

Materials Management of Science Laboratories in Public High Schools in La Union

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Abstract. This study examined the materials management practices in science laboratories of public high schools, specifically focusing on inventory, storage, safety protocols, and personnel management. The study employed a descriptive-survey research design, utilizing a researcher-designed questionnaire as the research tool. This questionnaire was administered to school heads, science teachers, and learners enrolled in public high schools within the Division of La Union. The weighted mean was the statistical tool used to treat the data gathered. The study revealed that the extent of materials management as a whole was mainly managed, with practices related to inventory, storage, and safety rated as capabilities. In contrast, personnel-related practices were generally rated as constraints that needed to be addressed. These imply that the learning tools, equipment, and processes in the Science laboratories are capably administered and supervised. To further improve the management of materials in science laboratories of public high schools in La Union, a set of policy recommendations was crafted by the researcher, specifically to alleviate the identified constraints.

Keywords: Laboratory materials management; Policy recommendations; Public senior high schools.

1.0 Introduction

Management is both administering and supervising the performance of duties, responsibilities, and practices. Difficulties in managing people, projects, and finances, as well as establishing effective workplace practices, are some of the potential challenges (Pain, 2012). This is also evident in science laboratories in schools, which are expensive to equip and maintain. Understanding the materials and procedures needed is essential for effective laboratory management. To teach the subject, science requires an expert who can determine which chemicals are hazardous or which processes may pose a hazard to learners (National Research Council, 2011). Laboratory management encompasses a range of tasks, from staffing to the maintenance of equipment and materials. Effective management of a science laboratory helps ensure that the laboratory achieves its intended purpose, enhancing and consolidating theoretical science teaching in classrooms. On the contrary, if a science laboratory is poorly managed, it will not only fail to achieve its intended purposes. Still, it will also affect the learners' interest and enthusiasm in learning science. Such a sad state of affairs should be avoided, considering the importance of science and technology in the modern world and the tremendous amount of funds invested in building and equipping laboratories (ConductScience, 2019).

Studies reveal that the goal of laboratory management is to guide laboratory personnel in delivering their assigned duties within limited time and resources. This includes personnel, equipment, or the necessary tools, as well as designing the workflow, overseeing the daily operation of the laboratory, and training new laboratory personnel.

For the most part, laboratory management involves specific laboratory maintenance tasks, such as maintaining instruments, restocking consumables, scheduling, providing technical advice, and documenting laboratory activities or incidents (ConductScience, 2019). Additionally, in most participating schools, there is a shortage of dedicated science laboratories. It was also found that many teachers faced difficulties when conducting science activities due to the large number of learners in each class, as well as inadequate equipment and materials (Pareek, 2019). The most significant constraint of laboratory activities in secondary schools is not only the lack of laboratory rooms, inadequate supply of laboratory equipment, or the absence of trained laboratory technicians and teachers, but also the poor management, monitoring, and evaluation of laboratory activities (Zengele & Alemayehu, 2016). In addition, safety and ethics are two of the most crucial parts of running a laboratory, yet they receive far too little attention compared to the other core lab-management skills. It is essential to work hard to create a laboratory culture where safety is taken very seriously (Ruys, 1990).

In the Philippines, the education department receives the most significant portion of the national budget. A portion of the budget was allocated to basic education facilities, including school buildings, laboratories, school furniture, and electrification. However, despite a large budgetary allocation, science laboratories are still found to need development (De La Cruz, 2022). According to DepEd Order 48, s. 2006 on the Observance of Safety Measures in Science Laboratories, to ensure safety in science laboratories, schools are directed to implement strictly the guidelines provided in the Laboratory Manuals issued by the Department (DepEd) on the management of hazards and observance of safety measures in the performance of laboratory activities and handling of tools and equipment and chemicals (Department of Education, 2006). Public High Schools in the Province of La Union have minimal supplies of chemicals that can be used in the laboratory, and if present, these are often products from old stock chemicals that have been stored in the laboratory cabinet for a considerable time. Equipment and other laboratory materials were delivered to the recipient school, which offers Science, Technology, Engineering, and Mathematics (STEM) programs, for the opening of Grades 11 and 12 in the K-12 Program of the Department of Education, as per DepEd Order No. 17, Series of 2017. However, Science teachers in public schools often lack sufficient skills in the use and care of such equipment and materials.

