students if a minimum of fifteen parents requested them. The National Language Act 1967 later reaffirmed the status of Bahasa Malaysia as the national language in the school curriculum.

Bahasa Malaysia was already a required examinable subject in the Lower Certificate of Examination, which had started in 1957. It finally became the sole medium of instruction in the national primary schools in 1970 and in all secondary schools in 1976.

Finally, to complement the two major educational enactments, the First Malaysian Plan (1966-1970) was introduced. This was the first in a series of five-year development plans that later became the country’s developmental blueprint. Among the aims of the First Malaysian Plan were the developments of a national educational system to foster unity by providing adequate educational facilities, especially in the secondary education, improving the quality of education and narrowing educational gap between urban and rural area. It aimed to expand educational facilities and training in the areas of agricultural, industrial and technologies and develop the training of teachers to produce sufficient qualified teachers to meet the demand (First Malaysia Plan 1966-1970).

The major concern during this period was on laying down the legal framework for the system. By the end of this period, the legal and structural foundation for a national educational system was well established.

Qualitative and Quantitative Expansion (1970-1990)

The racial tension that occurred on May 13, 1969 was also a significant incident in the evolution of Malaysia’s educational history. It stimulated the government’s efforts for fostering a united and harmonious society into two stages. First, the formulation of the Rukun Negara (National Ideology) and the Dasar Ekonomi Baru (National Economic Policy, NEP)
which laid the conceptual framework for these efforts. Secondly, the establishment of the Cabinet Committee to review the country’s educational system.

The underlying aims in the *Rukun Negara* were the basis for educational development (Appendix A). However, it was the economic policy stated in NEP that provided the strategy for achieving these aims. With the emphasis on improving and developing the economic and social sectors to ensure equal distribution of wealth amongst the populace, the NEP overrides all previous policies. Its redistribution objective was to be achieved over a twenty-year period from 1970 to 1990. The aims of the second five-year blue print for the nation’s development are stated as follows:

The Second Malaysia Plan is a blue print for the NEP. It incorporates the two-pronged objective of eradicating poverty, irrespective of race, and restructuring Malaysian society to reduce and eventually eliminate the identification of race with economic function

(Second Malaysia Plan 1971-1975, v)

In September 1974, the government formed a Cabinet Committee with the following aims:

To evaluate the aims and effects of the existing educational system, including the curriculum that is within the framework of the national educational policy for the purpose of ensuring that the nation’s short and long term manpower demands are met and especially to ensure that the system of education is able to fulfill the national aim to produce a united, disciplined and trained society

(Cabinet Committee Report 1979 [Malay] 1984, 1)
The Deputy Prime Minister, who was also the Education Minister, headed the Cabinet Committee, which included several other ministers in the government. However, the Secretary General of Education chaired the working committee. The committee included director generals and secretary-generals from all the ministries in the government and several representatives from local universities.

The Cabinet Committee received 302 memorandums from political bodies, non-government organisations and societies, and concerned individuals. One of the items it considered was the Ministry's Dropout Study Report (1973). The report, known as the Murad Report (1973), pointed to a disturbing state in student enrolment in the schools in early 1970s. In 1970, 31.4% of primary school students did not continue to secondary schools. The figures were 41.0% and 55.0% in Sabah and Sarawak (Cabinet Committee Report 1979 [Malay] 1984). Based on the recommendations from the Murad Report 1973, several steps were taken to improve the survival rate and redress the dropout problem: implementing the Textbook Loan Scheme in 1975 and the Supplementary Feeding Scheme in 1976, granting scholarships for students in the rural area, and implementing steps to remedy students’ learning difficulties at the primary level. Consequently, enrolment improved significantly: 420, 644 (1970) to 649, 706 (1975) at the lower secondary level, and 1, 682, 187 (1970) to 1, 897, 188 (1975) at the primary level. (Government of Malaysia 1976, 405).

The Committee identified several weaknesses in primary and secondary education. At the primary level, the curriculum was ‘compartmentalised’, with an emphasis on acquiring knowledge instead of developing basic skills. Consequently, coupled with inappropriate methods for teaching in the classroom, the situation presented a curriculum that was formulated without the learner in mind. In secondary education, the Committee reported that the curriculum shows lack of continuity between primary and secondary levels; it is too content-laden; and the practice of ‘streaming’ at the upper secondary level does not foster the attitude of lifelong learning in students. In addition, the system does not promote educational equity at the upper secondary level of schooling (Cabinet Committee Report 1979 [Malay] 1984).
Based on these perceived deficiencies in the existing curriculum, the Cabinet Committee made 173 recommendations to improve the national system of education, which were included in a report published in 1979. Among them was the extension of the general schooling period for all children from 9 to 11 years. The report was the basis for the conceptualisation of a new school curriculum that was implemented in the 1983 at the primary (NPSC) and 1989 at the secondary (ISSC) levels. This ten-year programme (1986 to 1990) to develop and improve primary and secondary education was financed by the World Bank loans (Commonwealth Secretariat 1990). These curriculum developments not only emphasised the need to improve skills and knowledge, but also to instil values and norms in line with the principles of Rukun Negara (Government of Malaysia 1981). The final version of the Falasafah Pendidikan Negara (National Education Philosophy) was published in 1989. It incorporated the national policy on education, as stipulated in the Education Act 1961 and guided by the ideology stated in the principles of the Rukun Negara. The education system during the early part of this period showed the steps taken from the recommendation from the Cabinet Committee report (Appendix J).

In addition to the preceding efforts, reorganisation of the administrative structure of the education system during the late 1970s lent further support to change. Several divisions were established within the ministry: including the Malaysia Examination Council (1970), Textbook Division (1972), Higher Education Division (1972), Curriculum Development Centre (1973) and National Institute of Education Management (1979). The government commitment towards educational change showed in the increased in educational expenditure from RM 1,462 million (1975) to RM 2, 575 million (1980) and RM 4, 493 million (1985) (Ministry of Education 1986, 61). Expenditure on education, which is a major item of public expenditure, averages about 18.8 % of national budget and 5.7 % of the Gross National Product (Commonwealth Secretariat 1990). As a result, the percentage of dropouts from the primary and secondary schools showed a decrease from 16 % and 57 %, respectively, in 1970 to 6 % and 20 % in 1980 (Murad Report 1973, 18). Finally, enrolment in the government and government-aided schools at the lower secondary levels increased by 2.4 %,
from 922,200 (1985) to 943,920 (1990), and the transition rate between primary and lower secondary levels remained constant at about 84% (Government of Malaysia 1990, 161).

Hence, by the end of this period, major recommendations from earlier enactment were in place in the system. By 1982, the national language as the sole medium of instruction was fully implemented in all secondary schools. Common examinations in the national language were conducted in 1988 and in 1987 for primary and secondary schools, respectively, and common content-syllabuses were taught at both levels of schooling. By the end of this period, the education system was in place for further expansion after further reorganisation (Appendix K).

Looking Ahead (1990 onwards)

The major thrusts in educational efforts during the 1970s and 1980s were providing quality education to the populace and promoting educational excellence. These continue to be Malaysia’s educational priorities. Similar strategies to the past continue to be used to precipitate change in the system, and the goals of education remain embedded in the country's overall development plans.

For instance, in 1991, the government proposed a blueprint (Vision 2020) for the nation’s development and progress to the year 2020, with the vision of a fully developed nation able to take its place within the international economic and social framework. A raft of legislation has been implemented to support the national aspirations of Vision 2020. As the state-funded educational system is increasingly being ‘primed’ to assist Malaysia in competing effectively in the global educational market, legal provisions have also been implemented to control and supervise the type and quality of education provided by the private sectors. The education system in this recent period accommodates the national educational aims (Appendix L).

During this recent period, six legislatives were introduced: the New Education Act 1996, the Council on Higher Education Act 1996, the Private Education Institute Act 1996,
the Universities and University College (Amendment) Act 1996, the National Accreditation Board Act 1996 and the National Higher Education Fund Board Act 1996. These were intended to support the Ministry’s mission “to develop a world class quality education which is flexible and innovative that in turn will make Malaysia a regional education hub and a centre for education excellence as we approach the next millennium” (Ministry of Education On-line 1998). The Education Act 1996 states that:

The purpose of education is to enable the Malaysian society to have a command of knowledge, skills and values necessary in a world that is highly competitive and globalized, arising from the impact of rapid development in science, technology and information.

(Education Act 1996, 103)

The Act acknowledges the crucial role of education in the attainment of the country’s aspirations through the development of the individual child’s potential in a world class quality system of education (Ministry of Education On-line 1998). However, it also reiterates the emphasis on promoting unity through a national system of education with “the national language as the medium of instruction, a National curriculum and common examinations” (Education Act 1996, 104). The Education Act 1996 also re-emphasises the integral role of the Falasafah Pendidikan Negara (National Education Philosophy) formulated in the previous educational period. It states that:

And Whereas [sic] the National Education Policy is based on the National Philosophy of Education which is expressed as follows: Education in Malaysia is an ongoing effort towards further developing the potential of individuals in a holistic and integrated manner so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in and devotion to God.
Such effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving a high level of personal well-being as well as being able to contribute to the betterment of the family, the society and the nation at large.

(Education Act 1996, 104, underlined are the added emphases in this recent version)

The intended aim of the Education Act 1996 is for a more flexible education system that is equitable and caters for all children. It also advocates the implementation of a more flexible examination system: ‘open certification’ at the upper secondary level (Ministry of Education On-line 1998). During his keynote address at the National Education Conference, the Minister of Education used some rhetoric slogans that reflect the direction of the nation’s educational system: ‘Education for the 21st century’, ‘Education Made in Malaysia’ and ‘Individual-Oriented Education (Ministry of Education On-line 1998).

**Historical Evolution of the School Curriculum**

In the early vernacular system of education, a diverse curriculum existed. The English medium schools had a curriculum with a marked Western bias and the Chinese schools used materials that had form and content imported from Mainland China. The curriculum of the English schools was highly academic and reflected the education characteristics of schools in England in preparation for the Cambridge Overseas School Certificate. Similarly, the Tamil schools looked to India for inspiration, with the content of textbooks largely focussed on India and Ceylon (now Sri Lanka). In the Malay vernacular schools, the teaching of Quranic verses and Arabic (religious teachings), which had existed before the arrival of British, were
taught in the afternoon, whereas ordinary school subjects were taught in the morning (Wong and Ee 1971; Chang 1973). "A policy for the Malay school was laid down, namely the provision of a sound primary education and the close linking of the curriculum with the environment of the children" (Winstedt 1931 quoted in Chang 1973). Besides acquiring the basic three R's, subjects related to the daily life in the kampongs, such as gardening, netting, sewing and basketry were also taught.

The earliest attempt at significant curriculum development occurred after the release of the Razak Report in 1956, which recommended that a common syllabus for all the schools in the Federation was an essential aspect of the national education policy (Razak Report 1956). Hence, the General Syllabus and Timetable Committee was established in 1956 to develop a common-content syllabus for all subjects in all schools. However, the formation of these curriculum committees was on an ad-hoc basis, depending on the subjects' need. There were dissolved as soon as their work was complete (Lewin 1984).

Until the 1980s, the general curriculum of the vernacular system of education in the national and national-type primary schools was subject-centred, with little emphasis on basic skills. However, several changes occurred in the secondary school curriculum following the recommendations in the Rahman Talib Report (1960) to extend the age of schooling 15 years old. Furthermore, the abolition of the MSEE in 1965, which led to an increase in students enrolment for the first three years of secondary education (134, 374 in 1964 and 387, 342 in 1966) (Ministry of Education 1985), requires the development of a new secondary school curriculum able to provide relevant education for a large number of students with mixed abilities and interest. To cater for the needs of these students, the General Syllabuses and Review Committee was established in 1964. The efforts to expand and diversify secondary education led to the introduction of a three-year post-primary course aimed at the less academically inclined students and intended to complement the existing academic exam-oriented course. However, lack of clarity in the aims and objectives of the programme influenced the acceptance of this less academic curriculum, which was later replaced by a comprehensive system of education in 1965 (Wong and Ee 1971; Chang 1973).

The Comprehensive Curriculum was a non-selective and diversified curriculum. Its unified, general and prevocational features helped to gear the educational system to meet the
growing requirements of the country’s economic manpower. The curriculum was organised into core compulsory subjects and elective prevocational subjects where the students choose either one or two subjects, depending on their capabilities and interest. The prevocational subjects (Industrial Arts, Home Science, Agricultural Science and General Business Practice) aimed to provide general education to all pupils before sitting for the Sijil Rendah Pelajaran, SRP or Lower Certificate of Education, LCE examinations (Wong and Ee 1971; UNESCO 1976). This integrated education replaced the practice of channelling students into academic, rural extension or continuation education that had been introduced following the Education Act 1957.

As indicated earlier, following the Education Act 1961, educational planning is divided into four levels of operation, with decisions being made through a committee system. The federal level is responsible for administrative and professional matters. However, the highest decision-making body in the Ministry is the Educational Planning Committee (EPC), which is chaired by the Minister of Education. It comprises several committees, including the Central Curriculum Committee, CCC, the Higher Education Committee, the Development and Training Committee, Finance Committee, and Scholarship and Training Division (Appendix T). It is responsible for formulating broad educational guidelines and policies that involve large amounts of money, co-ordinating the planning and implementing of all educational plans in the country. It acts as the centre to synchronise educational efforts from various divisions and levels of administrations that involve large financing. The state level is responsible for the implementation of all the educational programmes, including monitoring and providing professional advice to teachers (Appendix U). Each state office has a State Curriculum Committee, SCC, which provides reports and feedback to the CDC concerning curriculum matters. It also assists in the selection of pilot schools and is directly involved in the implementation process. It is also responsible for co-ordinating in-service courses, especially pertaining to the training and dissemination of educational programmes and relaying feedback to the Ministry. Finally, the district or division level links the state to the schools. The district education offices are crucial in assisting the dissemination and supervision of any curriculum innovation projects for the larger states in the country. At the
school level, there are two curriculum committees: School Curriculum Committee (SCC), chaired by the school principal, and the Subject Panels for each subject offered in the school.

As the task of curriculum development became more complex, the Ministry of Education took the initiative to reorganise its procedures (Appendix G). Following discussions at several conferences about the unsatisfactory *ad-hoc* nature of the previous curriculum committees, a suggestion was advanced in 1971 for a Science Education Centre for the country. However, the idea was later changed to include other subjects and all activities related to curriculum development. The centre was finally established and renamed the Curriculum Development Centre (CDC) in 1973. The project was funded by loans from the World Bank, the United States government and grants from UNDP (Lewin 1984).

The CDC's main task is to improve the quality of education based on the development needs of the nation, in accordance with the *Falasafah Pendidikan Negara* (National Education Philosophy) (Appendix V). It is responsible for the curriculum in both primary and secondary schools and for all subjects except technical and vocational subjects (Silver Jubilee CDC 1998). However, at the federal level, the responsibility for any decisions on curriculum lies with the Central Curriculum Committee (CCC), established in 1967 and, generally, it is the highest decision-making agency at the federal level. This committee comprises senior education officers, with the function of assisting the Minister in making decisions on curriculum matters. Its main task is to approve educational programmes and curricular changes made by other divisions in the Ministry. It also co-ordinates and determines the scope of curriculum practices in the production of syllabus and curricula for all schools in West Malaysia. It is also responsible for the formulation and implementation of all government curriculum policies. The CDC acts as the secretariat to the CCC, which is chaired by the Director General of Education. This 29-member committee comprises, "people of highest calibre in their own field to make decisions with regards to curriculum implementation" (Ahmad Hozi 1999), directors from all the divisions in the Ministry, representatives from local universities and institutions, and two Directors of Education.

(quoted in Sharifah Nor 1994). The Cabinet Committee Report 1979 has defined curriculum as:

... an educational programme that encompasses all the knowledge, skills, norms and values, cultural elements and beliefs chosen by the society to be transmitted to its members. The role of curriculum in education is to develop the child fully with respect to the physical, spiritual, mental and emotional aspects as well as to inculcate and develop desirable moral values and to transmit knowledge. In the Malaysian context, the curriculum also has a role to play in creating citizens that uphold the nation’s aspirations towards achieving unity based on Rukunegara and to produce trained manpower needed for the country.


