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In-Progress Reflection No.3 on *Current and Critical Issues in Curriculum and Learning*

SHARING MALAYSIAN EXPERIENCE IN PARTICIPATION OF GIRLS IN STEM EDUCATION

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Open Note

The IBE has launched the series In-Progress Reflections on *Current and Critical Issues in the Curriculum and Learning* to open a communal space for a global conversation, collective production and discussion on those issues of high concern for Member States. It intends to support country efforts in mainstreaming challenging issues within the processes of curriculum renewal and development across different levels, settings and provisions of the education system.

Initially, the focus areas of the In-Progress Reflections series encompass, among others,: (i) Early Childhood Care and Education (ECCE) as a foundation of holistic child development and learning; (ii) Reading and writing in early grades to support the development of essential competencies; (iii) Youth Culture and competencies for Youth in the early 21st century (covering formal, non-formal and informal education); (iv) ICT curricula and inclusive pedagogy contributing to relevant and effective learning outcomes; (v) STEM (Science, Technology, Engineering and Mathematics) curricula to foster sustainable development; (vi) Curriculum for Global Citizenship Education (peace, human rights, sustainable development, values, ethics, multiculturalism, etc.); (vii) Assessment to enhance and support learning opportunities; and (viii) Inclusive education as an over guiding principle of education systems.

The series of reflections covers a wide array of knowledge products, among them: discussion papers, policy briefs, frameworks, guidelines, prototypes, resource packs, learning tools and multimedia resources. These materials are discussed, refined, used and disseminated engaging education and curriculum agencies / institutes, and in particular curriculum developers and specialists, development experts, policy makers, teacher trainers, supervisors, principals, teachers, researchers and other educational stakeholders. Also, they serve as reference materials for the IBE menu of capacity-development training on curriculum, learning and quality education – namely masters, diplomas, certificates and workshops –, to forge policy and technical dialogue involving a diversity of stakeholders and to support sustainable country field work.

Through blogs and e-forums, we encourage the audience to actively interact and bring in diverse perspectives. Effectively, the online space for reflection allows us to stay connected, facilitates exchange between experts from different regions of the world, and truly fosters continuous reflection on the issues concerned. The blog is structured to gather diverse resources, which include tools and documents (as previously mentioned) under specific themes so as to provide a complex and rich set of materials targeted to the specific needs of Member States. The In-Progress Reflections will capture relevant visions, views and comments shared by the audience, and serve as a key resource to support Member States' efforts in mainstreaming relevant findings and effective practices in national policies, curriculum frameworks and developments and in professional practices.

Dr. Mmantsetsa Marope : Director, International Bureau of Education

Sharing Malaysian Experience in Participation of Girls in STEM Education

Abstract:

The Malaysia government has placed STEM as a focus in developing the country towards achieving the status of a developed nation. The government acknowledges the role of women as equal partners in nation building. Thus, various policies ranging from economy, education, women's welfare and human resources have been formulated through the years. These policies have resulted in among others, the increase in women researchers from 35.8% in 2004 to 49.9% in 2012 as well as more women's participation in selected STEM courses at the tertiary level. A total of 84 girls' day schools with 6 of them as residential STEM Girls' schools have been built since 1939. There are many female role models in STEM for the girls to emulate. This has been made possible by the successful implementation of the various policies related to women in STEM as well as innovative measures in facing the continuing challenges in STEM education.

Contents

Acronyms and Abbreviation **6**
1. An Overview of the Development of STEM Education in Malaysia **8**
2. The Concept of STEM in Malaysia **10**
3. STEM and Gender Related Policies in Malaysia **11**
3.1 New Economic Model *12*
3.2 National Policy on Science, Technology & Innovation, 2013-2020 .... *13*
3.3 Malaysia Woman Policy 2009 .... *13*
3.4 Malaysia Education Blueprint 2013-2025 .... *15*
3.5 Malaysia Education Blueprint 2015-2025 (Higher Education) *17*
3.6 STEM Professional Bodies *17*
3.7 STEM Policies in School Education *18*
3.7.1 The 60:40 Policy 18
3.7.2 The Establishment of Residential Science Schools 19
3.7.3 The Establishment of Girls' Residential Science Schools 19
3.7.4 The Establishment of Girls' Schools 20
3.7.5 STEM Curricula 20
4. Quality Assurance in the Curriculum Development Process **24**
5. Capitalizing Potential of Girls in Girls-only and Co-Education Schools **26**
6. Inspiring Female Role Models **27**
7. Gender Inclusiveness in Pedagogies **27**
8. Challenges in Implementation of STEM Policies **28**
9. The Way Forward **29**
References **31**
Appendix : Samples of Packages offered to Malaysian Upper Secondary School S&T Stream **32**

Acronyms and Abbreviation

ASM	Academy of Sciences
CDD	Curriculum Development Division
CPD	Continuing Professional Development
CEDAW	Convention on the Elimination of all Forms of Discrimination Against Women
CRC	Convention on the Rights of the Child
DSKP	Curriculum and Assessment Standards Documents
GERD	Gross Expenditure on Research and Development
HOTs	Higher Order Thinking Skills
ICT	Information and Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
ISTIC	International Science, Technology and Innovation Centre for South-South Cooperation
JPPT	Malaysia Higher Education Planning Committee
KSSM	Standard-based Secondary School Curriculum
KSSR	Standard-based Primary School Curriculum
MARA	Majlis Amanah Rakyat
MCKK	Malay College Kuala Kangsar
MEB	Malaysia Education Blueprint, 2013-2025
MEB-HE	Malaysia Education Blueprint, 2015-2025 (Higher Education)
MGC	Malay Girls' College
MOE	Ministry of Education
MOSTI	Ministry of Science, Technology and Innovation
MTUN	Malaysian Technical University Network
MWP	Malaysia Women Policy
NAM	Non Aligned Movement
NEM	New Economic Model
NGOs	Non-Governmental Organizations
NGSS	Next Generation Science Standards
NPC	National Preschool Curriculum
NPSTI	National Policy on Science, Technology & Innovation, 2013-2020
NRC	National Research Council
PTPW	Action Plan for Development of Women
PMO	Project Management Office
R&D	Research and Development

SBPI	Fully Integrated Residential Schools
SMKA	Religious National Secondary Schools
S&T	Science and Technology
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation
TIMSS	Trends in International Mathematics and Science Study
TKC	Tunku Kurshiah College
TVET	Technical and Vocational Education and Training
UMP	Universiti Malaysia Pahang
UniMAP	Universiti Malaysia Perlis
UTeM	Universiti Teknikal Malaysia Melaka
UTHM	Universiti Tun Hussein Onn Malaysia

1. An Overview of the Development of STEM Education in Malaysia

In 1967, the Malaysia Higher Education Planning Committee (JPPT) reported that out of the 4% of Malaysian secondary school students who transitioned to the tertiary level, a significant percentage enrolled for Arts and Humanities programmes. Consequently, the JPPT recommended that 60% of upper secondary school students needed to be enrolled in science programmes in anticipation of providing the country with adequate human resources in science and technology (S&T). Further deliberations resulted in the1970 enrolment policy of 60:40, which ensured that 60 and 40 percent of students enrolled in science and arts respectively. This policy was implemented throughout the country for both schools and higher education. The key policy objective was to increase the participation of students in S&T in order to produce more scientists, engineers, doctors and highly skilled technicians for nation building. Although, to date, Malaysia is yet to achieve the target ratio of 60:40, the policy provided an important threshold and continues to be used as a benchmark for formulation and development of related policies and programmes in the field of S&T.