This study aims to assess the laboratory management of public high schools in La Union, with the ultimate goal of preparing policy recommendations to improve the efficiency of materials management in science laboratories and, consequently, to effectively guide teachers and learners towards better and safer performance in the laboratory rooms. This study is primarily grounded in Northouse's (2015) Leadership Skills Theory, which posits that leadership is a process whereby a leader influences followers to perform effectively in a given situation. This theory was utilized in the formulation of the research instrument in the study. In addition, the Classical Management Theory (Thenmozhi, 2014), which focuses on enhancing the productivity of both the organization and the individual worker, was also employed in this study, particularly in developing the research instrument, during the conduct of laboratory activities, and in interpreting the findings. The System Approach Theory of Thenmozhi (2014) which provides managers a way of looking at the organization as a whole and as a part of the larger external environment; and was explicitly used in the study in providing a broader perspective towards a better understanding of the role of science laboratories and the laboratory activities geared towards effective science education.

The Evaluation Theory of Miller (2010) was employed in this study to examine the various dimensions involved in managing science laboratories, particularly in developing the research instrument used to assess materials management in science laboratories. Another relevant theory for this study is the Intervention Theory, which advocates analyzing the decision-making problems of intervening effectively in a situation to secure desired outcomes (Weiss, 2000; Argyris, 2004). This theory helped the researcher develop appropriate policy recommendations to address the identified constraints in managing science laboratories. Furthermore, the researcher developed Nuesca's Comprehensive Science Laboratory Management Theory, which posits that the efficient and effective management of materials, learning tools, and equipment (LTE) in the Science laboratory depends on the extent to which acceptable standards are practiced by all concerned parties, including school leaders, teachers, and users.

In reality, only a few public high schools have Science laboratories (for junior high school), so that in most cases, science teachers in senior high school had to make their classrooms into laboratories and improvise materials and equipment for their learners to perform experiments. There were also instances when public schools requested reagents from private schools to facilitate necessary scientific activities.

Generally, in public high schools in La Union, there are no Science laboratories to meet the needs of students enrolled in the STEM Strand. In Science subjects like Biology, Chemistry, and Physics, where experimental activities are essential, teachers often improvise. They make their classrooms as laboratories with a scarcity of learning tools and equipment. All learners need to use the available materials, apparatus, and equipment and rely on the resourcefulness and capabilities of their teachers.

Based on this scenario, the study examined the extent of materials management among school heads, teachers, and learners who are directly involved in the management, upkeep, and use of Science laboratories. Their observations, practices, and perceptions, along with inventory, storage, safety measures, and personnel aspects, were analyzed, which in turn were considered in offering policy recommendations to concerned authorities for formulating the necessary policy for improved science laboratory management. In addition, the study aimed to generate new knowledge in the realm of management by proving the efficacy of the researcher's theory and to benefit stakeholders by providing efficient and safe science laboratory management.

2.0 Methodology

2.1 Research Design

This study employed a descriptive-survey research design, which is concerned with assessing and analyzing the extent to which different conditions or situations are present among the subjects (Paler-Calmorin & Calmorin, 2012), particularly regarding materials management in Science laboratories of public high schools. The study was conducted in 16 public high schools in La Union, which offer senior high schools with the STEM Strand.

2.2 Participants and Sampling Technique

The study population consisted of 2,514 senior high school learners enrolled in the Science, Technology, Engineering, and Mathematics (STEM) strand in 16 public schools within the Schools Division of La Union, 65 science teachers, and 16 school heads. The sample size of 378 learners was determined using Slovin's Formula, with a 0.05 margin of error, and was identified through stratified sampling and k^{th} techniques. Total enumeration was used for the science teachers and school heads. The respondents were selected based on their experience in science laboratories as part of their STEM curriculum. The teachers were included as participants due to their active involvement in materials management; moreover, the school heads play a crucial role in the overall administration and supervision of materials management.

2.3 Research Instrument (If Applicable only, remove if not)

This study used a researcher-made survey questionnaire with a Likert rating scale. It was developed based on various sources, including DepEd Orders and Guidelines on the observance of safety measures in science laboratories, as well as other sources such as the Education Bureau (2013) and Love et al. (2020). The questionnaires aimed to measure the extent of materials management along four dimensions, namely: inventory, storage, safety practices, and personnel. Experts assessed the validity of the questionnaire along content, construct, and face dimensions, with an average rating of 4.86 (very high) on a 5-point scale. The questionnaires were then pretested on school heads, Science teachers, and learners in schools outside La Union. The coefficient of reliability for the questionnaires for teachers and learners was 0.70, which is interpreted as acceptable, reliable, and adequate; and 0.80 for that of the school heads, which is also interpreted as good, sufficient, and trustworthy.

