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Greening the Curriculum: A Strategic Waste Management for Chemical Wastes in School Laboratories

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ABSTRACT

Despite global awareness on the effects of improper chemical waste disposal, the actual practice of proper waste handling is still neglected. Serving as the best venue for information dissemination, schools can reinforce waste management programs through its curriculum. Identification of curriculum areas that can complement waste management strategies by evaluating the level of awareness and participation of its teaching employees, non-teaching staff, and students is the main objective of this study. Validated self-constructed survey-questionnaires were administered to 149 respondents representing the total population of the laboratory teachers, students, non-teaching employees, and researchers of the Western Institute of Technology, Philippines whose primary job deals with chemicals. The data gathered and analyzed using student t-test showed that there is no significant difference in the level of awareness among teaching and non-teaching employees in terms of the school's chemical waste management program. A significant number of senior high school students showed lack of awareness on Philippine environmental laws and the chemical waste management in school. Employees whose primary job is not associated with teaching and research do not realize their role in chemical waste minimization. More senior high school students show environmental concern over college students, but it is the latter group that apply the concepts of chemical waste management into actual practice.

Keywords — Bioremediation, green chemistry, chemical wastes, pollution control, Iloilo City, Philippines

INTRODUCTION

Two million tons of toxic wastes are discharged daily into the world's water, and about 1,500 km^3 of wastewater is produced yearly (UN WWAP, 2003). TheWorldCounts.com accounts for at least 400 million tons of hazardous wastes produced globally each year. This translates to at least 60 kg of hazardous wastes per person. In Europe, for instance, 95.0 million tonnes of classified hazardous wastes were generated in the year 2014 alone (Eurostat, 2017). The Resource Conservation and Recovery Act (RCRA) has recorded an amount of 20.3 to 28.8 million tons of hazardous wastes were generated in the US from 2001 to 2011 (US EPA, 2015). It has been noted that the progress of ASEAN countries

is directly proportional to the use and generation of toxic and hazardous wastes (UNEP, 2004).

In the Philippines, the National Solid Waste Management Commission of the Department of Natural Resources - Environmental Management Bureau (DENR-EMB) reported that special wastes which include hazardous wastes account for 1.93% of the municipal solid waste generated from 2008 to 2014 (National Solid Waste Management Status Report, 2015). The 1993 State of Hazardous Waste Management in the Philippines Report briefly described the characteristics of hazardous wastes generated per region in the country. According to the said report, metals and organic toxic wastes produced by nearby industries contributed to the contamination of Laguna Lake. The same report also revealed that mining industries were the primary hazardous waste generators in the Cordillera Autonomous Regions and chemical wastes were the major pollutants in Metro Manila. In 2004, the Brown Environment Report showed that oil industries contribute 55% of the total 2.3 million metric tons of hazardous wastes produced annually. Hospitals contribute 6.750 tons of infectious wastes yearly. The United Nations Statistics Division 2011 report showed a total of 1,900 metric tons of hazardous wastes generated by mining industries.

The ill effects of improper underground and land disposal of hazardous wastes since the 1970s to 1980s were persistent for decades (Watts & Teel, 2003). In a study conducted on 373 dumping sites in India, Indonesia, and Pakistan, serious health issues ranging from severe mental illness and physical disability to death due to environmental contamination of various toxic chemicals such as lead, pesticides, chromium, and organic chemicals (Berman, 2013) were recorded. Natural disasters can facilitate the absorption of toxins from buried hazardous wastes to reach groundwater supplies just like what happened after Hurricane Katrina in the US. Chemical accidents such as the Chernobyl disaster in 1986 and the chemical spill in Ajkai Timfoldgyar alumina refinery in Hungary last October 2010 were sufficient evidences to warrant the fatal effects of hazardous and toxic wastes.

Toxic and hazardous waste management is a worldwide challenge (Fazzo *et al.,* 2017). In addition to legal frameworks, various countries have developed their own waste management plans. EU waste management strategies, for instance, aims to create a recycling society for Europe (Eurostat, 2017). In 2016, Norway has recorded an annual total of 1.48 million tonnes of hazardous wastes approved for treatment (Berge, & Skjerpen, 2017). Singapore uses waste incinerators and off-site facilities for hazardous waste management; Thailand has incinerators,

waste management program for wastes coming from petrochemical, chemical, and non-ferrous industries, as well as licensed waste recovery facilities; Malaysia has various treatment plant facilities, Indonesia has a centralized hazardous waste treatment facility located in West Java (UNEP, 2004). Unfortunately, more industrialized nations tend to make developing countries their dumping grounds (Emmanuel, 1997). The notorious barge is known as Khian Sea recognized for roaming the globe to search for a dumping ground and found India as Southeast Asia's dumping ground.

