EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 4/ July 2015

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Chemical Management Practices in the School Science Laboratory: A study of the Lower Secondary Schools in the Western Division of Fiji Islands

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Abstract:

This study investigated lower secondary Basic Science Teachers' practices of chemical management in the school science laboratory through semi structured interviews, observation of the science storage space, chemical inventory and questionnaire survey. The rural and urban schools were stratified and randomly selected from each of the four education districts in the Western Division of Fiji Islands.

Findings reveal that majority of the surveyed schools showed poor chemical management practices. Chemical handling procedures focused comprehensively towards satisfying the school Occupational Health and Safety protocols rather than understanding the true hazardous nature of chemicals. Hence it may be concluded that teachers lack the knowledge and understanding of the important components of the Material Safety Data Sheet of chemicals.

The Ministry of Education has a Safety in Laboratory policy under its Occupational Health and Safety policy that appears to be silent on explicit chemical management practices. Whilst, the research

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finding is limited by its context, it may have implications on policy changes in proper chemical management practices in the science laboratory in schools in Fiji.

Key words: chemical management practices; material safety data sheets; occupational health and safety

Introduction

Role of the Science Laboratory to Science Education

Science laboratories play a fundamental part in science teaching and learning in schools and are regarded as one of the characteristic features of education in the sciences at all levels. Effective science education deals with supporting theoretical explanations with actual practices in the laboratory through observation and equipment utilization. Lagowski (2002) mentions that the science laboratory has been given a central and distinctive role in science education. Moreover, Hofstein, Nahum and Shore, (2001) argue that the science laboratory is central in attempting to construct a learning environment in which students construct their knowledge base and their understanding of scientific concepts as well as skills related to the scientific process.

Laboratory work describes the practical activities or experiments which students undertake using chemicals and equipment in a chemistry laboratory. Laboratory learning aims to develop students' scientific reasoning skills, technical or practical skills, teamwork abilities, and understanding of the processes and nature of science, including the complexity and ambiguity of empirical work (National Research Council, 1996). This in turn develops a scientifically literate individual who is a more informed citizen and better understands reports and environmental issues. In the framework of science education,

Chemistry is recognized as a vital science subject which plays a key role in modern science and technology.

Gilbert and Treagust (2009) mention that understanding Chemistry is very critical as our physical environment is heavily affected by Chemistry and filled with chemical products. Understanding Chemistry and the ability to apply that understanding to daily life is referred to as Chemical literacy (Tsaparlis, 2000).

A school science laboratory investigation (also referred to as a lab or practical or experimental work) is defined as an experience in the laboratory, the classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models (National Research Council, 2006). Scientific investigations provide students with opportunities to interact directly with natural phenomena by designing investigations, engaging in scientific reasoning (learnt through lectures, discussions and textbooks), manipulating equipment, recording and analyzing data and discussing their findings. In fact practical work provides students with opportunities to engage in processes of investigation and inquiry (Omosewo, 1995). The skills and knowledge fostered by laboratory investigations are an important part of inquiry—the process of asking questions and conducting experiments as a way to understand the natural world (National Science Teachers Association, 2007).

Many benefits accrue from engaging students in science laboratory activities (Hofstein and Mamlok-Naaman, 2007). Science laboratory activities allow students to work cooperatively in small groups investigating scientific phenomena and thus create a unique mode of instruction and learning. The science laboratories have a less formal atmosphere than a classroom and hence enhance more interaction between students and teachers; and between peers; creating a positive and constructive learning environment

(Hofstein *et al* 2001). Furthermore, Hofstein and Mamlok-Naaman (2007) report that laboratory applications aim at developing students' scientific processing skills, problem solving skills, and draw their attention and develop positive attitudes towards scientific approaches according to objectives of fundamental science education.

In the science laboratory, hands-on activities take precedence which enhances learning significantly. Hands-on activities relate to the scientific investigations which enable students to get directly exposed to laboratory chemicals and their reactions, glassware and instruments and these activities are in fact essential for learning chemistry. Tobin (1990) suggested that meaningful learning is possible in the laboratory if students are given opportunities to manipulate equipment and materials in order to be able to construct their knowledge of phenomena and related scientific concepts. This is reinforced by Liapi & Tsaparlis (2007).

