GENERATION, MANAGEMENT PRACTICES, AND USERS' AWARENESS ON WELDING WASTE AT VOCATIONAL COLLEGES

JIMMY CHONG

THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE MASTER OF SCIENCE (TECHNICAL AND VOCATIONAL EDUCATION) (MASTER BY RESEARCH)

FACULTY OF TECHNICAL AND VOCATIONAL EDUCATION
UNIVERSITI PENDIDIKAN SULTAN IDRIS

2015

ABSTRACT

This study aims to investigate the generation rates and composition, management practices, and peoples' awareness on welding waste related issues. Descriptive survey design was adopted, and data were collected from six vocational colleges located in the central zone of peninsular Malaysia. Methods used for data collection include on-site waste measurement, survey questionnaires, semi-structured interviews, and field observation. Quantitative data were analyzed using Statistical Programme for Social Sciences (SPSS) while the qualitative data were analyzed by classifying data into emerging categories and themes. The results revealed that welding waste issues in vocational colleges were significant, based on amount, composition, management and peoples' awareness. On average, welding waste generation rates were up to 83.42 kgw^{-1} and per capita generation rate was 1.23 $kgw^{-1}st^{-1}$. Welding wastes were composed of scrap metal, metal dust, welding electrodes, and grinding disks. Scrap metal constituted up to 92.89 percent of the total welding waste. Management practices such as on-site storage, handling, waste collection and removal from the source were relatively similar among the workshops. The study also found that waste separation and metal dust handling were unsatisfactory. In term of awareness, high levels of teachers' and students' awareness were recorded. Linear regression analysis suggests that students' waste practices were significant to explain 68.1 percent variance in waste generation rates. The obtained data have illustrated that further improvement in various aspects of welding waste management in vocational colleges welding workshops is needed. Initial effort can be made through the establishment of standard to guide peoples' practices and further enhance their levels of awareness on waste management in the welding workshop.

PENJANAAN, AMALAN PENGURUSAN DAN KESEDARAN PENGGUNA TERHADAP SISA KIMPALAN DI KOLEJ VOKASIONAL

ABSTRAK

Kajian ini bertujuan untuk menilai beberapa aspek berkaitan sisa kimpalan di kolej vokasional termasuk kadar penjanaan dan komposisi sisa kimpalan, amalan pengurusan sisa kimpalan serta tahap kesedaran guru-guru dan pelajar berkaitan dengan sisa kimpalan. Reka bentuk kajian deskriptif telah digunakan dalam kajian ini. Data diperolehi daripada enam buah kolej vokasional di zon tengah Semenanjung Malaysia. Kaedah pengumpulan data yang digunakan termasuklah pengukuran sisa di lokasi kajian, soal selidik, temu bual separa berstruktur, dan pemerhatian di lokasi kajian. Data kuantitatif dianalisis menggunakan Program Statistik untuk Sains Sosial (SPSS) manakala data kualitatif telah dianalisis dengan mengklasifikasikan data ke dalam kategori dan tema yang muncul. Dapatan kajian menunjukkan bahawa isu sisa kimpalan di kolej vokasional adalah signifikan berdasarkan kepada jumlah sisa yang dijana, komposisi sisa, pengurusan sisa dan kesedaran dalam kalangan pengguna. Secara purata kadar penjanaan sisa kimpalan adalah sehingga 83.42 kgw^{-1} dan kadar penjanaan per kapita adalah 1.23 $kgw^{-1}st^{-1}$. Sisa kimpalan yang dihasilkan di bengkel kimpalan terdiri daripada logam terpakai, debu logam, elektrod kimpalan, dan roda pencanai. Logam terpakai menyumbang sehingga 92.89 peratus daripada jumlah sisa kimpalan. Dari segi pengurusan, kaedah penyimpanan, pengendalian, pengumpulan dan pelupusan sisa di semua bengkel kimpalan yang terlibat secara relatifnya tidak mempunyai perbezaan yang ketara. Dapatan kajian juga menunjukkan amalan pengasingan sisa dan pengendalian debu logam adalah tidak memuaskan. Namun, tahap kesedaran guru dan pelajar terhadap pengurusan sisa adalah tinggi. Analisis regresi linear menunjukkan bahawa amalan pelajar terhadap pengurusan sisa mempengaruhi secara signifikan ke atas kadar penjanaan sisa dengan nilai varian 68.1 peratus. Data yang diperolehi menunjukkan keperluan penambahbaikan dalam pelbagai aspek pengurusan sisa kimpalan di kolej vokasional. Usaha awal perlu dilakukan dengan menyediakan piawai yang boleh memperbaiki amalan pengurusan sisa dalam kalangan pengguna bengkel dan seterusnya meningkatkan tahap kesedaran mereka terhadap pengurusan sisa di bengkel kimpalan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
EAP	East Asia and Pacific
EC	European Commission
EMS	Environmental Management System
EPA	The Environmental Protection Agency
ESAB	Elektriska Svetsnings-Aktiebolaget
ISO	International Organization for Standardization
ISO 14001	ISO 14001 Environmental Management System-Specification with Guidance for Use
KPM	Kementerian Pendidikan Malaysia
LCA	Life Cycle Assessment
MSW	Municipal Solid Waste
OECD	Organization for Economic Co-operation and Development
PPSPPA	Perbadanan Pengurusan Sisa Pepejal dan Pembersihan Awam
SPSS	Statistical Package for Social Science
UN	United Nations
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WHO	World Health Organization

