

**A COMPARATIVE STUDY BETWEEN
MALAYSIAN AND GERMAN SECONDARY
SCHOOL SCIENCE TEACHERS ON THEIR
INSTRUCTIONAL PRACTICES AND TEACHING
CONCEPTIONS**

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MALAYSIAN AND GERMAN SECONDARY
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by

TAY AI JING

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**KAJIAN PERBANDINGAN ANTARA GURU SAINS SEKOLAH
MENENGAH DI MALAYSIA DAN JERMAN TERHADAP AMALAN DAN
KONSEPSI PENGAJARAN**

ABSTRAK

Pada era globalisasi yang modern ini, generasi muda telah mendedahkan kepada penggunaan elektronik seperti telefon pintar dan komputer riba semasa mereka masih muda. Oleh itu, pendidikan sains diperlukan untuk memastikan bahawa negara kita akan menghasilkan tenaga kerja yang lebih baik pada masa akan datang. Menurut keputusan PISA, Jerman skor lebih tinggi dari Malaysia. Dengan ini, kajian ini dijalankan untuk menentukan amalan pengajaran guru-guru sains dan konsepsi mereka terhadap pengajaran sains di peringkat sekolah menengah di Malaysia dan Jerman serta menganalisis persamaan dan perbezaan antara negara. Pemerhatian dan temubual telah dijalankan dengan lapan orang guru sains di Malaysia dan lapan orang guru sains di Jerman. Data dianalisis secara kualitatif dengan menggunakan analisis tematik yang mengacu pada penjelasan Braun dan Clarke. Kesimpulannya, terdapat persamaan dan perbezaan antara kedua-dua buah negara ini. Guru-guru sains di Malaysia bergerak ke arah amalan pengajaran alternatif manakala guru-guru sains di Jerman adalah selari dengan amalan pengajaran alternatif. Guru-guru sains di Malaysia juga memilih konsep berpusatkan guru semasa mengajar teori dan memilih konsep berpusatkan pelajar dalam melakukan latihan dan eksperimen manakala guru-guru sains di Jerman memilih konsep pengajaran berpusatkan pelajar. Kajian ini juga menghasilkan sepuluh amalan pengajaran yang boleh dicontohi oleh guru-guru sains.

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ABSTRACT

In this modern era of globalization, our younger generations had been exposed to the advance technology such as smart phones and laptops since they were born. Thus, there is an obvious need for us to prepare our younger generations with the knowledge of science for their future. According to PISA result, Malaysia scored below the global average score where Germany ranked higher than Malaysia. Thus, the aim of the study is to determine the science teachers' instructional practices and their conceptions of science teachings at the Malaysian and German secondary school. It is also done to analyse the similarities and differences found in these nations. Classroom observations and semi-structured interviews had been conducted with eight Malaysian science teachers and eight German science teachers. The data were analysed qualitatively using Braun and Clarke's framework of thematic analysis approach. As the result of this study, there were similarities as well as differences between this two nations. It is found that Malaysian science teachers are moving towards the alternative instructional practices whereas the German science teachers are in line with the alternative instructional practices. Most of the Malaysian science teachers rather apply teacher-centred conceptions of teaching during theory lesson whereas they prefer to practise student-centred conceptions of teaching during the practical session. On the other hand, most of the German science teachers prefer student-centred conceptions of teaching. Ten good instructional practices were also been suggested in this study.

CHAPTER 1

INTRODUCTION

1.1 Introduction

It is no longer a doubt that our world is growing more advanced every single day. Living in this increasingly modernised world requires each and every one of us to become a little more technically savvy. In order to keep up with it, good knowledge and understanding of science and technology has now become increasingly important. Hence, looking at the current rate of technological and scientific advancement that our world is heading to, there is an obvious need for us to look into the preparation of our younger generation with steady knowledge and understanding of the science.

Thus, strong education in science would be able to equip our younger generation with the skills needed to live and work in an advanced knowledge society by providing them with the right opportunity to develop critical thinking and scientific reasoning that would enable them to have a better future. A good quality science education is also critical to ensure that a country could produce a number of highly qualified and highly skilled professional workforce to meet the demands in the future.

Science subject is a compulsory subject in Malaysian and German primary schools. The aim of the elementary science is to nurture the young generation to have the basic knowledge about science which enables them to explore and understand knowledge of science in their daily life. At Malaysian upper secondary schools, the science subjects are divided into two categories which are the core science and elective science subjects. The students are allowed to choose to study either core science or two elective science subjects which are physics, biology, chemistry and additional

science. However, the science subjects are taught in separated subjects which are physics, biology, chemistry and geography at German secondary schools.