The Cabinet Committee Report (1979) also recommended that specific measures were taken to ensure that primary education reflects basic education with an emphasis on the three R’s (Cabinet Committee Report 1979 [Malay], 1984, 18). This recommendation led to the introduction of the New Primary School Curriculum, NPSC (KBSR) for all primary schools nation-wide. This curriculum emphasises the acquisition of the three R’s (writing, reading and arithmetic skills) in Phase I of the primary school years (Years 1, 2 and 3). In Phase II of schooling, students will use these skills to acquire specific and explicit content knowledge. Subjects are grouped into three categories: Communication, Man and Environment and Individual Self-Improvement. (Appendix E). The nation-wide implementation of NPSC began in 1983 and the first cycle of implementation was completed in 1989.

Based on the Falasafah Pendidikan Negara, recommendations from the Cabinet Committee and considerations on the nation’s future needs, the Ministry had revamped the
secondary school curriculum (Ministry of Education 1992, 2). As Sharifah Nor (1994, 129) states: "The reforms in KBSR [NPSC], the National Education Policy, the recommendations of the Cabinet Committee Report and the projected needs of the country provide the basis for the development of KBSM [ISSC]". The Integrated Secondary School Curriculum, ISSC, was implemented in 1988 for all the language subjects. In 1989, it was implemented for all subjects in the first year of secondary school (equivalent to grade 7 in North American schooling system) and progressively extended to all secondary school levels. Both the NPSC and the ISSC were a part of a ten-year programme (1986-1996) to develop and improve primary and secondary education financed by the World Bank loan.

Subjects at the lower secondary level were grouped into core compulsory subjects in order to establish a curriculum that provides a basic universal education. Civics Education was dropped and its elements were absorbed into History. Another important feature of this curriculum was the integration of the elective prevocational subjects into a new subject named Living Skills. A new subject for non-Muslim students was also introduced: Moral Education (Ministry of Education 1992). The additional subject group comprises languages: Chinese, Tamil and Arabic (Appendix C). At the upper secondary level, in addition to the core compulsory and additional subjects, students were also offered electives subjects, according to their capabilities and interest in preparation for further specialisation (Ministry of Education 1992) at the post-secondary level (Appendix D).
Conclusion and Remarks

Goodson (1984) argues that a description of the "gradual and continuous nature of curriculum change" in a historical study allows the examination of the negotiations associated with the process. This chapter provides the backdrop for the evolutionary profile of the Additional Science curriculum syllabus presented in the next chapter. It shows political and social objectives as an integral element in the evolution of educational change in Malaysia. It also shows the centrality of the legislative net in the strategy employed for implementing planned change in the Malaysian educational system. However, in the interplay between political objectives and educational considerations, could one consider the decision for any particular change either as a conflict or as a subordination and realignment of interest?
CHAPTER V: THE NARRATIVE OF ADDITIONAL SCIENCE

Human is a creature that has been entrusted to manage the universe and its resources responsibly and intelligently.

Ministry of Education 1990

Prologue

Introduction

The foregoing chapter showed that the impetus for educational changes in Malaysia was, in general, policy-induced: through specific policy statements on a given educational concern or by ordinance or act. This chapter narrates the evolution of Additional Science as a subject in the secondary school curriculum reform. The narrative starts with the inception of the primary school curriculum and ends with recounting the perspectives of the developers and users of the Additional Science curriculum syllabus. It is a story of a science curriculum embedded within the evolution of a general school curriculum.

The Shaping of the Integrated Secondary School Curriculum, ISSC (KBSM)

The Introduction of the New Primary School Curriculum, NPSC (KBSR)

The NPSC was initially introduced experimentally to 305 primary schools in 1982 and to all national and national-type primary schools in the country by 1983. The NPSC was seen as the Ministry’s effort to breathe fresh life into teaching and learning at the primary level (Appendix E).
Science was not a formal subject but was introduced as an element in a new multidisciplinary subject named *Man and Environment* in Phase II (Years 4, 5 and 6) (equivalent to grade 4,5 and 6 in North American schooling system) at the primary level. However, this subject was unable to establish itself in the curriculum. It was replaced by the *Primary Science School Curriculum* in 1993. Sharifah Maimunah and Lewin (1991, 243) state that the main contributing factor to this failure was miscommunication between the developers and practitioners since the expected changes in the curriculum were “not only in the subject matter but also in pedagogy”.

The findings of several studies have suggested that, in general, NPSC is superior to the old curriculum and has positive effects on pupils’ achievement (Siti Hawa 1986; Azizah 1987; Hamzah 1988; Noor Azmi 1988, quoted in Sharifah Nor 1994). Consequently, a revision of the secondary school curriculum to complement and extend the NPSC was undertaken. The outcome of this effort, the Integrated Secondary School Curriculum, ISSC (*KBSM*), was implemented gradually, starting with the language curricula, in 1988, and for all subjects in the first year of secondary schooling in 1989 (equivalent to grade 7 in North American schooling system). With the exception of the introduction of a few new subjects, ISSC retained almost all of the subjects from the previous curriculum; however, changes were made in the emphases and the organization of the subjects’ contents (Ministry of Education 1992) (Appendix C).

The Recommendations of the Cabinet Committee Report 1979

The Cabinet Committee report acknowledges the importance of science education at both the primary and secondary levels (Cabinet Committee Report 1979 [Malay] 1984). However, it commented, “the quality of science education in general, cannot be considered satisfactory” (Cabinet Committee Report 1979 [Malay] 1984, 81) for either the *Integrated Science* or the *Modern Science* curricula at the secondary level, which had been implemented in 1969 and 1972, respectively. The report recommended that the upper secondary curriculum should reflect general education by providing for the school leavers and those students who intend to further their studies. It also recommended that the lower secondary
curriculum should be an extension of primary education; it should enhance basic education, introduce general education and incorporate the element of pre-vocational education (Recommendation 61, Cabinet Committee Report 1979 [Malay] 1984). The subsequent development of the secondary school curriculum to meet these recommendations resulted in the abolition of the practice of ‘streaming’ students into science and arts streams at the upper secondary level.

The ISSC Science Curriculum

There are two distinct science curricula in the ISSC. The general science curriculum or the KBSM Science Syllabus has a content planned to be taught for five years; it is a compulsory examinable subject. As one of the core subjects offered in the ISSC, it ensures that all students are provided with a general education for a “holistic, balanced and integrated self development” (Ministry of Education n. d., 3). However, a list of electives provides the students with the opportunity to choose other subjects according to their interest, ability and potential.

Electives in the ISSC

The Ministry of Education states the aims of introducing the electives as follows:
1. to adequately prepare students for higher learning;
2. to ensure students’ involvement in the country’s workforce after leaving school, and
3. to provide students the opportunity to choose subjects according to their interest, ability and achievement.

(Ministry of Education n. d., 3)

In his foreword address in the information book for the electives, the then Director General of Education refers to the two important functions of education for national development. Socially, it moulds the individual’s character in accordance with the nation’s aspirations; economically, it develops the individual’s potential to fulfill the country’s human resources (Ministry of Education n. d., v). It was assumed that the introduction of electives
into the ISSC at the upper secondary level would enable the realization of these aims. The Ministry saw electives as a form of ‘democratization’ of the curriculum at the upper secondary level, as aspired by the Cabinet Committee of 1974. For instance, a CDC officer referred to the intended students for Additional Science curriculum as “groups of students who like science and social science ... and students who have interest in science but unable to take three pure science courses”. However, the Ministry’s yearly report in 1995 has shown that although there were a maximum of twenty-four combination packages available, students’ tended to chose the Humanities and Humanities-Vocational and Technology (Ministry of Education 1995, 33). Among the 1994/1995 cohort, Humanities, and Vocational-Technology were the two most popular among the students (Ministry of Education 1995, 33).

Electives could also be seen as a form of ‘specialization’ at this level. This is because the twenty-four elective subjects are categorized into four groups: Humanities, Vocational and Technology, Science and Islamic Studies (Appendix D). In a profile of students’ choice of elective subjects, Molly et.al. (1996) have shown 75.3 %, 55.2 % and 59.7 % of 762 non-science Form Four (equivalent to grade 10 in North American schooling system) students chose Economics, Accounting and Geography, respectively (Molly et. al 1996, 7). These were the top three elective subjects chosen in the respective streams. These electives are under the Humanities-Vocational combination. The profile has also shown from the total of 897 science students, 95.4 % chose Additional Mathematics, 91.9 % Physics, 89.9 % Biology and 82.5 % chemistry (Molly et. al 1996, 7). It would seem that there is a pattern in the combination of elective packages that students choose but, in general, schools are unable to offer all the elective packages due to shortage of teachers, funds and physical infrastructure. Eventually, the schools offer only certain elective packages specializing in certain areas to their students.

It is also interesting to note that the Ministry refers to the combination packages of either the pure Science or the ‘bispecialization’ (Humanities-Vocational, Science-Vocational and Islamic Studies-Vocational) as having higher exchange value in terms of marketable and employable skills associated with the qualification (Ministry of Education n. d.). This may
have some influence on the combination of elective packages offered by a specific school. In a phone interview, a school administrator from a state in the east coast claimed that schools made the selection on electives combination packages that have been pre-selected and pre-assigned by the State Education office (Hassan [Malay] 1999).

There are seven requirements for the selection of electives (Ministry of Education n. d., 5). Students are required to choose two subjects from at least two elective groups and they must choose at least one subject from the Vocational-Technology group (Ministry of Education n. d., 8). The schools are required to counsel students in the selection process after they have sat for the Lower Secondary Assessment (PMR) examination in Form 3 (equivalent to grade 9 in North American schooling system). Students taking 2 or 3 pure science subjects are not allowed to take Additional Science.

The Additional Science Curriculum Syllabus

The aims and objectives of the Additional Science syllabus are to provide students with scientific knowledge, scientific skills, and to practice the moral values in an integrated manner to understand the universe better. Thus, enabling students to overcome changes, face life challenges, and manage the universe responsibly and intelligently for the betterment of humankind (Ministry of Education 1991 [Malay]).

Salient Features

The main thrust of integration in the ISSC is providing a curriculum that could contribute to the intellectual, spiritual, emotional and physical development of an individual (Ministry of Education 1992). Integration is an important over-arching approach in all the subjects in the ISSC (Ministry of Education 1992, 8). However, guided by the Falasafah Pendidikan Negara, the science education in the ISSC (KBSM) was also planned on the understanding of the phrase:
Human is a creature that has been entrusted to manage the
universe and its resources responsibly and intelligently.

(Ministry of Education 1991, 5; vii)

In the secondary science curriculum, the element of integration occurred through the
integration of scientific knowledge, scientific skills and moral values. However, the
Additional Science curriculum syllabus shows two dimensions of integration. In addition to
the integration of knowledge, skills and values, content from several science disciplines
(Physics, Chemistry, Biology, Earth Science, Oceanography, Marine Science and
Astronomy) is integrated through common themes. Content is selected to enable students to
face changes and contribute towards responsible management of self and the universe for the
betterment of humankind (Ministry of Education 1991). Since it is one of the ‘specialised’
subjects offered to students, “its aim is to produce the elite group of scientists and technocrats
for national development” (Ministry of Education 1991). As such, the organisation of the
content reflects the aims to provide science knowledge in a multidisciplinary form.

Thus, the emphasis on integration, coupled with an understanding of human
responsibility, has created a unique twist and presented another dimension for understanding
integration. In the Additional Science curriculum syllabus, the implicit integration is between
Man, Universe and the Creator through Man’s interaction with the Universe. The emphasis in
Man’s interaction with the Universe is manifested in the term “management of the universe
and its resources” (Ministry of Education 1991, 2-3) and the importance of these interactions
are clearly stated in three of the objectives in the curriculum syllabus. The main aim of the
syllabus is the acquisition of scientific knowledge and scientific skills through the practice of
good moral values in an integrated manner, such that students are enabled to ‘manage the
universe and its resources responsibly and intelligently’. The implicit concept of integration
in the aims of the Additional Science syllabus provides a platform for introducing and
discussing issues related to the history, philosophy and sociology of science at the upper
secondary level. Hodson (1992, 551) has argued that learning activities with “sufficient
opportunity for and support of reflection” are a powerful tool for integration in science. Consequently, the Additional Science syllabus assumed that teachers would plan and provide appropriate learning activities in the classroom that would enable students to learn science, do science and learn about science, and to recognise the relationship among them.

Course Design
The content of the syllabus is organized thematically, as follows (Appendix M):

A. *Penyengaraan Hidup* (Life Management)
B. *Penerokaan Unsur Alam* (Exploring the Elements)
C. *Pengolahan dan Pengurusan Sumber Alam* (Modification and Management of Resources)
D. *Penerokaan Bumi dan Angkasalepas* (Exploring the Universe and Beyond).

( Ministry of Education 1991[Malay], 5)

Blum (1994) has suggested that integrating content from several science disciplines along common themes or issues as one of the rationales for the teaching for science for practical purposes. Integration between the science disciplines and integration among the knowledge, skills and values were the two aspects of integration considered in the organization (Ministry of Education 1991). However, some questions arise concerning the underpinning assumptions in the rationales for designing the curriculum syllabus. First, the developers have made the assumption that a skill or a value is transferable across the disciplines, “the scientific skills and values mentioned is probably appropriate for a different aspect of scientific knowledge” (Ministry of Education 1991 5). A second implicit underlying assumption in the Additional Science syllabus is that of a method of doing science. However, as Hodson (1985, 51) has asserted “There are no content-independent (and, therefore, transferable) problem-solving activities in science”. In other words, science inquiry is an idiosyncratic activity with interrelated phases and it is contextual. Millar and Driver (1987, 38) have suggested that putting too much emphasis on the “science process”
might adversely influence teachers in planning the learning activities for the students, leading them to assert that scientific skills that the students are required to master are precise, unambiguous and measurable in students’ actions.

Teaching and Learning Strategies

The suggested teaching and learning strategies are based on experiential learning, with an emphasis on inquiry and discovery learning. Thus, all the suggested teaching and learning activities planned are student-centred, in order to foster the development of critical, analytical and creative thinking (Ministry of Education 1992, ix). Some suggested teaching methods in the curriculum syllabus are projects, simulations and case studies. In planning learning activities, teachers are urged to consider the other emphases in ISSC, in particular to make the effort to implicitly or explicitly instill nilai-nilai murni (alternatively translated as noble, ethical or pure values) into their classroom activities. Tan (1997, 557-558) regards these values as falling into four categories: epistemological values (from the discipline of science), supporting values (not inherent in science, but in the people practising science), society’s values and questionable values (values that science may inculcate in people who learn or practice science). Some of the values mentioned in the curriculum syllabus are cooperation, compassion and responsibility (Ministry of Education 1992, x).

The inculcation of the values espoused by the ISSC, coupled with an emphasis on ‘managing the universe and its resources responsibly and intelligently’, enable the Additional Science curriculum syllabus to provide greater opportunity to explore ethical issues in the science enterprise than the other science subjects at this level can provide. This could enhance the integration of science and the spiritual and ethical dimensions of an individual student in accordance with the aspiration for a total development of the individual. Indeed, Poole (1990, 72) asserted that explicit and implicit “beliefs and values need to be treated and exemplified in subject areas”.
Assessment

*Additional Science* is an examinable subject in the nationalized public examination, the *Sijil Pelajaran Malaysia* (Malaysian Certificate of Education), which is held at the end of two years of upper secondary schooling. The Examination Syndicate within the Ministry of Education administers it. The examination acts as a ‘selection’ process for entering institutes of higher learning and marks the completion of formal secondary schooling. The *Additional Science* paper is divided into three sections, as follows:

Paper I: 40 multiple-choice questions, time duration of 1 1/4 hours, and worth 40% of total marks.

Paper II: Section A: Maximum of 6 compulsory short-answer questions;

Section B: Choose 2 essay type questions from about 6 question, time duration of 2 1/2 hours, and worth 50% of total marks.

Paper II: 2 practical questions, time duration of 1 3/4 hours, and worth 10% of total marks.