Although demanding, proper waste management has important implications on public health and safety, environmental conservation and preservation, sustainability, and to the economy (WHO Meeting Report, 2015). The economics of pollution control, for instance, presents another compelling reason for proper waste management practices. Waste trading, export, and import have become a global trend in allocating recyclables to various countries especially to those who generate energy from wastes (Ray, 2008). In the 2004 Report on Philippine Economic Growth and the Environment, it was revealed that the estimated yearly economic loss caused by water pollution alone due to improper waste disposal reached PhP67 billion (US$1.3 billion). This amount includes annual economic losses for health (Php3 billion), for fisheries production (Php17 billion), and for tourism (Php47 billion).

In the year 2004 up to 2009, the Iloilo River has been tagged as the city's biggest septic tank (Hechanova, 2010). The initial remedy of the government was to set up a septic tank and the building of a sewage treatment facility, which was obviously very costly although beneficial. In addition to city ordinances, nearby hospitals and food establishments were advised to install wastewater treatment plant with the government's promise for financial assistance. Local Initiatives for Affordable Wastewater Treatment (LINAW) project has been ongoing since 2004, and a "low-cost" P4-million, wastewater treatment plant, is currently piloted in Barangay Tacas, Jaro. In the year 2014, The Department of Environment and Natural Resources (DENR) has submitted a proposal for a P32.1-million budget for ambient air and water quality monitoring and clean-up of the Iloilo River and its tributary Calajunan and Dungon creeks. In the same year, the river council also approved a resolution calling for the approval of Oplan SWIM (Sustainable Workplan for the Iloilo River Management). Overall, the total activity project cost P29.2 million while project monitoring and supervision will cost P2.9 million.

Although the country has enacted and amended significant laws to respond to environmental concerns such as Presidential Decree 1151 (Philippine

Environmental Policy) and PD 1152 (Philippine Environmental Code), as well as the Republic Act 6969 (Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990), most management and abatement strategies are very expensive. In addition, the country is not equipped with the right technology to appropriately address its environment-related concerns and does not have the manpower with the relevant technical expertise to respond to waste management issues (Tolentino, Brabante, David, 1990).

In Iloilo City, Iloilo, Philippines, the solid waste management team of the local government unit tapped the services of sub-contractors coming from another city to treat its medical wastes. Despite the existence of solid waste management monitoring and management program that involves academic and commercial institutions, chemical wastes generated from school and chemical laboratories still do not have existing treatment and disposal solutions. All these were based on the results of various meetings, attended by the main proponent of this study, with the local government unit and other representatives from different institutions, held at different occasions. Thus, in an attempt to come up with an on-site solution to chemical wastes generated from teaching and research laboratories and to present a potential inexpensive and environment-friendly solution to chemical waste problems, this study was conducted.

Aside from being a hazardous waste generator, educational institutions are also recognized as the best outlet in reinforcing environmental awareness (Mendez & Gonzales, 2013). Guided by RA 9512 (National Environmental Awareness and Education Act of 2008), relevant agencies in the Philippines are mandated to integrate environmental education in school curricula at all levels. In effect, most universities engage in various research undertakings related to environmental preservation and protection. Other schools include environmental awareness programs and activities in their subjects such as NSTP. Greening Technical and Vocational Education and Training (GTVET) has been conceptualized since 2012 following the 2004 Bonn Declaration (UNESCO, 2013).

FRAMEWORK

The interconnectedness of educational, environmental, economic, and social factors is the essence of sustainability (Timpson, 2017). To ensure sustainability, academic approaches per discipline need to sync together in order to formulate holistic programs that will benefit the different aspects of life - economic, social, and environmental.

In many political and social surveys, environmental protection came out to be a top-ranking concern (Marschall, 2006). All parts of an academic institution collectively contribute to the transformation of an individual, whether that is a positive or a negative impact (Cortese, 2006). However, it was observed that most educational constructs including most of the members of an academic institution do not realize their role and the impact of their decisions, actions, and inputs to the environment as they play their role in the society (Hayles & Holdsworth, 2015).

