



AVAILABILITY AND UTILIZATION OF CHEMISTRY LABORATORY RESOURCES IN HIGHER SECONDARY SCHOOLS

S. Sankar Prasath Kumar¹ and Dr. R. Ramnath²

¹Ph.D. Scholar (Part-Time), Department of Education, Alagappa University, Karaikudi, Tamil Nadu.

²Assistant Professor, Department of Education, Alagappa University, Karaikudi, Tamil Nadu.



ABSTRACT

The present investigation attempts to find out the availability and utilization of chemistry laboratory resources in higher secondary schools. Survey method was conducted on a simple random sample of 30 PG teachers and 300 higher secondary school students in Tiruvannamalai and Krishnagiri districts, Tamil Nadu. Data was analyzed by percentage. Results indicated that more than 70% of the schools have adequate chemistry laboratory resources. In terms of the utilization, 36.6% of the apparatus and materials and 42.5% of the salts are rarely utilized by students. In general, the rarely utilized responses were highly recorded than the always and occasionally used responses in terms of apparatus, equipments, salts, reagents, materials, acids, bases and resources.

KEYWORDS: Availability, Utilization, Chemistry Laboratory, Resources, Higher Secondary Schools.

INTRODUCTION:

Chemistry is one of the fundamental ingredients of science and technology. It is a branch of science that deals with the practical and experimental understanding of natural phenomena. As a science subject, scientific inquiry is the primary process by which scientific knowledge is gained. One of the most effective ways by which the process of inquiry can be learnt is a laboratory where the students can get first hand experiences. Thus, the study in a laboratory is an integral and essential part of science in general and chemistry in particular.

Quality and effective teaching of Chemistry depends largely on adequate provision and proper utilization of instructional resources. A practical based approach to Chemistry is the key and to breakthrough in Science and Technology advancement. Therefore, the study investigates the availability and Utilization of Chemistry laboratory Resources is imperative one.

NEED AND SIGNIFICANCE OF THE STUDY

Developed nations of the world are so called because of their advancement and growth in Science and Technology. For India to be at par with the developed nations of the world there is the need to make science more interesting among students and ensure effect resources and effective teaching of science in our schools which is possible by making necessary provision of laboratory resources and their utilization. From this perspective, the present study assumes greater significance.

Laboratory activities encourage students to construct knowledge by interaction with laboratory materials as they solve problems. Manipulation of equipments will help the learners not only acquire science process skills and new knowledge but also scientific attitude such as honesty, open-mindedness and co-operation as moralities of science and enhance understanding and retention of difficult concepts and procedures. The developments of such qualities rely on well equipped laboratory and the extent of their

utilization. Therefore the present study has been undertaken to find out the availability and utilization of Chemistry Laboratory Resources in Higher Secondary Schools.

OBJECTIVES OF THE STUDY

- To find out the extent of availability and adequacy of chemistry laboratory resources in higher secondary schools.
- To find out the extent of utilization of available chemistry laboratory resources in higher secondary schools.

HYPOTHESES

- The availability and adequacy of Chemistry Laboratory Resources in Higher Secondary Schools are low.
- The level of utilization of Chemistry Laboratory Resources in Higher Secondary Schools is low.

METHOD & SAMPLE

Survey method was adopted for the present study. The simple random sample consisted of 300 higher secondary school students and 30 PG teachers working in Government and Private Schools in Tiruvannamalai and Krishnagiri districts, Tamil Nadu.

TOOLS

The two instruments which employed in the study are developed and validated by the investigator. The two instruments were used for the study namely scale for availability of chemistry laboratory resources and adequacy of chemistry laboratory resources used to collect data from teachers and a scale of utilization of chemistry laboratory resources used to collect data from students. The investigator has established the validity and reliability (0.72) for the scale for availability of chemistry laboratory resources. The validity and reliability for the scale for adequacy of chemistry laboratory resources was (0.76).

ANALYSIS OF DATA

Table-1: Extent of Availability of Chemistry Laboratory Resources in Higher Secondary Schools