However, starting in 1999, a new format for the practical examination has been introduced. This school-based examination comprises a series of tests and exams within the two years of upper secondary schooling. The new format of the practical examination, which replaced the ‘one-shot’ examination, is more congruent with the emphases in the *Additional Science* curriculum syllabus and it enables students to improve their performance within the specific time period. This also matches the practice of A-level practical examinations in England and Wales. According to the Ministry guidebook, a credit in *Additional Science* in the *SPM* examination enables students to enter science and also social science matriculation programmes in five of the local universities in the country (Ministry of Education n.d.). It is also accepted as a requirement to enter several engineering courses leading to a degree programme at the *Universiti Teknologi Malaysia*, UTM (Ministry of Education n.d.).
Other curriculum materials

The Ministry of Education has published, through the Curriculum Development Centre (CDC), the Additional Science Syllabus (1991) and the Additional Science Syllabus Specification for the Form IV (1991) and Form V (1992) (equivalent to grade 10 and 11 in North American schooling system). These curriculum documents differ in their content and organisation. The curriculum syllabus explains the rationales for the aims and objectives of the curriculum, describes the organisation of the content and lists the content; the syllabus specification provides the scientific knowledge and the associated scientific skills for each topic in a theme. A section in the syllabus specification provides suggestions on the appropriate values and learning activities associated with certain topics. In addition, through the Textbook Loan Scheme (1975) administered by the Textbook Division of the Ministry, all secondary schools are provided with the required textbooks. Currently, there are two textbooks available for the Additional Science curriculum for each schooling year. Although they are both written to meet the syllabus specification, the scope and depth of the information given in these books differs quite substantially, as does the presentation of the materials. In Perlis (a northern state in Malaysia), these two different textbooks were used by different schools within the same town when the Additional Science curriculum was implemented in 1992. Apart from the curriculum documents and the textbooks, essentially there are no other supporting materials available for the curriculum syllabus.

In the Additional Science syllabus specification, Tanah (Land) is one of the topics under Pengolahan dan Pengurusan Alam (Environmental Management). Pengurusan Tanah Hutan (Management of Forestland) is the second area of scientific knowledge listed after Pengurusan Tanah untuk Pertanian dan Pernernakan (Management of Agricultural Land). This is a sensitive topic in relation to the logging industry in the country, and has enormous social, political and ethical implications. However, no specific skills and, importantly, no moral values were associated with this section in the syllabus specification (Ministry of Education 1992, 8). In the two textbooks, the topic has been broken down differently. One publisher discussed the definition, agents and process of soil erosion that may cause the extinction of the forest’s flora and fauna (Mokhtar et. al. 1992), whereas, in the other
textbook, a short section discussed the process of soil erosion due to the practice of logging (Chan et al. 1992). With a summary at the end of each section and chapter, followed by some revision and exercise questions that are content-based, the materials are presented in a very ‘exam-oriented’ form and students are implicitly ‘trained’ towards this format of presentation. This allows little opportunity to empower students to think critically and creatively on issues related to the subtopic. However, one of the textbook has made some commendable efforts to insert little boxes of “Do you know?” and “Think!”, filled with information and short questions (Chan et al. 1992) (Appendix N and Appendix O).

The Evolution of Additional Science

The term ‘additional’ associated with a science subject is neither unique nor new in Malaysian science education. In the 1970s, a subject known as Additional General Science was offered to students at the upper secondary level who might prefer to get extra science credits. It occupied 8.5 % of the total time allotted in the timetable, compared to 10.5 % for both Mathematics and General Science for the Art stream classes. As for the science stream, the subject was allotted the same time equivalent as Mathematics (Cabinet Committee Report 1979 [Malay] 1984, 105-106). ‘Additional’ re-emerged in the secondary school curriculum with the introduction of Additional Science at the upper secondary level in 1992. As the ex-head of the core developing group said, “we call it [the subject] Additional Science for lack of a better name”. Additional Science was developed within the framework of the Integrated Secondary School Curriculum, ISSC (KBSM), and was based on the recommendations from the Cabinet Committee of 1979. Following the release of the review report, several proposal documents were prepared by the core planning group at the Curriculum Development Centre (CDC) to conceptualize the secondary school curriculum as envisaged by the Cabinet Committee. From the end of 1980 to 1982, ‘brainstorming’ sessions and discussions were held among the educational officers in CDC to develop the rough outline for the proposed
general education. One of these documents dated July 16, 1981, set out the specifications for the curriculum, including area of studies, subjects to be offered and the rationale for the subjects' inclusion (Curriculum Development Centre, July 16, 1981). In a later document (dated February 1982), there was an identical list of subjects to be offered in spite of several suggestions for alternatives having been put forward. These include vocational education for the academic stream, economics as a compulsory subject and the option for students to choose four elective subjects in the curriculum (Ministry of Education 1981).

To obtain further fresh input from the educational community, a national seminar was held from 6 to 9 June 1983 to discuss the direction and goals of national education. One of the significant outcomes of this seminar was an explicit statement of the national philosophy of education. The *Falasahah Pendidikan Negara* (National Philosophy of Education) guided and established the conceptual framework for the development of the secondary school curriculum. Other key issues, such as the structure of education and the concept, rationale and objectives of general education at the secondary level, were also discussed. As Sharifah Nor (1994, 141) remarks, "the outcome of the three-day seminar definitely provided the CDC with much clearer direction and guidance for the development of curricular innovation", to be known as *Pendidikan Umum Untuk Sekolah Menengah* (General Education for Secondary Schools). During this initial stage of planning, efforts were maximized to formulate a statement of policy and the aims of education as a basis for further discussions.

The refined ideas and suggestions from previous documents and from the earlier seminar were later stated in another proposal document called *Rancangan Kurikulum Baru Sekolah Menengah: Satu Cadangan*. (The Integrated Secondary School Curriculum Project: A Proposal). In addition, a significant change occurred in the organization of the curriculum: the suggestion of a two-group classification for the subjects, *core* and *elective*. *Additional Science* was finally introduced as one of the elective subjects (Ministry of Education November 16 1984, 27). During the early planning stages of ISSC, the original idea for the structure of science education was for a general science subject and another elective science subject in the upper secondary curriculum, "science and additional science throughout the system" (Abd Wahab 1999). The idea was mooted by science educators associated with the
curriculum development project, where one of them who felt that “we’ll be losing ground...the standard of science education will suffer if such structure were implemented” (Abd Wahab 1999). After the core-planning group in CDC had conceptualized it, *Additional Science* was finally minuted as a subject under Group II, *Science and Technology*. Other subjects in this group include Industrial Arts, Home Science, Computer Science, Physics, Chemistry, Biology, Additional Mathematics and Economics (CDC, Minutes of Meeting with Ministry of Education, 20 September, 1985). The period from 1985 to 1986 was marked by further meetings and discussions held at the Ministerial level to refine the initial proposal.

In 1985, the National Union of the Teaching Profession (NUTP) sent a memorandum to the Ministry regarding the proposed new curriculum. It was based on the resolutions made in a seminar on the direction and planning of the ISSC that had been organized by NUTP. The Education Act 1961 recognizes the power of the Minister of Education pertaining to matters concerning educational policies and educational matters relating to schools and so it is difficult to gauge the extent to which external individuals or groups of individuals can have influence during any decision-making stage. However, in September of the following year, a new Minister of Education, Dato’ Seri Anwar Ibrahim, was appointed to replace Datuk Abdullah Hj Ahmad. Subsequently, with a new leadership in the Ministry, the previous curriculum proposal was revised with fresh new ideas and suggestions infused into it. The revision made in the conceptual framework changed the name of the proposed curriculum from *Kurikulum Baru Sekolah Menengah* to *Kurikulum Bersepadu Sekolah Menengah*. By replacing the term *Baru* (New) with *Bersepadu* (Integrated), the decision-makers were able to incorporate the element of integration into the newly proposed curriculum framework.

Following the name change, another series of ‘brainstorming’ sessions among educators took place to redefine the initial curriculum plan. Among the several new ideas incorporated into the new conceptual framework were an emphasis on moral values and the teaching and learning approach that emphasizes ‘Bahasa Melayu Across the Curriculum’ (Ministry of Education 1992, 6). It was during these sessions that the finalized version of the statement for the *Falasafah Pendidikan Negara*, with its emphasis on the idea of “holistic and integrated manner” in the development of the individual, was accepted (Ministry of
Education 1989, v). However, the element of ‘values and belief in God’ as a part of the Falsafah Pendidikan Negara was stated later.

At this time, there were signs of increasing concern among academics and educators about the direction and pace of the planned change in the country’s educational system. The concerns were evident in the large number of discussions that were organised, the major focus of which was the Integrated Secondary School Curriculum, ISSC, or Pendidikan Bersepadu (Holistic Education). Several major seminars were also held, Seminar Akta dan Dasar Pendidikan, UKM November 1986; Seminar Sehari Suluh Budiman ‘KBSM’, Kuala Lumpur February 1987; Seminar KBSM, IPPN April 1987; Ceramah kepada Sekumpulan Pegawi-pegawai Kementerian Pendidikan, Kuala Lumpur Ogos 1987. In all of these seminars and talks, the resolutions were mainly concerned with the emphasis given to the concept sepadu (integration). In the seminar held at IPPN, a paper was presented on the concept of Man as “the mortal benefactor of the universe, who has been entrusted to manage the universe and its resources in a responsible manner” (Tajul 1987). This concept later became the basis for the proposed science curriculum for the ISSC.

1986 was an important year for Additional Science as a part of the ISSC. First, the Central Curriculum Committee (CCC), with the CDC as its secretariat, established the structure and content of ISSC (KBSM) and agreed that ISSC would be implemented in 1989 for several subjects nationwide (Silver Jubilee CDC 1998). Second, a new proposal paper on the proposed curriculum included the revised version of the Falsafah Pendidikan Negara, incorporating “the elements of values and belief in God” (Sharifah Nor 1994, 144). Third, in November 1986, the Minister announced the implementation date of the new curriculum for secondary schools. It would seem that “apparently it was felt there was ‘no need’ for a trial period since experience of the ‘trial implementation’ of the KBSR [NPSC] in some schools resulted in little changes made to the programme” (Sharifah Nor 1994, 160).

Between 1988 and 1991, although the initial idea for two groupings for the subjects remained, there were changes in the list of subjects to be offered. However, in 1990, the elective subjects were grouped into three: Humanities, Vocational and Technology, and

In 1990, a series of workshops were organised by the Science and Mathematics Unit in the CDC with the aim of developing the syllabus and the syllabus specification for the Additional Science curriculum. The members of these workshops comprised a maximum of ten professionals with 2 to 3 core personnel. The educational officers in CDC acted as the core-planning group, headed by the Principal Assistant Director of CDC. University academics were invited to contribute scientific knowledge related to their own fields, such as Oceanography, Biotechnology and Automation. The contributions of experienced teachers were in terms of their 'personal practical knowledge' (Connelly and Clandinin 1988). The development of the syllabus document took almost 6 months, organised into 2 to 3 workshops: “we were not given much time to develop [it]” (Ahmad Hozi 1999). The developers claimed their curriculum practices were often influenced by external forces, “…and sometimes we are forced to cut the time, in case we are asked to do it and to develop a curriculum, and the curriculum should be implemented in a short period of time” (Ahmad Hozi 1999). For the next 8 months, the efforts of the planning groups were concentrated on developing the syllabus specification needed for teachers’ use.

At the decision-making agency, further developments ensued from the on-going meetings. In another circular letter dated July 10, 1991, another elective group was added to the initial elective groups: Islamic Studies. During this year, the Additional Science curriculum syllabus was implemented in the Form 4 classrooms (equivalent to grade 10 in North American schooling system) of about 10 secondary schools, for a two-month trial period, although there are about 1,400 secondary school in the country. During this period, efforts to promote the curriculum syllabus to the end-user system and the educational community were undertaken by the CDC. Senior teachers selected as key personnel were trained and talks were given to school administrators, school inspectorates, college lecturers and university academics. The implementation phase deviated from the statutory cyclic curriculum development model adopted by the CDC: the “CCC decided just implement [it] to all the schools”. However, in clarifying this comment, the ex-head of the core-planning
group admitted, "we should, I guess try out with more schools for at least 2 years before we implement throughout the nation". The Central Curriculum Committee (CCC) had some reservations when presented with the proposal from the CDC. The ex-project manager claimed that he had been personally instructed by the then Director General of Education to re-consider the content of the curriculum syllabus in light of the feedback the committee had been receiving. This instruction stemmed from the fact that Additional Science was a new curriculum and, consequently, this might influence its acceptance by students, teachers and university academics. The developers were more concerned about the teachers, as the head of the core-planning unit said, "the curriculum is good, we were accepted by the students but only some teachers don't like the subject". His comments were also echoed by the current officer in-charge of the Additional Science curriculum. In 1992, the first cohort of students used the Additional Science curriculum syllabus. To inform the public about the new secondary school curriculum, the Ministry had published information books and guidebooks explaining the principles of ISSC, the selection process of the electives and the emphases and organization of the curriculum. These books and materials also provided the administrative structure for the implementation of the ISSC and the role of each level in the process (Ministry of Education 1992).

Epilogue

Additional Science and the Developers

In the Malaysian context, any decisions regarding the Additional Science curriculum and the related aspects of its implementation were in the hands of the Central Curriculum Committee (CCC). However, the Curriculum Development Centre (CDC) planned and conceptualised the curriculum syllabus, prepared the syllabus specification and support materials, disseminated the information regarding the syllabus to the end-user system and
conducted in-service courses for the various groups of individuals (PPK n. d.). Thus, the developers of the Additional Science curriculum were the planning group comprising core personnel from the CDC and several professionals invited on an ad-hoc basis. The curriculum development process started in 1990 and took two years to complete. The emphases in the conceptualisation of the Additional Science curriculum were on societal needs and national development. The National Council for the Development of Science and Technology, under the Ministry of Science and Environment, had issued a broad policy on the development of science and technology for the country.

Were there only two groups of students at the upper secondary level, those inclined towards the pure sciences and those towards the humanities? The practice of 'streaming' students into two distinctive groups at the upper secondary level in the old school curriculum does not provide the kind of general education envisaged by the Cabinet Committee of 1974. The structure of the new secondary school curriculum, ISSC (KBSM), that offers electives was seen to provide a more democratic and general education for all students at this level. The KBSM elective curriculum is providing extra 'room' for students to choose their learning programme according to their needs and interest. It is an extension of the general education provided at the lower secondary level (Ministry of Education n. d.).

The science educators in the Science and Mathematics Unit within the CDC perceived that a multidisciplinary science subject was able to provide for a more democratic science education. According to the current officer in-charge of Additional Science, the curriculum could provide "room for students that have no inclination towards science but do have potential". Instead of seeing two groups of students, the developers were also concerned about a third group of students. The then Director General of Education, who was the real mover behind this idea in the development of the Additional Science curriculum, foresees the curriculum meeting the needs of students with various interests in science.

At the upper secondary level, a science subject is allotted a total of eight periods, equivalent to 320 minutes per week, and students are allowed to take a maximum of four electives with one compulsory elective from the Vocational-Technology group. Thus, those students capable in science but having an interest in social science will have limited opportunity to plan a diverse learning programme. The ex-project manager asserted, "one
subject for science would enable the students to take other subjects of their interest in the curriculum in accordance to the idea of a ‘total development’ of a person as stipulated in the *Falasafah Pendidikan Negara*. He said that it was intended “for about 11% of the science student population...with [a] wide scope of interest”. He stressed that “Additional Science was originally intended for those bright students” but the developers acceded that most people in the educational community have wrong perceptions of the *Additional Science* curriculum, largely because of its name.

The concern for providing a more equitable science education at the upper secondary level was also seen as addressing the wastage of untapped pool of human resources. Logically, from the point of development of human resources, neglecting the educational needs of a group of students with various interests was an inefficient management of resources. By addressing the needs of this group of students, the effort was also congruent with the Ministry’s aim of increasing the number of students taking science. The current statistics show that only 26% of upper secondary students chose the science subject from the *Science and Technology* elective group (Ministry of Education Online 1998). One developer felt that “we would lose these people”, which is “a large group of people” (Abdul Wahab 1999). He sees *Additional Science* as a way of attaining the Ministry’s aim for a 60:40 ratio of science to social science students at the upper and post-secondary education. The aim was based on the Science Committee Report of the Ministry of Education (1993) and the resolutions from the National Science Education Seminar that recommended the need to increase science student enrolment. Thus, the developers felt that the *Additional Science* could cater for the needs of the previously ‘marginalized’ third group of students at the upper secondary level and exploit their potential for national development.

