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Life Sciences Teachers' Profiles, Knowledge, Skills, Extent of Use, and Challenges in Utilizing Virtual Laboratories

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Abstract

This descriptive-correlational study examined the profiles, knowledge, skills, extent of use, and challenges faced by teachers in utilizing virtual laboratories. The respondents were 176 Junior High School Life Sciences teachers from public secondary schools in the Schools Divisions of Ilocos Norte, City of Batac, and Laoag City, selected through purposive sampling. Data were gathered using an adapted survey questionnaire. Most participants were female, aged of 30–34, with the position of Teacher II and four to six years of teaching experience. A majority had no training in virtual laboratories. Findings showed that teachers' knowledge, skills, and usage of virtual laboratories were at a moderate level, with strong correlations among these variables. Major challenges identified included difficulty in platform utilization, lack of awareness of resources, professional restructuring issues, poor internet connectivity, and insufficient training and facilities. Thematic analysis revealed four coping strategies, which are the use of alternative modes, training/seminars/workshops, provision of materials, and visual learning implementation. Despite the challenges, learners found virtual laboratories exciting and motivating due to their ICT and 21st-century learning features. Teachers reported that these tools are easy to access and manipulate. Most respondents recommend integrating virtual laboratories into science teaching, recognizing both their potential and limitations.

Keywords: extent of use, coping strategies, knowledge, skills, virtual laboratory.

Introduction

Under Life Sciences teaching, the common problem of many schools is that they do nothave the essential equipment in science laboratories. This result limits the student to performing a simple laboratory activity. In addition, due to a lack of laboratories or insufficient instruments, hands-on laboratory activities are rarely performed; instead, virtual laboratories are explored, especially now with the mandated computerization program of the Department of Education (DepEd). With this situation, the use of digital learning or virtual laboratories is expected to be put into practice.

There are perceived challenges in the use of virtual laboratories. For teacher administration, it includes software issues, insufficient teacher preparation for virtual teaching, ongoing technical advancements that require additional training, and educators' opposition to curriculum changes. On the other hand, teachers experience challenges such as poor communication with school technology centers, frequent laboratory equipment and software problems, permission of inept students to study electronically, and inadequate preparation for teaching in a virtual setting.

According to research findings from a local study in Ilocos Norte entitled "Exploring theEffect of PhET Interactive Simulation-based Activities on Students' Performance and Learning Experiences," physics instruction can be enhanced by using an interactive teaching approach that piques students' interests. It was emphasized that science instruction in K to 12 classrooms is supported by the efficient incorporation of technology. This is just one of the few studies about virtual laboratory integration and effects, but there are no available studies under the Life Sciences subject matter (Batuyong et al., 2018).

Thus, the researcher developed an interest in conducting this study to find out the knowledge, skills, extent of use, and the challenges in utilizing the virtual laboratories among Life Sciences teachers. The findings can be utilized in making decisions and improvements in the curriculum development and ICT integration, and program development in the three schoolsdivisions in Ilocos Norte. This will help Junior High School Life Sciences teachers gain more awareness and knowledge about virtual laboratories for their professional growth and development.

This study determined and described the teachers' profiles, knowledge, skills, extent ofuse, and challenges in the use of virtual laboratories in their Life Sciences classes. Specifically,it sought answers to the following questions: 1. What are the profiles of the teachers in terms of a.) Age, b.) Sex, c.) Position, d.) Years of teaching experience, and e.) Number of trainings relevant to ICT or virtual laboratories? 2. What is the teachers' level of knowledge in utilizing virtual laboratories? 3. What is the teachers' level of skills in using virtual laboratories? 4. What is the teachers' extent of use of virtual laboratories? a.) Is there a significant relationship between the teachers' profiles and their level of knowledge about virtual laboratories? b.) Is there a major connection between the teachers' level of skills and the extent of use? 5. Is there a crucial link among the teachers' level of knowledge, level of skills, and extent of virtual laboratories use? 6. What are the teachers' challenges in the use of virtual laboratories and how is the coping strategies?

