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Research Article

Exploring the Laboratory Equipment Status in Public Remote Schools: Basis for a Strategic Laboratory Development Plan

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ABSTRACT

This study looked into the status of laboratory equipment in the facilities of public remote secondary schools in the Schools Division of Ilocos Norte for the 2025–2026 academic year and in particular the lack of laboratory equipment. An inquiry of a case study research design using a mixed-methods method was carried out. Researchers recruited 50 science teachers from 20 distant secondary schools to participate in the study by using purposive and census sampling. An adapted survey questionnaire and checklist adapted from DepEd Order No. 118, s. 2009 the study purposely sampled teachers, comprising more than five years' experience and related training, in science teaching. Descriptive statistics including frequency counts and percentage analyses, as well as thematic analysis, were employed to analyze data as described by Braun and Clarke (2016). The results of this study demonstrated the notable lack of primary laboratory materials, such that several of the key items were found to be totally missing in all the schools identified. In contrast, most studies found cheap laboratory materials that only served the regular tasks were available. Such deficiencies limit access to hands-on experimentation, real world experience and hands-on science lessons that impact students' engagement and the acquisition of fundamental skills. Thus, the results underline a need for targeted interventions to supplement the provision of equipment, chemicals, and models not only to prepare teachers but also to reinforce science training within schools at a distance and assure students get an opportunity for laboratory training.

Keywords: *Hands-on learning, Ilocos Norte, Laboratory equipment, Public schools, Remote secondary schools, Resource availability, Science education, Science instruction, Teacher strategies*

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Background

Science education is essential in providing young people with the essential critical thinking skills and innovative mind-sets which they need to cope with modern society's increasingly complex problems. When teachers use laboratory equipment for instruction, the transformational potential is intensified.

Laboratory experiments provide students with the opportunity to transform abstract scientific theories into real and observable things. Learners gradually establish an in-depth conceptual understanding through direct observation of chemical reactions, experimentation with mechanical principles and manipulation of scientific tools.

A study on public secondary schools in Ilocos Norte examined availability, accessibility, and use of science lab resources (Cabusor & Antonio, 2025). The results indicated that basic lab equipment were widely available, but state-of-the-art equipment and chemicals had not yet found a widespread adoption. Most of these schools also did not have basic facilities like dark rooms and shower rooms. Resources were often underutilized, with no device reported as “always utilized” and dark rooms infrequently used. The descriptive research design of the study revealed gaps both in resource provision and in practice using purposive sampling of 50 science teachers. Further research was needed to provide an evaluation of the availability of laboratory resources nationwide, comparing to student performance, and to review policies that would ensure equitable distribution and effective use of science laboratory resources.

Lagura (2024) explored the experiences and difficulties faced by science educators working in last-mile schools located in Ilocos Norte, especially during the pandemic. It turned out that in spite of relatively rigorous scientific literacy, students frequently were not able to retain concepts, and to reason or solve real world problems. The Department of Education’s Last Mile School program was aimed at filling these gaps through improved facilities and teacher capabilities. The findings underscore the significance of the introduction of localized, contextually sensitive learning approaches and sustainable development goals (SDGs) to enhance the performance of science education programs in marginalized regions of the world. In addition, two public junior high schools in Lanao del Sur, Philippines undertook a study which focused on the readiness of science laboratory facilities (Hadji Abas & Marasigan, 2020).

The findings highlighted key obstacles: there were no specific laboratory rooms in both schools, either with broken or substandard equipment, and not enough necessary learning materials, utilities such as water and electricity. The deficiencies made it challenging for teachers in carrying out science modules and in enabling students to have substantive hands-on experiences.

Remote schools in the Philippines have resource deficits and infrastructural barriers that restrict effective science learning (Edulan & Fajardo, 2024). Many low-income remote and underserved schools in the Philippines remained beset by significant infrastructural divides, as Navarro (2024) underscored. Classrooms were frequently overcrowded or ill-equipped, electricity supply was unreliable, and access to ICT resources and internet connectivity were limited. Basic water, sanitation, and hygiene (WASH) facilities were also often lacking. Such conditions made not only the teaching and learning process even harder, but also exacerbated the inequities between rural schools and their more privileged counterparts. Escala et al. (2024) showed the challenges of rural private schools in the Philippines to insufficient technological infrastructure and insufficient teacher preparation that made it that much more difficult for distance education to be delivered in remote or geographically isolated parts of the country.