The students in both Malaysia and Germany explore science knowledge since young. Nonetheless, the science subjects are often labelled as hard and boring subjects which drastically declined in the number of students enrol in science subjects (“Dasar 40:60 pelajar”, 2009; Dieck, 2003; Reiss, 2000). This negative perception has led to the lack of interest towards the learning of science among students in both Malaysia and Germany.

Nevertheless, Germany science score still higher than Malaysia in the Programme for International Student Assessment (PISA) in 2012 where Malaysia score was far underneath the average worldwide score (OECD, 2012a). Since Malaysia is looking forward to improving its science education system and Germany has already had much experience in this area, a comparison among these two nations is truly beneficial for both nations.

1.2 Background

The aim of this study is to compare the science teachers’ instructional practices and their conceptions of teaching science in Malaysian and German secondary schools. Thus, the Malaysian and German science education will be discussed.

1.2.1 Malaysian science education

Malaysian formal education consists of four levels which are primary education, secondary education, pre-university education and tertiary education.

Among these, primary education and secondary education are categorised as basic education. The primary education lasts for six years whereas the secondary education lasts for five years.

The integrated science curriculum at the primary level and high school level in Malaysian schools was introduced in the late 1980s. Malaysian science education philosophy aimed to produce an all rounded individuals who are intellect, spiritual, emotional and physical balanced and harmonious (Curriculum Development Centre, 2003). The science curriculum is divided into core science subjects and elective science subjects (Syed, 2000).

At the primary school level, the science subject is a compulsory subject and it continues to be offered as a core subject to all the students at the lower secondary level (Syed, 2000). However, the students had a decision to take core science or elective science subjects at the upper secondary level. The students who take two or more electives science subjects are not required to take the core science subject (Syed, 2000).

The teaching and learning of science in Malaysia were mostly teacher-oriented (Saleh & Aziz, 2012). It centred around rote of memorization which focused on repetition learning strategies (Saleh & Aziz, 2012) where the teachers explained exercises given at the end of the textbook to familiarise students with the examination questions.

Malaysian education had an examination-oriented system (Tengku Kasim, 2014), thus the lesson conducted were passive where teachers spoon fed the students by discussing the theories before enabling them to conduct experiment in the laboratory (Tengku Kasim, 2014). Besides, teachers did a large portion of the talking and instructing while just a couple of students or none of them contributed their views

(Saleh & Yakob, 2014; Sim & Arshad, 2013; Saleh & Aziz, 2012). The teachers always used materials from the textbook and they only conducted demonstrations or laboratory activities occasionally (Saleh & Yakob, 2014; Sim & Arshad, 2013; Saleh & Aziz, 2012). The students memorised the facts to excel in their examinations without participating actively in the lessons.

Nonetheless, the Malaysian Ministry of Education had made a move to grow high order thinking skills when Malaysian demonstrated a low science score in Programme for International Student Assessment in 2009. The public examinations and the school-based assessments in Malaysians schools implemented a test paper that streamlined with higher order thinking questions (Sumintono, 2015) to prepare students to think critically. Therefore, this study is conducted to determine the current instructional practices used in the Malaysian science classroom as well as the science teachers' teaching conceptions.

1.2.2 German science education

German formal education starts from the primary education to the tertiary education and it is differing all through Germany because each state (*Land*) decides its own particular educational policies (Education system Germany, 2015). The primary education lasts for five years whereas the year to study in secondary education is depends on the type of secondary school that the students enter.

Science education in Germany has distinctive curricula. A paradigm occurred from the German thought of *Bildung* towards the Anglo-American idea of literacy. The National Education Standards (NES) were then introduced for the science subjects of biology, chemistry, and physics. (Neumann, Fischer, & Kauertz, 2010). Science

envelops learning and comprehension of the natural and physical parts of the world through observation and experiment.

The elementary science is educated at the primary school in Germany as a mandatory subject called *Sachunterricht*. It combines biology, chemistry and physics topics together with issues related to technology, geography, history and the social sciences. In the secondary schools, the science subjects are separated into biology, chemistry, physics, and geography (Mullis, Martin, Goh, & Cotter, 2016). A few states in Germany offer science as an incorporated subject in certain secondary school tracks (Mullis et al., 2016).

