A Comparative Study of Lower Secondary Science Education of Malaysia and Japan

マレーシアと日本の中学校理科教育の比較

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Abstract: This paper aims to compare the lower secondary science education of Malaysia and Japan by studying the commonalities and the differences of the science curricula in each country in terms of the two essential aspects: the aims and goals of the curriculum and the content and organization. The research is wrote based on the review of Malaysia science syllabus, Japan Courses of Study in science and the examination of typical secondary science textbooks, summary of school visit and discussion with science educators. Japanese students are found to have better basic in investigation, analysis and exploration ability compare to Malaysian students. The experiments designed for the lower secondary learners in Japan are highly recommendable for the Malaysian.

Keywords: science curriculum, lower secondary, comparison, Malaysia

1. Introduction

This paper aims to compare the lower secondary science education of Malaysia and Japan. It aims to study the commonalities and the differences of the science curricula in each country in terms of the two essential aspects: The aims and goals of the curriculum and the content of curriculum. The information is based on the review of documents from Organisation for Economic Cooperation and Development (OECD) , The Ministry of Education, Culture, Sports, Science and Technology (MEXT) , an examination of typical secondary science textbooks, school visit and discussion with university science educator. Malaysia and Japan progressively innovate the education policy to inculcate scientific culture among the students in order to create new generation which will be able to face the challenges of globalisation. Japan is used as comparison because Malaysia looks up to Japan as a model for science and technology development, in which Japanese students time and again ranked top in science and mathematics in the Programme for International Student Assessment (PISA) (Lilia, 2009) . The result of PISA 2012 shows that Japanese science education is more successful than Malaysian in terms of both quality and quantity of science education for the lower secondary students. The average level of cognitive achievement attained by Japanese students is higher, and so is the level of scientific literacy of the Japanese population. This lead to the Malaysian science educators and scientists to have great interest in Japanese science education program.

Malaysian students have scored below the global average under the Programme for International Student Assessment (PISA) 2012. According to the results released by the OECD, Malaysia scored 420 in Science respectively. The results achieved in the latest survey showed Malaysia was below the global average score of 501 in Science. Based on the mean score for 2012, Malaysia is still placed in the bottom third, ranking 52 out of 65 countries, and 55 out of 74 countries in the 2009 survey. 50% of 15-year old Malaysian students not meeting minimum international standards. The PISA results reinforce the case for Malaysia to embark in 2013 on the 13-

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year transformation programme outlined in the Malaysian Education Blueprint (2013-2025). Students in Japan remain higher performers in mathematics, reading and science. Among 34 OECD countries, Japan is now ranked first in science performance. Among the 65 countries and economies that participated in the 2012 PISA assessment of 15-year-olds, Japan I ranked fourth in science, with its range of ranks between 3 and 6. Students in Japan score 547 points in science, on average and the mean performance improved at an annual rate of 2.6 points.

PISA is an ongoing triennial survey that assesses the extent to which 15 year-olds students near the end of compulsory education have acquired key knowledge and skills that are essential for full participation in modern societies. The assessment does not just ascertain whether students can reproduce knowledge. It also examines how well students can extrapolate from what they have learned and apply that knowledge in unfamiliar settings, both in and outside of school. This approach reflects the fact that modern economies reward individuals not for what they know, but for what they can do with what they know. PISA offers insights for education policy and practice, and helps monitor trends in students' acquisition of knowledge and skills across countries and in different demographic subgroup within each country. The findings allow policy makers around the world to gauge the knowledge and skills of students in their own countries in comparison with those in other countries, set policy targets against measurable goals achieved by other education systems, and learn from policies and practices applied elsewhere (OECD, 2012).

2. Research Method

The method applied in this research is the qualitative research. To begin the research, the researcher had set up the role as an observer. First, a goal to study on the lower secondary science education of Malaysia and Japan was set up. Researcher hope to find out the similarity and difference of the curriculum of lower secondary science education of Malaysia and Japan. Information was collected while serving as researcher at the Hirosaki University start from October 3, 2013. The research on the lower secondary science education in Japan was carried out for 18 months under the MEXT scholarship teacher training program. During these 18 months, the researcher were given chances to access the documents and people as source of information on lower secondary science education. A group of 30 Junior High School Grade I students in Hirosaki University Junior High School was selected as the sample of the research.