These limitations not only led to a lack of quality instruction but they also brought to light the ongoing educational disparities in education for non-urban schools.

According to Garcia et al. (2022), science students compare learning without laboratory activities to “finding light in the dark,” describing the impossibility of understanding previously unknown scientific terminology and ideas without any field experiences. Lacking access to laboratories, learning materials or tools to conduct home-based experimentation, students had difficulty internalizing the scientific arguments in a meaningful way.

Mangarin and Macayana (2024) posited that long-term underfunding, differential resource allocation, and inadequate teacher training in Philippine public schools directly caused lab equipment scarcity. These systemic issues restricted students' opportunities to engage in hands-on experimentation, which weakened their conceptual understanding and adversely impacted their performance in science courses.

Similarly, Malaya and Panganiban (2021) demonstrated that access to well-equipped laboratories and modern science learning resources was strongly associated with higher science achievement among Grade 10 learners, while deficiencies in laboratory equipment were linked to lower levels of student performance.

Although the Department of Education (DepEd) had long mandated the provision of standard and functional laboratory equipment through policies such as DepEd Orders No. 88, s. 1988; No. 48, s. 2006; and No. 118, s. 2009, studies continued to reveal a persistent gap between policy and practice, particularly in remote schools.

Recent initiatives further emphasized the timeliness of reassessing laboratory resource availability in Ilocos Norte. For instance, the Lab-in-a-Box project launched by the Ateneo Intellectual Property Office provided training for science teachers and distributed portable kits to selected schools in Batac City as a way to compensate for the absence of fully equipped laboratories (Perote, 2025). Although this intervention showed some innovative strategies to address the shortages of resources, it also highlighted the need to systematically document the actual conditions of laboratory facilities across the province.

Amigo et al. (2023) found that science teachers in Ilocos Norte face a great challenge in carrying out practical activities during and after the pandemic due to the limited laboratory environment as well as the inadequacy of the ICT resources. This added another dimension of the challenges highlighted by the study, which emphasizes urgency in assessing the availability of laboratory resources within the province in order to further ensure that science instruction remained relevant, engaging and effective across the spectrum of traditional and dynamic learning situations. Although numerous studies have been conducted examining school facilities and resource utilization in the Philippines, for remote secondary schools in Ilocos Norte, there is limited data available on the status of laboratory equipment.

So, as a result of the lack of resources, science instruction frequently became mostly theoretical rather than active. This study is driven by the need to overcome that shortcoming. Without a clear awareness of which resources are missing, administrators' efforts to allocate budgets and initiate interventions tend to be both sweeping and ineffective. Researching these specific shortages is important to start thinking about restoration of resources beyond the surface and toward something more precise and profound.

In addition to the academic contribution the study has practical relevance for the Schools Division of Ilocos Norte. It acts as a diagnostic baseline, giving the school administrators and curriculum developers a clear, data-backed picture of what is currently needed. The latter will contribute to more equitable and knowledgeable distribution of MOOE funding. For science teachers, the study also recognizes and legitimizes the challenges of teaching in resource-limited settings. It provides an academic rationale for calling for localized instructional strategies that respond to such limitations. As a whole, it aims to reconcile the vision of national DepEd mandates with the practical situation at remote schools, thus providing a roadmap to increase science education in disadvantaged communities.

Limitation of the Study

This study aimed to explore and describe the status of laboratory equipment in public remote secondary schools during School Year 2025–2026 and employed a descriptive research design.

The respondents were science teachers currently teaching in these schools.

Methods

Research Design

This study employed a descriptive research design to explore and describe the status of laboratory equipment in public remote secondary schools in the Schools Division of Ilocos Norte for SY 2025–2026. This approach is suitable because it captures a clear snapshot of what resources are available, without attempting to test causes or implement changes (McCombes, 2023).

Population and Sampling Procedure

The target population consisted of all science teachers currently teaching in public secondary remote schools in all the municipalities covered by the SDOIN. Given the potentially limited number of science teachers in these schools, a combination of purposive and census sampling was employed.