Whereas the three pure science electives (Physics, Chemistry and Biology) are very academic, the multidisciplinary feature of the *Additional Science* syllabus content was another justification for implementing it. A developer insisted that, “It is not an integration...it is applied science that is not covered in the pure sciences”. “Additional Science is to be looked at as applied science which bring [sic] students to various field [sic] in education”, the ex-head of project argues. He continues, “We decided to design Additional
Science to have the element of Physics, Chemistry, Biology with comparable standard to the pure sciences and there are things...applied science in it...not covered in the pure science curriculum”. At the specialised upper secondary level, the inclusion of Malaysia’s geographical location has justified other areas in science that relate to local needs, such as Oceanography, Geology and Earth Science. Commenting on the content of the syllabus, the ex-project manager said, “It is only one subject...covering all the pure sciences as well as something else...it is a heavy subject and not for the weak hearted”. He said the reduced emphasis on the skills in the Additional Science curriculum syllabus enabled the developers to present a broad scope of content, producing a curriculum comparable to the pure sciences. Personally, he agreed that the scientific skills are not distinctly ordered but insisted, “we have to acquire and master the skills and then you are able to do science”. However, he has disagreed with the idea of specifying an approach to the teaching and learning process as a policy, “there is no single approach that is effective to everybody but to make an approach a policy is the wrong thing to do because you are denying certain people the right to learn”. When asked about their views on science, science education and knowledge, the developers involved with the Additional Science curriculum syllabus whom I was able to interviewed had these things to say:

“Science is a body of knowledge or discipline that tries to understand nature...by seeking knowledge about nature...” (Rosli 1999).

“Science is a way to discover things, there are other ways too...not everything could be explained by science, there are things that we have to believe” (Ahmad Hozi 1999).

“Science is not knowledge but ilmu, a combination of content, skills and values (Abdul Wahab 1999).

“The concept of Islamization of knowledge...study science for the benefit of humankind and everything come from God” (Ahmad Hozi 1999).
"Science education must be value-laden...connection with science, technology and society...approach it [Additional Science curriculum syllabus] from the religion or from the context of technology" (Ahmad Hozi 1999).

The ex-head of project acknowledged that some systemic constraints were encountered during the process of developing the Additional Science curriculum syllabus. These were either internal factors or originated from outside forces. In a centralised educational system, where educational legislature (Education Act 1996) invests the power regarding education and curriculum in an individual and the major decision-making agency (EPC) is chaired by a politician, this seems unavoidable. He said, "...but in Malaysia, sometimes those ideas come from the professional but sometimes or most of the times I guess, it comes from higher up in education, and come from political leaders". However, he admitted the necessity of political sanctions in any curriculum development project, but personally believes "political leaders should not interfere with educational matters", that is, "the nitty-gritty of the subject matter or the process of developing something. But, alas, what could we do? This is the situation in Malaysia". Thus, considerations of the nation's human resources need for national development, coupled with the situational contexts justified the development of a curriculum that includes science content not covered in the pure science courses.

Although the Central Curriculum Committee is the decision-making agency concerning policies related to curriculum matters, any curriculum development projects that incur large amounts of financing have to be answerable to the Educational Planning Committee (EPC) (Appendix T). It would seem that the establishment of the EPC, chaired by the Minister of Education, could produce a symbiotic relationship between the politicians and the professionals. However, according to the ex-head of project, politicians have been the key figures influencing the developmental stage of the Additional Science curriculum syllabus. The influence was in the form of imposing a time constraint on the developers. The imposed time constraint has affected the pace of developing the Additional Science curriculum syllabus.
When referring to the power vested in the Minister in the Education Act 1996, in respect of the announcement of the implementation date of a new curriculum project to the public, the ex-head of project said, he “can decide without going through the EPC”. In addition to the administrative constraint, the developers were also faced with internal factors that had influenced the developing of the curriculum syllabus. Given a specific time period for developing the curriculum syllabus, the developers were faced with another major constraint in terms of the scientific content. The broad scope of the Additional Science syllabus content required specialised expertise from various disciplines of science. The ex-project manager said, “...you don’t know everything when [you] have to consider a lot of areas...academic constraint”. However, he assured me, “...pedagogical concern is taken care of because basically you are an educationist [sic], you know how your students learn, and what is the best approach to use in order to deliver something in the curricula package”.

Without the luxury of time, and under the directives of the Minister, the Additional Science syllabus was implemented nationwide in 1992. Consequently, any implementation problems arising from the implementation phase were handled on an ad-hoc basis. According to the ex-head of project, “...we encountered a few problems but we tackled the problems along the way, there and then...”, he said, and their experience in curriculum development had helped in this process. However, a developer admitted that the widescale implementation of the Additional Science curriculum syllabus was inappropriate and ineffective because it required a large amount of financing and increased the chances of miscommunication occurring between the developers and implementers. The current officer in-charge suggested that consideration should be given to the variables that could influence the effectiveness of this widescale implementation, for instance, the qualifications of the science teachers, the school timetable, the number of students in a classroom. However, the ex-head of the project assured me that the CDC had taken into consideration the appropriate determinants for a successful project when planning and preparing the mechanism and infrastructure for implementing the Additional Science curriculum syllabus. Nevertheless, an ex-practitioner of the said curriculum sounded incredulous when I asked about the effectiveness of the steps taken to ameliorate the problems encountered in the implementation process: “Were there
steps taken to overcome any weakness?” The developers agreed that misinformed teachers, school administrators and university academics ‘put a damper on’ the implementation process and have considerably affected the acceptance of the Additional Science curriculum syllabus. They also claimed that the problems encountered in the implementation phase started at the school level. The ex-head of project agreed that teachers have been indirectly influencing the implementation process by not supporting the curriculum syllabus. However, he indicated that a similar situation was encountered earlier, during the implementation of the general KBSM Science syllabus. Furthermore, he linked the teachers’ influence at the implementation phase to the examination format, which does not complement the emphases in the Additional Science curriculum syllabus. He said, “teachers will teach any subject according to the need of the exam papers…” He suggested a better rapport should have existed between the divisions in the Ministry to minimise the effects of the situation, “CDC, Exam Syndicate and teachers training college or universities should be together”. Another developer echoed his view on the lack of co-operation that had existed between the components in the implementation machine. A developer claimed that teachers were not comfortable and had no confidence in their ability to teach a new multidisciplinary science subject, “they have no willingness to challenge, to try or to get out from the comfort zone”. The developers have argued that the end-user system has foiled their efforts for a successful implementation of the Additional Science curriculum syllabus and has contributed substantially to create the current situation.

The ex-project manager said, “People are conservative...like Additional Science, people did not get the message...the promotion of Additional Science was not strong enough”. The promotion of the curriculum syllabus was organised by introducing it to the teachers, schools inspectorate, lecturers and the universities during the first year of implementation and the students’ enrolment achieved the expectation of the developers. However, all the developers agreed that inadequate steps taken at the implementation stage of the new Additional Science curriculum syllabus have affected the establishment of the subject in the school curriculum. “One weakness was, we didn’t promote enough at the university level because they didn’t consider the subject as something that is useful for
students to enter the universities. Anyway, they don’t even look at the subject” (Abd Wahab 1999). The current officer-in-charge believes an aggressive promotional effort aimed at the administrators and students at the school level could help to establish the subject. However, all of them agreed that the connotation of a low status and second class science subject or “a tone down of pure science” (Abdul Wahab 1999) subject associated with the term ‘additional’ has affected the perception of the Additional Science subject within the country’s educational community. Consequently, this may have contributed to its level of acceptance in the secondary schools. The developers agreed that the current scenario was the subsequent result of inadequate promotion of the Additional Science curriculum syllabus, which causes the end-user system to misconstrue the curriculum syllabus. The ex-head of project suggested that efforts to change the misconceptions of the Additional Science curriculum syllabus are needed in order to boost its acceptance by the end-user system. Meanwhile, the ex-project manager has doubts on the continued life span of the Additional Science curriculum in the secondary school curriculum. He predicts, “it is becoming more unpopular now and in time to come will diminish altogether from the secondary school curriculum...a lot of subjects are coming out as elective subjects, which are a very magnified version of the components in Additional Science...Information Technology has evolved as a subject on its own”. In short, the developers have argued that the inappropriate strategies employed for implementing the Additional Science curriculum syllabus have indirectly contributed to its status in the current scenario. It would seem that the unequal attention given by the developers to the process of developing the curriculum syllabus and the process of implementing it might also have contributed to create this scenario.

Implications on the End-User System

Because of its status as an elective science subject, the Additional Science syllabus demands considerably more effort by the end-user system to promote it to the students
than does the core compulsory KBSM Science syllabus. In the implementation phase, the Principals, subject teachers and counsellors are the three important groups of individuals whose roles affect this process.

As the head of a societal unit, a Principal’s role is crucial in promoting an environment conducive to the implementation of a new curriculum. First, the school Principal acts as the mediator between the school and the community, and between the teachers and students. Second, in the management of planned change, the Principal’s awareness and understanding of a curriculum syllabus has a profound influence on the establishment of the subject in the school curriculum.

In the implementation machine for the ISSC (Appendix P), the end-user of the curriculum programme is the School Curriculum Committee (SCC). The committee initiates, plans, organises and evaluates all curriculum activities in the school. It is also involved in planning and co-ordinating in-house training courses for the teachers’ professional development necessitated by a new curriculum. The committee also assists in providing feedback and suggestions to the CDC on the curriculum’s appropriateness. The SCC comprises elected subject teachers and is chaired by the Principal. The Ministry considered teachers as the pillars of the educational system, directly responsible for the implementation of the ISSC (Ministry of Education 1992, 27). This acknowledgement was manifested in the expectations of the various roles that they had to assume: “[a] planner, facilitator and learning manager, knowledge provider, developer of skills, counsellor and role model” (Ministry of Education 1990, 163-165). Within the ISSC context, and to enable them to efficiently assume these roles, a teacher is expected to:

“understand the National Education Philosophy, understand the ISSC programme and the concept of integration, understand the objectives of a curriculum syllabus and the teaching and learning strategies, and; able to develop and use support materials ...”

(Ministry of Education 1992, 27)
Thus, would be *Additional Science* teachers have to familiarise themselves with the rationales of the ISSC, the subject matter and the science pedagogical skills associated with a multidisciplinary curriculum. To assist teachers in the induction process, the State Education Office, with the co-operation of the Curriculum Implementation Committee and the CDC acting as the secretariat, conducted several in-service courses. For instance, teachers in Perlis (a northern state in Malaysia) were introduced to the *Additional Science* curriculum through a one-week orientation course. The State Curriculum Committee within the education office organised this in-service course with the co-operation of the CDC and the School Curriculum Committee. Resource personnel from the CDC and the state office gave lectures on the ISSC and also on the *Additional Science* curriculum syllabus. The *Kakitangan Sumber* (Resource Personnel) chosen from experienced senior subject teachers, were trained at the federal level and became the “main channel and mediator for implementing the ISSC programme to teachers” (Ministry of Education 1992, 126). The five and a half days in-service course was packed with information on the ISSC and the *Additional Science* curriculum syllabus. By the end of the week, the teachers were awarded with a certificate of attendance. Sharifah Maimunah (1990, 119) refers these in-service courses as a ‘cascade method’ of dissemination. Although this model of disseminating information on a new curriculum might incur smaller financing implications, it is faced with the probability of ‘diluting’ the initial curriculum information. However, the *Kursus Orientasi KBSM* (ISSC Orientation Course) was later replaced by *Pukal Latihan KBSM* (ISSC Training Package), which started in 1990 and is organised by the School Curriculum Committee (SCC) (Ministry of Education 1990, 123) (Appendix W). The State and District education offices, college lecturers and other divisions in the Ministry act as the support system in this new training programme for disseminating the ISSC curriculum information.

At the school level, the *Panitia Matapelajaran* (Subject Panels), with the support of the School Curriculum Committee (SCC), meets at least once a term to discuss issues pertaining to the development and improvement of the teaching and learning process, examination results and other programmes related to a subject (Kementerian Pendidikan, Surat Pekeliling Iktisas 4/1986). These meetings also act as a venue for teachers to exchange
new ideas, voice problems and foster professional camaraderie. However, reports from the Federal Inspectorate of School showed that “most subjects panels were found to give more emphasis on administrative routine with less priority given for the professional development of staff” (Federal Inspectorate of Schools 1990, 221; 1991, 20).

School counsellors are teachers trained in psychology and counselling. These counsellors play a crucial role in promoting the Additional Science curriculum to students at the upper secondary level. School counsellors should, of course, be able to provide complete and detailed information on career opportunities related to the electives offered by the specific school. They should also assist students in selecting appropriate electives according to their interest, potential and abilities (Ministry of Education n. d.). Molly et. al (1997) have shown that the students in form 4 (equivalent to grade 10 in North American schooling system) are sometimes not fully informed about their post-upper secondary educational opportunities and job opportunities in the related field of science and consequently, this has influenced their selection of elective combination at the upper secondary school.

*Perceptions of the End-User System*

Several studies have investigated the perceptions of the practitioners in the implementation of the KBSM Science syllabus at the lower secondary level. Sharifah Nor (1994, 207) states: “The KBSM [ISSC] science programme is apparently perceived differently by teachers, principals and curriculum officers”. Although the teachers showed a positive response to the curriculum and find it easy to understand the principle of integration (Shamsiah 1990), the “teaching and learning methods, the types of instructional materials, and students learning assessments employed by teachers have not changed according to KBSM specifications” (Sharifah Nor 1994, 275).

But what was the teachers’ response towards the Additional Science curriculum in 1992? In Malaysian secondary schools, the bell rings at 7.45 every morning and ends the day at 1.25 in the afternoon. The school day is divided into about seven to eight 40 minute periods, with a twenty minutes break. The school year is divided into three terms, with a total
of 205 schooling days including public holidays (Ministry of Education Online 1998). Generally, due to a large student enrolment and limited physical infrastructure, schools are organised into two shifts. 'Double session' schooling is a common practice, especially in the urban areas. In general, the upper secondary classes occupy the morning session while the lower secondary classes start schooling in the afternoon. All co-curriculum or extra curriculum activities for the upper secondary level are organised either in the afternoons or during the weekends. However, efforts have been taken by the government to reduce this practice by providing better physical infrastructure for the schools. Of course, making these changes is costly. The estimated recurrent expenditure for the purpose of general educational administration in 1992 was RM 412 723 290 and the development and support programmes were allotted 0.64 % of this total expenditure (Ministry of Education 1995, 142). The total expenditure on education in 1997 was RM 9,999.7 million (Ministry of Education 1997).

In Perlis, at June 30 1992, there were a total 12,674 students enrolled in the upper secondary level in the regular government-funded schools, with a total of 800 teachers (50 % of whom were university graduates) (Ministry of Education 1992, 107). As at January 6, 1997, there were 17 764 students in the secondary school with 944 teachers in a total of 505 classes (Ministry of Education Online 1998). Thus, the ratio is about 15:1 student-to-teacher in the upper secondary level. A class with a total of forty students is fairly common, with the exception of the elective pure science classes, where the classes might be smaller.

In addition to their professional responsibilities, teachers are also charged with other administrative work. In general, teachers are assigned to a maximum of twenty-five periods per week. However, there were cases where a teacher was assigned 1,200 minutes per week due to a shortage of teachers for certain core subjects. Consequently, teachers were generally cautious during the implementation of the Additional Science curriculum in 1992. One teacher’s reaction reflects her initial uncertainties about the curriculum: “...the revisitation by the once curriculum demon fr.[from] the 70’s”, “Was there a reason for the reintroduction of this subject?”