In 1986, Malaysia achieved another milestone through the formulation of the first National Science and Technology Policy. This policy aimed at promoting self-reliance among Malaysians and ultimately enhancing economic development through S&T. The policy focused on facilitating scientific inventions and improving infrastructure in science, education and related areas. Subsequently, in 1991, the Government started implementation of Vision 2020 which aimed at transforming Malaysia into a fully industrialized and developed nation by the year 2020. One of the goals in Malaysia's Vision 2020 is to establish a scientific and progressive society, innovative and forward-looking, which is not only a consumer of technology but also a contributor to scientific and technological civilization of the future. This Vision is an important pillar in establishing S&T related policies and programmes.

In the last four decades, Malaysia embarked on various efforts to achieve the 60:40 policy. Among the early initiatives, the Second Malaysia Plan (1971–1975), involved the building of 10 dedicated Science Secondary Schools by the Ministry of Education (MOE) and 2 MARA Junior Science Colleges (MRSM) by Majlis Amanah Rakyat (MARA People's Trust Council), is a Malaysian government agency. During the same period, four Religious National Secondary Schools were upgraded to Integrated Fully Residential Schools offering three streams; Pure Science, Religious Pure Science, and Technical Science. Currently, there are 69 Science Secondary Schools, 51 MARA Junior Science Colleges and 12 Religious National Secondary Schools. Among these schools are six girls' schools. From the 1970s to date, many students have graduated from these schools, and many have proceeded to pursue university degrees and become prominent S&T players in the country.

In 2011, amidst the call for transformation to ensure that the education system continues to respond to the national vision of achieving developed nation status by 2020, Malaysia MOE embarked on reforms through systemic planning and execution of the Malaysia Education Blueprint (MEB). In order to review the Malaysian education system and develop the Blueprint, the Ministry established a dedicated Project Management Office (PMO) in October

2011 that reported directly to both the Secretary-General and Director-General of Education. The development of the MEB was a robust, comprehensive and collaborative effort that ensured participation of Malaysians from all members of the society, and was conducted in three phases.

Phase I entailed a comprehensive and diagnostic review of the education system which was used to assess its level of performance and identify a set of priority areas for improvement. Multilateral agencies, (including UNESCO and World Bank) and six Malaysian universities were also included to assist in conducting an objective evaluation of the Malaysian education system. One of the priority areas identified in Phase I was STEM.

Phase II focused on further exploration and understanding contextual issues, and the design of a comprehensive transformation programme which was to cover the period between 2013 and 2025 (Wave 1). In order to identify the priority issues from the public and to gather their ideas for education transformation National Dialogues were held throughout the country. One of the top themes that recurred from the dialogue was the need to improve STEM education, including enhanced use of information and communication technology (ICT) in schools, and provision of technical and vocational education. The national public dialogues and memoranda sent by organizations and agencies facilitated identification of the specific STEM needs and aspirations. The broad range and diversity of perspectives gathered from almost 12,000 members of the public and key stakeholder groups were crucial in shaping the development of the MEB. A series of education labs, which covered identified priority areas for improvement including STEM, were also held over a period of six weeks to develop initiatives especially for Wave 1 of the Blueprint and to sync it with the relevant stakeholder groups' positions.

Phase III involved the gathering of feedback on the draft Blueprint, further analyses and refining of Blueprint initiatives. It was in this phase that the Ministry solicited feedback in the form of nine public Open Days throughout the country as well as further discussions with relevant stakeholders. Further, The Ministry analysed feedback from the Rakyat and Malaysian civil societies in the form of about 20 independently organized seminars, 3,000 articles and blog posts. Finally, in September 2012, the MOE launched the Malaysia Education Blueprint, 2013–2025 (MEB). Among the 100 key initiatives contained in the MEB was the strengthening of the STEM initiative, which took into account documents such as the *Report on Strategies To Achieve the 60:40 Science/Technical: Arts Stream Policy* (MOE, 2012). The other related STEM initiatives in the MEB were accelerating ICT innovations in learning, and enhancing access and quality of technical and vocational education in schools.

The Government of Malaysia has set a national goal of producing one million specialists in STEM fields by the year 2020. This goal illustrates the government's commitment to align the STEM initiatives to the objectives of the New Economic Model, Economic Transformation Programme and the Government Transformation Plan launched in 2010. STEM is closely linked with economic development of the country to generate wealth and to prepare Malaysia to attain the status of a developed country by 2020. There were various methods designed to achieve these goals which included stimulating students' interest by using new approaches in the teaching and learning that promote higher-order thinking skills (HOTS), innovative and engineering design thinking, improving teachers' skills and competencies, increasing STEM awareness among students, teachers, parents and the community as well as the use of ICT in teaching and learning. The education system also emphasizes moulding of well-balanced and holistic individuals. Hence, values, ethics and a sense of nationhood are imbued in students so that they are able to face and overcome life's challenges and also make the right choices for themselves, their families, communities and the country.

In Malaysia, participation of girls in STEM has improved gradually in the last four decades both in schools and in higher education institutions. However there is no specific policy on Girls in STEM education but the issue of gender has been included in many of the national policies (Education, Economy, and S&T) all of which have contributed to the current robust participation of girls in STEM. Current trends show that more girls are enrolled in biological and health sciences than boys. Adult women have also been recognized nationally as important in contributing to this STEM field as well as related economy and as a result, one of the key agenda in the Tenth Malaysia Plan (2011–2015) is empowering women to enhance their economic contribution. The Government's goal has not only been to encourage more women to participate in the labour force, but also to enhance the quality of their participation by increasing the number of women in decision-making positions to at least 30%. Efforts have also been made to improve women's participation in entrepreneurial activities to achieve the target of creating at least 4,000 women entrepreneurs.

2. The Concept of STEM in Malaysia

The term STEM refers to Science, Technology, Engineering and Mathematics. The objective of the STEM initiative is to produce students who have knowledge, skills and values in the STEM fields in order to increase the number of experts, which is expected to spur the country's economic development.

To contextualize STEM in the Malaysian education system, various stakeholders in both basic and higher education sectors came together in 2014 to clarify the concept. They resolved that 'STEM' should serve as a benchmark to raise the standard of Malaysian S&T Education, aligning it with international practices. The concept of STEM is defined from three perspectives: STEM field, STEM stream and STEM approach.

STEM as a field covers traditional disciplines such as Medicine, Engineering, Food Technology, Physics, Chemistry, Biology, Mathematics and Statistics, as well as the more specialized disciplines such as Astrophysics, Biochemistry and Genetic Engineering.

STEM Stream refers to enrolling of students in upper secondary school to a stream of their choice and inclination. Traditionally, Malaysian students at upper secondary schools enrolled in either a Science or Arts Stream. For close to four decades, students in the Science Stream studied Physics, Chemistry, Biology, Mathematics and additional Mathematics at upper secondary level. In the beginning of the 1990s, with the expansion of the S&T field, more specialized S&T subjects were introduced in schools such as ICT and Invention. During this era, there was a movement to engage more students at the earlier stage in more career oriented courses such as Engineering, ICT, Innovation and Design. With the many options available, MOE Malaysia renamed the Science Stream to S&T Stream. S&T Stream students were described as those students who studied a minimum of two sciences and mathematics subjects at the upper secondary school level (Refer to Appendix for Samples of Packages). Currently, 29% of students are taking all three pure sciences (Physics, Biology and Chemistry) with Additional Mathematics, while approximately 13% opt for two S&T subjects with Mathematics. As Malaysia MOE adopts STEM to replace S&T, a change of nomenclature to the STEM stream is being contemplated.

STEM approach refers to a pedagogical strategy that emphasizes application of knowledge, skills and values from the disciplines of Science, Technology, Engineering and Mathematics, in an integrated manner to help students solve problems encountered in the real world. In this approach, students learn collaboratively and engage in problem-solving activities as they research, investigate, design, evaluate, carry out inquiry activities, innovate and reflect. The learning experiences gained through these inquiry-oriented, problem-based activities, provide opportunities for students to understand relevant issues and ability to think critically as well as creatively about the process of solving related problems. This form of contextual learning involving design thinking is important in preparing students to face challenges and be competitive at the global level. In engineering design process, scientific and engineering skills are core skills in this approach. STEM students are also provided with learning opportunities to learn independently and to use technology.