The inclusion criteria for this study consisted of science teachers with more than five years of teaching experience who had attended relevant seminars and training. The exclusion criteria included teachers with less than five years of experience, those who had not participated in relevant professional development, and those on extended leave during the data collection period.

Table 1. Distribution of Science Teachers by Municipality

Municipality	**f**	**%**
Badoc	4	8
Dingras	10	20
Marcos	5	10
Nueva Era	5	10
Pagudpud	4	8
Paoay	6	12
Piddig	2	4
Pinili	2	4
Vintar	12	24
Total	**50**	**100**

Research Instrument

To gather comprehensive data this study employed a survey questionnaire adapted from the Department of Education's standards for secondary science laboratories (DepEd Order No. 118, s. 2009). This served as the primary instrument for collecting quantitative data on the unavailable laboratory equipment in remote schools.

Data Gathering Procedures

This study began after obtaining clearance from the University Research Ethics Review Board (URERB). Formal permission was obtained from the Schools Division Superintendent of Ilocos Norte and the principals of the participating schools, and the research proposal and instruments were provided for their review prior to data collection. The selected schools in which the science teachers were invited to participate were selected with official channels of invitation, e.g. school memoranda or school principals meetings with instructions of study purpose/procedures, and an explanation of the study conduct, procedures and ethical principles including informed study consent were provided to the science teachers. Teachers completed the survey (face to face or online depending on practical convenience) with clearly stated instructions and adequate time for responding.

Data Analysis

Descriptive statistics, specifically frequency enumeration and laboratory equipment non-available percentages for the samples, were utilised to analyse data collected. All calculations were carried out manually to assess the availability of laboratory equipment and reporting accordingly.

Ethical Considerations

The ethical aspects to be respected for this study were stringent for the sake of the integrity of the participants. Each subject gave informed consent in writing after receiving detailed information on the research questions, procedure, and the right to withdraw from the study at any time without any consequences. No coercion or pressures were exerted; participation in the study was voluntary. Confidentiality and anonymity were respected by removing all participants' personal data, and pseudonyms were applied when reporting results. The study was prioritized with respect for persons by safeguarding their rights, dignity, and well-being throughout the research process.

The study design was guided by ethical principles to ensure participant well-being and reduce the risk of harm.

All collected data were stored securely and confidentially, accessible only to the principal researcher and authorized members of the research team. Digital data was password-protected and stored on secure servers, while physical data, such as paper questionnaires, were kept in locked file cabinets.

Finally, permission to conduct the study was obtained from relevant authorities, including the Schools Division Superintendent of Ilocos Norte, school principals of the participating institutions, and ethics review boards, ensuring compliance with institutional guidelines.

Result and Discussion Laboratory Equipment Status

Table 2 shows the laboratory equipment status in remote secondary schools in the Schools Division of Ilocos Norte. The laboratory equipment are classified into five: 1) Electrical Devices; 2) Glassware and Porcelain Apparatus; 3) Laboratory Tools; 4) Laboratory Reagents and Chemicals; 5) and Models.

Among Electrical Devices, results show that 50 (100%) teachers reported that the compound microscope, digital weighing scale, and centrifuge machine are not available in their schools. This indicates that these vital laboratory equipment are nearly non-existent, which severely restricts opportunities for hands-on science experimentation in distant secondary schools. Induction stove and calorimeter are not found in 49 (98%) of the schools, second most missing electrical devices. Being absent from laboratories means that heating processes, thermal energy, and calorimetric experiments are not possible. This highlights the difficulties for teachers trying to provide holistic science teaching. Water heaters (48, 96%) and stopwatches (47, 94%) rank third in unavailability for their devices. So even the most basic ones, which are necessary in time-based experiments or controlled heating activities, are largely unavailable.

Moreover, the refrigerator is reported by 44 (88%) teachers as the least unavailable. This is somewhat more accessible than water heaters, but it reflects a still continued shortfall of essential laboratory equipment.

This result is supported by the study of Mangarin and Macayana (2024) in which they observed that a number of secondary schools suffer from a shortage of basic laboratory facilities and equipment in general. They blamed these failings on restricted funding and poor infrastructure which therefore prevents laboratories from providing good science lessons.