In 2005, the United Nations declared the "Decade of Education for Sustainability" as part of Resolution 57/254 (Haigh, 2007). The goal of sustainability in the higher education may be achieved through its linkage with the community, its positive effect to the society, and its environmental responsiveness (UNESCO, 2006). This declaration became the basis of various environmental organizations to appeal to the academe for the incorporation of environment-centered activities and topics in the curriculum. RMIT University of Melbourne, Australia, for instance, adopted Education for Sustainable Development (EfSD) as they re-assessed and re-designed their curriculum to allow their students to engage in matters involving environmental concerns. In 2008, the University of Guam launched its three-level Green Initiative (Inoue, 2012). In America, higher education institutions began to work towards climate-neutral campuses (Louw, 2013).

In the Philippines, Republic Act 9512, "An Act to promote Environmental Awareness through Environmental Education and for other Purposes", Republic Act (R.A.) No. 7722, "Higher Education Act of 1995", and Republic Act 9729, "Climate Change Act of 2009" are the very first enacted laws that served as a basis for the Green Curriculum Model (Ogoc, 2015).

As presented in GreenHearted.org, the Green Curriculum Model is based on the idea that higher education institutions have the resources and the capacity to produce students who are ready to take on 21st century environmental challenges towards sustainability. However, for a more holistic result, greening the curriculum should not be restricted to disciplines with default eco-literary modules and to classroom instruction (Haigh, 2007).

This study was founded within the framework of green education for sustainability. Sustainability through green education must be shown and reflected by all areas of an HEI (Haigh, 2007). A green school educates beyond its curriculum (Heming, 2017).

Basing on the concept of ED-Green Ribbon Schools award program by the U.S. Department of Education, which was initially launched in 2011, one key

indicator that measures the effectiveness of green education is the reduction in environmental impact such as reduced wastes. One type of waste that poses both a great challenge and major concern to the Philippines is the group of hazardous and toxic wastes (Tolentino, Brabante, David, 1990). Generation of this type of waste continues to increase as the rate of industrialization in the Philippines progresses (Ohno, 2001).

Various researches show that green chemistry education offers a positive solution to current environmental concerns. Green chemistry originated from academic research and is primarily used for pollution control and prevention (Hjeresen, Boese, Schutt, 2000). But as researchers develop new technologies and methods, the environmental impact of research activities and advances are often neglected (Braun et al., 2018). For the purpose of sustainability and a more environmentally responsible globalization, curriculum modifications that include green chemistry can significantly enhance education (Braun et al., 2018). After an extensive review of the basic elements of a green education curriculum implemented in Iran, education program planners in China and in America decided to look closely into curriculum development with the integration of green chemistry concepts (Bodlalo, Sabbaghan, & Jome, 2013).

OBJECTIVES OF THE STUDY

This study aimed to identify opportunities for "greening" the curriculum. An initial survey of the level of awareness and practices among laboratory teachers and students as well as faculty and student researchers have been conducted to identify specific curriculum areas that need "greening". Furthermore, the status of the ongoing hazardous and toxic waste handling strategies were evaluated. Significant results and findings from this study will be used for the purpose of chemical waste management in teaching and research laboratories.

METHODOLOGY

The researchers used the survey method to achieve the objectives of this study. School involvement among respondents was used as basis of comparison and was categorized into teaching staff, college students, senior high school students, and non-teaching staff. The researchers tapped the participation of the upper management to address any ethical concerns in the use of the staff and the students as respondents to this study. Their participation resulted to easier

and more convenient solicitation of voluntary consent from the respondents to participate in this study.

All Senior High School (SHS) and college teachers who are handling laboratory subjects were chosen as teaching faculty respondents. Names of the SHS teachers and the subjects they were handling were taken from the SHS Department with the permission of the Principal. Details of the college teachers were taken from the College of Arts and Sciences with the permission of the Department Heads, the Dean, the Research Director, and the School President.

A total of ten (10) students, representing the whole population of BS Biology program who were enrolled in Chemistry Laboratory subjects were taken as college student respondents. One hundred twenty (120) students, representing the total population under the STEM track with laboratory subjects were taken as senior high school respondents. The names of the college student respondents and the SHS student respondents were taken with the permission of the Dean and SHS Principal, respectively.

Two (2) laboratory custodians coming from the Chemistry and Biology Laboratories, one (1) Purchasing Officer, one (1) safety officer, one (1) sanitation head, one (1) managing head, and three (3) ongoing faculty researchers were taken as non-teaching respondents. The participation of the non-teaching respondents was voluntary and with the permission of the School President.