2.4 Data Gathering Procedure

The questionnaires were administered personally by the researcher to potential participants during the 2nd semester of School Year 2022-2023 in their respective schools, with the assistance of their science teachers, particularly in the case of learner-participants. The retrieval rate was 100 percent.

2.5 Data Analysis Procedure

The collated data were treated quantitatively using frequency counts and weighted means. The weighted means per indicator were averaged and interpreted based on a given rating scale. Based on the weighted mean, each indicator was classified as either capability (3.51 - 5.01) or constraint (3.50 and below).

2.6 Ethical Considerations

The study was conducted according to ethical standards and norms. Data gathering was preceded by an Ethics

Clearance issued by the Research Ethics Committee and written permission issued by the Schools Division Superintendent. The researcher provided the respondents with an informed consent form, which, among other things, outlined the study's objectives and guaranteed confidentiality and privacy. To ensure the authenticity of the manuscript, it was subjected to Turnitin plagiarism detection software, which resulted in a Similarity Index of 8%.

3.0 Results and Discussion

3.1 Extent of Materials Management of Science Laboratories

Table 1 presents the extent of materials management in science laboratories, including inventory, storage, safety practices, and personnel, as perceived by school heads, Science teachers, and learners. As pointed out in the table, the Science laboratories were “Much Managed” with a grand overall mean of 4.06. This signifies that the schools have been administering and supervising their Science laboratories considerably. They were consistent in implementing the guidelines on inventory and storage of their LTEs, significantly adhering to safety practices in the laboratory rooms, and advising lab technicians and science teachers on performing their duties and responsibilities, as per DepEd Order No. 48, s. 2006., DepEd Order No.051, s. 2018.

Table 1. *Summary on the Extent of Materials Management of Science Laboratories*

Key Area	Respondents	Sub-Mean	Interpretation	Overall Mean	Interpretation
Inventory	School Heads	4.48	Much Managed	4.22	Much Managed
	Science Teachers	3.96	Much Managed		
Storage	School Heads	4.16	Much Managed	3.93	Much Managed
	Science Teachers	4.05	Much Managed		
	Learners	3.59	Much Managed		
Safety Practices	School Heads	4.43	Much Managed	4.12	Much Managed
	Science Teachers	4.22	Much Managed		
	Learners	3.72	Much Managed		
Personnel	School Heads	3.48	Moderately Managed	3.98	Much Managed
	Science Teachers	4.28	Much Managed		
	Learners	4.18	Much Managed		
Grand Overall Mean				4.06	Much Managed

This finding agrees with Anderson (2021) where it was emphasized the benefits of lab inventory system as: reduced errors and eliminate long and repetitive manual processing, improved efficiency and effectiveness in administration and management of records, more economical as it minimizes the time usage, easy to take corrective actions in a timelier manner, easy access to equipment details as it has search functionality, and increased productivity.

3.2 Capabilities and Constraints in the Extent of Materials Management of Science Laboratories

Inventory

Table 2 reveals the capabilities and constraints in the extent of materials management of Science Laboratories on inventory. As expressed in the Table, all attributes along inventory were capabilities except those as perceived by the teachers on: advising the Laboratory technician/Science teacher to maintain a chemical inventory to avoid purchasing unnecessary quantities of chemicals, advising the Laboratory technician/Science teacher to regularly check the chemicals' expiration date and dispose expired chemicals, and instructing the Laboratory technician/Science teacher to develop a program for dating stored chemicals and for re-certifying or discarding them after predetermined maximum period of storage. This signifies that the schools have been handling their LTEs significantly in their Science laboratory rooms, but their Laboratory technicians and science teachers are lacking skills in managing their laboratories.

The finding finds resemblance with those of Zengele (2016) and Ndiokubwayo (2017). The study found that the most determinant constraints of laboratory activities in secondary schools include the absence of trained laboratory technicians and teachers. The latter reveals that teachers face barriers, such as a lack of improvising skills, in their everyday science teaching life. During regular lab safety surveys, a common issue noted is the lack of safety training completion or documentation for lab personnel (UT- Houston Environmental Health and Safety, 2023).