The observation technique is mostly applied throughout the research. During the school visit, observation was focused on the Japanese students' learning attitude through the responses in the science class and also the skills of handling the experiments. Attending the science class conducted by the pre-service teachers was also providing useful information for this research. The discussion with the Japanese students, pre-service teachers, teachers and administrator were done after the class to gather more opinion on the current response on Japanese science education. Based on researcher's observation in the class, the learning attitude of Malaysia and Japan learners was compared. Beside of the observation technique, few methods were applied during the research. This including analysing the Malaysia and Japan lower secondary science curriculum through the Malaysia science syllabus, the Japan course of study in science and documents from MEXT and OECD. The content of the Malaysia science syllabus were used to compare with the Japan course of study in science. The similarity and differences in the content were pointed out in the following chapters. Documents from MEXT and OECD were used to study the current science education system in both countries. Then the data for the research is gather through the examination of the typical lower secondary science textbooks of both countries. The Malaysia Form 1 science textbook and Japan Aomori-ken Junior High School Grade I Science textbook were examined. The level of knowledge delivered in the textbook of both countries was identify and compared. Research also focused on the suggested experiments for the learner in the textbook.

3. The Education System: Brief Overview

The Malaysian Education System

The educational system of Malaysia is highly centralized due to the small size of the country. The Ministry of Education (MOE) is responsible for the enforcement of educational laws. The formal education system in Malaysia consists of five levels: (a) pre-primary education, (b) primary education, (c) secondary education, (d) post-secondary education and (e) tertiary education. Among these, primary (six years) and secondary (five years) are categorized as basic education. Secondary education caters to children and adolescents between the ages of 12+ and 16 + years. It is divided into two levels: three years of lower secondary education for 12+ to 14+ years old (Form 1-3) and two years of upper secondary education for 15+ to 16+ years olds (Form 4-5) . Primary education was made compulsory in 2003 in line with the stipulation in the Education Act of 1996. Although secondary education is not compulsory, the government provides eleven years of basic education free of charge, i.e. primary education, lower secondary education and upper secondary education, in accordance with Section 30 of the Education Act of 1996 (UNESCO, 2011).

All education institutions are required to follow the national curriculum. Localization of the curriculum is not widely implemented in Malaysia. However, teachers are allowed to plan and select the most appropriate method and material for students within the framework of the curriculum. The lower secondary curriculum emphasizes general education, consolidation of skills acquired at the primary level and the development of positive attitudes, values, personality and interests. The core subjects are Malay, English, science, mathematics, Islamic religious/ moral education and history. At the upper secondary level, the national curriculum puts emphasis on developing and strengthening knowledge, skills and values acquired at the lower secondary level. The curriculum focuses on the development of interests, personality, attitudes and values, with specialization in some fields to cater to the needs of the higher education and future careers. The Malaysia school opening days are minimally 190 days per year and the teaching hours per week are 29 hours for lower secondary and 30 hours for upper secondary (UNESCO, 2011).

The Japanese Education System

Japan has persistently benchmarked and regularly reformed its education system since the Meiji Restoration in the mid 19-century. Science methodologies and practices were imported from Germany, England, France and the U.S. The Fundamental Law of Education and the School Law of 1947 were promulgated under the influence of the US and the 6-3-3-4 organizational systems were started. The Japanese education system is grounded in a deep commitment to children a first-rate teaching force, a judicious use of resource and a curriculum that has consistently centred on core topics with high standard (OECD, 2012). Japanese system in basic education is composed of six years of elementary school, three years of lower secondary school and another three years of upper secondary school. Elementary and lower secondary are compulsory. The government owns most of the schools in basic education in Japan although some private school also exist.