There are no single mode of teaching portrays German instructional practices as the needs of the students are differ in different types of school (Stevenson & Nerison-Low, 2002). Most teachers adopted a various style of teaching that incorporated several strategies in each lesson such as lectures, group work, and demonstrations. The teaching strategies in German were more product oriented (Björkmana & Tiemann, 2013) where the repetition phase in the lesson was short while the new content was taught longer in the lesson. The lesson was mostly dominated by class discussion which the students actively participated in the lesson.

German science teachers conducted their lesson through conversation where the teacher and the students shared the scientific understanding. They encourage peer tutoring by having students work in pairs or in small groups (Stevenson & Nerison-Low, 2002). Thus, the students explore, record and share findings in the lesson.

1.2.3 Instructional practices

Instructional practices are firmly connected to the teachers' action in a classroom. It is specific instructing strategies that guide cooperation in the classroom. Grasha (1996) defined it as the individual characteristics and practices on how educators lead their classes. Instructional practices are the behaviours of a teacher which the teacher found comfortable and consistently used over time in the classroom (Elliott, 1996; Ahmed, 2013).

There are two teaching and learning-related indices found in the teaching and learning survey, TALIS which are the direct transmission and the constructivist beliefs about teaching. The direct transmission view implied that a teachers' role is to communicate knowledge in a clear and structured way to give students clear explanation (OECD, 2009). On the other hand, a constructivist view centred around dynamic members in the process of gaining knowledge. Teachers go around as facilitators and enable students to play an active role in instructional activities.

Dancy and Henderson's (2007) framework have two types of practices which are the traditional instructional practices and alternative instructional practices. Basically, the traditional instruction practices have a minimal interactivity while the alternative instructional practices have significant interactivity. Alternative instructional practices do not only rely on textbooks to present content to a class of learners. The teachers in this approach discover routes for students to relate science to the world outside of the classroom (Tobin & Garnett, 1988). In this study, the Dancy and Henderson's (2007) framework of instructional practices was used to explore and compare the current science teachers' instructional practices in Malaysian and German secondary schools.

1.2.4 Teachers conceptions

Conception is defined as an idea of what something or someone like or a basic understanding of a situation. It is something that one acknowledges as true or real. It is a firmly held opinion or conviction (Pearsall & Hanks, 1998) and a perspective in which trust or confidence is placed in some individual (Buabeng, 2015). In this study, the word ‘conceptions’ is preferred as there is already an existing body of literature.

Kember (1997) made a comparison between many categories and created a framework considering the relationship between the teacher, student, and content. The researchers marked teacher-centered and student-centered with an intermediate category as traditional view whereas student-teacher interactions were marked as constructivist view (Cheng, Cheng, & Tang, 2010). These two perspectives have huge contrasts in the conceptions of teaching and learning. The traditional view supports the teacher-centered conceptions where the teacher is responsible for the transmission of the knowledge. Teacher is the only one conveys the knowledge to his or her students accurately and clearly. Students are not anticipated that would take an interest effectively in the teaching and learning process.

Nonetheless, constructivist view believes that knowledge is created through the interaction. Students are relied upon to develop their own particular learning. In this approach, teacher acts as a facilitator. They facilitate the ongoing teaching to cover such development (Devlin, 2006). The teachers help their students in changing their views of the subject that they are studying (Parpala & Lindblom-Ylänne, 2007).

In this study, Kember’s model of teaching conceptions (1997) was used to determine the current teaching conceptions of Malaysian and German science teachers

and analyse the similarities and differences between Malaysian and German science teachers' teaching conceptions.

1.3 Problem Statement

Today, we have observed a steady increase in the levels of interest in science and technology in our younger generation, with the advent of the internet, technologically advanced toys, cell phones et cetera. However, when it comes to learning science in school, the interest has rather drastically diminished. The quantity of students taking up science in upper secondary school has declined ("Students taking up", 2017).

In Malaysia, the students at the secondary school lack interest towards the learning of science. In accordance with this, the research has found that Malaysian students regularly marked science subjects as difficult and boring subjects to be learned at school ("Dasar 40:60 pelajar", 2009). Students have also been found to avoid science courses as they are often perceived to be tougher. (Lee et al., 1996; Abd. Karim et al., 2006).

This phenomenon is not only happened in the developing country but also struck the developed nations. Germany is one of the countries which had faced the same problem as Malaysia. The young generation in Germany were also not interested towards learning of science (European Commission, 2007; Dieck, 2003; Reiss, 2000). Research has shown that science subjects were also often labelled as difficult and boring subjects at school in Germany (Dieck, 2003; Reiss, 2000). According to research, the number of students choosing the science-profile school curricula in *Sekundarstufe I* and of the students in *Sekundarstufe II* declined strongly (Dieck, 2003).