Methods

The study is anchored on the principles of Unified Technology Adoption and Use Theory (UTAUT). The theory focuses on answering questions related to technology adoption. Marikyan and Papagiannidis (2003) studied different technological models and formed the Unified Theory of Acceptance and Use of Technology (UTAUT).

This study employed a descriptive-correlational research design. This study was conducted in public secondary schools of the Schools Divisions of Ilocos Norte, Laoag City, and the City of Batac. JHS Life Sciences teachers from different schools of the divisions served as the respondents and sources of data to generate information. They were chosen to be the respondents of the study via purposive total enumeration.

The study utilized an adapted survey questionnaire from Ruiz (2020) from her GBLP (Game-based learning platform) study. To analyze the data acquired for this study, descriptive statistics of correlational statistical treatment were used to measure the strength of the linear relationship between the teachers' level of knowledge and the extent of virtual laboratories use. Frequency count was used to determine the number of respondents who belong to a particular age group, teaching positions, gender, and ICT training experience. Before implementation, ethical considerations were thoroughly followed in gathering critical data for this study. The University Research Ethics Review Board's requirements for research ethics approval were fully met when conducting this study

The researcher also obtained a letter of request and approval from the three school divisions for the distribution of the Google form link. The researcher briefly described the research process in the letter. Personal information such as a participant's name and phone number should not be included in the records that were shown. To maintain track and match the outcomes in this study, only the researcher had access to the names of the participants.

Results and Discussion

The findings reveal that most Life Sciences teachers in the Schools Divisions of Ilocos Norte, Laoag City, and the City of Batac are young, predominantly female, and hold the position of Teacher II, indicating a moderately experienced and technology-oriented workforce. A significant portion of these teachers have four to six years of teaching experience, reflecting a mid-career stage. However, despite this, the majority (79.55%) lack relevant training in ICT or virtual laboratories, pointing to a substantial gap in professional development in digital education tools. Teachers also demonstrated only moderate knowledge of virtual lab platforms like PhET, BioMan, and LabXchange.

This aligns with findings by Bugarso et al. (2021), who emphasized that while virtual laboratories are increasingly introduced in science education, many teachers remain underprepared due to limited access to training and infrastructure. These patterns suggest a pressing need for targeted training programs and support systems to enhance the effective use of virtual laboratories in Life Sciences teaching.

Table 1 shows the distribution of Life Sciences teachers based on their profiles in terms of age, sex, position, years of teaching experience, and number of trainings. It shows that Life sciences teachers is dominated by women teachers in the age of 30-34 years old, in the position as Teacher II. The teachers' experiences of teaching are mostly in 4-6 years of experience with the lack of relevant trainings to ICT or virtual laboratories

Table 1. Distribution of life sciences teachers based on their profiles

Components	Frequency (f)	Percentage (%)
1.1 Ages of Teachers		
20-24 years old	5	2.84
25-29 years old	39	22.16
30-34 years old	79	44.89
35-39 years old	40	22.73
40-44 years old	10	5.68
45-50 years old	3	1.70
TOTAL	176	100
1.2 Sex of Teachers		
Male	44	25.0
Female	132	75.0
TOTAL	176	100
1.3 Positions of Teachers		
Teacher I	33	18.75
Teacher II	100	56.81
Teacher III	39	22.16
Master Teacher I	1	0.57
Master Teacher II	1	0.57
Master Teacher III	1	0.57
Special Science Teacher I	1	0.57
TOTAL	176	100
1.4 Years of Teaching Experience		
1 – 3 years	12	6.82

Components	Frequency (f)	Percentage (%)
4 – 6 years	107	60.79
7 – 9 years	18	10.23
10 years and above	39	22.16
TOTAL	176	100
1.5 Number of Trainings Relevant to ICT or Virtual Laboratories		
PRAXILAB	1	0.57
BIOINTERACTIVE	7	3.98
BIOMAN	5	2.84
NOVALABS	1	0.57
LABXCHANGE	3	1.70
PHET	6	3.40
BIONETWORK	5	2.84
SHOCKWAVE	1	0.57
Others	7	3.98
No Training acquired at all	140	79.55
TOTAL	176	100