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter mainly provides the outlook of the research area, problems and significance which justify the relevance of this study. Furthermore, this chapter also elaborates the connection of each component investigated in this study.

1.1.1 Sustainability in educational institution

Sustainability is targeting at protecting the environment for future generation through best environmental practices to ensure the efficiency of resource usage and minimal pollution (Barrow, 2006). To date, many environmental best practices (green practices)

have been assembled in various areas, including in educational institutions for broad applicability and benefit towards the environment (Hens et al., 2010).

Educational institution is considered as an essential body for achieving sustainability (UNESCO, 2006). This is due to the fact that the quality of the environment depends critically on the level of knowledge, attitude, values and practices of the future leaders and citizens (Schultz & Oskamp, 1996; Kuhlemeier et al., 1999). Therefore, educational institution should have a healthy environment, prosperous economy through energy and resource conservation, waste reduction and an efficient environmental management. This will provide the basis to export the values associated with sustainable practices to the community, at national and global levels.

Education for sustainable development (ESD) is the key element in developing environmentally literate citizens. ESD is also known as education in the new millennium, in which it emphasizes on education for social transformation with the goal of creating more sustainable societies (UNESCO, 2012). ESD provides an integrated approach to develop the knowledge, skills, values, behavior, and lifestyles which will empower everyone to make appropriate decisions related to any emerging environmental issues.

ESD has been designed to emphasize on four major aspects which include (1) improving access to quality basic education, (2) re-orientating the existing education to address sustainability, (3) increasing public awareness on sustainability, and (4) providing professional training infused with the practices and principles of

sustainability (UNESCO, 2012). In general, these aspects can be achieved through formal and informal education.

1.1.2 Transformation of vocational education

Education is a multi-million ringgits industry and it is vital for the development of a nation and determine the future of engineering education, especially when the country aims to achieve the status of industrial based developed country as stated in the 2020 Vision. According to Nurazimah and Yusri (2013) , educational institutions play an important role towards achieving national educational goals of developing a world-class education system. A good and high quality of work ethic should be adopted to ensure that all educators feature excellent qualities, responsibility and a high level of professionalism in carrying out the duties and responsibilities.

The education system in Malaysia has gone through various reforms since the days of independence. These changes were done through an effort of the Ministry of Education (MOE) to improve the existing education system. The reforms are in line with the current requirements to improve the quality and productivity in Malaysia, and to make Malaysia as a center of educational excellence and providing world-class education in this country (Yusoff et al., 1999).

The aspirations of the Government Transformation Programme and the New Economic Model, which is based on the high-income economy is to produce innovative human capital with the ability to explore new areas and generate country wealth. This

high national economic growth has been demanding an increase in the number of graduates in technical and vocational fields. The government through the 2013 budget has allocated substantial funds to improve the quality of education in Malaysia, especially in fulfilling the National Education Development Plan (2013-2025). Therefore, vocational education in Malaysia has undergone a major change since the launch of Vocational Education Transformation on January 6, 2012. The new definition of success through vocational education can be seen through the operation of 15 upgraded vocational schools to the Vocational Colleges in 2012 with the enrollment of 3120 students. In 2013, another 72 vocational school were upgraded to Vocational Colleges with a total of 21,250 students' enrollment.

Vocational education transformation that began in 2011 has emphasized an industrial practices and internship program that will reduce the academic composition. The new curriculum are based on the National Occupational Skills Standards (NOSS) and other forms of certification that is recognized by the industry. Vocational education and training certainly have an important role in providing the main route towards producing highly skilled human capital, thus contributing to the generation of new wealth for the country. The new vocational colleges' curriculum consists of 53 types of courses in 12 fields of specialization.