However, the science results of Programme for International Student Assessment (PISA) in 2012 showed that Germany scored higher than Malaysia where Malaysia was still below the average global score (OECD, 2012a). According to the results released by Organisation for Economic Cooperation and Development (OECD), Germany scored 524 in science whereas Malaysia scored 420 in science. It showed that Malaysia was still below the global average score of 501 in science. Germany ranked at 16 out of 65 countries while Malaysia is languishing in a dismal position at 52 out of 65 countries (OECD, 2012a).

Although Germany is not ranked the top in PISA results, it was selected as Malaysia and Germany faced the same problems where the students in both nations engraved science as a difficult and boring subject. Besides, Malaysia and German classrooms have similar physical appearances. The students were either sat in group or pairs (Saleh & Liew, 2018). Moreover, the OECD reflected that both Malaysian and German students enjoyed learning and students believe that mathematics and science are important for their future careers in addition to perceive their mathematics and science competency positively (OECD, 2012b).

Nonetheless, German students have higher ability to solve a range of pure and applied problems than Malaysian students. Malaysian students have the relative lower level of self-adequacy. For German students, their exceptional execution in science literacy could be additionally clarified by their lesser feelings of stress and helplessness when dealing with science (OECD, 2012b). In this regard, larger amounts of uneasiness and worry in learning among the Malaysian students could be the reason where Malaysian students failed to meet expectations results.

Furthermore, German teachers explain scientific ideas in many or all lessons and adapt the lesson to the students' needs and knowledge more frequently (OECD, 2016a). German teachers monitor individual student progress consistently all through the academic year (Mullis et al., 2012a). However, the teaching strategies in Malaysia are heavily examination based. Malaysian teachers' teaching is organised and outfitted towards exam preparations for the major national examinations (Mullis et al., 2012b). Malaysian teachers tend to give more monitoring and support towards students with amazing academic records, sadly in the meantime Malaysian teachers effectively deprioritizing the less affluent students (Zamir & Faizli, 2013).

The role of a teacher was expected to change from knowledge transmitter to facilitator (Lee, 1992). In year 2000, Malaysian teachers failed to accept the role as facilitators (Ismail, 2000) and they choose the role of transmitters of knowledge for some reasons. Meanwhile, German teachers were ahead of Malaysian teachers. German teachers concurred that the students should learn actively and are more inspired to learn science when they are offered opportunities to commit during the lesson (Koballa, Graber, Coleman, & Kemp, 2000).

Teachers play a vital role in motivating all students and in helping them to build up their full potential, by holding high expectations, commending each student's endeavours and accomplishments, and compensating every student who accomplish particular learning objectives (OECD, 2012b). Teachers could modify or enhance their instructional strategies with trainings and endeavours to build students' self-efficacy and inspiration.

As per literature, German science teachers are ahead of Malaysian science teachers where Malaysian science teachers still using the traditional instructional practices in their lessons and German science teachers had been practicing the

alternative instructional practices. It is also found that they had different perspective in teaching science. The instructional practices chosen by teachers are likely align with their conceptions about teaching (Hewson & Kerby, 1993). Hence, this study is conducted to compare the science teachers' instructional practices and their conceptions of teaching science in Malaysia and Germany.

1.4 Research objectives

The aim of this research is to compare science teachers' instructional practices and their conceptions at the secondary school level in Malaysia and Germany. Based on these comparisons, the good instructional practices in teaching science were suggested. The specific aim is to:

1. Explore the current Malaysian and German science teachers' instructional practices in teaching science.
2. Explore the current Malaysian and German science teachers' conceptions of teaching science.
3. Analyse the similarities and the differences of Malaysian and German science teachers' instructional practices in teaching science.
4. Analyse the similarities and the differences of Malaysian and German science teachers' conceptions of teaching science.
5. Suggest good instructional practices in teaching science that could be adopted to bring about an improvement in the quality of science education in both Malaysia and Germany.

1.5 Research questions

The research questions in this study are as follows:

1. What are the current Malaysian and German science teachers' instructional practices in teaching science?
2. What are the current Malaysian and German science teachers' conceptions of teaching science?
3. What are the similarities and the differences of Malaysian and German science teachers' instructional practices in teaching science?
4. What are the similarities and the differences of Malaysian and German science teachers' conceptions of teaching science?
5. What are the elements of good practices utilised by both of Malaysian and German nations' science teachers that could be adopted to bring about an improvement in the quality of science education in both Malaysia and Germany?