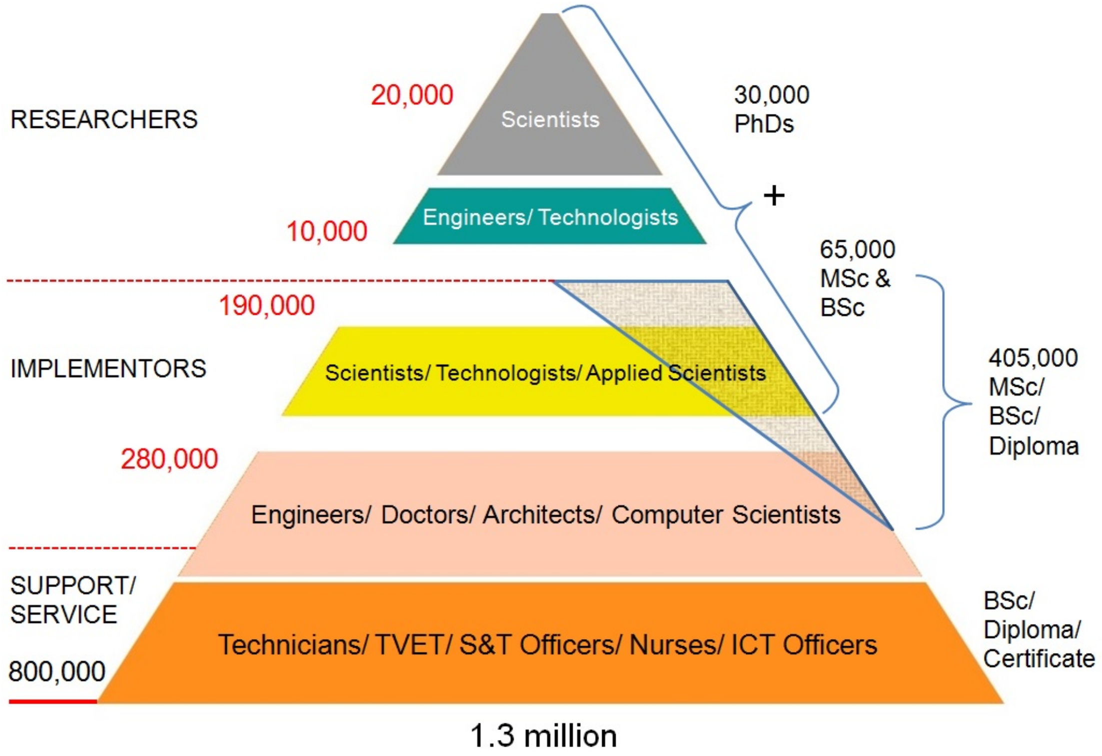
3. STEM and Gender Related Policies in Malaysia

The Malaysian government has identified STEM as one of the catalysts for transforming the country to a developed status by 2020 with STEM-related human capital, resources and infrastructure being the necessary pillars in this endeavour. The Government also recognized that participation of girls in STEM-related fields is critical in realizing this national goal. In order to improve the quality of the nation's human capital as well as upgrading the STEM supporting infrastructure, there is need for a holistic approach that supports the development needs of every Malaysian at every stage of their lives and every strata of the society is needed. The governance of this approach needs to be efficient and inclusive. It is also very critical to collaborate within and across ministries and agencies. Thus, the Government of Malaysia has painstakingly integrated STEM development into many of its policies as well as developed specific STEM policies in order to achieve the target set by the country. The Government appreciates that despite decades of S&T development and interventions, the gender gap in certain STEM fields still persist. The Government has, therefore, also integrated gender participation into many of its policies to enhance participation of girls in STEM. This section highlights some of the important STEM-related and gender-related policies.

3.1 New Economic Model

The New Economic Model (NEM) is an economic plan was launched by the Malaysian Government in 2010. The main goal of the NEM is to transform Malaysia into an inclusive and sustainable developed nation by 2020. The NEM envisages Malaysia that will be renowned for vibrant transformation arising from the resourcefulness of its people and exemplified by its harmonious diversity and rich cultural traditions. The economy will be market-led, well-governed, regionally integrated, entrepreneurial and innovative. NEM intends to stimulate economic growth by improving worker productivity across all sectors of society. The Government aims to create 1.3 million jobs in STEM discipline in various sectors by 2020 as shown in Figure 1, enabling infrastructure and supporting the development of industrial clusters. In terms of human capital development, Malaysia places great importance on STEM education as a means of becoming a developed nation, and to achieve the targeted number of STEM workforce and ultimately to meet the challenges and demands of a knowledge-driven economy by 2020. This workforce includes women who make up approximately 50% of the total population.

Figure 1: S & T Human Resource Development 2020



(Source: Science and Technology Human Capital Roadmap: Towards 2020)

(Source: Kementerian Pendidikan Malaysia, (KPM), Laporan Strategi Mencapai Dasar 60:40 Aliran Sains/Teknikal: Sastera, 2012, pg.5)

3.2 National Policy on Science, Technology & Innovation, 2013-2020

The National Policy on Science, Technology and Innovation, 2013-2020 (NPSTI) focuses on strategies to make Malaysia a sustainable and inclusive knowledge-oriented economy. It highlights the pivotal role of Science, Technology and Innovation (STI) in empowering men and women to achieve its vision of a scientifically advanced nation for socio-economic transformation and inclusive growth. The NPSTI is grounded on five fundamental foundations which are: STI for Policy; Policy for STI; Industry Commitment to STI; STI Governance; and STI for a stable, peaceful, prosperous, cohesive and resilient society. To ensure success and achievement, these foundations are embodied in six strategic thrusts which are:

(i) Advancing scientific and social research, development and commercialization;

(ii) Developing, harnessing and intensifying talent;

(iii) Energizing industries;

(iv) Transforming STI governance;

(v) Promoting and sensitizing STI; and

(vi) Developing strategic international alliances.

There are specific policy measures that have been formulated for each of the strategic thrusts. Among these measures are:

- Increase Gross Expenditure on Research &Development (GERD) to at least 2.0% of GDP by 2020
- Enhance commercialization and increase uptake of home grown R&D innovative products through clear guidelines and standards compliance
- Build and sustain domestic talent in STEM
- Increase the ratio of researchers per 10,000 workforce to at least 70 by 2020
- Enhance innovation and inculcate risk taking culture among entrepreneurs to accelerate R&D commercialization

Among these measures, women participation is specifically mentioned for Strategic Thrust (ii) involving building and sustaining domestic talent as well as ratio of female researchers.

3.3 Malaysia Woman Policy 2009

Malaysia Woman Policy (MWP), 1989 was revised in 2009, culminating into MWP 2009. This Policy continues the mission of MWP, 1989 but reflects contemporary issues and challenges. This policy upholds the country's commitment to National Principles (*Rukun Negara)* and National Social Policy for sustainable and balanced national development for the benefit of all citizens, regardless of gender. It also supports the principle of non-gender discrimination stated in the national constitution and other conventions and declarations such as Convention on Elimination of all Forms of Discrimination Against Woman (CEDAW), Convention on the Rights of the Child (CRC), Millennium Development Goals, Putrajaya Declaration and Action Plan on Development of Women for member countries in Non Aligned Movement (NAM).