Three (3) sets of validated survey-questionnaire were administered to the respondents, who gave their voluntary consent upon the explanation of the purpose of the survey. The survey-questionnaires were designed to assess the level of awareness and practices of the respondents in the following areas: knowledge about existing chemical waste management in the school, participation and contribution in the implementation of existing chemical waste management in the school, status evaluation of the ongoing chemical waste management in the school to identify curriculum development opportunities.

To come up with conclusions applicable according to school involvement, data gathered from college students were compared with Senior High School students (A) and the data gathered from the teaching staff were compared with the data gathered from the non-teaching staff (B). The researchers analyzed the data gathered from the four categories using descriptive statistics using SPSS (version 16). The p-values of less than 0.05 were considered significant.

RESULTS AND DISCUSSION

Schools generate hazardous waste as part of their operation and maintenance (SHWCCAF, 2009). An educational facility houses different kinds of hazardous wastes through its science laboratories, maintenance department, and supply rooms (Ellis, 2017). For the purpose of waste reduction, it is important that waste generators facilitate activities that will help monitor and reduce the source of hazardous and toxic chemical wastes (Nascimento & Filho, 2010). This prompted the researchers to conduct the awareness and participation surveys.

Tables 1, 2, and 3 show the total percentage of respondents who answered yes or no on each question. (A) p-value is the result of the analysis on the data gathered from college students compared with Senior High School students. Results of the analysis of data gathered from the teaching and non-teaching staff are shown in (B) p-values.

In terms of awareness, both the teaching and non-teaching staff are well aware of the Philippine environmental laws and the implementing chemical waste management in the school. There is no significant difference in the level of awareness between the two groups of respondents ($p>0.05$). Results of the survey showed that a significant number of students, mostly from the Senior High School department, are not aware of the Philippine environmental laws and the implementing chemical waste management in the school. Results show that there is a lack of programs that will properly orient the students about chemical waste management.

Further checking of the actual lab arrangements revealed that only student assistants assigned in the lab who were able to attend chemical waste management orientation were familiar with the Philippine environmental laws and the school's hazardous and toxic was management system. Teaching and non-teaching staff who are not yet familiar with the school's hazardous and toxic was management system are mostly newly-hired employees who reported for duty in the middle of the school year. The school orientation is usually conducted at the start of the school year.

Staff training and awareness can improve any existing shortcomings in the hazardous waste management system of an educational institution (Hassanvand, Naddafi, Nabizadeh, Momeniha, Mesdaghinia, & Yaghmaeian, 2011). To raise awareness towards environmental issues, the members of the institution must be thoroughly informed not only about environmental issues but also with existing environment-related rules that they need to respect and follow (Morar & Bucur,

2017). Carefully planned waste education strategies such as awareness activities has the power to develop students' behavior towards waste reduction (Desa, Kadir, & Yusooff, 2011).

Table 1. Awareness to Philippine environmental laws and WIT chemical waste management (p-values of teaching staff, college students, senior high school students, and non-teaching staff)

	Questions	Yes (%)	No (%)	p-value (A)	p-value (B)
1	Are you familiar with RA 6969 (Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990)?	36.91	63.09	0.1704	0.9475
2	Are you familiar with DAO 2013-22 and DAO 1992-29?	36.91	63.09	0.1704	0.9475
3	Are you aware of the existing chemical waste management system in WIT?	40.27	59.73	0.2026	0.9475
4	Have you attended any orientation or awareness program regarding chemical waste management?	29.53	70.47	0.2388	0.9475

Both college and senior high school students consider themselves as hazardous or chemical waste generator. Overall, there is a strong commitment to the strict implementation of the school's chemical waste management program but, in practice, a significant number of college students prioritize compliance to course requirements over environmental issues. Oftentimes, they tend to forget their environmental responsibilities due to time constraints during lab classes. Although more senior high school students show serious concern on the ill effects of improper chemical waste handling over college students, it is the latter group that applies the concepts of chemical waste management into actual practice. Most students refused to answer question number 6 of Table 2 because most of the time they relied only on what is in the lab manual and did not venture on reducing or upscaling any reagents for safety reasons.

Similarly, both teaching and non-teaching employees consider themselves as a hazardous or chemical waste generator. As shown in Table 3, all respondents from both groups are committed to the strict implementation of the school's chemical waste management program during lab classes, in research, and in other tasks that involve chemicals.