1.6 Significant of study

This study will contribute to the improvement of education not only in Malaysia but also in Germany. This study empowers us to recognise the components of the great practices utilised by both of Malaysian and German nations' science teachers at the secondary school which both nations can exchange the ideas and practices found from the findings.

Moreover, this study will also be beneficial to the teachers in instructional practices when they employ effective learning in their classroom. By understanding the needs of the students and benefits of quality education, these teachers and students be guaranteed of an upper hand.

Other than that, this study will provide recommendations on the most proficient method to build the interest of students towards learning science. Different ways are expected to inspire the students to learn science with the goal that science will be a fascinating subject for them to learn and not an exhausting conceptual subject.

1.7 Operation definition

The definitions of the terms employed in the study are explained as follows:

Comparative study:

Goedegebuure and van Vught (1996) states that the comparative study plays an important part by bringing into focus to determine the similarities and differences among the cases. In this study, the science teachers' instructional practices and their conceptions in teaching science in Malaysian and German secondary school are compared to determine the similarities and differences among these two nations.

Teaching conceptions:

Conception of teaching is teachers' beliefs about teaching and learning (Amundsen & Wilson, 2012). In this study, the teachers' conceptions in teaching science are categorised into teacher-centered and student-centered based on Kember's model of conceptions of teaching (Kember, 1997).

Instructional practices:

Grasha (1996) defined instructional practices as the individual characteristics and practices on how educators lead their classes. In this study, ten practices used by the teachers in their science lessons were observed. It included interactivity, instructional decision, knowledge source, student success, learning mode, motivation, assessment, content, instructional design and problem solving.

Secondary school in Malaysia:

According to Ministry of Education, secondary school in Malaysia is divided into two stages which are lower and upper secondary education (Education system Malaysia, 2015). The upper secondary education which involve students in Form 4 and Form 5 classes are the main focus in this study.

Secondary school in Germany:

Secondary education in Germany is divided into Secondary I (*Sekundarstufe I*) and Secondary II (*Sekundarstufe II*) (Education system Germany, 2015). This study involves the students aged between 16 and 17 which is in Year 8 to Year 10 classes.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The aim of the study is to compare science teachers' instructional practices and conceptions at the secondary school in Malaysia and Germany. Firstly, the important concepts such as the Malaysian education system, the German education system, teacher's conceptions and instructional practices are reviewed. The related past research and the related theories for this study research are further discussed.

2.2 The important concepts

Every research has their own key concepts. In this study, the aim is to compare the science teachers' conceptions and instructional practices in Malaysian and German secondary school. Thus, the Malaysia science education, German science education, comparative study, teachers' conceptions and instructional practices are the important concepts that need to be discussed.

2.2.1 Historical background of Malaysian education system

In the early stage, the Malaysian education was unplanned and unclear (Wong, 1973). It exists and was developing along the advancement of Islam in the states of the Malay Peninsula and the Malay Archipelago in the fourteenth century. The traders from the Arab and India who are Muslims came to Southeast Asia. At that time, an

educational institution called *sekolah pondok* was built. *Sekolah pondok* was created with the coordinated effort of the local community. *Sekolah pondok* spread in the Malay Peninsula, including Singapore when the hectic religious leaders appear to spread Islam in the Malay Peninsula. Malaysia still did not have formal education organizations until the twentieth century (Rahman, 1987).

When Malaysia was colonized by the British, the education system was the cultural heritage of the reign of the English education. Secular schools in Malaysia were to a great extent an advancement of the British colonial government. Five types of secular school such as Malay secular school, Chinese secular school, Indian secular school, English secular school and Madrasah which is known as the religious school was formed (Rahman, 1987).

Tamil education and Malay education continued with a plus Japanese during the colonialism of the Japanese government. The establishment of Nippon-Go was to replace Chinese and English secular school. The teaching in the school was more emphasis on the classic songs of Japan and Japanese Culture (Rahman, 1987).

After the Second World War in 1946, the British returned to Malaya. The situation at a time when the education system is disordered, the Malays have begun a strong spirit of nationalism whereas the society of Chinese and Indian still wants to remain as a resident in Malaya. Other than that, the Malays began to arise awareness to promote education. They realized that their economic and social will increased through education.

At the urging of the Malays and consciousness to expand educational opportunities for their children. The Malays began to urge the British government to improve the situation of education in the Malay schools. In 1950, a committee chaired

by L. J. Barnes been appointed to survey and enhance the education of the Malays (Rahman, 1987). The Malay language was a compulsory subject in the English school while the English language was an obligatory subject in the Malays school.