Table 2. Capabilities and Constraints in the Extent of Materials Management of Science Laboratories, along with Inventory

No.	Attribute	Mean	Interpretation	Classification
A.	<i>As perceived by School Heads, the school manages its Sc Laboratory Inventory by:</i>			
1	receiving and counterchecking the delivered packages of basic equipment delivered to the school	4.56	Very Much Managed	Capability
2	receiving all deliveries and signing the delivery receipt if the goods are in accordance with Contract or Purchase Order	4.50	Much Managed	Capability
3	receiving the delivered packages with a third party such as PTA or other stakeholders	4.13	Much Managed	Capability
4	preparing the Inspection and Acceptance Report and forwarding the documents to the School Inspection Team	4.44	Much Managed	Capability
5	keeping one set of the accomplished delivery documents for records purposes to ensure the correctness and quality of the delivered goods	4.69	Very Much Managed	Capability
6	ensuring that the inventory taking activities are executed in accordance with the approved Physical Inventory Plan	4.63	Very Much Managed	Capability
7	using the inventory working papers provided by the Property Unit as basis for inventory taking activities	4.50	Much Managed	Capability
8	informing the Regional Office (RO) and School Division Office (SDO) on the indicative delivery dates of the goods and of the concerned SDO and the recipient schools on the exact date a week before the delivery	4.38	Much Managed	Capability
	Sub-Mean	4.48	Much Managed	Capability
B.	<i>As perceived by the Science Teachers, the school manages its Science Lab Inventory by:</i>			
1	requiring the Lab technician/ Science teacher to conduct inventory and finally accept the delivered goods to validate the completeness and condition of the goods	4.23	Much Managed	Capability
2	requesting the Lab technician/ Science teacher to accomplish all the delivery documents found inside the package and retain copies for the forwarder	4.05	Much Managed	Capability
3	advising the Lab technician/Science teacher to keep one set of the accomplished delivery documents for records purposes to ensure the correctness and quality of the delivered goods	4.15	Much Managed	Capability
4	advising the Lab technician/Science teacher to inform the Regional Office and School Division Office on the indicative delivery dates of the goods and of the concerned SDO and the recipient schools on the exact date a week before the delivery	4.12	Much Managed	Capability
5	ensuring that the inventory taking activities are executed in accordance with the approved Physical Inventory Plan	4.12	Much Managed	Capability
6	using the inventory working papers provided by the Property Unit as basis for inventory taking activities	4.20	Much Managed	Capability
7	requesting the Lab technician/Science teacher to monitor the received Science and Math Equipment and ensure that it is stored in an area free from chemical fumes, corrosive elements, and moisture	4.36	Much Managed	Capability
8	advising the Lab technician/Science teacher to provide a copy of the document designating the composition of the School Inspection Team to supplier as a part of the delivery documents.	4.12	Much Managed	Capability
9	instructing the Lab technician/ Science teacher to record delivered materials in a logbook	4.05	Much Managed	Capability
10	instructing the Lab technician/Science teacher to accomplish the Acknowledgment Receipt for Equipment and the Inventory Custodian Slip	4.08	Much Managed	Capability
11	advising the Lab technician/Science teacher to maintain a chemical inventory to avoid purchasing unnecessary quantities of chemicals	3.41	Moderately Managed	Constraint
12	advising the Lab technician/Science teacher to regularly check the expiration date and dispose expired chemicals	3.09	Moderately Managed	Constraint
13	advising the Lab technician/Science teacher to list and indicate in the borrower's logbook the quantity of materials/ chemicals borrowed/ consumed	3.91	Much Managed	Capability
14	advising the Lab technician/Science teacher to check and indicate in the logbook the quantity and condition of materials used in the lab	3.97	Much Managed	Capability
15	instructing the Lab technician/ Science teacher to develop a program for dating stored chemicals and for re-certifying or discarding them after a predetermined maximum period of storage	3.50	Moderately Managed	Constraint
	Sub-Mean	3.96	Much Managed	Capability
	Overall Mean	4.22	Much Managed	Capability

Storage

Table 3 reflects that all the attributes related to storage, as perceived by the school heads and some of those of the teachers and learners, were capabilities. The constraints were those as perceived by teachers such as: freeing the storage facility from moisture, contamination of chemicals and its fumes, termites, dust and other elements or conditions that could endanger LTE and storing chemicals to a separate room that is well-ventilated and secured at all times; and those as perceived by the learners on: instructing the learners to list and store separately the apparatus and equipment from consumable supplies for easy reference as well as acids and bases from fuels and oxidizer, ensuring to learners that food is not allowed to be stored in a refrigerator with chemicals, and providing learners a laboratory safety manual which indicates laboratory rules, procedures, and practices. These duties and responsibilities in the laboratory room must be considered for improved performance and a safer learning environment.