Waste generators, as subjects, have different degrees of awareness and knowledge about the environmental impact of waste generation (Morar & Bucur,

2017) as confirmed by the results of the survey on awareness and participation among respondents. Awareness and participation are two critical components of any waste management system or program (Hasan, 2004).

Table 2. Participation in the implementation of chemical waste management (p-values of teaching staff, college students, senior high school students, and non-teaching staff)

	Questions	Yes (%)	No (%)	p-value (A)	p-value (B)
1	Do you consider the school, the lab, and yourself as hazardous and toxic waste generator?	84.56	15.44	0.2786	0.9475
2	Do you consider the effects of improper chemical waste disposal while doing any lab-related tasks?	58.39	41.61	0.0208	0.9298
3	Do you realize your role in the minimization of chemical wastes?	32.89	67.11	0.1900	0.9298
4	Are you committed to the strict implementation of chemical waste management?	100.00	0.00	0.4574	0.9475
5	Do you practice proper chemical waste collection, segregation, and disposal in the school and/or in the lab?	44.30	55.70	0.0445	0.9324
6	Describe in not more than three (3) sentences what you have actually done to minimize chemical wastes as guided by RA 6969, DAO 2013-22 and/or DAO 1992-29, and the school's chemical waste management.				

Laboratories, shops, photography studios, and maintenance rooms are common sources of hazardous wastes in schools (NEWMOA). Significant environmental problems have been associated with the generation of hazardous chemical wastes from research laboratories (Feild, 1990). Regardless of the source, the role of the teachers as environmental educators (Rada, Bresciani, Girelli, Ragazzi, Schiavon, & Torretta, 2016), the engagement of the students with matters involving the environment (Hayles & Holdworth, 2015), the cooperative abilities and support of the non-teaching staff (NHDES), and the administration's funding and legislation, comprise the necessarily requirement for the successful conception and implementation of waste management plans.

In this study, 41.61% of the respondents, who are not associated with teaching and research activities, do not consider the impact of their daily routine to the environment. 67.11% of the respondents, mostly students, who are required to follow what is stipulated in their lab manuals, did not realize their role in chemical waste minimization. These personnel are technically part of the actual consumption and disposal of chemicals in the school. The consequential oversight in terms of participation or role in chemical waste reduction among non-teaching staff is one opportunity for improvement in the school's existing waste management plan.

For teaching staff who are handling laboratory classes, proper chemical waste collection, characterization, and disposal are being practiced. However, the environmental issues that may arise due to improper chemical waste handling are assumed among students; hence, not given due emphasis because of time constraints and the goal to meet the demands of the laboratory course. Laboratory teachers dispose previously treated chemical wastes down the drain following the school's chemical waste treatment protocol prior to disposal. This explains the p-value higher than 0.005 for question number 5.

In response to question number 6, the school is actively engaged in promoting research undertakings which are focused on chemical waste treatment. Although chemical reduction during laboratory activities was not yet considered, most teachers continue to develop manuals with activities that do not make use of heavy metals and other chemicals that may require storage or complicated treatment. In addition, all senior high school laboratory activities which may not necessary require the use of chemicals will be improved to include instructions on proper waste disposal. All non-teaching respondents rely only on the research findings and the recommendations of laboratory teachers as endorsed by laboratory custodians in fulfilling their tasks that involve chemicals.

Environmental responsiveness is one component of the school's quality assurance. Although the school conducts chemical waste management orientation, only 58.39% of the respondents have received or have experienced laboratory orientation regarding chemical waste management. Orientation is practiced more often among college students than in senior high school laboratory classes. Results of the survey show that there is a provision of chemical waste containers. However, only 40.27% of the respondents were oriented about the location or existence of the school's hazardous waste storage area.

Some 70.47% of the respondents agreed that chemical waste management topics are currently not included in the school's curriculum. Results revealed that chemical waste management strategies should not only be applied in teaching and research but also in non-teaching tasks such as chemical requisition and procurement. Only 64.43% of the respondents are aware that the school is actively engaged in research undertakings that promote chemical waste management through bioremediation methods. Majority of the respondents in all categories agree that micro-scaling or chemical reduction is not yet implemented in both teaching and non-teaching activities.