Barnes Report had controversial component. It only showed the significance of an ethnic. The Razak Report (Report of Education Review Committee, 1960) and Rahman Talib Report (Report of Education Review Committee, 1960) has been the premise of the National Education Basics Policy to uniform the education system. The policy matters presented by the Report enshrined in the Education Act 1961.

Education in Malaysia has one extreme target which is the accomplishment of national integration and unity among the different races. National unity and development through the education system is showed in the National Philosophy of Education that stresses the holistic development of the individual in view of the principles of the national Ideology or Rukunegara (Ministry of Education, 2015).

The National Philosophy of Education states that education in Malaysia is an on-going exertion towards further developing the capability of individuals in all-encompassing and coordinated manner in order to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious. It is designed to produce Malaysia nationals who are proficient and skilled, who have high moral values and who are responsible and capable of accomplishing a high level of personal well-being as well as having the capacity to contribute to the harmony and betterment of the family, society and country (Ministry of Education, 2015).

2.2.2 The Current Malaysian education system

The education system in Malaysia is centralized. It is centrally controlled by the Ministry of Education which prescribes the supply of educators, the placement of students, the curriculum, the textbooks and the examination system. Despite the fact that there are different sorts of primary and secondary school in Malaysia, they take after the same curricula developed by the Curriculum Development Centre (Ministry of Education, 2015).

The school structure of the Malaysian education is as shown in Figure 2.1. After the non-compulsory pre-school years, the formal educational system in Malaysia has a 6-3-2-2 pattern which describes the length in years of the primary, lower secondary, upper secondary and pre-university levels respectively. The students are compulsory to enter the primary school at the aged of seven (Education system Malaysia, 2015).

In the present formal education system, there are six standards at the primary level. There are three different types of primary schools such as National Schools, National Type Chinese Schools and National Type Tamil Schools. The students are required to sit for the Primary School Achievement Test (*Ujian Pencapaian Sekolah Rendah*) before they can enter the secondary school.

In the secondary school, there are three years of lower secondary education after which they are moved to the upper secondary level for a further of two years. The students must sit for two examinations in the secondary school. They are required to sit for Junior Secondary School Test (*Pentaksiran Peperiksaan Tingkatan 3*) at the end of the lower secondary school and sit for Malaysian Certificate of Education (*Sijil Pelajaran Malaysia*) towards the end of the upper secondary education (Education

system Malaysia, 2015). In the event that the students would prefer not to sit for the Malaysian Certificate of Education, they can opt for the technical or vocational stream at the secondary schools for the vocational education (*Sekolah Menengah Vokasional*) following three long stretches of lower secondary education and they are required to take an examination to obtain the Malaysian Certificate of Vocational Education (*Sijil Pelajaran Malaysia Vokasional*) (Education system Malaysia, 2015).

This is then followed by another one and the half years or two years of pre-university. The students can choose either taking one and the half years pre-university education at a Sixth Form College or a Matriculation College which is only lasts for a year (Education system Malaysia, 2015). They will be awarded the Malaysian Higher School Certificate (*Sijil Tinggi Persekolahan Malaysia*) or the Matriculation Certificate respectively and they will continue their university education after obtained the certificate (Education system Malaysia, 2015). However, the students can opt to continue their studies in the polytechnics or community college to obtain a diploma certificate. After they obtained the diploma certificate, they can further their studies in the university and obtain a degree certificate.

Besides, there are a few Chinese secondary schools which allowed the students to learn in their mother tongue. It has a different system compared to government school. Following six years of education in the Chinese secondary school, the students will sit for an examination and obtained the Unified Examination Certificate and they will usually continue their studies at private university or foreign university (Education system Malaysia, 2015). Lastly, the students can further their master and PhD after the completion of degree education in the university.