The School Science Laboratory

The school science laboratory houses specialized scientific instruments, apparatus, glassware and chemicals required for scientific investigations for different levels of science taught in schools. Inquiry-based laboratory investigations at every level should be at the core of the science program and should be woven into every lesson and concept strand (National Science Teachers Association, 2007). The level of complexity of laboratory investigations should increase as the students move through preschool, elementary, middle and high school levels.

The science curriculum is such that the students study all sciences from preschool through to middle school levels in subjects such as Elementary Science and Basic Science respectively. Upon joining high school, the science curriculum branches out into specific science subjects namely, Biology, Chemistry and Physics. Thus Chemistry is an experimental branch of science and the laboratory is the only place that is

capable of developing students' scientific processing skills (Feyzioğlu, Demirdağ, Ates, Cobanoğlu, and Altun[a], 2011).

The science laboratory equipment teaches students to make scientific arguments through experiments and manipulation of the equipment and the instruments. In addition to this, personal protective equipment (PPE) is also a foremost requirement in the science laboratory. PPE include safety accessories such as eye protection devices (safety glasses), face protection shields, hand protection (hand gloves), foot protection (close toed shoes) and laboratory coats. Fire blanket, fire extinguisher, safety shower and eye wash are also located within the science laboratory.

Important science laboratory practices to be followed include promoting a safe laboratory culture; effective management of chemicals and waste produced in the laboratory; and practicing Occupational Health & Safety (OH&S) in the laboratory. Specifying the do's and don'ts of the school science laboratory enhances a safe laboratory culture. This includes stating the laboratory policies explicitly through display on school science laboratory notice boards and allowing students to sign a safety contract with the science department so that each user is fully aware of these policies and is capable of taking precautionary measures before, during and after scientific investigations. Usually, each scientific investigation / experiment has its own requirements, which the teachers and students are confined to follow.

Practicing OH&S policies in science laboratories becomes mandatory on the users. OH&S includes maintaining a safety culture within the laboratory so that accidents/mishaps can be minimized and or avoided.

Šorgo & Špernjak (2012), Feyzioglu et al, (2011) and Liapi & Tsaparlis (2007), recognize Chemistry as fundamental basic experimental science course where experimentation is a basic method of school work. The experimental nature of Chemistry implies that chemicals will be used in science classes

as they play a crucial role in the delivery of science content knowledge for the better understanding of scientific phenomena and the relationship of science to technology. Before being introduced to Chemistry at higher levels, students study Basic Science and one of the components of the Basic Science curriculum is the study of chemical concepts.

The inclusion of chemicals to aid in the delivery of science content knowledge leads to the fact that chemical safety has to be of paramount importance in the lab. Chemical safety in a science laboratory is in fact the prevention and management of the adverse effects [both short and long term] to the humans and environment from the production, storage, transportation, and use and disposal of chemicals (World Health Organization, 2014).

Hence, management of chemicals is the most essential laboratory practice and this includes inventory; purchase; labeling; storage; use and disposal of chemicals. Before the purchase of chemicals, a chemical inventory has to be carried to determine the availability of chemicals at the schools and hence only the required amount needs to be ordered. Once purchased, labels have to be checked thoroughly, inventory taken and chemicals have to be stored in an appropriate place for safe use and handling.

Therefore, management of chemicals becomes an essential etiquette in school science laboratories and hence becomes the school's responsibility. The development of good chemical management practices becomes imperative in science lessons starting as early as in the Elementary science classes.

Chemical Management

Chemical management practices in a science laboratory include conscious consideration of all aspects of safe, responsible and economical chemical handling through all stages of chemical purchasing, storage, use, and disposal (Environment Protection Agency, 2006). These practices provide opportunity for

economic gain, environmental protection and improve health and safety issues within any school. According to Environment Protection Agency (2006), Michigan Department of Environmental Quality (2009) and National Research Council (2011), chemical management is critical to controlling a variety of environmental, health, and safety issues within any school.

The knowledge of what chemicals are present in schools and their usage, storage and disposal develops the understanding of the issues associated with these chemicals. Environment Protection Agency (2006), Michigan Department of Environmental Quality (2009) & National Research Council (2011) report that a majority of middle and high schools have outdated, unknown, improperly stored or unnecessary chemicals which can potentially put students and staff at risk.

Schools contain a variety of places where chemicals are stored such as the science laboratories, vocational workshops, agricultural workshops/laboratory, kitchen, and Food & Textiles laboratory.