Teachers' Level of Knowledge in the Use of Virtual Laboratories

The findings show that most Life Sciences teachers lack adequate training and skills in using virtual laboratories, despite their exposure to technology. This gap suggests a need for focused and sustained professional development to improve their confidence and competence in integrating digital tools into instruction. Limited access to ICT training and minimal support from institutions further hinder teachers' ability to fully utilize virtual labs. Viernes (2021) highlighted that out of 3,566 DepEd learning resources, only 162 are technology-based, indicating a clear scarcity of digital instructional materials. Additionally, Tang et al. (2020) emphasized that while virtual laboratories have great potential to enhance science learning, their effectiveness depends largely on teachers' digital literacy and the institutional structures supporting them. Without structured and accessible training, many teachers remain hesitant or unprepared to fully adopt these tools, despite the growing emphasis on digital integration in education. These results emphasize the importance of aligning curriculum development with teacher capacity-building to ensure effective and meaningful use of virtual laboratories in Life Sciences teaching.

Table 2. Level of knowledge in the use ofvirtuallaboratories.

PRAXILAB	2.81	MK
BIOINTERACTIVE	2.85	MK
BIOMAN	2.86	MK
NOVALABS	2.79	MK
LABXCHANGE	2.81	MK
PHET	2.96	MK
BIONETWORK	2.85	MK
SHOCKWAVE	2.80	MK
Overall Mean	2.84	MK

Legend:

Range of Mean	Descriptive Interpretation (DI)
4.51 – 5.00	Very Highly Knowledgeable (VH)
3.51 – 4.50	Highly Knowledgeable (HK)
2.51 – 3.50	Moderately Knowledgeable (MK)
1.51 – 2.50	Slightly Knowledgeable (SK)
1.00 – 1.50	Not Knowledgeable (NK)

Teachers' Level of Skills in Using Virtual Laboratories

The findings indicate that Life Sciences teachers exhibit a moderate level of skills and extent of use in integrating virtual laboratories into their instruction. This suggests that while teachers are generally capable of operating virtual lab platforms, they may not be maximizing these tools to their full pedagogical potential. Contributing factors likely include insufficient training, limited institutional support, or a lack of consistent opportunities for practice and implementation. The moderate usage reflects a functional understanding without mastery, indicating a need for more targeted professional development. This aligns with the findings of Omolafe (2021), who emphasized that while teachers have a positive perception of technology integration, its effective use relies on accessible digital tools and proper training. Similarly, Ayoubi and Faour (2021) argue that the successful implementation of virtual laboratories depends not just on availability but also on educators' familiarity and skills level in navigating virtual environments. These findings reinforce the importance of equipping teachers with tools, confidence, and competence in utilizing virtual laboratories meaningfully for Life Sciences education.

Table 3. Mean ratings on the teachers' levelof skills in using virtual laboratories

Virtual Laboratories	Mean	DI
PRAXILAB	1.93	MS
BIOINTERACTIVE	2.02	MS
BIOMAN	1.97	MS
NOVALABS	1.91	MS
LABXCHANGE	1.93	MS
PHET	2.02	MS
BIONETWORK	1.97	MS
SHOCKWAVE	1.89	MS
Overall Mean	1.96	MS

Legend:

Range of Mean	Descriptive Interpretation(DI)
3.25 – 4.00	Very Highly Skilled (VHS)
2.50 – 3.24	Highly Skilled (HS)
1.75 – 2.49	Moderately Skilled (MS)
1.00 – 1.74	Non Skilled (NS)

Teachers' Extent of Use of Virtual Laboratories

The results reveal that Life Sciences teachers moderately use virtual laboratories across all platforms assessed, with an overall mean of 2.78. Among the platforms, BioInteractive (mean, 2.84), Bioman (mean, 2.82), and PhET (mean, 2.82) are the most used, while Shockwave (mean, 2.69) is the least. This indicates a general familiarity with these digital tools, yet suggests that their integration into science teaching remains at a moderate level. This average use highlights a clear opportunity for growth in terms of frequency, diversity, and depth of virtual lab integration in classroom instruction.