MWP 2009 aims to develop human capital, and empowering women to be competent, resilient, knowledgeable, visionary, creative, and innovative, while demonstrating moral values. This Policy also provides strategies for planning for development of women who constitute half of the national workforce. An Action Plan for Development of Woman (PTPW) which detailed actions to be taken by government agencies, NGOs, private sector and civil societies was subsequently developed. The policy targets a total of 13 sectors, including economy, poverty, legal, violence towards women, health, education and training, science and technology, decision making, institutions for development of women, media, environment, sports, culture, arts and heritage. The aim of MWP is foremost to develop the potential of women from various strata of society as well as empowering them as agents of change to contribute towards national, economic and social development. Secondly, MWP aims to promote the dignity and welfare of women by using a holistic approach that targets physical, economic, social, political, health, psychology and spiritual aspects. Thirdly, MWP works towards enculturing gender equality and enhancing women participation in decision making at all levels. Fourthly, the policy aims at ensuring that women and men share resources and opportunities in participation, and both enjoy the benefits that accrue from the development of the country through family institutions, community and national development.

In the field of STEM, the Policy seeks to empower women adequately so that they can be competitive and not marginalized in national development. STEM is conceived as one of the key drivers in improving the potential of women towards acquisition of knowledge and skills and participation in the pathways for innovation. In the annual National R&D Study (*Laporan Kajian Penyelidikan dan Pembangunan Kebangsaan)* by the Ministry of Science, Technology & Innovation (MOSTI), women researchers increased from 35.8% in 2004 to 37.7% in 2006. The total number of women researchers in 2006 was 7,162, as compared to male researchers who were 11,859. By 2011, the percentage of female researchers rose to 49.90% (UNESCO Institute for Statistics, 2015). Efforts are also being made to reduce the digital gender gaps in terms of access to ICT and competence in ICT utilization. This is necessary for improving the economic status and quality of life of women through the use of e-commerce and e-learning, among other socio-economic developments driven by ICT.

The National Securities Commission has launched a new initiative, requiring companies to include a gender diversity index in their annual reports. This is part of the country's policy to raise the number of women in decision-making positions in the private and public sectors to 30% by 2016. The policy will facilitate tracking of the public and private sector in terms of inclusion of women in boards, managerial positions and other levels of employment. Other efforts include a career comeback programme for women who have left the workforce to take care of their families to return and a national action plan for single mothers. There is also a Women's Advisory and Consultative Council which monitors and advises the Government in formulating policies and legislation that address women issues.

3.4 Malaysia Education Blueprint 2013-2025

In October 2011, the Malaysia MOE launched a comprehensive review of the education system with the aim of developing an evidence-based education transformation to better prepare Malaysia's children for the needs of the 21st century. MOE collected the views of stakeholders from both public and private institutions. The government also commissioned international and local experts to conduct studies involving stakeholders in schools and education departments, and to suggest the way forward. In 2013, the draft Malaysia Education Blueprint (MEB) was launched, and town hall sessions and national dialogues were again conducted to obtain feedback on the draft MEB. The inputs were debated and relevant suggestions and comments incorporated into the revised MEB. Five system aspirations were developed to address access, quality, equity, unity and efficiency. The system aspirations of 'equity' specifically tackled gaps in students' achievement, focused on rural-urban, gender and socio-economic status. Six key attributes needed by every student to be globally competitive were also identified, these included knowledge, thinking skills, leadership skills, bilingual proficiency, ethics and spirituality and national identity. Eleven strategic and operational shifts have been designed to bring the nation towards achieving the goal set for each student.

Strengthening STEM is one of the key elements under the shift of 'providing equal access to quality education of an international standard. At the out-set of MEB, factors contributing to enrolment and quality of students' outcomes in STEM were identified, specifically on unawareness, curriculum, quality of teaching and learning and infrastructure. Based on the evidence collected and outcomes of roundtable discussions, three core measures under this STEM initiative were identified:

- Raising student interest through new learning approaches and an enhanced curriculum incorporating higher-order thinking skills, increasing the use of practical teaching tools and making the content relevant to everyday life;
- Sharpening skills and abilities of teachers; and
- Building public and student awareness in STEM

The ultimate aim of the STEM initiative is to ensure Malaysia has a sufficient number of qualified STEM graduates to fulfil the employment needs of the industries that support its economy. STEM graduates are expected to take up jobs in among other sectors, engineering and medicine. Further to providing quality STEM education through the academic pathway, MEB also promotes the vocational education pathway. Projections show that by 2020, at least 46% of all jobs will require vocational certificates or diplomas compared to 22% requiring university degrees (MOE, 2013). Majority of these vocational courses are STEM related. This will also contribute towards achieving the 60:40 policy.

MEB is being rolled out in 3 Waves, whereas Wave 1 on strengthening the foundations, Wave 2 building on the foundations in Wave 1, and Wave 3 emphasizing innovations. Aspects of STEM and gender issues under each Wave are outlined in Table.

Table 1: STEM and Gender Focus under each Wave

Wave	Focus
Wave 1 (2013–2015): Strengthening the foundations	• Raising students' interest through new learning approaches and an enhanced curriculum emphasizing higher order thinking Sharpening skills and abilities of teachers • Building public and student awareness • Enabling high performing teachers and school leaders
Wave 2 (2016–2020): Building on the foundations of Wave 1	• Rolling out the new primary and secondary schools curriculum (KSSM and Revised KSSR curriculum) • Encourage development of inter-school learning communities • Upgrade existing science equipment and facilities in schools to ensure that they are optimal for effective teaching and learning of STEM • Extension of STEM awareness programmes, to primary school students and parents • 50% reduction in the urban-rural students' achievement gap, 25% reduction in the socio-economic and gender students' achievement gap
Wave 3 (2021–2025): Innovating to the next level	• Introduce fresh initiatives and programmes based on the success of the first two Waves and develop a roadmap for the future • Maintain or improve on 50% reduction in the urban-rural, socio-economic and gender students' achievement gap.

The Malaysia MOE is concerned about the various gender issues in education. One key area of focus is the 'lost boys', who either leave school early or have low attainment levels. The trend in the last five years shows that school achievement gaps between genders is widening, with girls consistently outperforming boys at every level of education from primary schools to university, where females comprise approximately 70% of enrolment (MOE, 2013). Under MEB, the Malaysian school system aspires to halve these gender achievement gaps by 2020. Strategies have been developed to address this gap. Among these are increasing places in vocational and technical schools, which favours boys.

3.5 Malaysia Education Blueprint 2015-2025 (Higher Education)

The current development of higher education in Malaysia is guided by the Malaysia Education Blueprint, 2015-2025 (Higher Education) (MEB-HE) of April 2015. MEB-HE outlines ten focuses that will spur continued excellence. The first four focuses are on talent outcomes and the other six are on important enablers of higher education, namely funding, innovation, governance, online learning, global prominence and delivery.

MEB-HE identified Technical and Vocational Education and Training (TVET) at the tertiary level as a STEM initiative to be focused on in this decade. It will provide new pathways for post-secondary and post-college students regardless of gender. In line with mainstreaming TVET at the tertiary level, four technology-based universities, namely Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Malaysia Pahang (UMP) and Universiti Malaysia Perlis (UniMAP) formed an alliance called the Malaysian Technical University Network (MTUN) (Strategy Paper 9, 11th Malaysia Plan). It was expected that by 2015, 60% of total student enrolment, regardless of gender, in MTUN universities would be in technical fields providing the much needed professional technologists as per market demands (Strategy Paper 9, 11th Malaysia Plan). MEB-HE, 2015-2025 has set a target of 500,000 STEM graduates by 2020 and 650,000 TVET enrolments by 2025.