According to Michigan Department of Environmental Quality (2009); Environment Protection Agency (2006) and National Research Council (2011); chemical management comprises of various components such as formulating a chemical management team; assessment of current chemical management programs and conditions; carrying out chemical inventories; chemical cleanout and disposal; proper labeling, storage and handling of chemicals; purchasing guidelines; chemical safety and training and education. These components play a significant role in developing a proactive rather than a reactive attitude towards chemicals amongst teachers. The most important aspect of chemical procurement is the Material Safety Data Sheet (MSDS) and an understanding of the MSDS is crucial in carrying out chemical management practices in the science classes.

Material Safety Data Sheets (MSDS)

MSDS is considered to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. It provides basic knowledge of the chemical and relates information on various aspects of a chemical concerning safety, health and environmental protection (Environment Protection Agency, 2006 and National Research Council, 2011). It also states recommendations on protective measures and emergency action, handling, transport and storage. Furthermore, it defines the hazards including fire and exposure and basic toxicological information.

Role of schools in promoting Chemical Management Practices

Schools are responsible for creating a safe environment and for encouraging a culture of safety. Hence, school leaders and teachers play a very significant role in developing the right attitude towards chemical management practices. Joshua and Basey (2004) regard teachers as an indispensable member of the school organizational team, as the effectiveness of any system is dependent on the quality of the individual teachers delivering the service. Therefore, it requires that the teachers have adequate knowledge about prudent laboratory practices which can be utilized in science laboratory classes. On one hand teachers have the opportunity to inform students about chemical exposures, integrated vector control and self-protection whilst on the other school administrators have the responsibility to ensure the safety of their students with appropriate use of chemicals as part of integrated vector control strategies (World Health Organization, 2014). Properly recognizing and controlling the hazards inherent to these materials, enhances the schools ability to create a safe school

with minimal environmental liabilities/lawsuits (Environment Protection Agency, 2006).

Imitating safe chemical management practices in the classroom requires that teachers have adequate knowledge of the chemicals to be used in the science classes and their interactions with the environment. The MSDS provides this information about the chemicals (Environment Protection Agency, 2006, and National Research Council, 2011).

World Health Organization (2004) in collaboration with the United Nations Environment Protection and International Labour Organization strongly emphasize that good chemical safety habits introduced early, better prepare students to learn how to work safely and develop their individual sense of responsibility and good habits for the safe handling and use of chemicals. Students imitate teachers and consider them as their role models; hence teachers need to display good chemical safety habits so that students model the same. For example even if dilute acid is used in a scientific investigation, teachers should emphasize the precautionary measures for handling and disposal that need to be taken when using the acid. Good quality laboratory management ensures a safe and sound place for teaching-learning together with the cooperation and support of students, faculty members, staff and the school administrators.

Rationale of Study

This study considered teachers' practice of chemical management in the school science laboratory as critical starting point for developing insights into prudent behavior in chemical safety. The authors' are of the view that there has been no research done in Fiji on chemical management practices in the school science laboratories and therefore the study assumes that it may be a problem in lower secondary schools (Years 7 – 10). Hence, this study investigated lower secondary Basic

Science teacher's practices of chemical management within the school science laboratory. The following questions guided the study:

1. How are the teachers storing, handling and disposing chemicals used in Basic Science classes in the school science laboratory?
2. What role do teachers play in the development of a culture of safe practices amongst students in the Basic Science classes?

Methodology

The study used a triangulation mixed method design, which is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative research and methods in a single study to understand a research problem (Creswell, 2005, Johnson, Onwuegbuzie& Turner, 2007).

In this study, 25 % of the primary schools and 25 % of the secondary schools from the Western Division of Viti Levu, Fiji Islands were randomly selected. The sample comprised of 54 primary and 16 secondary schools from the four education districts of the Western Division, namely Ba/Tavua; Lautoka/Nadi/Yasawa; Ra and Nadroga/Navosa.

The research participants comprised of upper primary (Years 7 & 8) and lower secondary (Years 7-10) Basic Science teachers' and Heads of Science Department (Secondary)/Science Teachers-in-charge (Primary). Years 7 and 8 of the primary schools are equivalent to years 7 and 8 in the secondary schools; hence the study title refers to them as 'Lower Secondary'.