Table 3. Capabilities and Constraints in the Extent of Materials Management of Science Laboratories along Storage

No.	Attribute	Mean	Interpretation	Classification
A.	<i>As perceived by the School Heads, the school manages the Storage of Science Laboratory materials by:</i>			
1	providing a spacious, well-lighted, and well-ventilated science laboratory room	4.00	Much Managed	Capability
2	conducting periodic, unannounced laboratory inspections to identify and correct hazardous conditions and unsafe practices	4.13	Much Managed	Capability
3	making sure that the Learning Tools and Equipment (LTE) are stored properly, safely, and securely	4.13	Much Managed	Capability
4	freeing the storage facility from moisture, contamination of chemicals and its fumes, termites, dust and other elements or conditions that could endanger LTE	4.06	Much Managed	Capability
5	storing heavy goods on the lower levels with the heaviest on the lowest level for stability of the storage cabinet.	4.38	Much Managed	Capability
6	storing large equipment in a closed, secured, and flood-free room with concrete flooring and proper ventilation	4.13	Much Managed	Capability
7	wrapping the large equipment that will be stored in the stock room with a plastic to prevent accumulation of dust and placing it on a wooden or plastic pallet to elevate it from the floor so as to also prevent direct contact with water in case of flood	4.31	Much Managed	Capability
	Sub-Mean	4.16	Much Managed	Capability
B.	<i>As perceived by the Science Teachers, the school manages the storage of Science Laboratory materials by:</i>			
1	making sure that LTE are stored properly and safely	4.18	Much Managed	Capability
2	freeing the storage facility from moisture, contamination of chemicals and its fumes, termites, dust and other elements or conditions that could endanger LTE	3.41	Moderately Managed	Constraint
3	advising the lab technician/Science teacher to store systematically in appropriate shelves, cabinet, the apparatus and supplies	4.33	Much Managed	Capability
4	advising the Laboratory technician/Science teacher to store materials of right quality and right quantity	4.32	Much Managed	Capability
5	storing heavy goods on the lower levels with the heaviest on the lowest level for stability of the storage cabinet.	4.21	Much Managed	Capability
6	storing large equipment in a closed, secured, and flood-free room with concrete flooring and proper ventilation	4.06	Much Managed	Capability
7	wrapping the large equipment that will be stored in the stock room with a plastic to prevent accumulation of dust and placing it on a wooden or plastic pallet to elevate it from the floor so as to also prevent direct contact with water in case of flood	4.05	Much Managed	Capability
8	instructing the lab technician/Science teacher to deliver materials at the right place at the right time	4.00	Much Managed	Capability
9	advising the lab technician/science teacher to list and store separately the apparatus and equipment from consumable supplies for easy reference as well as acids and bases from fuels and oxidizer	4.11	Much Managed	Capability
10	advising the lab technician/science teacher to ensure learners that there is a secured, spacious, well-ventilated cabinet for storage of chemicals	4.11	Much Managed	Capability
11	advising the lab technician/science teacher to ensure learners that food must not be stored in a refrigerator with reagents	4.21	Much Managed	Capability
12	advising the lab technician/science teacher to label all chemicals and equipment	4.42	Much Managed	Capability
13	instructing the lab technician/science teacher to provide lab safety manual which indicates laboratory rules, procedures, and practices	4.05	Much Managed	Capability

14	advising the lab technician/science teacher to conduct periodic, unannounced lab inspections to identify and correct hazardous conditions and unsafe practices	3.88	Much Managed	Capability
15	storing chemicals to a separate room that is well-ventilated and secured at all times	3.45	Moderately Managed	Constraint
	Sub-Mean	4.05	Much Managed	Capability
C.	<i>As perceived by the Learners, the school manages the storage of Science Laboratory materials by:</i>			
1	instructing the learners to list and store separately the apparatus and equipment from consumable supplies for easy reference as well as acids and bases from fuels and oxidizer	3.50	Moderately Managed	Capability
2	ensuring to learners that there is a secured –spaced, well-ventilated cabinet for storage of chemicals	3.87	Much Managed	Capability
3	ensuring to learners that food is not allowed to be stored in a refrigerator with chemicals	3.48	Moderately Managed	Constraint
4	providing learners a laboratory safety manual which indicates laboratory rules, procedures, and practices	3.49	Moderately Managed	Constraint
	Sub-Mean	3.59	Much Managed	Capability
	Overall Mean	3.93	Much Managed	Capability