This finding aligns with the study by Al-Rahmi et al. (2021), who emphasized that the successful implementation of digital learning tools in education is largely influenced by teachers' motivation, perceived usefulness, and institutional support. Without sustained training and infrastructure, even accessible platforms remain underutilized. Therefore, there is a pressing need to strengthen professional development and provide technical support to encourage more extensive use of virtual laboratories in science education.

Table 4. Mean ratings on the teachers' extent of use of virtual laboratories.

Virtual Laboratories	Mean	DI
PRAXILAB	2.77	MU
BIOINTERACTIVE	2.84	MU
BIOMAN	2.82	MU
NOVALABS	2.73	MU
LABXCHANGE	2.77	MU
PHET	2.82	MU
BIONETWORK	2.81	MU
SHOCKWAVE	2.69	MU
Overall Mean	2.78	MU

Legend:

Range of Mean	Descriptive Interpretation (DI)
4.51 – 5.00	Very Highly Used (VHU)
3.51 – 4.50	High Used (HU)
2.51 – 3.50	Moderately Used (MU)
1.51 – 2.50	Slightly Used (SU)
1.00 – 1.50	Not Used (NU)

Relationship between the Teachers' Level of Knowledge, Skills, and Extent of Use of Virtual Laboratories

Based on the presented data, a generalization can be drawn that age and teaching experience significantly influence teachers' skills and the extent of use of virtual laboratories, although they do not determine knowledge levels. Younger teachers and those with less experience appear more inclined to adopt and integrate virtual labs into their instruction, likely due to their greater familiarity with technology and recent exposure to ICT-based training. In contrast, senior teachers may rely more heavily on traditional methods, such as hands-on or wet laboratory techniques. Thus, they exhibit less technological engagement despite their expertise.

Moreover, gender and professional rank (e.g., Teacher I or Master Teacher) do not significantly affect knowledge or skill levels in using virtual laboratories. Technological competencies may be more influenced by personal initiative and training opportunities than by demographic or professional status. However, teachers in higher positions tend to show higher usage, possibly due to expectations of broader instructional innovation or more access to training.

This aligns with findings by Mahlaba (2021), who emphasized that younger and early-career educators are more adaptable to digital learning tools, including virtual laboratories, due to their exposure to evolving educational technologies and flexible pedagogical perspectives. The study also noted that effective integration of ICT in teaching is more strongly correlated with recent professional development experiences than with tenure or position.

Table 5. Relationship between the teachers' level of knowledge, skills, and extent of use of virtual laboratories.

Age	r-value	p-value	Interpretation
Level of Knowledge	-0.123	0.103	Not Significant
Level of Skills	-0.303	0.000	Significant
Extent of Use	-0.196	0.009	Significant
Sex			
Level of Knowledge	0.022	0.776	Not Significant
Level of Skills	-0.009	0.904	Not Significant
Extent of Use	0.101	0.181	Not Significant
Position			
Level of Knowledge	-0.002	0.975	Not Significant
Level of Skills	-0.005	0.948	Not Significant
Extent of Use	-0.155	0.040	Significant
Years of Teaching Experience			
Level of Knowledge	-0.076	0.317	Not Significant
Level of Skills	-0.270	0.000	Significant
Extent of Use	-0.278	0.000	Significant

Legend: Significant at p-value < 0.05

Significant Relationship between the Teachers' Level of Knowledge, Level of Skills, and Extent of Use of Virtual Laboratories

It is shown that there is a significant relationship between the teachers' level of knowledge, skills, and extent of use of virtual laboratories. The absence of substantial correlations between these variable pairs (knowledge and skills, knowledge and extent of usage, skills and extent of use) indicates that these elements may function rather autonomously in this specific scenario.