Data was collected via semi-structured interviews with Science Department Heads/Science Teachers-in-charge, questionnaires (filled in by the Basic Science teachers) and comprehensive observation of the science laboratories / cupboards and observation of the chemical inventory log books. For this research, semi-structured interviews were considered

the best option due to the fact that heads of science department (secondary) were university graduates with Chemistry background whilst science teachers-in-charge (primary) were general teachers. The interviews lasted for 20 minutes and questions were focused on the chemical procurement and disposal and an understanding of the MSDS. The number of completed questionnaires depended on the school size and the availability of the Basic Science students and teachers.

Results

The chemical management practices of the Basic Science teachers' in the school science laboratory and their roles in promoting a safe laboratory culture within the Basic Science classes are summarized here.

1. Chemical Management Practices in the School Science Laboratory

a. The Science Laboratory

7 % (n=4 out of 54) of the sampled primary schools have a separate science room, which consists of the required chemicals of the appropriate levels, glassware, apparatus and a sink area. For the remaining 93 % of the sampled primary schools, the science cupboards are stored either in a classroom, the library, the computer lab or the main office. A teacher is responsible for the science cupboard and is the one who normally distributes the chemicals and apparatus for use during Basic Science classes. Students are at times allowed to handle chemicals from the science cupboards without the use of proper PPE.

However, for secondary schools, specialized laboratories are available for chemical storage and the Head of Science department is normally responsible for the distribution of chemicals to Basic Science teachers. All the surveyed secondary schools have an established science laboratory which

accommodates junior and senior science students. Important provisions within the science laboratory include:

i. Laboratory ventilation

69 % of the surveyed (n=11 out of 16) secondary schools maintained a well-ventilated science laboratory and proper chemical storage areas. For 7 % of the primary schools, there was poor ventilation in the place where chemicals had been stored. Chemicals had been stored in European Union (donor aid) boxes and hence these storage areas had a musty smell.

ii. Laboratory Safety accessories/necessities

94 % of the secondary schools visited, had safety accessories such as a fire extinguisher, bucket of sand, safety shower and fire blanket and first aid kit. This was an indication that teachers were aware of safety issues around work areas. Laboratory (fume) hoods were prevalent in all surveyed secondary schools; however in most cases these were non-functional and were used for chemical storage.

It was seen that in 4 % of the primary schools, safety equipment such as a fire extinguisher had been placed in the head teacher's office, where there was no chemical storage.

iii. Safety contract

One secondary school in particular requested students to sign a laboratory safety contract with its Science Department. This Science department had its own departmental policy and accident report form, which had to be followed by the signatories. This ensured good laboratory practice for the department and school and hence encouraged students and teachers to be more conscious during scientific investigations in terms of handling chemicals and glassware.

b. Chemical procurement

Chemical procurement involves purchasing of the required chemicals by relevant authorities of the school, receiving chemicals and sorting labeling and storing it.

76 % of the surveyed lower secondary schools had partial awareness of chemical procurement procedures out of which only 17 % of the schools had a consciousness of MSDS. MSDS was mostly obtained from the internet and shared amongst colleagues as it was not supplied by the chemical companies. 24 % of the schools which do not have knowledge about procurement procedures either received the chemicals as donation from the Ministry of Education or the European Union or borrowed from neighboring secondary schools.

No particular emphasis had been made about the grade of the chemicals to be used in schools; however 6 % of the secondary schools have mentioned that they have used industrial grade chemicals which had been donated to the school.

i. Chemical inventory, storage and handling

Chemical inventory had been carried out by all the surveyed schools; however, the information supplied in the inventory logs was quite inadequate. It only included the names of the chemicals and the date on which they were obtained.

50 % of the surveyed schools showed good chemical handling techniques which included displaying chemical safety rules for students, informing students about the specific precautions relating to a chemical, and maintaining OH&S protocols in the Basic Science classes during scientific investigations.

80 % of the sampled schools showed inconsistency in chemical storage practices. It has been noted that storage of chemicals was extremely challenging and a safety concern because chemicals were stacked together irrespective of their classification. None of the primary schools in the study had

proper chemical storage. Chemicals were stacked in cabinets, science kits or open cupboards, with least concern given to the classification of chemicals. Chemicals had been stacked alongside the science apparatus, which in some cases had corroded.

Some chemical containers were so old that there were cracks in the containers and the contents were spilling out with no due care shown by the relevant authorities, whilst in some schools chemicals were not stored in properly labeled bottles or inappropriate bottles were used for chemical storage. In some cases, the label of the chemicals had worn out or was missing from the bottle with the teachers unaware of the exact chemical in the bottle.