3.6 STEM Professional Bodies

Malaysia has enacted many STEM related pieces of legislation. The prominent ones are: Academy of Sciences Malaysia Act, 1994; Chemists Act, 1975; Engineers Act, 1967 (Revised 2007); Architects Act,1967; Pharmacists Act, 1951; and Town and Country Planning Act, 1967. Each of these Acts is implemented through an institution or a Ministry, which include the Academy of Sciences (ASM), Malaysia Institute of Chemistry, and Malaysia Institute of Engineers. These professional bodies are established and recognized under an Act of Parliament. They bring together specialized STEM experts to provide advice to the government and to the practicing scientists. This legislation and professional bodies motivate students to pursue STEM-related courses and become professionals. Concerted efforts are made by most of these professional bodies to support and encourage STEM education for all, regardless of gender, at school and tertiary level. The following are specific interventions that address gender issues, and specifically on women, in STEM:

- All government ministries and private sector organizations have been sensitized to recognize that women bring different and unique capabilities to the workplace. This has led to a mindset change and genuine recognition by society and policy makers that there are benefits in valuing women and pursuing policies that promote their participation, including in STEM, at all levels.
- There is a paradigm shift on how success is defined, which incorporates the female perspective. This has a positive impact on girls' identity and freedom to make choices.

- Organizations are required to be inclusive and equitable and to provide opportunity for both men and women to undergo leadership training and development that takes into account male and female leadership styles in all fields, including STEM.
- The Government is providing a supportive and enabling environment, which includes the national policy, integrated eco- system that is both women and family friendly through alternative and flexible work arrangements.
- The Women in STI Forum will be institutionalized by ISTIC hosting the forum once every two years in Malaysia.

3.7 STEM Policies in School Education

Malaysia places great importance in STEM education to achieve a developed nation status and to meet the challenges and needs of a knowledge-based economy by 2020. The following are policies that create an enabling environment for implementation of STEM education.

3.7.1 The 60:40 Policy

The 60:40 Policy ultimately aims at placing 60% of students in a STEM stream at the upper secondary school level. This has been implemented since 1970. Currently, 42% of students in upper secondary school level are a STEM stream. Although the target of 60:40 has not been achieved, Malaysian MOE continues to pursue this policy, which has so far contributed to production of a significant proportion of STEM manpower.

Science and Mathematics are compulsory subjects for all primary and secondary school students. However, at upper secondary school (Grade 10-11), students can opt to join a STEM Stream and take more S&T related subjects or remain in a non-STEM Stream taking only one core Science and one core Mathematics subject. Upper secondary school STEM Stream students take an average of five STEM subjects and spend an average of 15 hours per week studying STEM subjects. This curriculum policy prepares the students for future STEM studies or careers.

Under the 60:40 policy, students who score a grade A or B in both Science and Mathematics at the Lower Secondary Assessment which is administered at the end of lower secondary school(after Grade 9) are automatically placed in the STEM stream at upper secondary level unless there is an objection from the students or parents. For the last 4 decades, this policy has facilitated selection of students who have the necessary aptitude and academic ability to study STEM subjects. A study conducted by Curriculum Development Division (CDD) in June 2015, revealed that this policy of automatic placement contributed the most to increasing participation of girls in STEM education (BPKb, 2015). There is a trend of more girls scoring grades A and B in the Lower Secondary Assessment than the boys. For example, in 2013, there were 13% more girls than boys who scored grades A and B in Mathematics, and 11.3% more girls who scored grades A and B in Science. This trend has led to more girls than boys being enrolled in STEM at upper secondary school level. The same study revealed that this raised the girls' self-esteem and confidence.

3.7.2 The Establishment of Residential Science Schools

Malaysia has always been determined to raise Science awareness and prepare young technocrats. As early as 1905, the first residential school, Malay College Kuala Kangsar (MCKK) was established. Initially, it was exclusively for educating members of noble families and for the training of admission into some areas of government service. 42 years later, the first girls' college was established, which is Malay Girls' College (MGC). Much later, in 1961, MGC was renamed Tunku Kurshiah College (TKC), named after the first Queen of Malaysia). In both MCKK and TKC, most of the students study pure sciences at the upper secondary school level, and majority of them ultimately pursue S&T courses at the university.

Through the Razak Report of 1956, Education Ordinance, 1957 was established. This resulted in the establishment of a fully Residential MOE Science School. The 2ndMalaysia Plan (1971-1975) expanded this to 10 residential secondary science schools. Currently, there are 69 fully residential science schools across the country, which include six for boys, six for girls and the rest are co-ed schools. Residential Science Schools were originally conceptualized to provide quality education to students from rural areas to pursue their education in science subjects. Today, students with outstanding academic achievement are accepted as well.

The Majlis Amanah Rakyat, MARA (People's Trust Council), a Malaysian government agency, built its first residential MARA Junior Science Colleges (MRSM) in 1972 with the aim of providing quality S&T education to Malay students at the secondary school level. There are currently 51 MRSM across the country. MRSMs have succeeded in producing many outstanding STEM professionals through the years.

3.7.3 The Establishment of Girls' Residential Science Schools

In 1939, after 24 years of establishment and great success of MCKK (a boys' school), the Selangor Sultan (equivalent to King of State), Sir Hishamuddin Alam Shah Alhaj ibni Al-Marhum Sultan Alaudin Sulaiman Shah proposed the establishment of an English medium residential school dedicated to the royal and elite family of Malay girls to prepare the future wives of Sultans and leaders of the state. This proposal was seconded by the Sultans of three other states. Consequently, in 1947, the Malay Girls' College (MGC) was successfully established. It enrolled 41 Malay girls from various English medium secondary schools in the country. The girls in MGC were taught exactly the same curriculum as the boys (Mathematics, Science, Geography, and History) with an addition of a subject called Home Management. Subsequently, after sitting the Senior Cambridge examination in 1952, 1953 and 1954, they were allowed to pursue their ambition without any prejudice. Some of them enrolled for Dentistry, Science, Medicine and Education for their tertiary level of education. Over the years, MGC has produced many Malay ladies who are competitive in various fields, including the Sciences. Over time, the MGC has evolved. It was renamed Kolej Tunku Kurshiah in 1961 and shifted to bigger premises. To date, there are 6 girls' residential schools from among the 69 residential schools all over Malaysia.

3.7.4 The Establishment of Girls' Schools

Apart from the girls' residential schools, the British built a number of girls' day schools, especially in big towns such as Kuala Lumpur, Penang, Malacca and Johor Bahru in the 1940s and 1950's. Most of these are missionary schools attached to churches. Examples of such schools include the Bukit Nanas Convent School, St. Mary's School, St Georges Girls' School, and Methodist Girls' Schools. There are also non missionary girls' day schools built by the community such as Kuen Cheng Girls' Schools, the Penang Chinese Girls' High School and Union Girls' School. At the same time there are Islamic religious girls' schools. All these schools offer pure science and other S&T subjects for its upper secondary students. There are currently 84 such girls' schools throughout the country, 7 of them are Islamic Girls' Schools while 45 of them were affiliated with the churches before. The residential girls' science schools, as well as the girls' day schools have produced many top notch STEM experts serving in the public and private sectors.

3.7.5 STEM Curricula

STEM Curricula at all levels (preschool to pre-university) in Malaysia are developed to address the needs of all students, regardless of gender. In avoiding gender bias and ensuring equity for all, learning objectives as well as teaching and learning activities are all carefully crafted to be gender neutral. The Curriculum Development Division of the MOE engages panels of curriculum developers from both gender and gives special attention to gender inclusivity in the curriculum.

Preschool

Acquisition of basic skills in STEM (scientific skills) starts from preschool in Malaysia. The National Preschool Curriculum (NPC) is compulsory for both public or private preschools and kindergartens. There are two components in NPC which are related to STEM, which are Early Mathematics and Early Science. In Early Science, children explore nature and the world around them, engage in inquiry learning and acquire basic process skills such as observing, comparing and grouping in the process. In Early Mathematics, children are exposed to number sense, early numeracy activities and simple problem solving activities. Methods of delivery include thematic learning, play-based learning as well as inquiry-based learning. The emphasis of STEM in NPC is important for promotion of inquisitiveness and to develop early science and mathematics process skills.

