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An insight into primary science education in Malaysia

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Malaysia has given a high priority to educational development since gaining independence in 1957. The country's main post-independence concerns were to create a national identity and to expand the educational system with the aim of 'eradicating poverty and redressing the economic imbalance among races' (Lee, 1992, p.253). Over the past 50 years, Malaysia has transformed from an economy that is heavily reliant on primary commodities to one which is driven by high- tech manufacturing and foreign direct investments. Malaysia aspired to move beyond its middle-income status to become a high- income and developed nation state by 2020, with the development of science education being one key way of achieving this.

However, now, a number of years after this aim was put forward, science education in Malaysia is still underdeveloped and yet has so much potential to improve. To harness the knowledge economy for sustained growth and inclusive development, the country relies on science and technology. However, young people are not enrolling on courses in the science field as much as previously, and the quality of results based on major national level examinations is about average on a global level (ASM, 2018). In response, this article will review primary science education in Malaysia to highlight some of the possible factors that have contributed to young people's declining interest in science. It will explore five core areas: the development of the primary science curriculum, assessment of primary science, the language of science instruction, science teaching during the COVID-19 pandemic, and the 60:40 (science and Arts) policy.

The development of the primary science curriculum

The emphasis on science education in Malaysia began in 1960 in response to the Education Review Committee reports, which called for an explicit commitment to improving the quality of science education. These reports highlighted some dissatisfaction with teaching and learning in science, and the need to update existing courses to reflect recent developments in science (Syed Zin & Lewin, 1993). In the 1960s, General Science was taught as a compulsory subject at the lower secondary level. Since then, science education in Malaysia has undergone several changes and innovations. In 1968, the Ministry of Education (MOE) instigated science curriculum reforms with the introduction of *Projek Khas* (literally 'Special Project'), which aimed to improve primary pupils' performance in school science and mathematics (Lee, 1992). However, the lack of trained teachers and an unrealistic plan that failed to consider the potential problems, such as the overwhelmingly top-down nature of science education, impeded the implementation of the project (Abdul Rahman, 1987).

In 1969, the MOE, through the Curriculum Development Centre (BPK), adapted the Scottish Integrated Science Syllabus for lower secondary school science (Forms 1, 2 and 3) to replace the existing General Science subject. Subsequently, in 1972, the newly-formed BPK introduced new science subjects for Forms 4 and 5 – Modern Physics, Chemistry and Biology – that were derived from Nuffield Science materials from England. For upper secondary non-science stream pupils, the Modern Science subject was introduced in 1974, derived from Nuffield Secondary Science (Lee, 1992). As stated by Syed Zin and Lewin (1993), these new subjects represented a move away from content-based science to more pupil-centred approaches. In primary schools, the subject 'Man and the Environment' was introduced in the New Primary School Curriculum (KBSR), implemented nationwide in 1983, which completed its first entire cycle in 1988 when the 1983 pupil cohort entered the sixth year of primary schooling. After that, science was taught as an integrated rather than a stand-alone subject in Malaysian primary schools.

However, teachers were not confident when it came to implementing the integrated primary curriculum, as it lacked clarity and incorporated elements of science, history, geography, health education and civics, as well as other areas of knowledge (Mohd Yunus, 2001). Therefore, in December 1994, the Integrated Curriculum for Primary Schools (hereafter designated 'new KBSR') was implemented, with the revised curriculum replacing the original KBSR. New subjects were introduced, including science as a separate subject that was compulsory for all pupils aged 7-12 years old. Specifically, science in the 'new KBSR' became central to Malaysian ambitions to become a developed country with a scientific and progressive outlook (Syed Zin & Lewin, 1993). The curriculum stressed the development of scientific skills through an enquiry- based approach, where pupils are actively involved in problem-solving and discovering scientific phenomena through investigation (MOE, 2005), and where the teacher acts as a resource, giving only sufficient help for the pupils to undertake the enquiry (Johar *et al*, 2004).