A teacher working in this environment and faced with several systemic constraints was quick to question the justification behind the implementation of another new curriculum.
For instance, in the implementation of the KBSM Science syllabus, time constraint has been identified as one of the major barriers (Shamsiah 1990; Nor Hafizah 1990). However, the main reservations of the teachers, which echoed mine during the implementation of the Additional Science curriculum, were the content of the syllabus and the teaching strategies in relation to the emphasis on integration. Since most of the upper secondary level science teachers were specialised in a single science subject, the emphasis on integration of scientific knowledge, skills and values, coupled with the depth of the content of the Additional Science curriculum syllabus, became an important issue. In other words, the teachers were expected to teach a multidisciplinary syllabus that is content-laden compared to the more general KBSM Science syllabus in the ISSC.

"The syllabus is a jumble of everything...not many teachers are willing to teach it" (Mukhtar [Malay] 1999).

"The scope [of the syllabus] was too wide" (Unidentified Teacher 1999).

"There was no reference available for the teachers" (Hassan [Malay] 1999)

These initial concerns were in accordance with suggestions made by James (1988) about teachers showing a gradual evolution of concerns, starting with personal ones and developing towards an increased with details of the proposed innovation. In articulating the Concerns Based Adoption Model, James (1981) has suggested a developmental stage in teachers’ concern about an implemented innovation: their immediate personal concern with the new curriculum syllabus will eventually be replaced by an interest in creatively exploring the syllabus.

Based on attendance at the in-service course during the initial implementation phase of the Additional Science curriculum in Perlis, the response from the schools’ administrators were positive. Almost all of the 15 secondary schools in the state sent a representative to attend the induction course. The unidentified teacher quoted earlier reflected on her
Principal’s initial enthusiasm about the curriculum syllabus: “The then HM was extremely keen on implementing the Additional Science curriculum. Almost a religious fervour”. However, it seems this enthusiasm, which is shown in other schools, has ‘died out’ after a couple of trial years.

“It has been abandoned after one trial year (SPM 1994: pass rate 77.65% with a mean grade of 7.02” (Unidentified Teacher 1999).

“Syed Alwi is only reoffering the subject [Additional Science] this year” (Mukhtar [Malay] 1999).

During the one-week induction course on the Additional Science curriculum, the teachers’ initial reactions to the curriculum syllabus were positive, but I got the impression that they were less enthusiastic about the success of the programme as the week passed. However, these opinions and views were only voiced and discussed among us during breaks. This was because the in-service course was not an appropriate and conducive venue for discussing the rationales for implementing the curriculum. In addition, the exposition format of the sessions did not allow discussion between the lecturers and the participants in the course. Most of the teachers attending the course had been selected by the School Curriculum Committee (SCC) to teach the Additional Science subject and had been directed to attend the in-service induction course, but I had volunteered to teach the subject out of self-interest. The unavailability of any personnel from the Examination Syndicate during the induction course for the Additional Science curriculum conducted by the Perlis’s State Education office had also exacerbated the teachers’ concern about the content of the syllabus. However, I would say that these concerns vary substantially from teacher to teacher.

Abu Bakar (1985) has confirmed the finding that teachers faced with the imminent implementation of the Additional Science curriculum were primarily concerned with the acquisition of scientific knowledge and teaching strategies. In her study, both teachers and
Thus, the teachers' other major concern was the students' future educational opportunities in the system. The teachers had doubts about the ability of the Additional Science curriculum to gain from the educational community and to establish itself in the secondary school curriculum. Although these doubts are still prevalent seven years after its introduction, there is some hope with the proposed new format for the SPM examination, "...where a university required qualification from Additional "Science/pure Science for admission to certain faculties. There is change...it has value" (Mukhtar [Malay] 1999). Incidentally, the teachers' concerns are supported by a group of students in Penang, who ranked Additional Science twenty-eighth out of thirty core and elective subjects. Koay (1997) has suggested that the students' concerns about scoring in the examinations and competing for a place in science-related courses in the university might have influenced their perceptions of the subject. However, a student whom I interviewed indicated that the Additional Science was difficult but had had positive effects on him.

What are the perceptions of the institutes of higher learning concerning the Additional Science curriculum? In the Malaysian educational context, students are able to enter institutes of higher learning after the completion of formal secondary schooling (equivalent to grade 11 in North American schooling system). There are ample opportunities for post-upper secondary education, for example, students could continue their studies in local universities, polytechnics and private colleges in the matriculation programmes that would lead to a degree, or they could study abroad at their own expanse, or be sponsored by various private and government agencies.

Locally, student admission to a degree programme is with the SPM qualification via a two-year matriculation programme, except for the programmes offered by the Universiti Teknologi Malaysia (UTM) (Ministry of Education n. d.). The admission qualifications required by the university show that a credit in Additional Science would enable students to enter either a science or social science programme leading to an undergraduate degree. Interestingly, one of the country's most prestigious universities, Universiti Sains Malaysia (USM), does not include a credit in Additional Science in its academic qualifications for its science and engineering courses (Ministry of Education n. d.). However, according to the ex-
project manager, some officers from the CDC have been invited by USM to present a talk to the university's science academic committee about the syllabus. He said, although the CDC "has no direct link with the universities", representatives from the universities are members of the Central Curriculum Committee (CCC). In Universiti Malaya (UM), a qualification in Additional Science would only admit students to the social science and language matriculation programmes (Ministry of Education n. d.). The ex-project manager also pointed out that although most institutes of higher learning accept a qualification in Additional Science, there are a few "...like UM, for instance, they are very, very conservative in nature" (Abd Wahab 1999). The fact that UM is the oldest university in the country might have contributed to this line of reasoning. Furthermore, in the government-funded secondary schools, a credit in Additional Science only enables students to enter the Humanities stream in Form 6 (equivalent to grade 12 in North American schooling system) (Ministry of Education n. d.). Moreover, a qualification in Additional Science is not accepted for admission into the diploma programmes in the polytechnic colleges in the country (Ministry of Education n. d.).

In a telephone interview, a school administrator who is also a science teacher said, "the higher learning institutes consider it [Additional Science] as a selective not a main subject, students taking it are not acknowledged as a science student. They will need to combine it with other subject". He referred to Additional Science as a 'non-status' subject, while another teacher said, "it [Additional Science] is not valued". This "lack of support in terms of recognition shown by the universities is why the schools decided not to offer it [Additional Science]" (Hassan [Malay] 1999). School administrators and teachers concerned with students' welfare often referred to the universities as the basis for their decision on the most appropriate and beneficial elective packages to promote to their students.

My analysis showed that although most universities accept a credit in Additional Science as an admission qualification, certain programmes and certain universities do not. The practice of 'streaming' students into two distinct categories, either science or arts streams, appears to have some influence on the perception of a subject's status by the institutes of higher learning. The educational system is still comfortable with a 'clear cut'
distinction between science and humanities in terms of a subject's status in the school curriculum. Consequently, the multidisciplinary feature of the *Additional Science* is problematic; it cannot be categorised distinctively. This issue contributes to the adverse perception of the subject by end-user system, and has prejudiced its acceptance into the school curriculum.

What are the forms of training programmes available for a would-be *Additional Science* teacher? In Malaysia, teacher education is the responsibility of the Teacher Education Division of the Ministry.

**Pre-service Education**

The training of student teachers in Malaysia is organised in two levels. At the Teachers Training Colleges, a six-semester science-major course is offered in the *Diploma Perguruan Malaysia* (Malaysian Teaching Diploma) programme. The course comprises two components: science pedagogy and academic studies. The academic component emphasises the acquisition of scientific knowledge arranged thematically and based on the Primary School Science Curriculum in NPSC. Student teachers are usually placed in government-funded *national* and *national-type* primary schools or in secondary schools, where they teach the *KBSM* Science syllabus at the lower secondary level. They are also placed in the technical and vocational secondary schools (Ministry of Education n. d.). The student teachers taking education programmes in the Education Faculty in the local universities are prepared to teach at the upper secondary and post-secondary levels. There are two programmes: the Bachelor of Science with Education, where the education and science components run concurrently, and the Bachelor of Science followed by a one year Diploma of Education, requiring four years in total for completion. However, the Diploma of Science with Education programme requires only three years for completion. In the *Universiti Kebangsaan Malaysia* (UKM), the four-year programme leading to the Bachelor of Science with Education offers majors in Biology/Science, Physics/Science, Chemistry/Science and Mathematics/Science. The aim of these programmes is "to produce teachers capable to teach science, *additional science*, pure science and mathematics at the secondary schools."
effectively” (UKM 1995/96, 63). The education programmes offered by the Universiti Pertanian Malaysia (UPM) and the USM have a similar pattern of science subject majors (UPM 1996-1997; USM 1993-1994), though there is no specific Additional Science major offered in the science education programmes in these universities.

In addition, USM and UKM also offer professional courses that lead to a Diploma in Education with the aim to “train students [graduated with a science degree] with an interest to teach in the science and arts streams in secondary schools” (UKM 1995/96, 66). The Ministry of Education also offers a similar programme in its colleges. In 1983, the Teacher Education Division launched a professional training course called Kursus Perguruan Lepas Ijazah (KPLI) (Ministry of Education 1998). Over the years, the curriculum for this programme has undergone several revisions to complement changes in the school curriculum. The science programme is planned around the core and elective science subjects in the ISSC, with the aim of improving the students’ knowledge and understanding of science and science pedagogical skills to enable them to “practice scientific attitudes and moral values in their everyday working life as a science educator” (Ministry of Education 1998, 2).

In-service Education

With the co-operation of the State and District Education offices, the CDC conducts in-service teacher education that relates to a new curriculum. Thus, one of the CDC’s task is to conduct in-service courses for the resource personnel, school Principals, senior assistants and officers in the Ministry and State Education offices to introduce them to the pre-school programme, KBSR and KBSM. Another important agency that provides in-service training is the Regional Centre for Education in Science and Mathematics (RECSAM), established in 1967 by the Southeast Asian Ministers of Education Organisation (SEAMEO). The regular member countries of SEAMEO are Thailand, Malaysia, Indonesia, Singapore, Viet Nam, Brunei Darussalam and the Philippines. Australia, Canada, France, Germany, Netherlands and New Zealand are the associate member countries and Japan is the donor country. The decision to set up a regional centre was taken at a Technical Workshop in Kuala Lumpur in
July 1966 by the delegates from seven SEAMEO countries. Initially, the centre was established to help member countries improve “the teaching of science and mathematics in order to lay the foundation for meeting the technically and scientifically trained man power requirement” of the region for national development (SEAMEO-RECSAM 1997, 8). However, it also conducts non-sequential training and research/development and diploma courses through its Science, Mathematics and Technology Education programmes. These training programmes cover areas such as Pedagogy (Science and Mathematics), Computers in Education, Educational Technology, Remediation/Enrichment and Action Research.

An agency called Institut Latihan Pegawai-pegawai Pendidikan Malaysia (Training Institute for Malaysian Educational Officers) was established in 1979. Its name was changed twice before being renamed Institut Aminuddin Baki (Aminuddin Baki Institute) in 1988. The function of the National Institute of Educational management is to train educational officers and administrators, publish materials related to educational management, provide consultant services on educational management and act as the ‘think tank’ for management policies in education. It also conducts courses in school management, special in-service courses and twinning degree programmes with several local and overseas universities.

Analysis of the provision for teacher education shows that Additional Science is not perceived as a science subject and has lower status than the pure science subjects. In the science training programmes offered to pre-service student teachers, the scope and depth of the science content in the Additional Science syllabus has not been thoroughly investigated, but it would seem that emphasis has been given to the more established pure sciences. The underlying assumption is that the acquisition of science pedagogical skills would adequately equip student teachers with the appropriate level of comfort to enable them to teach Additional Science if required. The current format of science teacher education programmes may have contributed to the perception of Additional Science held by student teachers and teachers in schools. Clearly, this perception negates the underlying assumption of the developers on the ability of the subject to compete with the pure sciences in the upper secondary school curriculum.
The need for a university specifically for education was fulfill when the status of a teachers training college was upgraded to a university, *Sultan Idris Training University*, in May of 1997. The university provides professional and academic programmes for teachers' professional development with the cooperation of other colleges in the country.
PART THREE: CONCLUSIONS

Chapter VI: Interpreting and Understanding the Effort

Compulsion in education destroys originality and intellectual interest
B. Russell, 1932, Education and Social Order

Introduction

In this thesis, I have used songket as an analogy for the science curriculum under study. I discovered that there are several similarities between songket and the songket process and the Additional Science curriculum syllabus and the process for developing it.

The beginnings of the songket and kain limur weaving in the Malay Peninsula remain obscure, but historically it may have been stimulated by the flourishing trading between the East and West in this area during the thirteenth and fourteen centuries. Similarly, these active trading activities also created a separate vernacular system of education, which resulted in a socially and economically segregated and diverse populace in those early days. These situations have sparked subsequent educational changes and have become the major concern underlying all these changes in Malaysia.

Songket belongs to the brocade family of textiles, and is also often referred to as the 'queen' of hand-woven fabrics. This is because the luxurious hand-woven textile of gold and silver produces an interplay of light and gentle shadow on the fabric to create a gorgeous shimmering effect. Although the Additional Science curriculum syllabus is not as rich, it is an historical curriculum document that evolved from the interplay of tensions and negotiations between various elements in society. The contextual examination of the Additional Science curriculum syllabus has revealed a number of elements embedded in the curriculum documents. Trees, fruits, flowers, birds, butterflies, and other elements of nature surround the Malay women weavers of Kelantan and Terengganu. Their looms are usually situated under their houses, which are built on stilts, or on an airy verandah, or in their homes near low windows. Thus, Mother Nature surrounds them and, as a consequence of their own
experience, the weavers infuse all these elements into their designs. Likewise, the makers of curriculum documents infuse a variety of life experiences, knowledge, understanding and aspirations into their work.

A key question remains: Due to changes in time and demands, what will be the future of songket and the Additional Science curriculum?

**Current Scenario of the Additional Science Curriculum**

The Additional Science curriculum syllabus has survived for seven years in the secondary school curriculum. In Table 1, recent statistics on the Additional Science syllabus are represented for three states: Perlis, Terengganu and Wilayah Persekutuan Kuala Lumpur. Perlis is a small northern state; Terengganu is a state in the East Coast of the Peninsula; Wilayah Persekutuan is a federal territory, where the nation's capital, Kuala Lumpur, is located. The data in Table 1 represent enrolment as at January 6, 1997.

Table 1. Basic Educational Statistics, by states

<table>
<thead>
<tr>
<th>States</th>
<th>Number of Secondary Schools</th>
<th>Number of Classes</th>
<th>Number of Teachers</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perlis</td>
<td>15</td>
<td>509</td>
<td>944</td>
<td>17,764</td>
</tr>
<tr>
<td>Terengganu</td>
<td>62</td>
<td>2,296</td>
<td>4,118</td>
<td>77,790</td>
</tr>
<tr>
<td>Wilayah Persekutuan</td>
<td>67</td>
<td>2,815</td>
<td>5,123</td>
<td>101,133</td>
</tr>
</tbody>
</table>


Note: The data is for academic schools only.
There are a total of 1,375 regular government-funded secondary schools in the country as at January 6, 1997. Thus, the schools in these three states comprise 10.4% of the total secondary schools in Malaysia and, consequently, do not necessarily represent the whole country.

Table 2 gives the particular subject choice for students taking science subjects from the science elective group in 1993. Table 3 provides similar data for non-science students. These data were taken from a study undertaken by the Ministry of Education to examine student participation in the Form 4 (equivalent to grade 10 in North American schooling system) cohort for the KBSM electives. The purpose of the study was to provide feedback on the implementation of the KBSM electives. In the study, the term "science students" refers to those students taking at least two elective subjects from the science group. In general, Additional Mathematics is also taken as an elective. These students have obtained at least a credit in both Mathematics and Science in the Lower Certificate of Education examination in Form 3 (equivalent to grade 9 in North American schooling system).