Primary and Secondary Schools Core Science Subjects

The primary and secondary school core science curricula are compulsory for all students. Primary Core Science and Secondary Core Science Subjects have been designed to reflect the characteristics of STEM education, especially the STEM approach. The curriculum emphasizes thinking skills, science process skills, problem solving in real life situations, designing, innovating, working collaboratively as well as inquiry-based learning using approaches such as the 5E (engage, explore, explain, elaborate and evaluate). Scientific attitudes and noble values are instilled through experiential learning either through spontaneous or planned activities. These attitudes and values, together with scientific knowledge and skills, are used in the process of scientific investigation and conducting projects.

The Primary School Science Curriculum is organized under six themes: scientific inquiry, biological science, physical science, material science, earth and space, technology and sustainable living. The Secondary School Science Curriculum is organized into six content areas, which are Management and Continuity of Life, Man and Variety of Living Things, Matter in Nature, Force and Motion, Technological and Industrial Development in Life, and Astronomy and Space Exploration. School Science education provides opportunities for students, especially the girls, to explore through experiments and projects collaboratively. This inquiry-based learning has contributed to enhancing girls' interest and confidence in STEM (Bahagian Pembangunan Kurikulum a, b, 2015).

Primary and Secondary Schools Mathematics

The Mathematics curricula for both primary and secondary schools are designed to develop mathematical thinking among students. Mathematics Curriculum Standards stress on mathematical processes which are: problem solving, reasoning, communicating mathematically and making relationships and representations. Solving both routine and non-routine problems, as well as integrating the use of ICT in teaching and learning of Mathematics is essential in Malaysia's Mathematics curricula. Higher level thinking and non-routine questions are stressed to achieve the desire of the country to produce learners who are thoughtful, creative and innovative, competitive in the globalization era, as well as capable of facing 21st century challenges. The Mathematics curriculum covers content areas of Numbers and Operations, Measurement and Geometry, Relationship and Algebra, Statistics and Probability and Discrete Mathematics. In order to develop a gender inclusive curriculum, a small survey was conducted by CDD MOE Malaysia to get views of boys and girls on some common topics of STEM subjects. Against all expectations, the findings revealed that girls like topics in Mathematic such as algebra and calculus. These were included in the curriculum.

Secondary School Elective STEM subjects

At the upper secondary level, students are allowed to choose elective subjects to be taken together with the core subjects. There are four groups of elective subjects, which are language, STEM, Islamic studies, humanities and professional arts. The list of STEM subjects and the time allocation is outlined in Table 2.

Table 2: STEM Subjects offered in Malaysian schools

STEM Subjects	Level	Hours per week (current)	Hours per week (beginning 2017)
Primary School			
Mathematics	1 & 2	3	4
Science	1	1	1.5
Science	2	2	2
ICT/Design & Technology	2	1.5	1.5
Secondary School			
Mathematics	3 & 4	3.3	3.5
Science	3 & 4	3.3	3.5
Design & Technology/Basic Computer Science (either one)	3		2
Computer Science	4		3
Elective STEM Subjects at Secondary Schools			
Additional Science	4	3	3
Additional Mathematics	4	3	3
Chemistry	4	3	3
Physics	4	3	3
Biology	4	3	3
Technical Graphic Communication	4	3	3
Basics of Sustainability	4	-	3
Invention	4	3	3
Sport Science	4	3	3
Home Science	4	3	3
Engineering Drawing	4	3	3
Mechanical Engineering	4	3	3
Agriculture Science	4	3	3
ICT	4	3	3

Note: Level 1 refers to Primary Year 1 – 3, Level 2 refers to Primary Year 4-6, Level 3 refers to Secondary Form 1-3, Level 4 refers to Secondary Form 4-5

STEM Curriculum at Pre-University Level

Pre-University refers to 2 years of post-secondary school education. At the end of Pre-University, students take a public examination which determines whether they qualify for university admission. At Pre-university level, there is a Science stream, Technical stream and Arts stream. Core Subjects offered for the Science stream are Mathematics, Chemistry, Physics, Biology and Computer Science. For the Technical stream, subjects offered are Mathematics, Engineering, Chemistry, Engineering Physics and Engineering Study.

Standards-based Thinking Oriented Curriculum Design

The current curriculum design adopted by the Curriculum Development Division of the MOE, is a standards-based thinking oriented curriculum. Standards imply equity and quality. A standard dictates the quality expected of the curriculum and learning. The purpose of a standards based curriculum is to ensure equity and quality, equity in the sense that all students regardless of gender, socio-economic background and geographical location are entitled to a quality education, enabling them to achieve the same learning standards required by the curriculum. The Curriculum and Assessment Standards Documents (Dokumen Standard Kurikulum dan Pentaksiran, DSKP) have been used in Primary Schools since 2014 and will be extended to Secondary Schools beginning 2017. Content standards, learning standards and performance standards are provided for each learning area in the DSKP for all subjects offered in preschool, primary and secondary schools.

DSKP for all subjects, especially STEM subjects, are thinking oriented. Specific efforts have been made to deliberately design learning outcomes incorporating cognitive skills with disciplinary knowledge. The aim is to make thinking skills explicit in order to assist teachers in translating the curriculum into teaching more effectively. This curriculum design is in tandem with Resnick's & Klopfer's (1989), Fennimore's and Tinzman's (1990) ideas of a thinking curriculum fulfilling a dual agenda of integrating content and process. A thinking curriculum allows students to be taught content through processes encountered in the real world. Examples of such processes include problem solving, decision making, evaluating and comparing. Students engage in learning experiences by thinking about and thinking with what they are learning.

Character Building Curriculum

UNESCO (1996) identified four pillars of learning, which are *learning to know*, *learning to do*, *learning to live together* and *learning to be*. *Learning to live together* and *learning to be* are closely related to character building. The Malaysian Philosophy of Education emphasizes the importance of religious beliefs and moral values which are integrated across subjects as well as offered as compulsory subjects for all students (Muslim students study Islamic studies while students of other faiths study Moral Education). The DSKP for all subjects are developed with an emphasis on belief in God and moral values. The Malaysian Philosophy of Education also emphasizes moulding of a balanced individual who can work together with others, has strength of character and is responsible. In building character, students need to be given the opportunity to communicate and express themselves. They also need to develop a positive self-concept through participation in verbal and non-verbal presentations, and their views being respected during discussions. The centre of learning should shift from teachers to students, which mean that students should be responsible for their own learning. This will facilitate development of independent learners. DSKP for all subjects include the component of character building within its learning objectives and learning standards.

4. Quality Assurance in the Curriculum Development Process

Curriculum is generally regarded as a plan of study or a plan of learning experiences. In the Malaysian context, 'curriculum' is defined as "An educational programme that includes curriculum and co-curricular activities which encompasses all the knowledge, skills, norms, values, cultural elements and beliefs to help develop a pupil 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" (Government of Malaysia: Education Act, 1996). The process of development of Malaysia national curricula follows a curriculum cycle developed by Curriculum Development Division (CDD) of the MOE Malaysia (refer to Figure 2).

Curriculum development is a dynamic and intensive process involving many stakeholders and extensive consultations and engagements. Curriculum developers need to be meticulous to ensure the views of stakeholders are incorporated in the curriculum designs, while at the same time adhering to principles and theories of curriculum design and development. To ensure quality of the product (curriculum specifications), a systemic approach is adopted. Clearly mandated mechanisms and guidelines for selection of panels, decision making, information gathering and dissemination, monitoring and evaluation are established and adhered to. CDD adopted the curriculum development cycle as shown in Figure 2 and developed standard procedures in curriculum development in the form of Quality Manual ISO 9001. All curriculum development tasks follow the procedures outlined. These working procedures (Figure 3) were developed based on the curriculum development cycle illustrated in Figure 2.