In October 2010, the MOE issued a circular on the implementation of the new Standard Curriculum for Primary Schools (KSSR) in phase one (years 1-6), starting from 2011. The new curriculum builds on the Integrated Curriculum for Primary Schools (KBSR) introduced at the end of the 1990s. The KSSR complies with the Ministry's recent policies, including the MBMMBI. The new science KSSR aims to develop pupils' interests and creativity through everyday experiences and investigations that promote the acquisition of scientific and thinking skills, as well as the inculcation of scientific attitudes and values (MOE, 2018). Based on the aims of the new science KSSR, enquiry has not been presented as a priority in the science education curriculum; however, the features of enquiry clearly stated in the curriculum encompass science process skills, manipulative skills and thinking skills, as well as scientific attitudes and appropriate values (MOE, 2018). The enquiry approach in the curriculum, however, is highlighted as one of the teaching and learning strategies in science:

'The inquiry approach emphasises learning through experiences. Generally, inquiry means that students should seek to find information, to question and to investigate a phenomenon around them. Discovery is the main characteristic of inquiry (Bruner, 1961). Learning through discovery occurs when the main concepts and principles of science are investigated and discovered by pupils themselves. Pupils can investigate a phenomenon and make conclusions by themselves through activities such as experiments. Pupils are guided to understand the science concepts through an inquiry approach. Thinking and scientific skills are developed during the inquiry process. However, the inquiry-discovery approach may not be suitable for all teaching and learning situations' (MOE, 2018, p.24).

Though the curriculum document presents enquiry as one of the teaching and learning strategies in science, it states that '*discovery is the main characteristic of inquiry*' (MOE, 2018, p.24). Guided discovery is suggested as the most effective approach for primary school pupils, as they need teachers' guidance to discover a concept or principle through discussion, questioning or problem-solving (Honomichl & Chen, 2012). However, in this interpretation, teachers see their role in conducting experiments as providing the materials and problems for the pupils to investigate, thus emphasising scientific process skills such as observation and data collection (Johar *et al*, 2004). The curriculum also suggests that the enquiry approach may not be suitable for all topics in science (life science, physical science, materials science, Earth and space, and technology and sustainability of life), and that certain concepts and principles are best taught by direct teacher instruction (MOE, 2018). Teachers are encouraged to use different teaching and learning strategies to enable pupils to acquire knowledge and scientific skills, and to practise moral values. Constructivism, contextual learning, mastery learning, project-based learning and Science Technology and Society (STM) are other teaching and learning strategies in primary science, as presented in the curriculum.

The assessment of primary science

As in many Asian countries, examinations are viewed as of vital importance in Malaysia. In 1999, another significant change took place, as the government introduced the Assessment of Science Process Skills (literally *Penilaian Kemahiran Amali* or PEKA) to enhance the effectiveness of teaching and learning in science. The initiative was premised on the understanding that practical science classes strengthen theoretical knowledge; allow pupils to develop psychomotor skills and the dexterity to use tools and equipment; help establish a strong correlation between theoretical knowledge and practical application; increase creative thinking and higher-order thinking skills; and develop an appreciation for scientific working methods (Ishak, 2014). However, with PEKA, the number of contact hours for science subjects was reduced, laboratory classes were not mandatory, and the centralised practical examinations were abolished (ASM, 2015). This in turn led to low levels of interest in and poor attendance at lab classes. In fact, the Academy of Sciences Malaysia (ASM, 2015) also reported that only 20% of schools (both primary and secondary) have science labs, many of which are poorly equipped.

Too much emphasis on examinations may constrain or distort the implemented curriculum and produce unintended consequences (Cizek, 2001). Realising this fact, in 2017 the MOE introduced a school- based assessment called *Pelaporan Pentaksiran Sekolah Rendah* (PPSR), literally 'Primary School Assessment Report', to reduce exam-oriented 'obsession'. PPSR is a holistic academic and non- academic assessment for pupils who have undergone six years of primary education (Chin *et al*, 2019). There are four main components of PPSR, including: a Primary School Achievement Test (UPSR); Classroom Assessment (PBD); Physical, Sports and Co-Curricular Activity Assessment (PAJSK); and Psychometric Assessment (PPsi).

Assessment of Science Process Skills (PEKA) is still part of UPSR, but it does not affect science test scores because the assessment is conducted at the school level and carried out by the teachers themselves. In addition, previous research reported that the implementation of PEKA at the school level was too taxing and unmanageable and that teachers were being compelled to cover the entire science syllabus while, at the same time, completing all the practical work assessments or PEKA within the limited timeframe (Ong *et al*, 2015). Nevertheless, it is still too early to evaluate the effectiveness of PPSR in general, as its implementation is still in its early stages.