The values for the three states show that Additional Science was popular with the non-science students in the cohort, especially in Perlis. The data also shows that Additional Science was accepted as part of the elective package offered by the schools to their non-science students during the first few years of its implementation. However, Table 2 shows that the number of science students taking Additional Science was less than 5% and, in fact, 0% in Perlis. It appears that the Additional Science curriculum syllabus was either not in the elective package offered to these bright students by the schools or was not popular with the science students.
Table 2. Selection of Science Subject (Science students), by states

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Chemistry</th>
<th>Physics</th>
<th>Biology</th>
<th>Additional Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>States</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. Persekutuan</td>
<td>3,721</td>
<td>3,576</td>
<td>3,223</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>96.10%</td>
<td>86.62%</td>
<td>0.03%</td>
</tr>
<tr>
<td>Perlis</td>
<td>331</td>
<td>331</td>
<td>308</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>93.05%</td>
<td>-</td>
</tr>
<tr>
<td>Terengganu</td>
<td>1,657</td>
<td>1,617</td>
<td>1,309</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>97.47%</td>
<td>78.90%</td>
<td>0.06%</td>
</tr>
</tbody>
</table>


Note: Percentage was calculated based on the total number of science and non-science students for the specific states.

Table 3. Selection of Science Subjects (Non-science students), by states

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Chemistry</th>
<th>Physics</th>
<th>Biology</th>
<th>Additional Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>States</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. Persekutuan</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01%</td>
<td>0.03%</td>
<td>0.67%</td>
</tr>
<tr>
<td>Perlis</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.81%</td>
</tr>
<tr>
<td>Terengganu</td>
<td>-</td>
<td>-</td>
<td>46</td>
<td>288</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.72%</td>
<td>4.52%</td>
</tr>
</tbody>
</table>


Note: Percentage was calculated based on the total number of science and non-science students for the specific states.
As at 31 January 1998, in the Federal Territory of Kuala Lumpur, there are a total of 77 secondary schools, including regular, fully residential, special, and vocational and technical schools (Ministry of Education 1998). Sekolah Menengah Kebangsian Seri Ampangan was the only school offering the Additional Science curriculum at the Form 4 level (equivalent to grade 10 in North American schooling system). This represents 1.29% of the total secondary schools in the Wilayah Persekutuan in 1998.

Table 4 shows the statistics on the number of classes and student enrolment in Additional Science in Terengganu in 1998. Form 4 and Form 5 are equivalent to grade 10 and 11 in the North American schooling system.

Table 4. Number of class and students, by forms

<table>
<thead>
<tr>
<th>Forms</th>
<th>Form Four</th>
<th></th>
<th>Form Five</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of classes</td>
<td>112</td>
<td>22.7 %</td>
<td>100</td>
<td>21.69 %</td>
</tr>
<tr>
<td>Number of students</td>
<td>3,624</td>
<td>23.18 %</td>
<td>3,228</td>
<td>22.1 %</td>
</tr>
</tbody>
</table>

Source: Pejabat Pendidikan Terengganu 1998

Note: Percentage was calculated based on the total number of classes and total number of students in all government-funded academic and religious schools for each specific forms.

There were a total of 30,221 students in 953 classes in all the academic and religious schools in Terengganu in 1998 (Pejabat Pendidikan Terengganu 1998). Thus, the total number of students in both Form 4 and Form 5 that were taking the elective subject was 6,852 in 1998, which is only 22.6% of the total student enrolment in the upper secondary level.
Apparently, a similar pattern in student enrolment in *Additional Science* exists in Perlis. Corresponding by e-mail, a teacher in Perlis said, “Only Sekolah Menengah Syed Alwi is offering Additional Science this year [1999]” (Mukhtar [Malay] 1999).

Table 5 shows the statistics on the number of candidates sitting for the *KBSM* Mathematics and *Additional Science* in the *SPM* examination for five consecutive years.

Table 5. Number of Candidates in *SPM*, by year.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mathematics</strong></td>
<td>186,418</td>
<td>197,812</td>
<td>192,360</td>
<td>228,282</td>
<td>252,042</td>
</tr>
<tr>
<td><strong>Additional Science</strong></td>
<td>4,271</td>
<td>4,109</td>
<td>2,373</td>
<td>1,607</td>
<td>2,030</td>
</tr>
<tr>
<td></td>
<td>2.3%</td>
<td>2.1%</td>
<td>1.2%</td>
<td>0.7%</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>Physics</strong></td>
<td>37,229</td>
<td>40,979</td>
<td>40,088</td>
<td>48,756</td>
<td>57,592</td>
</tr>
<tr>
<td></td>
<td>19.9%</td>
<td>20.7</td>
<td>20.8</td>
<td>21.3%</td>
<td>22.8%</td>
</tr>
<tr>
<td><strong>Chemistry</strong></td>
<td>38,788</td>
<td>42,048</td>
<td>40,934</td>
<td>49,359</td>
<td>58,401</td>
</tr>
<tr>
<td></td>
<td>20.8%</td>
<td>21.2%</td>
<td>21.3%</td>
<td>21.6%</td>
<td>23.2%</td>
</tr>
<tr>
<td><strong>Biology</strong></td>
<td>34,784</td>
<td>38,102</td>
<td>36,549</td>
<td>44,016</td>
<td>46,315</td>
</tr>
<tr>
<td></td>
<td>18.6</td>
<td>19.3%</td>
<td>19.0%</td>
<td>19.3%</td>
<td>18.4%</td>
</tr>
</tbody>
</table>

*Source:* Social Statistics Bulletin, Malaysia. 1998

*Note:* Percentage for Additional Science was calculated based on the number of students taking Mathematics. Mathematics is a core compulsory subject and the number of its candidate represents the total number of candidates for a year.

Thus, there was a decrease in the percentage of students choosing *Additional Science* for the first four years after its implementation. From 1996 to 1997, there was an increase of 9.4 % in the number of *SPM* candidates, which is reflected in the student enrolment for all the subjects, *Additional Science*, Physics, Chemistry and Biology. In general, ever since its
implementation, student enrolment in the Additional Science elective has been small compared with enrolment in the pure science subjects. In addition, analysis shows that fluctuations in the Additional Science enrolment have been quite drastic, whereas the pure science subjects have had a much more stable enrolment.

*Retrospection and Interpretation*

*From the Empirical Data*

The Additional Science curriculum development was initiated as a by-product of the Malaysian educational reform that started in the early 1980s. The recommendations from the Cabinet Committee Report 1979 provided the impetus for the restructuring of the primary and secondary education in the country, with the development of the Additional Science curriculum syllabus evolving from the restructuring of the general secondary school curriculum. The aims and objectives of the curriculum syllabus were determined in relation to the pre-set national goals in education. In particular, the principles and philosophies of the *Falasafah Pendidikan Negara* and *Rukun Negara* were translated into specific aims and objectives for the Additional Science curriculum syllabus. In addition, the aesthetic dimension in the aims of the curriculum syllabus was derived from religious and moral considerations of science knowledge and science education. The overall rationale for developing another science curriculum at the upper secondary level was as follows:

1. To provide an alternative science curriculum to a third group of students who have varied interest in science and social science. The needs of this ‘marginalized’ group had been neglected in the previous secondary school curriculum.
2. To develop a more applied-based science curriculum compared to the existing pure science curriculum for the government-funded academic schools.

3. To provide a more democratic and equitable science education at the upper secondary level that reflects the goals of general education envisaged in government documents on reform.

The consensus on the needs of the upper secondary school curriculum for a multidisciplinary science curriculum was a compromise to meet the country's developmental needs and interests. Unfortunately, the participation and contribution of the end-user system in the formulation of the curriculum documents were strictly limited to their 'personal practical knowledge' and experience (Connelly and Clandinin 1988). It has become clear that the development of the Additional Science curriculum syllabus was wrought with constraints imposed from within the system. These systemic constraints were recognised as:

1. Administrative constraint
2. Academic constraint

The developers acknowledged that administrative constraints are inevitable in a centralised educational system. As might be predicted, professional power and the political clout of individuals in decision-making committees have significantly influenced the development of the Additional Science curriculum syllabus in terms of its pace and direction. However, the content and organisation of the curriculum syllabus were firmly 'in the hands' of the professionals in the Curriculum Development Centre (CDC). The decision to adopt a broad-based multidisciplinary syllabus content created the need for expertise from various fields of science. Thus, university academics and professional groups contributed very significantly to the formulation of the curriculum document. Apparently, when developing the final curriculum syllabus, the science pedagogical aspect of the curriculum syllabus was confidently assumed from the educators' personal practical knowledge and experience. In
other words, input into those aspects of the curriculum that relied on pedagogical content-knowledge was implicitly drawn from the participants' own experience. Theories on the current issues on teaching and learning of science were not extensively incorporated.

The Additional Science curriculum syllabus was implemented nationwide in 1992, with a trial period of two months. The experience gained from implementing the KBSR (NPSC) curriculum justified the nation-wide implementation strategy employed by the decision-makers. Obviously, the strategy chosen for the development of the Additional Science curriculum has deviated from the usual statutory model adopted by the CDC. In the implementation stage, the ‘conduit system’ has been used to transmit and disseminate information on the Additional Science curriculum to the end-user system. Resource personnel trained at the federal level became the ‘conduits’ in the in-service courses organised by the State or District Education offices, with support provided by the CDC. These Kakitangan Sumber (Resource personnel) were senior teachers and educators from the State or District Education offices and became the link between the developers and the end-user system. Teachers, as the end-user system, were introduced to the curriculum documents through the short in-service induction courses conducted by the ‘conduit system’. In this ‘cascade model’ (Sharifah Maimunah 1990) of disseminating and transmitting the Additional Science curriculum syllabus and syllabus specification, 2 to 3 teachers/educators per school district were elected as the Kakitangan Sumber from a total of 76 school districts in the country. Concurrently, efforts to introduce and promote the new Additional Science curriculum syllabus to university academics and school administrators were also undertaken by personnel from the CDC.

Acceptance of the Additional Science curriculum as an elective subject at the school level and its establishment as a science subject at the upper secondary level were influenced by several groups of individuals. The Principals, counsellors and teachers have been directly responsible for promoting the curriculum syllabus to the clients (students), but the School Curriculum Committee, SCC and the Panitia Matapelajaran (Subject Panels) have also played a substantial role in establishing the Additional Science curriculum syllabus in the schools.
From the Inquirer's Lenses

To facilitate the process of interpretive analysis, I have separated the development process of the Additional Science curriculum into two stages, as follows:

1. Planning and Development stage.
2. Implementation and Establishment stage.

It is possible to interpret the Additional Science educational episode from the actions and the stated and inferred intentions of the groups of individuals involved in these stages. However, two assumptions underlie the following discussion. First, although the decision-making process was conducted through committee systems, the elected Minister of Education has the 'final say' over all decisions on matters pertaining to curriculum and education. Second, these decisions carry an underpinning agenda and are located in the vested interest of either the government or the individuals involved.

Planning and Development Stage

Aims and Objectives

It is possible to perceive a compromise between the goals for national development and personal development in the development process of the Additional Science curriculum. The decision-makers and developers have taken an over-arching practical and sociological consideration (Lawton 1973 quoted in Hodson 1990) in the planned secondary school curriculum change, ISSC. It seems that in the development of the Additional Science curriculum, the aims and objectives of the curriculum syllabus have been realigned in accordance with the rhetoric in the goals for the national educational system. These

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1 Lawton characterises the influences on curriculum building in terms of four major elements: philosophical factors (relating to the purpose of education, nature of science, and so on); psychological factors (concerning theories of learning, motivation, etc.); sociological factors (relating to societal stability or change) and practical factors (relating to resources, staffing levels, time available and the like). At particular periods in history, and in particular cultural contexts, the predominant influences will reflect the prevailing sociopolitical, academic and economic situations.
educational goals were fixed in relation to the priority given to practical and sociological considerations by the decision-making committee. These events reflect similar trends in curriculum reforms in most New Commonwealth countries, where “political and popular pressures...[and the] necessity of attaining economic self sufficiency” (Havelock and Hubermann 1977, 118) are the underpinning goals for the educational system (Havelock and Hubermann 1977; Dove 1989).

The Falasafah Pendidikan Negara set the agenda by stating that the efforts of the education system should be directed towards the development of Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving a high level of personal well-being, as well as being able to contribute to the harmony and betterment of the family, society and the nation at large (Ministry of Education 1991). Consequently, the aims of the Additional Science curriculum are “to enable students to overcome changes, face life challenges and to enable them to manage the universe responsibly and intelligently for the betterment of humankind” (Ministry of Education 1991, 2). Inevitably, the bureaucratic or power-coercive approach (Lewin 1991; Benne, Bennis and Chin 1969) for planning and enforcing planned educational change in a centralised educational system were employed at the macroscopic level to achieve this pre-set national agenda. In addition, curriculum information was disseminated using the ‘link system’ (Havelock and Hubermann 1977). The ‘conduit system’ has connected the planners/developers to the end-user system in the implementation process.

A compromise was also perceived between the goals for social development and science education. The emphasis in science education shifted among the three goals: scientific knowledge, scientific method and social-personal development (Bybee and DeBoer 1994). The subordination of the goals for personal development profoundly influenced and affected the nature and organisation of the Additional Science curriculum documents at the developing stage. However, emphases on the acquisition of scientific knowledge and the acquisition and application of scientific method in the curriculum documents are still prominent, and are seen as a vehicle for the promotion of personal-social development. Obviously, the developers’ rationale to develop the Additional Science curriculum as an
alternative (applied-based) science curriculum for a ‘marginalized’ group of students was strongly influenced by the centralised government’s underpinning political agenda. This interpretation is supported by an examination of the emphasis given to the goal for personal development in the general science education in the ISSC at the upper secondary level. Consideration for the individual student’s development in the planning of the Additional Science curriculum was subsumed within and realigned to complement and support, the aims for social economic development. As evidence, attention is drawn to the explicit statement in the curriculum documents on the aims to “produce an elite group of scientists and technocrats for the country’s development for the specialised science education at the upper secondary level” (Ministry of Education 1991, 1).

It seems that after more than forty years of independence, the educational legacy from the colonial era is still prevalent. At the macroscopic level, it is possible to discern stability in the face of change. First, the emphasis on fostering and maintaining racial unity and harmony has substantially influenced planned change throughout the Malaysian educational history. Second, legal frameworks have continuously supported policy mandates and set the broad context for planned change in the system, and have contributed to the particular emphases in curriculum development activities. Indeed, the power-coercive strategy commonly employed for planned change has subjected the curriculum development process and the curriculum documents to a series of controls at various levels within the system.

Another important influence was the resurgence of the Islamic perspective on education and knowledge, which created a different perspective on science education and led to this particular vision on the role of Man in the world: “Man has been appointed the viceroy in the world”. This became the basis for formulating the aims of the Additional Science curriculum syllabus in relation to the over-arching national interests. Taken together, these two views of science, learners, teachers and society led to two particular curriculum emphases for the Additional Science curriculum: the science, technology, decisions, and the scientific skill development (Roberts 1988). These emphases have underpinned the assumptions taken for the development of the curriculum syllabus.
Curriculum Syllabus and Syllabus Specification

Although the decision making phase showed a realignment of the goal for personal development to support the nation's interests, it is possible to perceive discrepancy between the rhetoric of the emphases in the Additional Science curriculum documents and educational considerations. The emphasis on the integration of scientific knowledge, scientific skills and values carries the underlying assumption that the skills are transferable across the disciplines. Implicitly, the curriculum syllabus also carries the assumption of a method of doing science, comprising distinct stages. In recent years, many science educators have used arguments from the history, philosophy and sociology of science to show the invalidity of these assumptions (Elkana 1970; Hodson 1982; 1985; 1988; Millar and Driver 1987). Consequently, it would seem that the concept of integration in the Additional Science curriculum syllabus does not reflect current thinking about the relationship between teaching and learning science and the history and philosophy of science. Rather, it reflects the rhetoric of integration in the arguments for a general secondary school curriculum. The overemphasised concern for integration as a unifying theme in the ISSC (KBSM) has created major problems in terms of the structure and organisation of content, strategies for teaching and learning, and the overall 'curriculum emphases' of Additional Science curriculum documents.

During the development process, science educators and professionals reached consensus on the nature and structure of the syllabus content, though this consensus was in accordance with the pre-set educational goals. In general, however, the nature and structure of the curriculum syllabus does not consistently reflect the political rhetoric of the aims of education and science education. The broad-based multidisciplinary syllabus content carries several assumptions that create conflict between educational considerations and the aims and objectives of the syllabus. First, the Additional Science syllabus boasts a very broad-based content in order to provide a more applied-based science programme. However, to boost the status of the subject to be comparable to the more established pure sciences, the developers produced a very academic and content-laden syllabus. Such content perpetuates the prevalent 'exam-oriented' culture among students in upper secondary schools, and may even introduce
some students to this culture who might otherwise have escaped it. The format and presentation of the textbooks written to support the curriculum documents exacerbate this situation. The intention of developing a broad-based applied science content to expose students to various issues in science and technology negates the educational aim of empowering students to think critically, creatively and analytically.