1.2 Background of the study

The environmental quality and its health state are continuously deteriorated mainly due to increase in human activities. Human activities which contribute to environmental

degradation may range from small scale home activities to large scale industrial and mining activities (Goudie, 2006). Due to this, many countries around the world is targeting at reducing the human impacts on the environment through sustainable practices in most activities (UNEP, 2007).

Educational institutions have been recognized to have the same standard as industries with regards to its impact on environment (Savely et al., 2007). Human activities resulting from educational institutions may give more pressure on the environment partly due to high solid waste generation rates (USEPA, 2008). Additionally, solid wastes generated from educational institutions are also composed of hazardous and scheduled waste (USEPA, 2008).

In Malaysia, the largest number of educational institution is school, which made up of primary, secondary and vocational schools. In 2012, vocational schools were transformed into vocational colleges. In total, 10,019 of primary, secondary and vocational institution are currently operating with approximately 5.3 million students enrolled and 0.4 million teachers employed (Kementerian Pelajaran Malaysia, 2012). As a result, approximately 20 percent of Malaysia population is directly involved with activities in these institutions. These numbers depict the significant amount of solid wastes being generated there. It has been suggested that educational institution could generate up to 30 percent of the total national wastes (Baca, 2011). Furthermore, many studies and reports have shown that educational institutions' waste materials, particularly from science laboratory or workshop, are considered as hazardous with health risks potential (USEPA, 2006). Even so, a recent study had suggested that proper solid waste management system is lacking in educational institutions and contributing

to various environmental issues especially pollutions (Ana et al., 2011). Therefore, solid waste is an important issue to be addressed in educational institutions to ensure minimal environmental impacts due to waste being produced.

1.3 Problem statement

Teaching and learning in vocational schools (currently known as vocational colleges) is associated with more activities in workshop and laboratory, in comparison to other types of school. In vocational colleges, 70 percent of student's learning time are workshop (Kementerian Pelajaran Malaysia, 2011). Hence, vocational colleges may generate more solid wastes through teaching and learning activities. Additionally, it has been suggested that activities being carried out in vocational workshops will produce by-products that may have impact to the environment (Darmiatun, 2008).

There are many teaching workshop in vocational colleges and each is producing unique type of solid wastes. For example, vocational colleges welding workshops produce many types of waste and by-products which include metal scrap, welding slags, dusts, powders and mists that may contain various hazardous metal oxides (Geraghty et al., 2011). The potential environmental impacts of welding wastes are significant as welding technology course is being offered in up to 55 percent (Kementerian Pelajaran Malaysia, 2015) of government-owned vocational colleges nationwide.

Despite of the large potential of environmental impacts due to activities in vocational colleges, this issue has received minimal attention from researcher and the

authorities. In fact, educational planners are more interested in issues such as the number of schools, teachers, and students' infrastructural facilities like classrooms and school buildings in improving educational institution (Egim, 2003 as cited in Obong et al., 2010). As a result, it is common to see poorly maintained school environment, thus effecting environmental quality and students' learning and intellectual development (Obong et al., 2010). To the writer's knowledge (through literature research), the present state of environmental practices, particularly on solid waste management in Malaysia vocational colleges workshops, remain insufficiently explored. To address this gap, this study has focused on waste generation and composition, current waste management practices, and teachers' and students' awareness in vocational colleges welding workshop. The findings of this study are essential to trigger necessary actions towards achieving sustainable waste management practices in vocational educational institutions.

1.4 Research objectives

In relation to the discussed issue, vocational colleges welding workshops will be studied as a proxy to understand the pattern in waste generation and composition, current waste management practices, and teachers and students level of awareness on waste related issue in vocational colleges. This is mainly due to the significance of welding workshop in relation to high waste generation. In more specific, the specific objectives are as follow:

i. To identify the generation rates and composition of waste in vocational colleges welding workshops;

ii. To determine the current waste management practices in vocational colleges welding workshops;

iii. To assess the levels of teachers' and students' awareness on waste generation issues, the importance of proper waste management and waste minimization in vocational colleges welding workshop;

1.5 Research questions

In order to meet the stated objectives, this study will seek answers to the following research questions:

i. What are the waste generation rates and composition in vocational colleges welding workshops?

ii. What are the current waste management practices in vocational colleges welding workshops?

iii. What are the teachers' and students' levels of awareness on waste generation issues, the importance of proper waste management and waste minimization in vocational colleges welding workshops?