S.No.	APPARATUS AND MATERIALS	AA		OA		UD		RA		NA		ADEQUACY			
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Burette	18	60	7	23.3	0	0	5	16.7	0	0	17	56.7	13	43.3
2	Pipette	21	70	7	23.3	0	0	2	6.7	0	0	20	66.7	10	33.3
3	Conical flask	20	66.7	7	23.3	0	0	3	10	0	0	18	60	12	40
4	Funnel	22	73.3	6	20	0	0	2	6.7	0	0	20	66.7	10	33.3
5	Reagent Bottles	17	56.7	4	13.3	0	0	9	30	0	0	17	56.7	13	43.3
6	Retort Stand and Clamp	18	60	7	23.3	0	0	5	16.7	0	0	18	60	12	40
7	Porcelain Tile	18	60	6	20	0	0	6	20	0	0	18	60	12	40
8	Wash Bottle	19	63.3	9	30	0	0	2	6.7	0	0	16	53.3	14	46.7
9	Measuring Cylinder	26	86.7	2	6.7	0	0	2	6.7	0	0	22	73.3	8	26.7
10	Volumetric Flask	18	60	5	16.7	0	0	7	23.3	0	0	18	60	12	40
11	Weighing Balance/Electronic Balance	24	53.3	2	6.7	0	0	4	40	0	0	24	80	6	20
12	Beaker	26	86.7	2	6.7	0	0	2	6.7	0	0	24	80	6	20

13	Bunsen Burner	12	40	4	13.3	0	0	4	13.3	10	33.3	12	40	18	60
14	Tripod stand	22	73.3	8	26.7	0	0		0	0	0	18	60	12	40
15	Wire Gauze	21	70	7	23.3	0	0	2	6.7	0	0	17	56.7	13	43.3
16	Dropper	24	80	3	10	0	0	3	10	0	0	22	73.3	8	26.7
17	Test Tube	26	86.7	2	6.7	0	0	2	6.7	0	0	24	80	6	20
18	Test Tube Stand/Rack	26	86.7	2	6.7	0	0	2	6.7	0	0	21	70	9	30
19	Test Tube Brush	26	86.7	2	6.7	0	0	2	6.7	0	0	22	73.3	8	26.7
20	Test Tube Holder	22	73.3	4	13.3	0	0	4	13.3	0	0	17	56.7	13	43.3
21	Boiling Test Tube	19	63.3	4	13.3	0	0	4	13.3	3	10	11	36.7	19	63.3
22	Spatula	26	86.7	2	6.7	0	0	2	6.7	0	0	24	80	6	20
23	Watch glass	27	90	3	10	0	0	0	0	0	0	23	76.7	7	23.3
24	Glass rod	27	90	3	10	0	0	0	0	0	0	24	80	6	20
25	China Dish	16	53.3	5	16.7	0	0	5	16.7	4	13.3	12	40	18	60
26	Fire Extinguishers	14	46.7	4	13.3	0	0	6	20	6	20	14	46.7	16	53.3
27	Gas Supply	14	46.7	0	0	0	0	0	0	16	5.3	11	46.7	19	63.3
28	Water Supply	18	60	7	23.3	0	0	5	16.7	0	0	16	53.3	14	46.7
29	Preparatory Table	19	63.3	9	30	0	0	2	6.7	0	0	12	40	18	60
30	Preparatory Room	19	63.3	9	30	0	0	2	6.7	0	0	18	60	12	40
31	Filter paper	22	73.3	8	26.7	0	0	0	0	0	0	22	73.3	8	26.7
32	First Aid Kit	12	40	0	0	0	0	5	16.7	13	43.3	12	40	18	60
WEIGHTED AVERAGE		21	70	4.7	15.6	0	0	3.1	10.3	1.2	4	18.3	61	11.7	39

S.No.	SALTS	AA		OA		UD		RA		NA		ADEQUACY			
		f	%	f	%	f	%	f	%	f	%	A		NA	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Lead Nitrate	19	63.3	4	13.3	0	0	7	23.3	0	0	17	56.7	13	43.3
2	Aluminium Sulphate	17	56.7	5	16.7	0	0	8	26.7	0	0	16	53.3	14	46.7
3	Aluminium Nitrate	21	70	6	20	0	0	3	10	0	0	18	60	12	40
4	Zinc Sulphide	18	60	7	23.3	0	0	5	16.7	0	0	17	56.7	13	43.3
5	Zinc Sulphate	21	70	4	13.3	0	0	5	16.7	0	0	19	63.3	11	36.7
6	Calcium Carbonate	19	63.3	6	20	0	0	5	16.7	0	0	16	53.3	14	46.7
7	Barium Chloride	22	73.3	6	20	0	0	2	6.7	0	0	19	63.3	11	36.7
8	Magnesium Carbonate	21	70	5	16.7	0	0	4	13.3	0	0	20	66.7	10	33.3
9	Magnesium Sulphate	21	70	6	20	0	0	3	10	0	0	18	60	12	40
10	Ammonium Carbonate	19	63.3	5	16.7	0	0	6	20	0	0	19	63.3	11	36.7
11	Ammonium Sulphate	20	66.7	7	23.3	0	0	3	10	0	0	17	56.7	13	43.3
12	Ammonium Chloride	22	73.3	5	16.7	0	0	3	10	0	0	18	60	12	40
WEIGHTED AVERAGE		20	66.7	5.5	18.3	0	0	4.5	15	0	0	17.8	59.4	12.2	40.6