Second, the content of the Additional Science curriculum syllabus is organised thematically, with an emphasis on local issues, in order to portray scientific knowledge as relevant to students’ contextual needs and in accordance with the nation’s aspirations. Presumably, the assumption that underpinned this move was that the themes would provide a platform to discuss moral and ethical issues relating to man’s responsibility to manage the universe and its resources. However, the academic nature of the content presented in the curriculum documents, coupled with insufficient consideration given to the realities of the classroom, created a conflict between the developers’ intentions and actions. Indirect controls, such as examination pressure and university acceptance, resulted in insufficient opportunities to explore moral and ethical issues, thus negating the intention to provide a safe and conducive environment to empower students to think creatively, critically and analytically on matters pertaining to science in order “to enable students to overcome changes, face life challenges and manage the universe responsibly and intelligently for the betterment of humankind” (Ministry of Education 1991, 2). Lewin and Stuart (1991, 20) have referred to these kinds of contradictions in the intended aims as the “planners’ paradox”. In planning for the implementation of the Additional Science curriculum syllabus, the planners/developers had planned rational strategies but with underpinning assumptions that do not hold true in the real educational situations in the schools. Such paradoxes widen the gap in the transmission line during the implementation stage. It seems that the hierarchical organisation of the content of the Additional Science curriculum syllabus, with its emphasis on learning science and doing science and its specific view of science, the learner and the society, is an impediment to the attainment of the principal aim of the Additional Science curriculum syllabus, which is to produce a scientifically based work force that could act as a responsible and intelligent manager of the universe and its resources.
Implementation and Establishment Stage

In retrospect, it appears that the complexity of organisational change associated with implementing the new *Additional Science* curriculum syllabus was inadequately considered. The assumption that the path from the planning and development stage to the implementation stage in the schools is a smooth one has been proven incorrect. Unjustified assumptions about the perceptions and acceptance of the end-user system in a centralised system of education have also led to the neglect of factors crucial to the implementation stage. This neglect has undermined efforts for a successful implementation and has adversely influenced the establishment of the *Additional Science* curriculum in the schools. These factors can be grouped into three categories:

1. Socialisation into the curriculum syllabus.
2. Indirect controls on the curriculum syllabus.
3. Conflict of aims in the curriculum syllabus.

The ‘cascade model’ (Sharifah Maimunah 1990) employed for disseminating the *Additional Science* curriculum syllabus diluted the essential curriculum information and is cited here as an ineffective and inadequate strategy to socialise teachers into the multidisciplinary content of the new curriculum. In addition, neglecting inherent teachers’ conservatism and their perceptions of the nature and relevancy of the new curriculum syllabus have also been detrimental to the acceptance of the *Additional Science* curriculum. It is well known, for example, that many teachers have very strong single subject loyalties (Whilty 1985). Thus, any attempt at integration will encounter teachers’ opposition. Moreover, the long-term sociologically oriented aims of the intended curriculum syllabus were in conflict with the teachers’ proximate aims for subject-oriented academic excellence. This conflict of aims, coupled with the indirect controls imposed on the *Additional Science* curriculum syllabus by examination pressure and the refusal of the universities to legitimise its content, contributed to the current unsatisfactory scenario. Fensham (1993) has discussed
similar academic influence on the Australian school science curricula. Apparently, the end-user system community has employed an unintentionally "accommodate-endorse-adopt or reject" strategy during the implementation of the curriculum syllabus. In spite of positive support during the initial accommodation period, the curriculum syllabus received minimum endorsement due to the imposition of indirect controls in the form of examination pressure and lack of recognition by the university academics. These factors clearly undermined the planners' assumption of cumulative positive support from the end-user system at the implementation stage. Apart from the human related factors, it appears that curriculum history was also an influential factor affecting the perceptions of the Additional Science curriculum syllabus by the end-user system. The history of an earlier integrated science curriculum with similar name, but with a 'second class' status, combined with the reputation of the more established pure science disciplines, served to undermine the implementation of the curriculum syllabus at the upper secondary level. It is also possible to argue that the failure to provide support services for the Additional Science curriculum syllabus, in terms of personnel, funding for training and physical infrastructure, also contributed to the 'lukewarm' acceptance of the curriculum syllabus in the schools. The planners and developers appear to have assumed that the end-users' acceptance of the practicality and validity of the Additional Science curriculum syllabus during the implementation and establishment stage in a centralised educational system was guaranteed. In other words, they failed to recognise the realities of the classroom. Olson (1990) sums up this kind of situation very succinctly when he says:

The problem teachers have in using innovative ideas can be traced to a failure of the innovators to take seriously one of the rules of giving advice: they did not find out about the life of the people they presumed to advise.

(Olson 1990, 219)
Thus, instead of a stimulus, the *Additional Science* curriculum development episode was a product of an attempt at wholesale educational reform in a centralised system. Becher and Maclure (1975, 19) refer to this approach to educational reform as the ‘Scandinavian model’ of curriculum development: curriculum change initiated through policy-induced statements. The development of the *Additional Science* curriculum syllabus could also be described as an example of the *decision making view* of science curriculum change (Hodson 1987), a view that contrasts directly with Layton’s (1973) *evolutionary view* of change (Prophet and Hodson 1988). However, no overt attempt at ’social’ control’ was discerned, although the curriculum development episode clearly reflects the interest and views of those wielding the power to decide. Sharifah Nor (1994) supports this view of the development of the ISSC (*KBSM*) when she succinctly states:

The introduction of the KBSM has been a political decision. In the case of the KBSM, the curriculum decision-making system had become more politicized.

(Sharifah Nor 1994, 386-387)

In its concern for achieving pre-determined aims and objectives, the curriculum development procedure of the *Additional Science* curriculum suffered from inadequate assessment of the system and, as a consequence, failed to undermine or overcome the systemic barriers to successful implementation.

*Additional Science-Man and Environment: Common Pattern and Issues*

The *Additional Science* curriculum syllabus was implemented as an elective science subject at the secondary school level. However, *Man and Environment* was a compulsory subject in Years 4, 5 and 6 in the primary schools (equivalent to grade 4, 5 and 6 in the North
American schooling system) before being replaced by the *Primary School Science Curriculum* in 1993. Despite the differences outlined earlier, there are many parallels in the emphases of the syllabus content. Moreover, the developers employed similar implementation strategies for both curriculum episodes.

*Course Design*

Essentially, both curricula have similar underlying models of the interaction between Man and his milieu. However, the *Additional Science* curriculum syllabus refers to the milieu as the Universe, encompassing outer space and beyond. Generally, the content for both curricula is organised thematically, with topics that are of local interest and meet local needs. The hierarchical organisation of the content seems to indicate similar views on learning science, rooted in the inquiry and discovery methods of learning. The suggested teaching strategies are child-centred and appear to be developed from Piagetian theory and epistemology.

While *Additional Science* boasts a multidisciplinary syllabus content from several science disciplines, *Man and Environment* was an integration of elements from several disciplines, including science, social science and humanities. The integrating element in the curriculum syllabus was also between the various skills needed for a particular planned learning activity in a classroom through the discovery method of learning. However, in the *Additional Science* curriculum syllabus, emphasis is on integration between scientific knowledge and skills and moral values and, implicitly, the integration of Man, Universe and the Creator.
Implementation Stage

Teachers’ perceptions of the curricula during the implementation stage were similar, with concerns about the multidisciplinary nature of the curriculum syllabus and its relevancy uppermost in many teachers’ minds. Sharifah Mainunah (1990) showed that teachers were not convinced of the need for the Man and Environment curriculum. Similarly, a teacher asked me: “Was there a reason for reintroduction of this subject [Additional Science]?” Another important observation is that inadequate socialisation with a ‘new’ multidisciplinary curriculum syllabus, demanding far-reaching changes in content and pedagogy, contributed to teachers’ reluctance to accept the curriculum. The same teacher informed me: “We were not aware of any support from authorities except for the syllabus and exposition to [sic] it. The official text provided was the main source of factual material and sample questions”. She was describing the type of support available, or not available, during the implementation of the Additional Science curriculum syllabus. Sharifah Maimunah (1990) also reported that teachers were not adequately prepared for implementing the Man and Environment curriculum, and received insufficient support from relevant people and agencies. Apparently, the implementation strategy employed for both the curricula episodes created many similar problems.

First, it is possible to discern a break in the ‘transmission line’ during the process of disseminating and transmitting information about the ‘new’ curriculum. Efforts to ascertain the reasons for the ineffective link, which resulted in a miscommunication about curricular aims and objectives between developers and the end-user system during the implementation stage, would help to ameliorate the problem for the future. Second, it seems that inadequate consideration of the end-user system, and the everyday concerns of teachers, has contributed to teachers’ adverse perception of the curriculum. Teachers’ conservatism, the exam-oriented culture of schools, and the patterns of educational administration have also affected the implementation stage for both the curricula. “Students who passed Additional Science have equivalent status as those taking the Core Science. What’s the point [?]…people do not value it”, a teacher lamented. Similarly, with respect to Man and Environment, Sharifah Maimunah
(1990, 389) states: “The schools culture also exercised influence over the implementation of the innovation”.

Issues and Observation

Interestingly, it seems that similarities in syllabus emphases, content and teaching approaches between the two curricula have produced similar perceptions from the two end-user systems from different levels of schooling. The Additional Science curriculum has suffered from the inability of planners and developers to fully utilise the educational experience from the primary school curriculum episode and transfer it to the development of a science curriculum syllabus at the upper secondary level. Careful consideration of the reasons why the Man and Environment failed could have assisted the developers in selecting appropriate implementation strategies for a similar multidisciplinary science curriculum at the secondary level. The experience from the Man and Environment episode could have been utilised to anticipate the perceptions of the end-user of the Additional Science curriculum syllabus, and could have minimised the problems encountered during the implementation stage. Obviously, similarity in the strategy employed for implementation has produced similar outcomes in the implementation of the Additional Science curriculum syllabus, and will probably bring about similar fate to it as well. In both cases, the planners and developers have undermined the power of the end-user system in a centralised educational system. Through lack of foresight, the planners and developers have lost yet another opportunity to introduce an alternative multidisciplinary curriculum syllabus in the school curriculum.
Rethinking Planned Curriculum Change

A simple electric circuit model, based on my physics background, has helped to make sense of my thinking about planned educational change.

The aim of increasing the brightness of a light bulb, which is connected in series with an ammeter, a battery and a switch, could be considered as analogous to planned educational change. While there are several ways to achieve the aim, it is sensible to determine the most appropriate solution. To find that solution, the existing system has to be appraised, and the likely outcomes of various changes have to be carefully considered.

The simple solution to the electrical circuit problem is to add another battery in series with the original battery. However, other considerations may be important before implementing this simple solution. It is important to consider the following questions: Will the circuit manage to sustain itself after the addition of another battery? Will the bulb blow? How long will the bulbs last with the addition of the new battery? Will the ammeter’s specification be able to adapt to the anticipated increase in current in the circuit? Should a fuse be added or another resistance added in parallel with the ammeter? The ammeter could be exploited to become a voltmeter, by adding a resistance in series, and used to check the voltage across the bulb. Another bulb could be added parallel to the original bulb, in case the first one blows. These are some considerations on the provision of support for the existing system before implementing the simple planned change. The situation in planned educational change is similar, the crucial first step is needs analysis: sociological, practical, economic and psychological considerations. The second step is careful consideration of the likely impact of every proposed change.

Thus, it is possible for a planned change to be perceived from the ‘problem solving’ and ‘scientific’ approaches, where the clients’ needs are paramount in the change (Lewin and Stuart 1991). Inevitably, any approach selected for a planned change depends on the amount and scope of controls exercised within the system. What seems clear is that thinking about planned curriculum changes necessitates the consideration of several possible strategies and
their likely implications during the planning stage. What follows are my own recommendations about planned curriculum arising from this study. First, at the planning and development stage, involvement of experts from the field of science education, rather than only the science disciplines, is imperative in order to provide input on the science pedagogy aspect of the curriculum syllabus. Too much emphasis on the views of scientist has resulted in an excessively content-laden curriculum syllabuses at the upper secondary level. Equal emphasis should be afforded to the implementation stage, in terms of need analysis of the end-user system. This includes the provision of appropriate and continuing professional development courses and the provision of adequate support systems during the implementation stage.

Secondly, at the Implementation and Establishment Stage, there needs to be concerted efforts and effective co-operation from every division and level in the Ministry. There must be on-going monitoring through teacher feedback of the implementation stage and sufficient flexibility in the operational stage to meet specific local needs and conditions. There should be flexibility in the structure and organisation of the induction courses and the role of the ‘conduit system’, which acts as the mediator between the planners/developers and the practitioners, should be further examined. Good communication between all the systems is essential to the process of transmitting and disseminating curriculum information.

Developers’ Suggestions

Following discussions of the current scenario in the schools, the developers’ of the Additional Science curriculum syllabus have provided several suggestions for overcoming the declining student enrolment.

1. The name of the curriculum syllabus should be changed to correctly reflect the content. Dropping the word Tambahan (Additional) from Sains Tambahan (Additional Science) should achieve this and alleviate teachers’ misconceptions of the subject.
2. An increase in personnel is necessary if the effort of promoting the Additional Science curriculum in the schools is to be successful. Several suggestions for the promotional drive of the curriculum syllabus are:
   a. Merging the Additional Science curriculum syllabus with a technical curriculum syllabus offered in the Vocational-Technology elective group.
   b. Reorganising the curriculum syllabus into a modular approach.
   c. Reorganising the syllabus content by deleting the pure science elements in the curriculum syllabus.

3. The retraining of teachers via professional development courses. The participation of, and support from, the universities in providing educational pedagogical courses focusing on Additional Science as a major subject could mediate these promotional efforts, and could simultaneously provide much needed recognition of the curriculum syllabus.

4. Imposing a policy mandate that requires all secondary schools to offer the elective combination packages, which include the Additional Science curriculum syllabus, to all their students.

5. Conducting in-depth case study research to determine the factors affecting the implementation stage of the Additional Science curriculum syllabus.

Concluding Remarks

Further Research

Further research to examine the factors that influenced the acceptance and establishment of the Additional Science curriculum syllabus is suggested. A historical case
study including the essential features of 'illuminative evaluation' (Parlett and Hamilton 1972) could be employed to evaluate the effectiveness of the implementation strategy in all the schools within a specific political state in the country. The study could reveal the progressive development of the implementation stage, ascertain the factors that created stability in the face of intended planned changes in the school curriculum and elicit the perspectives of the end-user system, including the views of the linkage system. The role of the 'conduit system' in the transmission process could be critically examined. Presumably, a detailed contextual 'bottom-up' view of the implementation stage of a curriculum innovation would assist planners and developers in visualising the implementation stage from different perspectives. Such a study could identify the determinant factors influencing the establishment of a curriculum syllabus in a centralised system, and so be of enormous value in future curriculum reform efforts.

*Personal Experience*

For a science educator with a physical science background, employing the qualitative research methodology to describe and interpret the development process of the *Additional Science* curriculum syllabus has been rewarding. Naturalistic inquiry has enabled me to interpret and clarify the empirical data from the multiple meanings given to the curriculum episode by the participants' various perspectives. Historical case study has enabled the thesis to provide a detailed portrait of a specific curriculum syllabus by examining and describing the general structure and processes of curriculum development in the Malaysian context. As the research progressed, the focus of the study evolved from discussing, interpreting and evaluating the curriculum development episode to describing and interpreting it. This was due to the unavoidable time constraint on data collection because of the distance of the actual research site from OISE/University of Toronto.

The process of writing the thesis in a naturalistic inquiry mode has been rewarding to a non-native speaker. While grammatical errors, sentence structure and stylistic writing were the main language and writing constraints faced, these have been compensated by the
freedom provided by the naturalistic inquiry to creatively organise the thesis. However, my main concern in the process of writing the historical development of the Additional Science curriculum syllabus was the issue of ‘trustworthiness’ towards the meanings given by the individual participants in the study. I have ensured that all efforts were taken to maintain a high standard of ‘trustworthiness’.