In the aspect related to Glassware and Porcelain Instruments 50 (100%) teachers reported the lack of volumetric pipettes and spot plates. This complete absence of these materials is indicative of ongoing lack of laboratory-based science teaching and thus, limited ability for the students to use accurate measurement, meaningfully perform experiments and acquire the scientific skills which is necessary, and is a discomposing situation for students in less-resourced schools.

By contrast, one teacher (2%) said funnels, stirring rods, mortar and pestle were just missing. This indicates that the basic laboratory equipment is more often supplied at lower prices than with less common tools and that these everyday devices are less expensive, but it also indicates that the divide in laboratory resources, including for more advanced scientific tasks, is not even as large as their counterparts. A study by Ezeiheukwu (2025) further supports this finding, where the researchers found that public secondary schools located in rural and geographically-isolated areas lack basic laboratory apparatus including volumetric glassware, experimental tools, and actual science equipment, which limits the amount of laboratory experimentation that students can perform.

The research highlighted that if these standards are not met, students develop no measurement skills, lack experimental accuracy, and lack scientific reasoning; all factors that contribute to inferior science instruction in their schools. In relation to Laboratory Tools, hose clamps and electrolysis apparatus are not available in the schools of all 50 (100%) of the teachers.

This complete lack of the necessary equipment precludes experiments that need controlled flow systems and electrochemical reactions. By contrast, 1 (2%) of our teachers said tripods and clamps were unavailable. Their presence indicates that some basic support tools are within reach, but there are persistent gaps in access and use of critical laboratory resources.

Secondary school science teachers in the Philippines often describe limited access to laboratories and technology as a constraint to education in science through limited access to laboratory tools and equipment (Calo and De Vera, 2025) and consequently limiting hands-on learning and student learning, to the detriment of motivation.

In Class 4 – Laboratory Reagents and Chemicals, results indicated that all teachers (50 (100%) in all categories) mentioned the lack of gentian violet, iodine solution, spirit of ammonia and boric acid. This means complete lack of the necessary reagents necessary for basic chemical experiments and practical work. 47 (94%) of teachers reported immersion oil and formalin which are among the list of the least unavailable chemicals. This means that these chemicals are fairly well-supplied in the schools.

According to Mangarin and Macayana (2024), few public high schools in the Philippines have adequate science laboratories and equipment, thus hindering the hands-on experimentation and learning of learners. This reinforces the present results that specialized glassware such as volumetric pipettes and spot plates were missing, while very simple items including funnels and stirring rods were generally available. Regarding the final category on Models, 46 (92%) teachers stated that human skeletons and life-size human torsos were not available, thus indicating that the learners did not have access to primary anatomical models for learning by doing. However, only 2 (4%) of the teachers indicated that solar system models and periodic tables of elements are missing, indicating that they are the most available models. The widespread availability of these models supports a much enhanced understanding of scientific concepts by pupils in learning.

According to Brumpt, Bertin, Tatu, and Louvrier (2023), three-dimensional anatomical models allow students to better understand human anatomy as they feel more realistic (in touch) about what actually exists in a structure. Their research demonstrates that such models can improve both engagement levels and teaching methods for learning. However, they are expensive and not widely available.

Table 2. Laboratory Equipment Status in Public Remote Schools

Types of Laboratory Equipment		f	%
Electrical Devices	Compound Microscope	50	100
	Digital Weighing Scale	50	100
	Induction Stove	49	98
	Centrifuge Machine	50	100
	Stopwatch	47	94
	Water Heater	48	96
	Refrigerator	44	88
	Calorimeter	49	98
	Conductivity Apparatus	45	90
	Beaker (50ml, 250ml, 500ml)	39	78
	Test tube	3	6