Figure 2: Curriculum Development Cycle Model adopted by Ministry of Education Malaysia

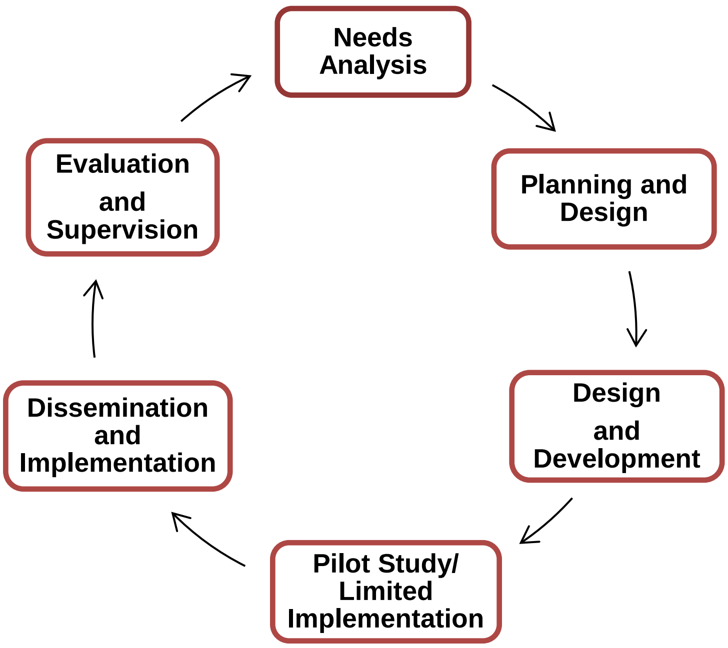
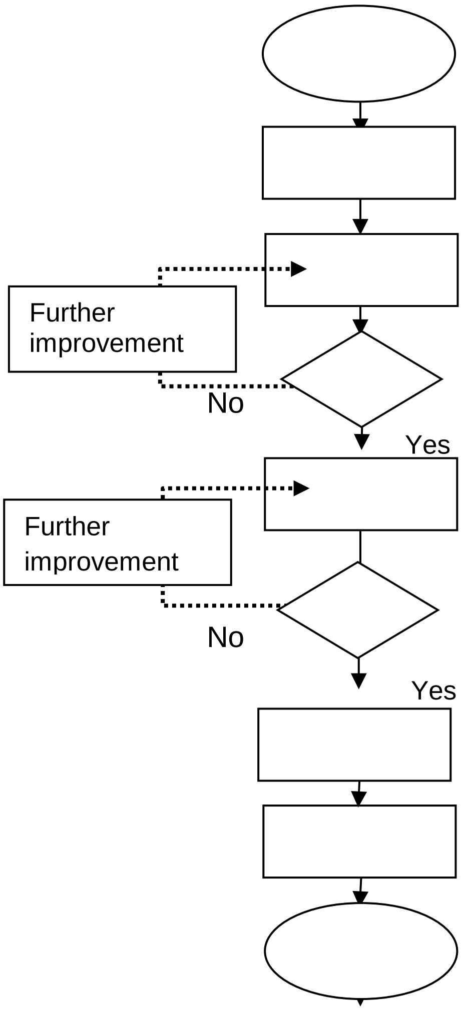


Figure 3: Procedure of Curriculum Development (MOE, 2011)



Receive instruction to develop curriculum or conduct curriculum review

Needs Analysis

Preparation of conceptual framework of the new curriculum

Presenting the conceptual framework to the Central Curriculum Committee*, MOE for approval

Formulating the curriculum specification based on the approved conceptual framework

Bringing the curriculum specification to the Central Curriculum Committee again for approval

Pilot the curriculum

Publish the curriculum

Complete

The adoption of the Curriculum Development Cycle (Fig 2) and Manual Procedure (Fig 3) ensures quality control in the process of curriculum development.

Gender inclusiveness in STEM curriculum and textbook

Generally, there are differences between gender in terms of their preferences and choices. Research has revealed that female teachers or educators are more likely to design learning activities which are more female-centric. As such, Curriculum Development Division made specific rules regarding gender of the panels of experts invited to be involved in developing the various curricula. By having equal or near equal representation of male and female in the curriculum development teams, gender biases can be reduced in term of content and learning outcomes as well as selection of learning activities. Similarly, CDD ensures that illustrations in text books are gender responsive.

5. Capitalizing Potential of Girls in Girls-only and Co-Education Schools

Capitalizing Potential of Girls through Girls-only Schools

Asian culture has traditionally been more male dominated; in a family, the decision maker is usually the father while the nurturing role is often taken up by the mother. Culturally, an Asian female submits to the male, thus traditionally girls tend to be less assertive in a male dominated community. However, in Malaysia, this trend is gradually changing and there is more equitable representation of males and females in various spheres of education and careers.

A case study involving 3 girls' schools was conducted by CDD in Oct 2015 (BPK a, 2015) and interviews with the school administrators, teachers and students, and classroom observations were carried out. Among the responses by school administrators and teachers were that the girl students are very active, they volunteer to do many tasks and are very focused in what they are doing. The principals and teachers asserted that 'at times the girls were becoming too aggressive and needed to be reminded to be more feminine'. Students felt that in girls' only schools (some of them were from co-ed schools before, thus they could make comparisons), they are less inhibited and they are not shy to express themselves freely. These girls said that since there are no boys to do the 'boys stuff', they had to do everything, thus becoming more independent. It is apparent that the ambience in girl schools nurtures the girls to face challenges and be assertive. The girls enjoy doing experiments and projects. In the word of a school principal; 'In my old school, boys seem to be more innovative than girls, but in girls' schools, once provided with the exposure and opportunities, they produce real good innovations' (she was referring to the Innovation Competition in her school).

Getting Girls to be involved in Co-ed Schools

Malaysian schools are generally co-education schools, that is boys and girls learn in the same class. Co-ed schools have also produced many successful female STEM professionals too. A case study involving 3 co-educational schools was conducted by CDD in Oct 2015 (BPK a, 2015). Following implementation of the 60:40 policy, the study noted that there were more girls than boys in the STEM classes at upper secondary school as the girls did better in Science and Mathematics at the lower secondary school. It was observed that when there are more girls in the class, the girls become more active than the boys. Girls are involved actively in conducting experiments and science projects.

6. Inspiring Female Role Models

A motivating factor to encourage more girls into STEM is having female role models. There are many females involved in STEM fields in Malaysia, specifically in the health sciences and medical field. There is also a trend of increasingly more females venturing into physical sciences, such as engineering. Interviews with these female STEM role models were conducted and useful feedback was obtained.

In this study conducted by CDD in Oct 2015, a number of successful female CEOs working in STEM related fields, female STEM academicians and female STEM students were interviewed (BPK, 2015b). The study sought to establish the factors or experiences that influenced them to take up a STEM course or career, as well as their advice to girls on the importance of studying STEM subjects. The findings revealed that most of them took up a STEM course or career based on their interests in exploring and doing experiments. They talked about their teachers who inspired them and motivated them as well as their peers whom they wanted to learn together with. STEM related competitions were also cited as a motivating factor. Further, career guidance was reported to play an important role in encouraging girls to study STEM subjects.

7. Gender Inclusiveness in Pedagogies

The Next Generation Science Standards (NGSS) developed by National Research Council (NRC), United States advocates STEM through the eight practices of asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using Mathematics and computational thinking, constructing explanations and designing solutions, engaging in argument from evidence and obtaining, evaluating, and communicating information. Students are engaged in these STEM practices through teaching and learning pedagogies such as inquiry based learning, project based learning and research based learning.