The experience has led me to question conventional thinking on the practicality and viability of a naturalistic inquiry in Malaysia. Although systemic constraints may occur to impede the widespread usage of naturalistic inquiry in science education, efforts should be made to encourage the move from the prevalent quantitative research paradigm towards the multiple realities approach of naturalistic inquiry. Naturalistic inquiry brings diversity to the practices of research and development, fosters aesthetic values in science educators and strengthens their creative thinking skills. I hope the study has helped to legitimise this alternative research paradigm.

Nevertheless, as a responsible researcher, I acknowledge that there are several improvements that could be made to the procedure I have employed. First, a much longer data collection period, in order to include more voices from teachers in several more states in the country. Second, the voices of students who are taking the subject, and those who intend to take it, were inaudible in this study. More time allotted for the data collection period would have enabled these valuable perspectives to be included.

The fate of the Additional Science curriculum is as uncertain as the songket process in Malaysia. Due to changes in times and demands, it is difficult to predict the future of the songket and songket weaving industry. Similarly, changes in the public examination format and electives combination packages at the upper secondary level to complement the changes in school curriculum for the next millennium could also act to alter the future of the Additional Science curriculum. The inclusion of several new and ‘up-to-date’ curriculum syllabuses, such as Information Technology, could also affect the future of the Additional Science curriculum. As a Malaysian, I hope that songket will continue to be treasured as part of the contemporary aesthetic life of Malaysia. As a science educator, I hope that the Additional Science curriculum will continue to exist in the secondary school curriculum to
provide an alternative 'specialised' science education to students at the upper secondary level.
Part I: General Reference


Part II: Malaysian Reference


Cabinet Committee Report see Jawatankuasa Kabinet Mengkaji Pelaksanaan Dasar Pelajaran.


Ministry of Finance. see Kementerian Kewangan Malaysia.


SEAMEO-RECSAM. Data base available at http://www. seameo.org (several hits).


Appendix A

RUKUNEGARA

Declaration

OUR NATION, MALAYSIA, being dedicated

to achieving a greater unity of all her peoples;
to maintaining a democratic way of life;
to creating a just society in which the wealth of the nation shall be equitably shared;
to ensuring a liberal approach to her rich and diverse cultural traditions;
to building a progressive society which shall be oriented to modern science and technology;

WE, her peoples, pledge our united efforts to attain these ends guided by these principles;

Belief in God
Loyalty to King and Country
Upholding the Constitution
Rule of Law
Good Behaviour and Morality
Appendix B

National Philosophy of Education

Education in Malaysia is a continuous effort to further develop individual potential holistically and in an integrated manner to produce a balanced and harmonised individual; intellectually, spiritually, emotionally and physically based on the belief in God. The effort is designed to produce Malaysian citizen who are knowledgeable, and competent, who possess high moral standards, and who are responsible and capable of achieving a high level of personal well being as well as being able to contribute to the harmony and betterment of the family, society and the nation at large.

Source: Jabatan Perkhidmatan Penerangan, Malaysia. 1996.
Structure of the Secondary School Curriculum (Upper Secondary Level)

CORE

BAHASA MELAYU
BAHASA INGGERIS
PENDIDIKAN ISLAM
MATEMATIK
*SAINS
SEJARAH
PENDIDIKAN JASMANI dan KESIHATAN

TAMBAHAN

BAHASA CINA
BAHASA TAMIL
BAHASA ARAB KOMUNIKASI

ELEKTIF

KUMPULAN I  KUMPULAN II  KUMPULAN III  KUMPULAN IV
(Humanities)  (Vocational & Technology)  (Science)  (Islamic Education)

Geography  Principles of  Add. Science  Tasawwur Islam
Malay Lit.  Account  Physics  Al-Quran Education
English Lit.  Basic Economics  Chemistry  Syariah Education
Art Edu.  Commerce  Biology
Arabic  Home Science  Design
Add. Mathematics  Agricultural Science
Machine Engineering
Civil Engineering
Electrical and
Electronic Engineering
Engineering Technology
Engineering Drawing
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<tr>
<th>Kumpulan I</th>
<th>Kumpulan II</th>
<th>Kumpulan III</th>
<th>Kumpulan IV</th>
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<td>(Vokasional &amp; Teknologi)</td>
<td>(Sains)</td>
<td>(Pengajian Islam)</td>
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<td>Sains Tambahan</td>
<td>Pendidikan Al-Quran</td>
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<td>Fizik</td>
<td>Pendidikan Syariah Islamiah</td>
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<td>Tasawwur Islam</td>
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<td>Sains Pertanian</td>
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Source: *Curriculum Development Centre, KL, n.d.*, PP.4
Structure of the Primary School Curriculum

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<td>Recreation</td>
<td>Art Education</td>
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<td>Co-curriculum</td>
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</table>

Notes:

* The medium of instruction in national schools is Bahasa Malaysia.
  The medium of instruction in national-type Chinese and Tamil schools are Chinese and Tamil, respectively.

** When Muslim pupils and others who choose to do so study Islamic Religious Education, pupils of other religious denominations must study Moral Education.

*** Replaced by the Primary School Science Curriculum
Appendix F

Structure of the Secondary School curriculum (Lower Secondary Level)

**CORE**

- BAHASA MELAYU
- BAHASA INGGERIS [ENGLISH]
- PENDIDIKAN ISLAM [ISLAMIC RELIGIOUS EDUCATION]
- PENDIDIKAN MORAL [MORAL EDUCATION]
- MATEMATIK [MATHEMATICS]
- SAINS [SCIENCE]
- SEJARAH [HISTORY]
- GEOGRAFI [GEOGRAPHY]
- KEMAHIRAN HidUP [LIVING SKILLS]
- PENDIDIKAN JASMANI dan KESIHATAN [HEALTH and PHYSICAL EDUCATION]
- PENDIDIKAN SENI [ART EDUCATION]

**ADDITION**

- BAHASA CINA [CHINESE]
- BAHASA TAMIL [TAMIL]
- BAHASA ARAB KOMUNIKASI [ARABIC for COMMUNICATION]
Curriculum Development Process Flowchart

Educational Planning Committee

Central Curriculum Committee

Curriculum Development Centre
- Identification of Curricular needs
- Program Planning and Development
- Planning for Implementation
- Evaluation
- Preparation for Implementation

Curriculum Implementation Committee

Other Divisions
- Education Technology Division
- Teacher Education Division
- Department of Technical Education
- Finance Division
- Education Planning and Research Division
- Department of Moral and Religious Education
- School Division
- Textbook Division
- School Inspectorate
- Examination Syndicate

State and District Education Departments

School

Evaluation and Feedback

Finding from Formal Educational Institutions

Public Opinions

World Trends and Research Findings
The Malayan Schools System in the 1930s

Source: Wong and Be 1971, PP34
Figure 11.1  The education system in Malaysia, 1989

AGE

6 7 8 9 10 11

6 7 8 9 10 11

PRIMARY

LOWER SECONDARY

UPPER SECONDARY

FORM SIX

HIGHER EDUCATION

LEVEL

1 2 3 4 5 6

NATIONAL SCHOOL

1 2 3 4 5 6

NATIONAL TYPE CHINESE SCHOOL

1 2 3 4 5 6

NATIONAL TYPE TAMIL SCHOOL

KEY:

R REMOVE CLASS

LOWER CERTIFICATE OF EDUCATION

MALAYSIA CERTIFICATE OF EDUCATION

MALAYSIA CERTIFICATE OF VOCATIONAL EDUCATION

MALAYSIA HIGHER SCHOOL CERTIFICATE

Source: MOE 1989
The National Education System

www.moe.gov.my/curriculum
Appendix M

Content Organisation of the Additional Science Curriculum Syllabus
Form 4 and Form 5

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<tr>
<td></td>
<td>Respiration.</td>
<td></td>
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<tr>
<td>B. Exploring the Elements</td>
<td>Measurement</td>
<td>Waves</td>
</tr>
<tr>
<td></td>
<td>Atom and Chemical</td>
<td></td>
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<tr>
<td></td>
<td>Reaction</td>
<td></td>
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<td></td>
<td>Force</td>
<td></td>
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<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td>C. Modification and Management of Environment</td>
<td>Solar Energy</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Biosis Source</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minerals</td>
</tr>
<tr>
<td>D. Exploration of Earth and Beyond</td>
<td>Earth</td>
<td>Exploration of Space</td>
</tr>
</tbody>
</table>
3.2.1 Kesan pembebanan ke atas tanah

Di dunia ini, pemusnahan hutan untuk mendapatkan kayu balak berlaku dengan pesat terutamanya di negara tropika seperti Malaysia, Indonesia dan Thailand. Pemusnahan hutan ini telah menjelaskan keseimbangan ekologi di dalam ekosistem semula jadi. Gangguan terhadap ekosistem hutan mendatangkan kesan yang buruk.

Daun dan dahan pokok hutan menyerap air hujan daripada jatuh secara terus ke permukaan tanah. Oleh itu, air hujan yang sampai ke permukaan tanah akan meresap masuk ke dalam tanah secara perlahan-lahan dan seterusnya mengalir ke sungai. Akar pokok pula menyerap air hujan di samping mencengkam serta memperkuatkan tanah supaya sukar dihakisi.

Operasi tebangan biasanya menyebabkan hakan tanah yang serius, terutamanya pada lereng bukit (lihat Rajah 3.29). Hakan tanah ini membawa kesan yang buruk kepada tanih. Tanih akan menjadi kurang subur, gondol, mudah runtuh dan mudah dibanjiri air (Rajah 3.31).

Apabila hutan ditebang secara berleluasa, terhampaslah pokok-pokok yang melindungi tanah daripada kepanasan matahari dan tindakan curahan hujan lebat. Tanah lapar yang terdedah itu mudah dihakisi oleh air hujan. Tanpa hutan, hujan akan turun turun membasahi tanah yang padat dan menghakisi lapisan atas tanah yang subur. Pengaliran air yang deras pula boleh menyebabkan kerosakan tambahan apabila lapisan atas tanah yang subur dihanyutkan yang kemudiannya memasuki kawasan sungai sehingga mencemarkan airnya serta membunuh hidupan yang terdapat di dalamnya. Akibatnya pemendakan sungai dan kadar larian air yang bertambah itu, kejadian banjir lebih mungkin berlaku.

Source: Chan, Chew, Tow and Azizan 1992
Pernahkah anda melihat sistem saliran dalam sesuatu kebun atau ladang? Apakah jenis tanaman yang diusahakan? Mengapa sistem itu anda fikir sesuai dengan kebun atau ladang berkenaan?

**LATIHAN 3.1**

1. Nyatakan perbezaan sifat-sifat tanah pasir, tanah lom dan tanah lempung dari segi tekstur dan strukturnya.
2. Apakah perbezaan antara:
   - mineral dengan sebatian tak organik
   - luluhawa dengan pemineralan
   - mineral primer dengan mineral sekunder.
3. Terangkan secara ringkas peranan organisma tanah dalam menyuburkan sesuatu tanah.
4. Apakah yang anda faham tentang perkara-perkara berikut?
   - tekstur tanah
   - kelengkapan tanah
   - profil tanah
   - baja organik
   - sungkup asli
   - kesan kapilari
5. Berikan takrif tentang:
   - tanaman bersepadu
   - tanaman campuran
   - tanaman kontan
   - tanaman selingan
   - tanaman selangan
   - tanaman giliran
7. Apakah faedahnya pengairan dan saliran dalam sesuatu ladang?
8. Senaraikan beberapa kelebihan pengairan permukaan dalam penyaluran air ke sawah padi.

3.2 PENGURUSAN TANAH HUTAN


Kesan Pembalakan

Pembalakan yang tidak terkawal atau tidak diuruskan dengan baik boleh mendatangkan pelbagai kesan yang buruk terhadap keseimbangan alam semula jadi hutan rimba. Antara kesan tersebut termasuklah hakisan tanah hutan dan kemusnahan flora dan fauna.

Hakisan Tanah

Apakah yang anda faham tentang hakisan? Tahukah anda bahawa selain agen hakisan biasa seperti air dan angin, manusia juga boleh dianggap sebagai agen hakisan?

Appendix P

The
ISSC (KBSM) Committee

ISSC Implementation Machine

Educational Planning Committee
Chair: Minister of Education

Central Curriculum Committee
Chair: Director General of Education

Curriculum Implementation Committee
Chair: Deputy Director General of Education

State Curriculum Committee
Chair: State Director of Education

District Curriculum Committee
Chair: District Education Officer

School Curriculum Committee
Chair: Principal
Kepada

Dr Noor Azmi b Ibrahim
Pengarah
Pusat Perkembangan Kurikulum
Perserian Duta off Jln Duta
50604, Kuala Lumpur

Tuan

Memohon Kebenaran Menemubual Pegawai-pegawai bagi Tujuan Menjalankan Kajian

Adalah saya dengan segala hormatnya ingin memohon kebenaran bagi menemubual beberapa pegawai dari Pusat Perkembangan Kurikulum bagi tujuan menjalankan kajian. Penyelidikan tersebut adalah bagi peringkat M.A. dari Ontario Institute for Studies in Education of University of Toronto.

2. Tajuk cadangan penyelidikan saya ialah:
The Role of Illuminative Evaluation in Curriculum Innovation:
A Comparative Studies of Man and Environment and Additional Science

3. Sehubungan dengan itu saya berharap mendapat kerjasama tuan bagi menemubual pegawai-pegawai berikut:
   3.1 En Ahmad Hozi b Hj Abdul Rahman
       Ketua Penolong Pengarah Bidang Sains Teknologi
   3.2 En Abdul Wahab b Ibrahim
       Penolong Pengarah Kurikulum
   3.3 En Rosli b Suleiman
       Penolong Pengarah Kurikulum


'BERKhidMAT UNTUK NEGARA'

Saya yang menurut perintah,

(Nor Ruzaini Jailani)
Ruj. Tuan:
Your Ref:

Ruj. Kami:
Our Ref: UPE: 40/200/19.Sj. Jld (B)

Tarikh:
Date: 26 Januari 1999

Ketua Pengarah,
Arkib Negara,
Jalan Duta,
50568 Kuala Lumpur.

Puan,

Permohonan Menjalankan Penyelidikan di Arkib Negara


2. Sehubungan dengan itu, Unit ini tiada apa-apa halangan kepada permohonan tersebut selama tempoh yang dipohon. Walau bagaimanapun, persetujuan ini adalah tertakluk kepada segala peraturan yang dikenakan oleh jabatan puan.

Sekian, terima kasih.

'BERKHIDMAT UNTUK NEGARA'

Saya yang menurut perintah,

(MUNIRAH ABD. MANAN)

( MUNIRAH ABD. MANAN)
b.p. Ketua Pengarah,
Unit Perancang Ekonomi.
The Decision-Making Committee System

Cabinet

National Development Planning Committee

Economic Planning Unit

Educational Planning Committee (EPC)

- Central Curriculum Committee (CCC)
- Higher Education
- Development Committee
- Textbooks
- Finance Committee
- Scholarship and Training
The Organisation of the State Education Office

Deputy Director I
- Service Unit
- Pupils Affair Unit
- Planning and Development Unit
- Registration Unit
- Primary School Unit (Supervisor)
- Secondary School Unit (Supervisor)

District Education Officer → Director of Education

Deputy Director II
- Religious Unit
- Evaluation and Examination Unit
- Co-curriculum Unit
- Curriculum Unit
- Education Technology Unit
Organisational Structure of the Curriculum Development Centre

Director

Social Science Unit
Policy Planning and Evaluation Unit
Management and Special Projects
Language
Arts and Health
Science and Technology

Mathematics
Science
Living Skills

Source: Silver Jubilee CDC 1998
The In-Service Training Operational Model

**Core Training Group**

- Principal
- Resource Personnel
- Senior Assistant 1
- Senior Assistant 2
- Afternoon School Session Supervisor
- Head of Subject Panels

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- Divisions in the Ministry of Education
- College Lecturers
- State/District Resource Centre
- Support Service System
- All Teachers