Safety Practices

Table 4 presents the capabilities and constraints in the extent of materials management in Science Laboratories, along with safety practices. The attributes related to safety practices encompassed capabilities from both school heads and teachers, as well as those of the learners. The constraints were those as perceived by the learners on: allowing learners to use a minimum amount of flammable liquids in the laboratory, checking furniture arrangements to enable free flow of traffic and for learners to work comfortably without interference from others, instructing learners to use plastic pails or floor crock for broken glassware and other solid disposable items utilized in the experiment and for suppressing fire, advising learners to practice the Acid to Water (A-W) method in diluting acids, providing signage in forbidding horseplay and practical joking of any kind, instructing learners to secure compressed gas cylinders with a strap or chain at all times, forbidding learners to do experimental work with radioactive material or equipment in ionizing radiation.

Table 4. Capabilities and Constraints in the Extent of Materials Management of Science Laboratories along Safety Practices

No.	Attribute	Mean	Interpretation	Classification
A.	<i>As perceived by the School Heads, the school manages its Science Laboratory Safety by:</i>			
1	providing first aid kit, fire extinguisher, and list of safety precautions inside the science lab room	4.44	Much Managed	Capability
2	posting of safety guidelines in the lab room	4.56	Very Much Managed	Capability
3	ensuring the conduct of pre-laboratory discussions by science teachers	4.50	Much Managed	Capability
4	cleaning and lubricating tools and equipment after every use and before storing	4.44	Much Managed	Capability
5	storing lubricants in a well-ventilated room far from source of heat or flame to prevent accidental fire and to prevent personnel getting suffocated with the fumes	4.25	Much Managed	Capability
6	storing separately chemicals in a rust-and-chemical resistant storage cabinet made of material like stainless steel, with exhaust for proper ventilation	4.38	Much Managed	Capability
	Sub-Mean	4.43	Much Managed	Capability
B.	<i>As perceived by the Science Teachers, the school manages its Science Lab Safety by</i>			
1	providing first aid kit, fire extinguisher, and a list of safety precautions inside the science laboratory room	4.27	Much Managed	Capability
2	requesting the lab technician/science teacher to give a pre-lab discussion including health and safety aspects	4.29	Much Managed	Capability
3	ensuring the lab technician/science teacher that there is no conduct of unauthorized and unsupervised experiments and research activity	4.36	Much Managed	Capability
4	advising the lab technician/science teacher to report all accidents occurred in the lab to the science teacher for evaluation of the school head	4.24	Much Managed	Capability
5	instructing the lab technician/science teacher to allow a minimum amount of flammable liquids in the laboratory	4.41	Much Managed	Capability
6	advising the lab technician/science teacher to forbid learners to smoke, eat, and drink in the laboratory	4.14	Much Managed	Capability
7	advising the lab technician/science teacher to check furniture	4.28	Much Managed	Capability