Their relationship could also be interpreted as having virtual laboratory knowledge helps educators to be more skillful and confident in integrating virtual laboratories into classrooms. The same with having skills in virtual laboratory integration in Life Sciences classes means that the educators have knowledge or expertise from the frequent use of virtual laboratories in class. Also, the more frequently the application of virtual laboratories in the classroom setup, the more skillful and knowledgeable the teachers are.

Table 6.1 Relationship between the teachers' level of knowledge and level of skills.

Variables	Level of Knowledge	Interpretation
Level of Knowledge	-	Significant
Level of Skills	0.648	Significant

Legend: Significant at p-value < 0.05

Table 6.2 Significant relationship between the teachers' level of knowledge and the extent of use of virtual laboratories

Variables	Extent of Use	Interpretation
Level of Knowledge	0.834	Significant
Extent of Use	-	Significant

Legend: Significant at p-value < 0.05

Table 6.3 Significant relationship between the teachers' level of skills and the extent of use of virtual laboratories

Variables	Level of Skills	Interpretation
Level of Skills	-	Significant
Extent of Use	0.685	Significant

Legend: Significant at p-value < 0.05

Teachers' Challenges and Coping Strategies on the Implementation of VirtualLaboratories

The most common answers with trend among the 116 respondents are consolidated for a more detailed elaboration of the respondents' answers.

The table above shows 4 themes based on the generated answers of the respondents. Under alternative methods, the teachers use other modalities like PowerPoint, Slideshare, videos, and other ICT-based materials as alternatives to virtual laboratories. Teachers are always learning. In order to address the challenges and difficulties in virtual laboratory implementation, they also do their research and practice virtual laboratory applications before implementing them in the classroom. They also seek training about virtual laboratories and other ICT-based instructional materials. Most of them also seek technical support from learners and ICT teachers who are more skilled in accessing this kind of technological means. These coping strategies allow the respondents to address the challenges and difficulties they encounter in virtual laboratories in their Life Sciences classes.

The study reveals that Life Sciences teachers adopt various coping strategies to overcome challenges in implementing virtual laboratories. These include utilizing alternative digital tools such as PowerPoint, Slideshare, and videos, engaging in self-directed learning and practice, seeking formal training, and relying on technical support from students and ICT specialists. Such adaptive behaviors reflect teachers' proactive efforts to integrate technology effectively despite barriers, emphasizing continuous professional development and collaboration as key factors in the successful virtual laboratories. This aligns with findings by Trust and Whalen (2020), who noted that teachers' resilience and resourcefulness, supported by peer collaboration and ongoing training, significantly enhance technology integration in science education.

Table 7. Mean ratings on the teachers' challenges in the implementation of virtual laboratories

Statements	Mean	DI
1. I am concerned about students' attitude toward VirtualLaboratories.	3.90	VTMN
2. I know of some other approaches that might work better than Virtual Laboratories.	3.86	VTMN
3. I am concerned about other platforms in the teaching and learning.	3.91	VTMN
4. I am concerned about not having enough time toorganize myself in utilizing Virtual Laboratories.	3.89	VTMN
5. I would like to help other faculty in the use of Virtual Laboratories.	3.88	VTMN
6. I have a very limited knowledge of the Virtual Laboratories.	3.88	VTMN
7. I would like to know the effect of reorganization of myVirtual Laboratories professional status.	3.91	VTMN
8. I am concerned about the conflict between my interest and my responsibilities with the utilization of VirtualLaboratories.	3.86	VTMN
9. I am concerned about revising the use of VirtualLaboratories. .	3.86	VTMN
10. I would like to develop working with relationships with both our faculty and outside faculty using VirtualLaboratories.	3.89	VTMN
11. I am concerned about how Virtual Laboratories affectsstudents.	3.89	VTMN
12. I am not concerned about Virtual Laboratories at this time.	2.11	NTMN
13. I would like to know who will make the decision in theutilization of Virtual Laboratories.	3.87	VTMN
14. I would like to discuss the possibility of using VirtualLaboratories.	3.88	VTMN
15. I would like to know what resources are available if wedecide to adopt Virtual Laboratories.	3.91	VTMN
16. I am concerned about my inability to manage all thatthe innovation requires.	3.86	VTMN
17. I would like to know how my teaching or administration is supposed to change with VirtualLaboratories.	3.89	VTMN
18. I would like to familiarize other departments or personswith the progress of this new Virtual Laboratories.	3.89	VTMN
19. I am concerned about evaluating my impact of VirtualLaboratories on the students.	3.90	VTMN
Overall Mean	3.71	VTMN