For the secondary schools, chemicals were stored separately from the equipment and glassware. Chemicals were either arranged according to their class (6 %; n=1 out of 16); in alphabetical order (6 %; n=1 out of 16), or according to their salts (56 %; n=9 out of 16) or elemental order (31 %; n=5 out of 16). Especially teachers with an awareness of MSDS were able to properly classify and store the chemicals.

Furthermore, the design of the science chemical cabinets was not of a specific standard. Some science chemical cabinets had a height exceeding 2m, with the chemicals placed on the top shelves (chemicals were out of reach of children) and in order to get the chemicals down, teachers had to use stools or benches.

6 % of the surveyed (n= 1 out of 16) secondary schools had corrosive substances such as acids placed on high shelves. This in itself posed risk and was an OH&S issue.

Through the science laboratory observations, it became apparent that most of the secondary schools (50 %) had storage of excess chemicals than what was required and some chemicals had become obsolete. In 13 % of the surveyed secondary schools, chemicals have been stored for so long that chemicals have actually leached out of the bottles. One such

scenario was for a secondary school where nitric acid had leached out of the bottle and was left unattended by the head of the department. In some instances, chemicals had decomposed in their respective bottles, with the teachers unaware of what to do.

ii. Chemical disposal in schools

After a scientific investigation in the Basic Science class, 99 % (n= 69) of the surveyed teachers mentioned that chemicals are diluted before being discarded by the students. Of which, 78 % discard it in either sinks or in school drains, which eventually lead to a water body. However, 22 % teachers request their students to discard the chemicals on the ground, in incinerators, in soak pits and even in pit latrines after dilution. Discarding chemicals in such areas is considered 'safe' by the Basic Science teachers as not all students have access to these areas. This is especially apparent for rural and remote schools.

Lower secondary schools (50 %) also maintained a chemical disposal bottle, which was used to discard all organic solvents.

2. Role of teachers in the development of a culture of safe practices amongst students in the Basic Science classes.

Surveyed teachers were able to clearly express their views on chemical safety during usage of chemicals within the Basic Science classes and relate to OH&S. In particular teachers were able to relate about hazards of chemicals like acids to their students.

However, there is a contradiction between the teacher's concept of student safety and the teacher's practice of student safety. Although, through the questionnaires and interviews, it was apparent that teachers are very particular about safety of students during experiments, these do not reflect in action as students are required to carry chemicals to and from their

classrooms, dispose and clean glassware containing the chemicals. Students are exposed to chemicals without even having proper PPE. The Fiji Ministry of Education's (MoE) OH&S policy states clearly the role of teachers and school pertaining to safety in laboratories:

> Teachers who want to use the science materials/ equipment should personally take materials from the teacher in charge. Extreme care must be taken when moving chemicals from one room to another. All safety regulations must be displayed and followed.
>
> (MoE Policy in Occupational Health and Safety. 1997)

Even though the policy is quite explicit in terms of handling chemicals and science materials, teachers still allow students to handle these, especially when moving chemicals from one room to another and cleaning of glassware containing chemicals. The chemicals used by the lower secondary schools are mostly diluted. However, the fact remains that students are allowed to touch chemicals during disposal and hence may later treat any chemical as being diluted and misuse them.

Discussion and Summary

The science laboratories play a crucial role in the dissemination of science knowledge and at the same time fosters positive student attitudes about science. The laboratory is an indispensable aspect of science teaching because the laboratory gives students appreciation of the spirit and methods of science, promotes problem solving, analytic and generalization ability (Daramola, 1985). Science laboratories allow students to appreciate and in part emulate the role of the scientist, and ultimately understand the sophistication of modern science and technology. It in turn enables the scientist to be a considerate environmental scientist. Hence, it is of paramount importance

to promote effective science teaching via organized science classrooms or laboratories as is available in a particular school.

A special place or area could be allocated as a science room where the science equipment and chemicals are stored in a systematized manner. Furnishing science laboratories with informative and colorful visual aids will stimulate interest in students and hence interest developed in the lower secondary Basic Science classes may initiate a motivational instinct to undertake science related subjects such as Chemistry in the upper secondary classes.

National Institute for Occupational Safety and Health (2006) mention that teachers and teacher-aides should lead by example and wear personal protective equipment; follow and enforce safety rules, procedures, and practices; and demonstrate safety behavior and promote a culture of safety. National Institute for Occupational Safety and Health (2006) further state that the teachers should be proactive in every aspect of laboratory safety, making safety a priority.