Results of the survey confirmed the findings of the study conducted by Hassanvand and Nabizadeh (2011). Knowledgeable and trained personnel such as those in the teaching and research areas have the initial responsibility to evaluate hazards and to provide the necessary preventive measures to minimize chemical waste generation (National Research Council (US), 2011). Formulation of procurement guidelines on the purchase of chemicals for teaching and research laboratories as well as the provision of proper temporary storage facilities for collected hazardous wastes pose effective solutions to any existing shortcomings of an existing hazardous waste management plan (Hassanvand & Nabizadeh, 2011). Non-teaching staff should know the available facilities of the school intended for hazardous waste management (NHDES). The adoption of green chemistry in the curriculum is an effective way of chemical safety (Braun et al., 2018). Decisions based on environmental protection as a result of green audit procedures can help the institution to be attuned to various environmental themes (Ogoc, 2015).

Table 3. Implementation of chemical waste management (p-values of teaching staff, college students, senior high school students, and non-teaching staff)

	Questions	Yes (%)	No (%)	p-value (A)	p-value (B)
1	Are chemical waste management topics included in the school's curriculum?	29.53	70.47	0.1985	0.9098
2	Is environmental responsiveness included in the school's quality assurance policy?	85.23	14.77	0.2878	0.9475
3	Does your school promote and implement chemical waste management through requisition and procurement of chemicals, teaching, and research?	24.16	75.84	0.2377	0.8952
4	Is your school engage in researches involving chemical waste management?	35.57	64.43	0.0840	0.8600
5	Do lab teachers conduct orientation regarding proper chemical waste disposal during the first lab meeting?	41.61	58.39	0.0380	0.8310
6	Is "Green Chemistry" taught and practice in the classroom?	0.00	100.00	0.4574	0.9475
7	Is "Microscale or Reduced Scale Chemistry" applied in the requisition and procurement of chemicals, in teaching, and in research?	21.48	78.52	0.2568	0.9253
8	Is proper chemical waste characterization observed in any of your laboratory classes and research centers?	30.87	69.13	0.1590	0.8902
9	Is proper chemical waste disposal strictly implemented in any of your laboratory classes and research centers?	32.89	67.11	0.1590	0.8310
10	Are there designated chemical waste collection bottles or jars in laboratories and research centers?	84.56	15.44	0.2786	0.9475
11	Are chemical waste containers stored in properly maintained storage areas?	40.27	59.73	0.2026	0.9475

CONCLUSION

Increasing the level of awareness on chemical waste management among teaching and non-teaching employees and among students through orientation is important in soliciting their commitment to participate in the implementation of the program. To strengthen the effectiveness of the chemical waste management program and to forge long-term results, the program must be aligned with the school's curriculum and must be a team effort.

Results of this study revealed that there is a need to review the curricula for courses with laboratory subjects for college and senior high school students. The laboratory orientation and routines must emphasize proper chemical waste handling. Moreover, there is a need for teachers and laboratory custodians to review laboratory activities and to make the necessary adjustments in terms of incorporating "Green Chemistry" through the use of least hazardous and least toxic chemicals or reduction in the amount of chemicals and reagents as stipulated in the prescribed laboratory manuals can be done.

Non-teaching employees can also contribute to chemical waste minimization by dealing only with suppliers that offer help in handling expired chemicals. Researchers are encouraged to engage in the development of methods to treat chemical wastes.

TRANSLATIONAL RESEARCH

The researchers have shared the findings of the awareness survey to the Personnel Office and the Student Government for a possible chemical waste management school orientation to be included in the school calendar. A separate and more thorough orientation will be given to faculty members and students who have laboratory classes.

Focal persons from DENR-EMB were initially contacted to solicit their help in conducting action planning on chemical waste management that involve the teachers, non-teaching employees, and the students. Chemical waste management will be included as one research priority area under the College of Arts and Sciences - Center for Research and Development. Findings from the previous researches involving the development of remediation methods to manage the chemical wastes of the school shall be shared with DENR-EMB.

In order to minimize wastes from the source, existing laboratory activities will be re-examined and re-designed to apply "Green Chemistry". Syllabi shall include applicable and relevant lessons and discussions of concepts and theories that can help in chemical waste minimization and, if possible, chemical waste recycling. Laboratory custodians along with the purchasing officer shall be advised to reduce the amount of requisitioned and purchased chemicals. In addition to purchasing policy, "green audit" may be done on other school policies.

Results of this study will be utilized to conduct an experimental study to quantitatively determine the impact of greening the curriculum in waste

reduction. The researchers aspire to publish results of studies on pollution control and waste management in related local, national, and international journals.

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