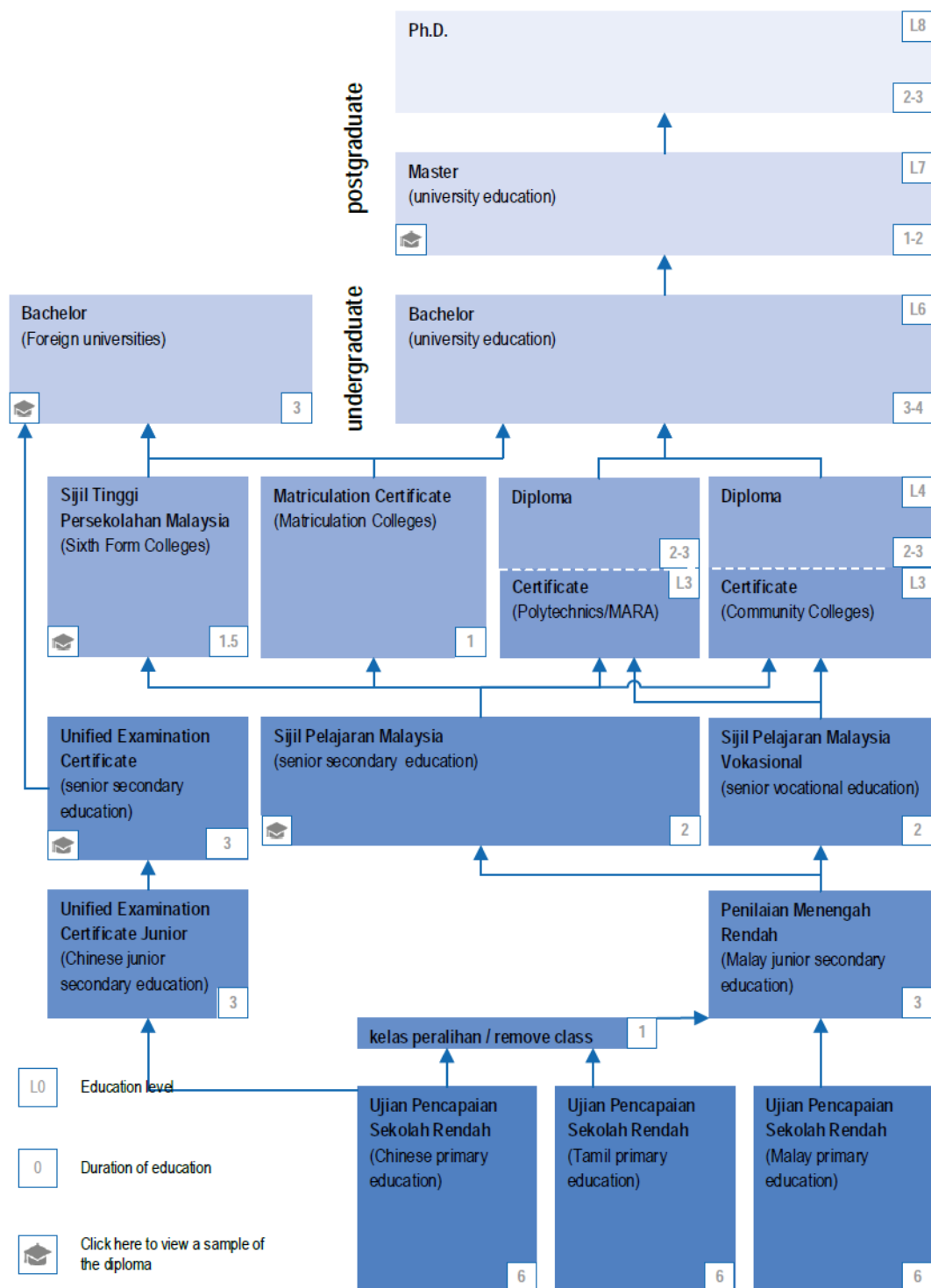


Figure 2.1. Structure of Malaysian education system (Adapted from Education system Malaysia, 2015).

2.2.3 The science education in Malaysia

Malaysia achieved independent from the British on 31 August 1957. After the free day, Malaysia keep on applying the science curriculum which originated from England. Three bits of curriculum teaching of science were embraced which are the Scottish Integrated Science Syllabus, the Nuffield Secondary School Science Curriculum and the Nuffield O-Level Pure Science Syllabus. As indicated by Tan (1991) and Lee (1992), the lower secondary science curriculum used the Scottish Integrated Science Syllabus though the upper secondary science curriculum used the Nuffield Secondary School Science Curriculum and the Nuffield O-Level Pure Science Syllabus.

It is good to have cross-country exchange of education syllabus. It will give a lot of impacts to the school system. However, Thair and Treagust (1997, 1999) revealed that they simply take up the science curriculum from developed countries without transforming it to adapt the curriculum which suit to the locals. There are problems faced by Malaysian when they applied the science curriculum from the Western culture. The content and structure of the curriculum followed the post-sputnik era which centered around the scientists' science. The utilization of Greek letters in the formula was troublesome for many students in developing countries to comprehend (Tan, 1991).