Findings of this study reveal that chemical management is a grave issue in lower secondary schools but at present is not given due deliberation. The study reveals that there is poor record keeping and inventory management in the surveyed schools. There is also lack of knowledge and awareness on sound chemical management practices within the science laboratories/classroom. Mogopodi, Paphane, and Petros, (2015) aptly state that the unsound management and use of chemicals poses threats to human well-being at many levels.

Chemical safety seems to be guised under the framework of OH&S in schools, where concern is only during a scientific investigation in class. However, the OH&S policy of MoE appears to be silent on chemical management practices to be observed in science classes and so far there has been no explicit policy in place to guide teachers on management of chemicals. The MoE OH&S policies and the school policies

allude to general laboratory rules and generalized safety with different types of chemicals.

When handling chemicals, MSDS of chemicals needs to be taken into consideration and incorporated into the Basic Science classes with clear explanations. The type of chemical, its classification and hazards, storage, handling and disposal need to be mentioned in each class. However, it is obvious that most of the teachers are unaware of MSDS of chemicals and hence as a result showed poor chemical management practices regarding storage, usage and disposal of chemicals. For example, for primary schools, it was observed that chemicals had been stacked together in the science cupboard with the equipment; storage of incompatible chemicals together; and storage of chemicals on high shelves. Similar sentiments were expressed by Mogopodi et al (2015), who mentions, "upon visiting junior secondary school science laboratories, the researchers found a lot of deficiencies; for example, chemical containers were either not labeled or had fading labels and incompatible chemicals were stored together increasing the risk of chemical accidents".

Schools also possess chemicals like chloroform, which is now banned due to its carcinogenic properties. Usually after completion of experiments involving chloroform, the chemical is allowed to evaporate within the classroom. It has a very high vapour pressure of 159 mmHg at 20°C (Environment Protection Agency, 2000). Evaporation of this chemical in a poorly ventilated lab can cause respiratory problems.

Hence, there is a need to raise awareness amongst school leaders and teachers of chemical hazards and provide tools to prevent chemical exposures. There is also a need to remove unnecessary, obsolete and excess chemicals from schools and encourage responsible chemical management practices. Excess and obsolete chemicals in a school may lead to disposal problems later on. In his study, Mogopodi et al

(2015) also found obsolete chemicals kept within chemical store rooms.

From a survey of K- 12 schools in 55 states in USA, it has been found that a large majority of middle and high schools had out dated unknown, improperly stored or unnecessary chemicals with potential of high risk (Environment Protection Agency, 2006). Similar findings were recorded by Michigan Department of Environmental Quality (2009) and National Research Council (2011). The researchers' are of the view that excessive and obsolete chemicals present in the surveyed schools are an indication that schools do not have the capacity to dispose them and as such no measures have been put in place for their disposal.

During the course of this study, the authors' encountered only 1 (6 %) secondary school which had 'buried' excessive and obsolete chemicals. This is an indication that teachers with MSDS knowledge have awareness of disposal of obsolete and excessive chemicals. However, there is no such policy in Fiji Ministry of Education's OH&S policy regarding disposing off obsolete chemicals in schools.

Hence, it can be concluded that chemical management policies must be explicitly integrated in the current "Safety in laboratory policy" of the OH&S policy of the Ministry of Education in terms of chemical procurement, chemical emergency response and chemical storage, usage and disposal. There is also a need for continuous training and professional development for school leaders and teachers on chemical management practices and this has been indicated by the surveyed teachers. Furthermore, 93% of the sampled primary teachers have requested for a separate science room to carry out effective chemical management practices.

Since chemical management practices in a school science laboratory includes all aspects of safe, responsible and economical chemical handling through all stages of chemical purchasing, storage, use, and disposal, it therefore become

everyone's responsibility. Furnishing teachers with adequate knowledge about chemical management practices would enable teachers to impart current and up-to-date knowledge about chemicals and science in particular to students. This would ultimately create environmental conscious students, who would always have the protection of the environment at their heart. Mogopodi et al (2015) aptly states that there is a need to put measures in place to promote chemical safety in schools such as through developing a chemical safety continuing education curriculum for school teachers. American Chemical Society (1995) elaborates further that it is essential for all involved in the science instruction program to develop a positive approach to a safe and healthful environment in the laboratory.

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