	arrangement to allow free flow of traffic and for learners to work comfortably without interference from others			
8	requesting the lab technician/science teacher to provide first aid equipment and instruction of its proper use	4.36	Much Managed	Capability
9	instructing the lab technician/science teacher to designate warning signs to particular hazards	4.00	Much Managed	Capability
10	advising the lab technician/science teacher to instruct learners to carefully read the reagent bottle before using it in the experiment	4.32	Much Managed	Capability
11	advising the lab technician/science teacher to instruct learners to use plastic pails or floor crock for broken glass wares and other solid disposable items used in experiment	4.27	Much Managed	Capability
12	requesting the lab technician/science teacher to provide a pail of sand for suppressing fire.	3.95	Much Managed	Capability
13	instructing the lab technician/science teacher to practice the acid-to-water method in diluting acids	4.08	Much Managed	Capability
14	advising the lab technician/science teacher to instruct learners to wear safety goggles or industrial quality safety spectacles in laboratories.	4.32	Much Managed	Capability
15	advising the lab technician/science teacher to forbid horseplay and practical joking of any kind	4.41	Much Managed	Capability
16	advising the lab technician/science teacher to instruct learners to label containers of chemicals showing name of the chemical, date, owners' name and safety precaution if hazardous	4.36	Much Managed	Capability
17	advising the lab technician/science teacher to secure compressed gas cylinders with a strap or chain at all times	4.02	Much Managed	Capability
18	advising the lab technician/science teacher to forbid experimental work with radioactive material or equipment in rating ionizing radiation	4.05	Much Managed	Capability
19	instructing the lab technician/science teacher to advise learners to wear glasses, aprons and protective sleeves while working in the chemical laboratory	4.35	Much Managed	Capability
20	instructing the lab technician/science teacher to advise learners to roll their long sleeves above the wrist as a definite safety habit	4.09	Much Managed	Capability
21	instructing the lab technician/science teacher to permit talking only if control and restrain are practiced	4.05	Much Managed	Capability
22	letting the lab technician/science teacher to instruct learners to study the purpose of an experiment as one of the most important steps of beginning chemistry lab practice	4.33	Much Managed	Capability
23	requesting the lab technician/science teacher to instruct learners to point away from a group or from a fellow worker test tubes or any pieces of equipment which could possibly expel a gas or liquid	4.24	Much Managed	Capability
24	advising the lab technician/science teacher to instruct learners to check all glassware for cracks before/ after use	4.36	Much Managed	Capability
25	advising the lab technician/science teacher to instruct learners to place glassware of all types at the back of the laboratory to prevent from falling and unnecessary breakage	4.30	Much Managed	Capability
26	instructing the lab technician/science teacher to advise learners to hold long pieces of glass tubes vertically when walking through the laboratory	4.03	Much Managed	Capability
27	requesting the lab technician/science teacher to advise learners to flush drain thoroughly after spilling out reagents	4.12	Much Managed	Capability
28	instructing the lab technician/science teacher to advise learners to clean and dry used glassware before storing.	4.29	Much Managed	Capability
	Sub-Mean	4.22	Much Managed	Capability
C.	<i>As perceived by the Learners, the school manages its Science Laboratory Safety by:</i>			
1	giving the learners a pre-lab discussion to include consideration of health and safety aspects	3.98	Much Managed	Capability
2	instructing learners to report all accidents occurred in the lab to the science teacher for evaluation of the school head	4.02	Much Managed	Capability
3	allowing learners to use a minimum amount of flammable liquids in the laboratory	3.48	Moderately Managed	Constraint
4	providing signage in forbidding learners to smoke, eat, and drink in the laboratory	3.75	Much Managed	Capability
5	checking furniture arrangements to allow free flow of traffic and for learners to work comfortably without interference from others	3.49	Moderately Managed	Constraint
6	providing learners first aid equipment and instruction on its proper use	4.02	Much Managed	Capability
7	designating warning signs to particular hazards	3.96	Much Managed	Capability
8	instructing learners to carefully read the reagent bottle before using it in the experiment	4.06	Much Managed	Capability

9	instructing learners to use plastic pails or floor crock for broken glassware and other solid disposable items utilized in the experiment and for suppressing fire	3.42	Moderately Managed	Constraint
10	advising learners to practice the acid to water (a-w) method in diluting acids	3.18	Moderately Managed	Constraint
11	advising learners to wear safety goggles or industrial quality safety spectacles in laboratories	3.78	Much Managed	Capability
12	providing signage that forbid any horseplay or practical joke	3.43	Moderately Managed	Constraint
13	requesting learners to label containers of chemicals showing the name of the chemical, date, owners' name and safety precaution if hazardous	3.74	Much Managed	Capability
14	advising learners to secure compressed gas cylinders with a strap or chain at all times	3.37	Moderately Managed	Constraint
15	forbidding learners to do experimental work with radioactive material or equipment in ionizing radiation	3.41	Moderately Managed	Constraint
16	advising learners to wear glasses, aprons and protective sleeves and closed shoes while working with reagents	3.83	Much Managed	Capability
17	instructing learners to roll their long sleeves above the wrist as a definite safety habit	3.60	Much Managed	Capability
18	advising learners to talk with control and restraint	3.72	Much Managed	Capability
19	instructing learners to study the purpose of an experiment as one of the most important steps of beginning chemistry laboratory practice	4.04	Much Managed	Capability
20	advising learners to point away from anybody when heating test tubes or any piece of equipment which have a potential for expelling a gas or liquid	3.72	Much Managed	Capability
21	instructing learners to check all glassware for cracks before and after use	3.90	Much Managed	Capability
22	requesting learners to place glassware of all types at the back of the laboratory to prevent unnecessary breakage	3.83	Much Managed	Capability
23	preventing learners to hold long pieces of glass tubes vertically when walking through the laboratory	3.53	Much Managed	Capability
24	advising learners to flush thoroughly any spilt reagents	3.65	Much Managed	Capability
25	advising learners to properly clean and dry used glassware before storing	4.02	Much Managed	Capability
	Sub-Mean	3.72	Much Managed	Capability
	Overall Mean	4.12	Much Managed	Capability

Personnel

Table 5 presents the capabilities and constraints in the extent of materials management of Science Laboratories along with personnel. It is evident from the table that, generally, personnel are a constraint, as indicated by the school heads. Specifically, the constraints were on training the lab technician or Science teacher in: basic first aid and the use of fire extinguishers, cleaning and proper storage of chemicals and equipment, proper disposal of chemicals, especially hazardous chemicals, and safe handling and use of equipment and chemicals.