The Malaysian education experts realized the problems. They worked together with the Ministry of Education and attempted to obtain a science curriculum format that suit the local needs. The Curriculum Development Center was set up in 1972. It was responsible for conducting research and development curriculum locally (Tan, 1991).

The integrated science curriculum both at the primary level and high school level was introduced in the late 1980s. There are three core science subjects and four elective science subjects in Malaysian science curriculum. Science for primary school level, lower secondary school level and upper secondary school level are the core science subjects taught in Malaysia whereas the elective science subjects made up of biology, chemistry, physics and additional science are offered at the upper secondary level. Additional science comprises elements of physics, chemistry, biology, earth science, agriculture, oceanography and space science (Syed, 2000).

In 1983, the Ministry of Education implemented the Integrated Curriculum for Primary School and it is revised in 2011. The modified primary level science curriculum is organized into six learning domains. The six learning domains consists of introduction to science, life science, physical science, material science, earth and space science, and technology and sustainable living. It is a compulsory subject at the primary level (Syed, 2000).

In 1989, the Integrated Curriculum for Secondary School has been introduced. It covered an extensive variety of subjects in the arts and sciences, as well as vocational and technical subjects. The aim of the science curriculum was to furnish students with knowledge and scientific skills (Razali, 1998). It additionally aimed to prepare students to pursue further education in science and technology. At the upper secondary level, the students had a choice to take core science or elective science subjects. The students who take two or more electives science subjects are not required to take the core science subject.

Due to the aim to become a developed nation, the Ministry of Education proposed the use of English medium in teaching and learning of science and

mathematics (PPSMI) (Azman, 2016). The Education Ministry of Malaysia implemented the PPSMI in 2003 with the aims of enhancing students' command of English and quickening their mastery in science and mathematics (Yunus & Ahmad Sukri, 2017). It began with the Year 1 students in primary school whereas it began with Form 1 and Lower 6 students in secondary schools. After endless debate and contentions with respect to the implementation of the policy, it was announced that the policy would be put to an end in 2012 (Suliman, Mohd Nor, & Yunus, 2017a).

So as to oblige the requirements of a few guardians who bolster for the continuation of PPSMI, the Ministry of Education implemented a soft-landing approach named 'To Uphold Bahasa Malaysia To Strengthen Bahasa Inggeris' (MBMMBI) policy (Suliman, Mohd Nor, & Yunus, 2017b). The Dual Language Programme (DLP) is assumed to be the resurrection of the PPSMI policy but it contrasts in a few aspects of its implementation. DLP gives adaptability to the schools, teachers, students as well as guardians in their preferred language of instruction, especially the schools (Suliman, Mohd Nor, & Yunus, 2017b).

Although Malaysia has participated in TIMSS since 1999, the result showed Malaysian science score were still below the average global score after almost a decade participated in it (OECD, 2009). The Malaysian Ministry of Education then has made exceptional move to address this condition. The Education Blueprint states that Malaysian students need to develop high order thinking skills (HOTS). The expectation is for students to be globally competitive and remain relevant with the expectations of the current market and have the capacity to confront the expanding worldwide challenges and competitions (Sumintono, 2015).

Furthermore, the Ministry of Education has taken strategic initiatives to enhance HOTS among students and also for the continuous professional development of teachers. Thus, the public examinations and the school-based assessments in Malaysian schools implemented a test paper that will be streamlined with high order thinking questions (Sumintono, 2015). This renewed focus on HOTS is to furnish students with cognitive skills that will prepare them to think critically and have the capacity to innovatively extrapolate and apply logical reasoning in different settings.

2.2.4 Historical background of German education system

Religion has constantly discovered a decent footing in education. The German education system began in the early days of Martin Luther's teachings. He believed that every human being must have the capacity to read and write so that they able to interpret the bible independently ("The history of German", 2018).

The German education began as ahead of schedule as the Prussian Era. It was not an official public education system until Fredrick the Great, the Prussian's king mandated the education system in 1763. He instructed the students from the age of five until either thirteen or fourteen must attendance the regular school. In that era, the majority of the schools were Church supported and funded. The teachers often worked as sextons or church organists, and clergymen served as the school inspectors ("The history of German", 2018)

After World War I, the Weimar Republic built up a free education which is the *Grundschule*, a universal four-year elementary school. They able to attend one or two years in *Mittelschule* with additional charges. After that, the students had a choice to either stop studying or continue completing the exams and apply for a place at one of