The Ministry of Education, Culture, Sports, Science and Technology, MEXT, the central authority responsible for developing and implementing national education policy, distributes public resources for education at the national, prefectural and municipal level, and guides national curriculum standards, textbook developments, and teacher training. Each of the country's 47 prefecture has its own board of education responsible for co-ordination education its own geographic area. These boards are responsible for establishing and closing institutions and for certifying teachers. In addition, each of the approximately 1700 municipalities in Japan has its own board of education responsible for selecting school textbooks. Teachers in Japan are largely responsible for how the curriculum is taught and are given authority over instruction and actual classroom practice (OECD, 2012). All elementary, junior high, and high schools are obliged to use text books that have been evaluated and approved by MEXT. The purpose of the official authorization system, which has been in effect since 1886, is the standardization of education and the maintenance of objectivity and neutrality on political and religious issues. A system of free distribution of textbooks for compulsory education was established in 1963. The textbooks used in each public school district are chosen from among government- authorized candidates by the local board of education based on a review by the prefectural board of education. At private schools, the school principal is responsible for the choice. The school year has a legal minimum of 210 days, but most local school board add about thirty more days for school festivals, athletics meets and ceremonies with non-academic educational objectives, especially those encouraging cooperation and school spirit. With allowances for the time devoted to such activates, the number of days devoted to instruction is close to 195 per year (Wieczorek C. C., 2008).

Science Curriculum in Malaysia

The national science education philosophy of Malaysia is as below:

In consonance with the National Education Philosophy, science education in Malaysia nurtures a Science and Technology Culture by focusing on the development of individuals who are competitive, dynamic, robust and resilient and able to master scientific knowledge and technological competency.

The Malaysian science syllabus has been designed to provide opportunities for students to acquire scientific knowledge and skills. It also seeks to inculcate noble values and love for the nation towards developing a future generation which is capable of contributing to the harmony and prosperity of the nation and its people. The curriculum aims at producing active learners. The pupils are given ample opportunities to observe, ask questions, formulate and test hypotheses, analyse, interpreted data, report and evaluate findings (Curriculum Development Centre, 2003).

For every science subject, the curriculum for the year is articulated in two documents: the syllabus and the curriculum specifications. The syllabus presents the aims, objectives and the outline of the curriculum content for a period of two years for elective science subjects and five years for core science subjects. The curriculum specifications provide the details of the curriculum, which includes the learning objectives, suggested learning activities, the intended learning outcomes, and vocabulary. The aims of the science curriculum for secondary schools are to provide students with the knowledge and skills in science and technology and enable them to solve problems and make decisions in everyday life based on scientific attitudes and noble values. Students who have followed the secondary science curriculum will have a basic foundation in science to enable them to pursue formal and informal further education in science and technology. The curriculum also aims to develop a concerned, dynamic and progressive society with a science and technology culture that values nature and works towards the preservation and conservation of the environment. The science curriculum is organised around themes. Each theme consists of various learning areas, each of which consists of a number of learning objectives. A learning objective has one or more learning outcomes. Learning outcomes are written based on the hierarchy of the cognitive and affective domains. The Suggested Learning Activities in the supporting document entitled 'Curriculum Specifications' provides information on the scope and dimension of learning outcomes (Curriculum Development Centre, 2003).

The curriculum content is organised around the following themes:

A. Introducing Science
B. Man and the Variety of Living Things
C. Matter in Nature
D. Maintenance and Continuity of Life
E. Force and Motion
F. Energy in Life
G. Balance and Management of the Environment
H. Technological and Industrial Development in Society
I. Astronomy and the Exploration of Outer Space.

Science curriculum in Japan

In 1996, the "zest for living" reform became a driving force for educators, teachers and familiars in their attempt to prepare Japanese students for the 21 century. The Japanese Course of Study in revised periodically in 10 years cycle. And the 1998 revision as well the latest 2008 revision aim not only to identify what are the basic competencies that every student needs to master, but encourage tailored learning so that each students can develop according to his or her level of understanding of the subject taught. The latest version of the Course of study in 2008 increased hours of class instruction in literacy and emphasised the importance for students of being able to express their thoughts in other subjects as well (OECD, 2012).