From the teachers and learners, the capabilities were on making learners realize that safe learning is an integral and essential part of science education, or work, and of life; explaining to the learners the potential hazard of all the materials, processes and equipment in the school laboratory; making all learners adhere to necessary laboratory safety requirements established as a condition of participation; providing close supervision of the daily activities of learners in laboratories to be reasonably sure of good compliance; explaining and demonstrating to learners basic first aid and use of fire extinguisher for any accident or untoward incidents; and instructing learners to wear appropriate PPEs at all times.

Table 5. Capabilities and Constraints in the Extent of Materials Management of Science Laboratories along Personnel

No.	Attribute	Mean	Interpretation	Classification
A.	As perceived by the School Heads , the school manages its Science Laboratory along Personnel by:			
1	assigning a full-time lab technician or science teacher to take charge of the science laboratory	3.69	Much Managed	Capability
2	training the lab technician or science teacher basic first aid and use of fire extinguisher	3.50	Moderately Managed	Constraint
3	training the lab technician or science teacher in the cleaning and proper storage of chemicals and equipment	3.34	Moderately Managed	Constraint
4	training the lab technician or science teacher in proper disposals of chemicals especially hazardous chemicals	3.44	Moderately Managed	Constraint
5	training the lab technician or science teacher on safe handling and use of	3.41	Moderately Managed	Constraint

	equipment and chemicals			
	Sub-Mean	3.48	Moderately Managed	Constraint
B.	<i>As perceived by the Science Teachers, the school manages its Science Lab Personnel by:</i>			
1	making learners realize that safe learning is an integral and important part of science education, work, and life	4.18	Much Managed	Capability
2	explaining to the learners the potential hazard of all the materials, processes and equipment in the school lab	4.29	Much Managed	Capability
3	making all learners adhere to necessary laboratory safety requirements established as a condition of participation	4.38	Much Managed	Capability
4	instructing learners to wear appropriate PPEs at all times	4.23	Much Managed	Capability
5	providing close supervision of the daily activities of learners in laboratories to be reasonably sure of good compliance	4.32	Much Managed	Capability
	Sub-Mean	4.28	Much Managed	Capability
C.	<i>As perceived by the Learners, the school manages its Science Laboratory Personnel by:</i>			
1	making the learners realize that safe learning is an integral and important part of science education, or work, and of life	4.33	Much Managed	Capability
2	explaining to learners the potential hazard of all the materials, processes and equipment in the school lab	4.20	Much Managed	Capability
3	explaining and demonstrating to learners basic first aid and use of fire extinguisher for any accident or untoward incidents.	4.12	Much Managed	Capability
4	instructing learners to adhere to necessary laboratory safety requirements established as a condition of participation	4.08	Much Managed	Capability
	Sub-Mean	4.18	Much Managed	Capability
	Overall Mean	3.98	Much Managed	Capability

4.0 Conclusion

In conclusion, the study revealed that the processes involved in inventory, storage, safety practices, and personnel management in the Science laboratories of public high schools in La Union are well-managed; however, the identified constraints, particularly those related to personnel, need to be addressed. The set of policy recommendations is implementable, sustainable, and addresses the need for improvement in the materials management of science laboratories in public schools. In addition, the findings provide evidence to support Nuesca's Comprehensive Science Laboratory Management Theory, which holds that the efficient and effective management of materials, learning tools, and equipment in the Science laboratory depends on the extent to which acceptable standards are practiced by all concerned parties, including school leaders, teachers, and users.

Based on the findings and conclusions, the following recommendations, among others, were offered. The policy recommendations to improve the management of materials in science laboratories should be adopted and implemented by all school heads and other relevant education officials to help ensure that science laboratory rooms form part of a safe teaching and learning environment. A Science Laboratory Operations Manual should be crafted to aid the science teachers, laboratory custodians, and learners as they perform laboratory experiments in the Science laboratories. Future researchers should consider the findings of this study when undertaking parallel or similar studies related to the improvement of laboratory skills, in particular, and Science education, in general.

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7.0 Conflict of Interest

None declared.

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