Types of Laboratory Equipment		f	%
Glassware and Porcelain Apparatus	Graduated Cylinder (50 ml, 100ml, 150, ml, 200 ml, 500ml)	39	78
	Erlenmeyer Flask (250ml)	3	6
	Funnel	1	2
	Watch Glass	3	6
	Stirring Rod	1	2
	Thermometer	4	8
	Alcohol Thermometer	48	96
	Reagent bottle	4	8
	Weighing bottle	47	94
	Petri dish	2	4
	Glass Slides	2	4
	Cover slip	2	4
	Prepared Slides	2	4
	Hydrometer	48	96
	Glass Tubing	45	90
	Burets	48	96
	Volumetric Flask	49	98
	Florence Flask	45	90
	Condenser	48	96
	Volumetric Pipette	50	100
	Mortar and Pestle	1	2
	Spot plate	50	100
	Evaporating Dish	22	44
	Crucible	2	4
	Tripod	1	2
	Clamp	1	2
	Spatula	2	4
	Hose Clamp	50	100
	Iron stand and ring	3	6
	Test tube holder	2	4
	Crucible tongs	4	8
Laboratory Tools	Test tube rack	6	12
	Bunsen burner	48	96
	Gas Valves	48	96
	Alcohol Lamp	2	4
	Wire gauze	4	8
	Rubber Aspirator	48	96
	Wash bottle	4	8
	Test tube brush	5	10
	Rubber Stopper	48	96
	Forceps	46	92
	Utility Clamp	48	96
	Beaker tongs	41	82
	Striker	49	98
	Clay Triangle	5	10
	Filter Paper	22	44
	Centrifuge tubes	31	62

Types of Laboratory Equipment		f	%
	Magnifying Glass	3	6
	Dissecting Set	44	88
	Dissecting Pan	44	88
	Water Bath	45	90
	Syringe	6	12
	Litmus Paper and pH meter	12	24
	Medicine Dropper	2	4
	Osmosis Apparatus	49	98
	Electrolysis Apparatus	50	100
	Cork Borers	49	98
Laboratory Reagents and Chemicals	Baking soda	48	96
	Lye powder	48	96
	Gentian Violet	50	100
	Iodine Solution	50	100
	Bromothymol blue	49	98
	Vegetable oil	48	96
	Yeast powder	49	98
	Immersion oil	47	94
	Denatured Alcohol	48	96
	Acetone	48	96
	Activated carbon	49	98
	Spirit of Ammonia	50	100
	Water ammonia	49	98
	Boric Acid	50	100
	Calcium Chloride	49	98
	Copper Sulfate	49	98
	Hydrogen Peroxide	48	96
	Hydrochloric Acid	48	96
	Potassium Permanganate	48	96
	Magnesium Oxide	49	98
	Magnesium Ribbon	49	98
	Engine Oil	48	96
	Potassium Iodide	49	98
	Sulfur Powder	49	98
	Zinc Chloride	49	98
	Zinc Pellets	49	98
	Formalin	47	94
Models	Sun-Earth-Moon	9	18
	Solar System	2	4
	Human Torso, life-size	45	90
	Human Skeleton, life-size	46	92
	Animal mitosis	14	28
	Animal meiosis	15	30
	Plant cell	14	28
	Animal cell	14	28
	DNA Double Helix	3	6

Types of Laboratory Equipment	f	%
Periodic Table of Elements	2	4
Layers of the Earth	8	16
Types of Volcano	41	82
Tectonic Plate	43	86

Recommendations

School administrators should prioritize acquiring and maintaining essential laboratory equipment, especially those completely unavailable.

Proper use and regular monitoring of existing equipment can ensure that students benefit fully from hands-on science learning.

Future researchers are encouraged to continue studying laboratory resources, including equipment availability in other regions and factors that affect their effective use in instruction.

Conclusion

By the analysis it can be concluded that the laboratory apparatus of the public remote secondary schools in the Schools Division of Ilocos Norte are generally not available.

Key electrical instruments such as compound microscopes, centrifuge machines and digital weighing scales are largely unavailable. Certain laboratory reagents – like gentian violet and iodine solution are also missing. On the other hand, simple equipment like funnels, stirring rods and solar system models are more commonly accessible.

These findings are consistent with the Resource-Based Learning (RBL) Theory which emphasizes that meaningful learning arises from active engagement with materials. When learners possess a range of different, easily accessible resources, such as standard laboratory implements, makeshift equipment or digital simulations, they tend to find themselves more capable of deeper learning and critical thinking.