The language of science instruction

The medium of instruction has been one of the most controversial topics in Malaysia since the introduction of KBSR in 1983. This is in spite of the fact that the colonial English language science curriculum has been 'decolonised' in the form of a national curriculum, which has been translated for use in Malay, Chinese and Tamil schools. In 2003, the Malaysian government announced the Teaching of Mathematics and Science in English (ETeMS) policy. The policy was an aspiration of Mahathir Mohamad, the Prime Minister of Malaysia at the time. He introduced the policy to ensure pupils' mastery in science and mathematics because most of the resources available were in the English language. In addition, the country needed a population that was competent in English to produce top-grade workers who would be able to compete in a globalised world (Selamat *et al*, 2010). However, this policy was controversial, with Malay linguists and nationalists, as well as Chinese educationalists, treating the decision as an attack on their identity, and unconstitutional. They felt that the decision made by the government had hampered the process of decolonising the science curriculum in Malaysia. Section 17(1) of the Education Act 1996 states that the national language shall be the main medium of instruction in all educational institutions in the National Education system. The MOE found that, during the implementation of ETeMS, the majority of teachers had to switch to Malay in their teaching because pupils could not understand their lessons in English (Muhammad, 2012). In addition, ETeMS hampered pupils' ability to understand scientific concepts, hence resulting in their poor performance in mathematics and science (Tajuddeen, 2006).

After careful deliberation, the Ministry decided to abolish the ETeMS policy in 2009 and stipulated that mathematics and science teaching and learning would be conducted in Malay in national schools and in vernacular languages in the Chinese and Tamil national primary schools. The Ministry realised that, for many decades, Malay had been the national language and the language of knowledge production (Education Act, 1996). It had proven to be an effective medium of instruction in the national schools. The main purpose of strengthening English language education was to enable the exploration of diverse knowledge and to increase pupils' competition at national and international levels. In addition, the Ministry realised that the English language is an international language of communication and, therefore, pupils should be nurtured to learn English as a foreign language from a young age. For these reasons, the MOE introduced the *Memartabatkan Bahasa Malaysia dan Memperkukuhkan Penguasaan Bahasa Inggeris* (MBMMBI) policy (literally 'Upholding the Malay Language and Strengthening Command of English') in 2010 to replace ETeMS. Mathematics and science teaching are no longer subject to the implementation of the policy, but the Ministry is committed to improving English instruction methods in schools, to help pupils become proficient in English (Ahmad *et al*, 2012).

Although the ETeMS policy was abolished in 2009, the MOE introduced the Dual Language Programme (DLP) in 2016 because of the requests of parents from urban areas, who sought to support pupils' English proficiency through increased exposure to English in science. In addition, the Ministry believes that the DLP can provide an opportunity for high-achieving pupils to gain improved access to a wider range of knowledge to help them to compete globally and to enhance their employability in the real world. The ETeMS and the DLP share one thing in common: they still espouse the notion of using English as a vehicle for disseminating information in science (Md Yunus & Ahmad Sukri, 2017).

However, the DLP gives an option for pupils and their parents to choose their preferred medium of instruction as either English or Malay when studying science (Suliman *et al*, 2017). The implementation of DLP was less controversial compared to ETeMS, as only a few schools located in urban areas subscribed to the programme by choice. Suliman *et al* (2017) reported some initial insights into the problems pertaining to the implementation of the programme, with regards to the influence of the language mastery aspect. Undeniably, teachers' competency in the language is one of the major issues contributing to their lack of readiness for the DLP. However, the policy implementation process takes time, and requires research and reflection that will result in new ideas, new ways of doing things and, inevitably, new problems (Lian & Sari Pertiwi, 2017).