Legend:

Range of Mean	Descriptive Interpretation (DI)
3.25 – 4.00	Very True of Me Now (VTMN)
2.50 – 3.24	Somewhat True of Me Now (STMW)
1.75 – 2.49	Not True of Me Now (NTMN)
1.00 – 1.74	Irrelevant (I)

Teachers' Coping Strategies

Table 8. Identified coping strategies of Life Sciences teachers to virtual laboratory challenges

Themes	Categories	Codes
Use of Alternative Methods	By searching for new and easier Virtual Laboratories apps and programs to useeven offline	Virtual Laboratories apps and programs touse even offline,other virtual
	Trying other Virtual Laboratories appsand pages	Laboratory apps and pages
	I've been using PHET Simulations in my class by projecting it in the TV of my class. Aside from that, I'm using lab videos to do it	Using lab videos
	I use other ICT-based techniques	Other ICT-based techniques
	I only showthem through projector viewing	Projector viewing
	Relying on assisted videos on YouTube	Assisted videos on YouTube
	Use of PowerPoint	PowerPoint
Training/Seminar/Self-Practice	Employ a management strategy	Management strategy
	Use of student tech support	Student tech support
	Practice before implementation	Practice
	Attending a seminar and training	Seminar and training
Provision of Materials	Use of personal PCs and laptops	Personal PCs and laptops
	Allocating budget for wifi/ internet connectivity	Allocating budget
	Allowing the use of personal phones to access Virtual Laboratories	Personal phones to access Virtual Laboratories
Visual Learning Implementation	It is difficult to look for readily available materials. My coping action would be to demonstrate virtually. Through demonstration only (Case to case basis).	Demonstrate virtually
	By showing how to do it, so they canaccomplish	Demonstration

Conclusion

The majority of the study participants are female, aged 30-34, primarily hold the position of Teacher II, and possess four to six years of teaching experience. Most of these teachers have limited training in the use of virtual laboratories.

Teachers exhibit a moderate level of knowledge, skills, and extent of use regarding virtual laboratories. Age does not significantly relate to teachers' level of knowledge about virtual laboratories, but it is significantly associated with their skills and frequency of use. Additionally, there is no significant relationship between teachers' sex and their knowledge, skills, or use of virtual laboratories. Similarly, teachers' position does not significantly relate to their knowledge or skills, although it is significantly connected to their extent of use. Years of teaching experience do not show a crucial correlation with knowledge, but it has a significant relationship with both skills and the extent of use of virtual laboratories. Furthermore, there are important relationships among teachers' knowledge, skills, and the extent of use of virtual laboratories.

Respondents identified challenges such as navigating different teaching platforms, understanding changes in professional status, and awareness of resources available for virtual laboratory implementation. These concerns indicate an ongoing apprehension regarding the effective use of virtual laboratories.

Four main coping strategies emerged from the study: First, the use of alternative instructional tools like PowerPoint and other ICT resources. Second, engaging in self-directed training, seeking student support, and attending formal workshops and seminars on virtual laboratories. Third, provision of personal technological resources, such as laptops and internet access, and permitting the use of mobile devices during lessons. Lastly, employing visual learning methods, including multimedia presentations and demonstration teaching, allows students to observe virtual laboratory activities instead of direct interaction.

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