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References

Abbey-Kalio, I. (2024). *Laboratory resources availability, accessibility and utilization as correlate of chemistry students' academic achievement*. Direct Research Journal of Chemistry and Material Science, 12(2), 15–19. https://doi.org/10.26765/DRJCMS3956849

Amigo, R., Gabu, K., Diego, R., & Lagura, L. (2023). Challenges in teaching science and its transition to post-pandemic education. *American* constructive comments that

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Brumpt, M., Bertin, H., Tatu, L., & Louvrier, A. (2023). Educational value of three-dimensional anatomical models in anatomy learning. *Anatomical Sciences Education, 16*(3), 345–353.

Cabusor, S. M. B., & Antonio, V. V. (2025). Availability, accessibility, and teachers' utilization of science laboratory resources in public secondary schools of Ilocos Norte. *International Journal of Multidisciplinary: Applied Business and Education Research, 6*(3). https://www.ijmaberjournal.org/index.php/ijmaber/article/view/2203

Calo, J. C., & De Vera, R. M. (2025). Barriers to effective science instruction in Philippine secondary schools. *Journal of Philippine Education Research, 7*(1), 22–34.

Department of Education. (1988, September 21). *DO 88, s. 1988 – Standard science, mathematics and practical arts equipment for secondary schools*. https://www.deped.gov.ph/1988/09/ 21/do-88-s-1988-standard-science-mathematics-and-practical-arts-equipment-for-secondary-schools/

Department of Education. (2006). *DepEd Order No. 48, s. 2006 – Strengthening science education in public secondary schools*. Department of Education.

Department of Education. (2009). *DepEd Order No. 118, s. 2009 – Guidelines on laboratory equipment and facilities for secondary schools*. Department of Education.

Edulan, D. J. B., & Fajardo, M. T. M. (2024). Challenges, coping mechanisms, motivation, and support needs for out-of-field science teachers in Western Mindanao. *American Journal of Educational Research, 12*(7), 461–467. https://doi.org/10.12691/education-12-7-8

Escala, J. P., Santos, M. L., Rivera, N., & Cruz, R. T. (2024). Technological preparedness of rural private schools in distance learning implementation. *Philippine Journal of Education, 99*(2), 45–58.

Ezeiheukwu, J. C. (2025). Availability of laboratory apparatus and its influence on science instruction in rural secondary schools. *International Journal of Science Education Research, 4*(1), 19–30.

Garcia, J., Uluan, A. Y., Barat, I. J., Lubay, J. N., Macagba, I., & Mahinay, H. (2022). Lived experiences of science major students in the absence of laboratory activities. *American Journal of Education and Technology, 1*(2), 75–82. https://doi.org/10.54536/ajet.v1i2.5 13

Hadji Abas, H. T., & Marasigan, A. P. (2020). Readiness of science laboratory facilities of the public junior high school in Lanao del Sur, Philippines. *SSRN*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5075822

Lagura, R. T. (2024). *Exploring science education in last-mile schools: Experiences and challenges*. ResearchGate. https://www.researchgate.net/publication/381939849

Malaya, J. D., & Panganiban, J. C. (2021). Determinants of science achievement: A quantitative study of Grade 10 learners' academic performance and its associated factors. *International Journal of Research and Innovation in Social Science, 5*(7), 388–395. https://doi.org/10.47772/IJRISS.2021.5709

Mangarin, J. P., & Macayana, F. M. (2024). Funding constraints and laboratory resource gaps in Philippine public secondary schools. *Asia Pacific Journal of Educational Management, 11*(2), 66–78.

McCombes, S. (2022, October 10). *Descriptive research design: Definition, methods & examples*. Scribbr. https://www.scribbr.co.uk/research-methods/descriptive-research-design/

Navarro, L. R. (2024). Infrastructure disparities in remote and underserved Philippine schools. *Philippine Social Science Review, 76*(1), 101–118.

Perote, C. (2025, February 10). *Lab-in-a-box brings hands-on science closer to Ilocos Norte through teachers' training and school visits*. Ateneo Intellectual Property Office. https://www.aipo.ateneo.edu/post/lab-in-a-box-brings-hands-on-science-closer-to-ilocos-norte-through-teachers-training-and-school-v