Science teaching during the COVID-19 pandemic

Since the beginning of the COVID-19 pandemic in 2020, the MOE has urged all teachers to carry out distance teaching and learning, referred to as *Pengajaran dan Pembelajaran di Rumah* (PdPR) (literally 'Teaching and Learning at Home') (MOE, 2020). It has been challenging for all teachers in Malaysia to quickly implement such an intervention, because they were not prepared and did not have sufficient experience in digital teaching and learning. In particular, science teachers were unable to conduct hands-on activities as suggested in the primary science curriculum. An important theme highlighted in the curriculum is enquiry in science (scientific skills). Teachers are expected to integrate science process skills such as observing, classifying and predicting into science teaching and learning (MOE, 2005).

However, during the implementation of PdPR, most of these important scientific skills were not fully explored because of a lack of materials at home, pupils' basic devices (the majority of Malaysian pupils were using parents' mobile phones), and low Internet connectivity, all of which prevented full interaction with teachers (Ahmad Saifudin & Hamzah, 2021). As a result, science teaching, which is supposed to be fun and active, has become boring because teachers can only give homework to students through limited interaction using messenger applications such as WhatsApp and Telegram. Hence, research reported that many Malaysian pupils became disengaged with teaching and learning during the COVID-19 pandemic (Abdul Rashid *et al*, 2021).

The 60:40 (science and Arts) policy

Since 1967, the National Education Policy has targeted a 60:40 ratio of pupil participation in science and Arts subjects respectively, to ensure that the country has human resources in science and technology (Phang *et al*, 2014). The policy has been restated multiple times since then, first in the 1999 National Education Policy, then in the 2000 National Science and

Technology Policy 2, and finally in the 2001 Education Development Plan. Despite policy targets, the extent to which 60:40 targets have been reached has varied over the years. The science to Arts pupil ratio dropped from 31:69 in 1986 and to 20:80 in 1993. In the following years, the ratio showed an encouraging rise – 29:71 in 2001, 36:64 in 2004 and 41:59 in 2011 (ASM, 2015). However, the MOE (2012) reported a huge drop in science stream enrolment, reaching a low of 29% in 2012, which may be due to the perceived difficulty of science subjects. These observations were reinforced by Phang *et al*'s (2014) study, which also found that a low level of academic confidence in science has caused many pupils not to choose science programmes at upper secondary levels.

Consequently, the MOE launched the Malaysia Education Blueprint 2013–2025 in 2012 and revisited the 60:40 policy. The Ministry has started to recognise the growing economic importance of vocational education and has adjusted its 60:40 policy to encourage greater enrolment in the vocational pathway. Therefore, the current target is for 60% of upper secondary enrolment in the regular academic pathway (either science or Arts), with the balance of 40% in the vocational pathway. However, the 60:40 ratio has been applied to the academic pathway. That is, 60% of pupils in the academic pathway should be focused on science and 40% on the Arts. To date, the target ratio of 60:40 for the number of pupils enrolling for science and non-science programmes has not been met. ASM (2018) reported that science programme enrolment declined from 48.15% in 2012 to 45.74% in 2017.

This consistent decline in pupils' enrolment on science programmes is due to a lack of interest as a result of crowded classrooms and extensive negative coverage of the science education syllabus (Syed Hassan, 2018).

Conclusion

This review has provided an overview of primary science education in Malaysia, through its discussion of five main areas: the development of the primary science curriculum, the assessment of primary science, the language of science instruction, science teaching during the COVID-19 pandemic, and the 60:40 (science and Arts) policy. Over the past 50 years, education in Malaysia has transformed in an effort to decolonise the curriculum after independence. Despite various efforts introduced by the government to advance the development of the primary science curriculum in Malaysia, data show young people's declining interest in science. Is science education unattractive, or is the pedagogy losing touch with the learning style of millennials? As this review has discussed, there are a number of contributing factors.

First, there is the inconsistency of curriculum development due to the political influence of the Ministry. The current primary science curriculum (KSSR), for example, was influenced by the results of the OECD's Programme for International Student Assessment (PISA). Since 2009, Malaysian students' performance in science was below the OECD average.

Second, frequent changes in the language of science instruction and a heavily examination-based system for primary science has also had an impact. This problem has also been compounded by the COVID-19 pandemic, which has led to constraints being put on science teaching and learning in the digital contexts, notably the inability to undertake active and hands-on activities.

Nevertheless, the government is committed to the belief that science education in the classroom is the most important formal method of science enculturation, and therefore, a large amount of research and investment needs to go into strengthening primary science education in Malaysia.

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