The female role models interviewed in the study by CDD in 2015, cited the experiments they conducted in school as a motivating factor (BPK, 2015b). Pedagogies that promote exploration and inquiry are core to the Malaysian STEM curriculum. Gender equity is accomplished as students of either gender access opportunities to do hands-on activities. Gender inclusiveness in pedagogies is one of the success factors in getting more girls to be involved in STEM. Other than curriculum related pedagogies, university or community initiated academic or co-curricular activities play an important role as well. The Academy of Science (ASM) role in Inquiry-Based Science Education programme, BITARA STEM by Universiti Kebangsaan Malaysia, nobel laurette mindset by PERMATA PINTAR are examples of such endeavours.

8. Challenges in Implementation of STEM Policies

Cultivating a culture that values STEM at an early age is essential to increase awareness of the importance of Science, Technology and Innovation in the society. The Malaysian education system equips students, regardless of gender, with the skills to meet the science and technology challenges. This aims at ensuring that Malaysia has a sufficient number of qualified STEM graduates to contribute to Malaysia's STEM talent pool. At the outset, gender issues are not usually the focus. Malaysian community has progressed through time to a point where in general, the public is gender-blind due to the dominating culture of treating all as children of God and accepting girls and boys as equal. Gender inequality is not obvious in the Malaysian society and in general, women in Malaysia accept their responsibilities in integrating the role of mother, wife and career woman. Reported cases of gender discrimination are not rampant besides the current low percentage of women holding high positions.

Malaysian communities are aware of the importance of STEM policies formulated by the government. However, there are still challenges in implementing these policies. Among these challenges are decline in students' enrolment in STEM, quality of STEM education and support from private sector and local communities.

The Decline in Student Enrolment in STEM at Upper Secondary School

The last two decades have recorded a gradual decline in number of students' participation in STEM. Decline in enrolment may be attributed to the interest and confidence levels of the students. Students have the impression that the STEM fields are difficult to learn. This sense of difficulty can result in low students' confidence to get good results in public examinations. TIMSS Studies by International Association for the Evaluation of Educational Achievement (IEA) have revealed that confidence level can be correlated with performance (IEA, 2012). Other than this, the lowered interest of students in STEM is also a consequence of the influence of family and perceived lesser opportunities in careers. Generally, parents and students observe that more of non-STEM graduates such as accountants and lawyers seem to be better off economically. In 1999, Malaysia implemented the open certificate system where students are free to choose any number of subjects to be taken in the Malaysian Certificate of Education, a mandatory public examination at the end of the Upper Secondary School. Many students began to take mixed-assortments of science and arts subjects which do not qualified them to do STEM courses at the university level. This was a watershed in school STEM education in Malaysia where prior to this, students in Science stream at upper secondary level must take the three pure sciences including Physics, Chemistry and Biology. Student enrolment in STEM was affected partly by this open certificate system. The open certificate system has been amended to limit the choice. Traditional teaching and learning approaches which are more teacher-led played a role in making STEM less attractive to the younger generation who grow up as native digital users.

STEM Education Quality

The quality of STEM education is perceived differently by various stakeholders. For the general public and employers, the frequently asked question is: does the quality of STEM education in schools today fulfil the needs of the work force in STEM fields? Are we preparing students who can meet the demands of the 21st century? For policy makers, the questions asked include whether our students are able to compete globally in international assessments or competitions. The general scenario in Malaysia currently is the preoccupation with examination results by the society. This has given rise to negative trends, such as students not doing science experiments because the science practical examinations have been replaced by school based assessment for more than 15 years. Teachers are less likely to allow students to explore scientifically and mathematically due to perceived lack of time, resources, tools, professional support and laboratory infrastructure. Curriculum has also been cited as being over-crowded with too many subjects. From the gender perspective, using TIMSS and PISA results as a gauge, the Malaysian girls students consistently outperform boys in these international assessment bringing Malaysia to the reality of the problem of 'lost boys'. (IEA, 2012)

Support of STEM from private sector and community

Generally, participation of private sectors and local communities in STEM programs is still insufficient. At the same time, financial support is also influencing the quality of STEM education as the cost of scientific equipment escalated in the last decade.

9. The Way Forward

Today, Malaysia can confidently tell the world that our girls are at par with boys in education in quantity and quality. Malaysian girls are performing well in STEM from primary schools up to university, academically and co-academically. This is a consequence of decades of implementing 'education for all' policies. As of 2014, the enrolment rate of preschool children was 84.2%, primary school 97.9%, Lower Secondary 92.5% and Upper Secondary 86.4%. Half of these children are girls. A lesson learnt is that as we strive to provide quality education for all, we are also bringing up the girls at the same time. There is still room for improvement as we need to motivate the girls to further enhance their cognitive abilities, skills acquisition as well as leadership qualities. However, currently as a result of the various policies put in place such as the 60:40 policy or the residential girls' schools policy, Malaysia is facing the problem of the 'lost boys'. Issues of 'lost boys' need to be handled early and effectively. As girls excel in school because they know that success needs persistent hard work and should not be taken for granted, the boys get complacent and demotivated. Effective strategies need to be developed to address the plight of the boys. The priority of Malaysia at this moment should be to provide quality education for both boys and girls and engaging more boys and girls in STEM. Although there is need for more gender inclusiveness in all STEM related programmes, it is worthwhile to analyse the presumably gender neutral activities to discover possible gender biases. The hidden biases could hinder the progress of both gender in STEM. The way forward for Malaysia include initiatives such as enhancing professionalism of STEM teachers through long term continuing professional development (CPD) plan, a course focusing on both boys and girls’ preferred way of learning should be included. There is also a need to emphasize the need for hands-on exploratory activities, campaigns to educate the public about the diversity of career opportunities in STEM, popularizing informal STEM learning centres, using more contemporary youth oriented approach in teaching and learning, and partnership between schools and relevant agencies in collaborative research or projects. In all these activities, concerted efforts need to be made to ensure needs of both gender are addresses.

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Appendix: Samples of Packages offered to Malaysian Upper Secondary School S&T Stream

(1) Pure Science Package

Core Subjects	S&T Elective Subjects (minimum 3 subjects)
Bahasa Malaysia English Language Mathematics Islamic/Moral Education History Health Education/Physical Education	Physics Chemistry Biology Additional Mathematics

(2) Pure Science and Professional Elective Subjects (S&T) Package

Core Subjects	S&T Elective Subjects (minimum 3 subjects)	S&T Professional Elective Subjects (MPEI) (minimum 1 subject)
Bahasa Malaysia English Language Mathematics Islamic/Moral Education History Health Education/ Physical Education	Physics Biology Chemistry Additional Mathematics	Technical Communication Graphic Basic Sustainability Design Computer Science Agriculture Home Science Sport Science

(3) Pure Science and Religious Study Package

Core Subjects	S&T Elective Subjects	Islamic Study Elective Subjects
Bahasa Malaysia English Language Mathematics History Health Education/ Physical Education	Physics Chemistry Biology Additional Mathematics	Al-Quran & As-Sunnah Education Islamic Syariah Education Arabic Language

(4)Science and Additional Science Package		
Core Subjects	**S&T Elective Subjects**	**Other Electives**
Bahasa Malaysia English Language Mathematics Science Islamic/Moral Education History Health Education/ Physical Education	Additional Science Additional Mathematics	Any elective

(5) Science and Additional Mathematics Package		
Core Subjects	**S&T Elective Subjects**	**Other Electives**
Bahasa Malaysia English Language Mathematics Science Islamic/Moral Education History Health Education Physical Education	Additional Mathematics	Any elective

(6) Science & MPEI (Science) Package	
Core Subjects	**S&T Professional Elective Subjects (MPEI)**
Bahasa Malaysia English Language Mathematics Science Islamic/Moral Education History Health Education/Physical Education	Technical Communication Graphic Basic Sustainability Design Computer Science Agriculture Home Science Sport Science

Note:

- Core subjects are compulsory to be taken by all students
- Each student is advised to take an optimum of only 10 subjects
- Students who take a minimum of 2 Pure Sciences are exempted to take Core Science