The new course of study emphasized the following points:

(a) Language activities in each subject to enhance thinking ability, judgement and expressive ability.
(b) Mathematics and science education to give foundation of science and technology.
(c) Education on traditional culture to enhance own identities.
(d) Moral education to acquire basic standard of behaviour.
(e) Activities to have various experiences.
(f) Foreign activities in elementary school.

Basic principles for science are the following points:

(a) Reconstruction of domains in the science curriculum to cultivate basic knowledge and skills:" Energy", "Particles", "Life "and "Earth".
(b) To cultivate scientific thinking and expressive ability: Emphasizing on interpretation of observation and experiment results, on expression about what learners think.
(c) To cultivate interest for science: to connect science content with the leaners' daily life, future career and sustainable development.
(d) To experience learner activities in nature and practical exercises of making instruments.

(Ozawa. H, 2011)

4. Examination of typical secondary science textbooks.

The science textbooks remains a fundamental tool in science education. Textbooks are a critical factor in the development of scientific literacy and provide an avenue for life-long learning in science. Studies had also shown that textbooks play a dominant role in science teaching and learning (Bob C. S. Y., 2010). As much as 75% of classroom instruction and 90% homework are structured around science textbooks and textbook are positioned so as to affect profoundly the learning experiences of students and their perception of the scientific enterprise (Penney, 2003). Science textbook is the ultimate source of the science classroom in Malaysia and Japan. As the impact of science textbooks on curriculum is immense, this study investigate the content and context of the science textbooks of both countries. The level of knowledge, process skills, activities, nature of science and integration topics are compared. Two sample of textbooks is chosen for this research: The Form 1 science textbook of Malaysia and Junior High School Grade I science textbook of Aomori-ken, Japan. In the Malaysia government schools, students and teachers in the primary and secondary levels are provided with science textbooks. They rely heavily on them for learning and teaching science as they are the main reading material available for them. The Form 1 science textbook of Malaysia is used by Form 1 students in all the secondary schools throughout the state. It was designed and written by a review panel consisting of education officers and teachers who took considerable efforts to use language, materials and examples that are suitable and appropriate for the local context. In Japan, textbook in the school used is decided by the prefecture government. Junior High School Grade I science textbook which is published by the Gakkou Tosho Publisher is used in all the junior high school of Aomori Ken.

There are several common features found in the both science textbooks. The textbooks are designed to enhance students' comprehension where objectives are outlined and chapter overviews are provided, questions and exercise are provided. Then is the present of explicit illustration in the textbook promote problem-solving transfer and to assist learners in their construction of meaning. Analogies is used to help students to build meaningful relations between their prior knowledge and a new experience. Both countries have emphasized on inquiry and problem solving in the content of the textbook. The activities in the textbook aims to develop skills in investigating the environment, which involves thinking skills, thinking strategies and scientific skills. Measurement, experiment and observation are the most popular activities in the textbook of both countries. On the other hand, significant differences are figured out through the examination of the textbooks. Firstly, physics, chemistry, biology knowledge are equally distributed in the Malaysian textbooks and it is emphasized more on theory and basic knowledge of science. The Japanese textbook covers evenly on energy, particles, life and earth knowledge and it is more emphasize on the process skills. The Malaysian textbook contains mostly the basic concepts of science. The analysis of the textbooks showed that Japanese textbook has the higher level of science knowledge. The activities and experiments designed in the Japanese textbook are more challenging and brain-storming.

5. Classroom observation

Learner is one of the elements that it believes have most important position in structure of curriculum (Najafi, 2012). Kamisah, 2013 reported that Malaysia students' attitude towards science is high and there exist significant difference in terms of students' attitude towards science with respect to level of educational experience. As for the scientific attitude, analysis reveals that overall, Malaysian students possess low scientific attitudes expect in terms of inclination towards respect for evidence and honesty.

In this study, researcher mainly focused on the students' scientific attitude in the science classroom in Malaysia and Japan. Both countries have provided very conducive learning environment and comfortable science classroom. Students are all provided with sufficient tools and apparatus. The authorised textbooks is used in the science classroom in both countries. Demonstration and experimental work is always carried out in the science lesson. It is found that most Japanese students have well established basics and fundamentals compare to Malaysian students. They also show higher curiosity, thinking ability, judgement, expressive ability and problem solving ability towards the scientific investigation compare to Malaysian students. The Japanese students have better suspended judgement or decision based on scientific view. The Japanese students have better scientific skill in solving the problem. However, researcher's experience showed that Malaysian students seemed to be more passive during the hands-on activity. Besides, Japanese students in this study behave more positively compare to the Malaysian students in the science classroom. The smaller class size in Japan might be one of the reason that the instructor are able to handle all the needs of every students. The students showed that they work together on the same material at the same: no one left out. The smaller class size in Japan might be one of the reason that the instructor are able to handle all the needs of every students. The science lesson conducted in Japan are more complex and engage the students in developing cognitive structure in science. The smaller class size in Japan might be one of the reason that the class disciplinary is better and instructor are able to handle all the students.

6. Discussion

In 2003, there was a significant change in the language policy in the Malaysian education system whereby the Malaysia government decided to introduce English as a language medium to teach science and mathematics at all levels of the education system in stages. The aim of the policy was to arrest declining standard of English among Malaysian students (Tan Y. S., 2007). A bilingual system was set up with English is used for teaching Science and Mathematics. According to the Curriculum Development Centre of Malaysia, the teaching of science using English is also aims to enable students to obtain various sources of information written in English either in electronic or print forms and help them to keep abreast of developments in science and technology. Students would be able to see science and technology in a wider context and learn to relate their knowledge to the world beyond their school. This also aims to ensure that students can acquire the required proficiency in English to fulfill the needs for employment in the private sector as well as to access scientific knowledge.

However, it is important to note that there are three type of primary school in Malaysia: national school, Chinese primary school and Tamil primary school. All these schools are being conducted in the mother tongue (Tan Y. S., 2007). This brings the fore the ability of the students to learn the science knowledge through a second language as the second language is often their weaker language even though the bilingual system is applied. The lack of proficiency in English hamper the science learning processes among students. Researcher consider the bilingual system of teaching science has deep impact on the low science achievement of Malaysian students in PISA 2012. At the opposite, the Japanese science class is conducted in Japanese Language. The Japanese students are found to be able to generate ideas and opinion better compare to the Malaysia students at the same age. They can freely express their ideas and questions regarding to the subject matter. The use of mother tongue help them to avoid the language barrier and able to think, consider and analysis the scientific problem better.

7. Conclusion

Lower secondary represents a crucial transition for science education. At this point, important conceptual foundation for learning science have been established, and students must make important decisions about the future direction of their science education in high school. It is at this school level that many students begin to lose interest in science or develop the view that science is too hard (Penney, 2003). Science education plays an important role in cultivating problem solving skills because learner will be able to think of the method for the scientific investigation, collect data and draw conclusion. By possessing positive scientific attitudes, the students will have strong inclination towards science. As a developing countries, Malaysia needs to have students who have high problem solving skills, able to interpret the scientific knowledge and methods into their daily life and hence being able to actively participate and contribute to the future Malaysia society.

Based on the information analysed, Malaysia and Japan both have very unique lower secondary science curriculum. Both science curriculum for secondary schools aims to provide students with the knowledge and skills in science and technology and enable them to solve problems and make decisions in everyday life based on scientific attitudes and noble values. The findings of this study provide direct implications on the implementation of science education in Malaysia, particularly, the lower secondary level. The implications of these findings could serve as a guideline for Malaysia educational practitioners and curriculum developers so that they can ensure that thoughtful learning and optimising the students learning. The experiments designed for the lower secondary learners in Japan are highly recommendable for the Malaysian.

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