S.No.	REAGENTS AND SOLUTIONS	AA		OA		UD		RA		NA		ADEQUACY			
												A		NA	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Potassium dichromate	12	40	14	46.7	0	0	0	0	4	13.3	11	36.7	19	63.3
2	Sodium Carbonate	19	63.3	6	20	0	0	0	0	5	16.7	17	56.7	13	43.3
3	Silver Nitrate	12	40	11	36.7	0	0	0	0	7	23.3	10	33.3	20	66.7
4	Ammonium hydroxide	14	46.7	4	13.3	0	0	8	26.7	4	13.3	13	43.3	17	56.7
5	Ammonium Oxalate	12	40	6	20	0	0	6	20	6	20	10	33.3	20	66.7
6	Potassium Iodide	8	26.7	7	23.3	0	0	11	36.7	4	13.3	11	36.7	19	63.3
7	Potassium ferrocyanide	16	53.3	5	16.7	0	0	3	10	6	20	15	50	15	50
8	Potassium Chromate	14	46.7	10	33.3	0	0	4	13.3	2	6.7	10	33.3	20	66.7
9	Aluminon Reagent	14	46.7	9	30	0	0	2	6.7	5	16.7	13	43.3	17	56.7
10	Nessler Reagent	16	53.3	7	23.3	0	0	3	10	4	13.3	14	46.7	16	53.3
11	Magneson Reagent	13	43.3	7	23.3	0	0	5	16.7	5	16.7	13	43.3	17	56.7
12	Potassium Permanganate	18	60	4	13.3	0	0	3	10	5	16.7	17	56.7	13	43.3
13	Ferrous Ammonium Sulphate	19	63.3	1	3.3	0	0	6	20	4	13.3	18	60	12	40
14	Ferrous Sulphate	17	56.7	2	6.7	0	0	7	23.3	4	13.3	17	56.7	13	43.3
WEIGHTED AVERAGE		14.6	48.7	6.6	22	0	0	4.1	13.8	4.7	15.5	13.5	45	16.5	55

S.No.	ACIDS AND BASES	AA		OA		UD		RA		NA		ADEQUACY			
												A		NA	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Hydrochloric Acid	22	73.3	3	10	0	0	3	10	2	6.7	20	66.7	10	33.3
2	Sulphuric Acid	20	66.7	3	10	0	0	4	13.3	3	10	19	63.3	11	36.7
3	Nitric Acid	13	43.3	7	23.3	0	0	6	20	4	13.3	12	40	18	60
4	Acetic Acid	12	40	6	20	0	0	7	23.3	5	16.7	12	40	18	60
5	Oxalic Acid	18	60	4	13.3	0	0	5	16.7	3	10	17	56.7	13	43.3
6	Sodium Hydroxide	19	63.3	6	20	0	0	3	10	2	6.7	17	56.7	13	43.3
WEIGHTED AVERAGE		17.3	57.6	4.8	16	0	0	4.7	15.7	3.2	10.7	16.2	54	13.8	46

S.No.	CHEMISTRY LABORATORY RESOURCES	AA		OA		UD		RA		NA		ADEQUACY			
												A		NA	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	Apparatus and Materials	21	70	4.7	15.6	0	0	3.1	10.3	1.2	4	18.3	61	11.7	39
2	Salts	20	66.7	5.5	18.3	0	0	4.5	15	0	0	17.8	59.4	12.2	40.6
3	Reagents and Solutions	13	43.3	7	23.3	0	0	5	16.7	5	16.7	13	43.3	17	56.7
4	Acids and Bases	17.3	57.6	4.8	16	0	0	4.7	15.7	3.2	10.7	16.2	54	13.8	46
GRAND TOTAL		17.8	59.3	5.5	18.3	0	0	4.3	14.3	2.4	8	16.3	54.3	13.7	45.7

*AA-Always Available, OA-Occasionally Available, UD-Undecided, RA-Rarely Available, NA-Not Available
 A-Adequate, NA-Not Adequate.

INTERPRETATION

From Table-1, it is evident that,

- 1) 70% of the Apparatus and materials are always available and 61% of the Apparatus and materials are adequately available.
- 2) 66.7% of the Salts are always available and 59.4% of the Salts are adequately available.
- 3) 48.7% of the Reagents and Solutions are always available and 55% of the Reagents and Solutions are not adequately available.
- 4) 57.7% of the Acids and Bases are always available and 54% of the Acids and Bases are adequately available.
- 5) 59.3% of the Chemistry Laboratory Resources are always available and 54.3% of the Chemistry Laboratory Resources are adequately available.

Table-2: Extent of Utilization of Chemistry Laboratory Resources by Students

S.No.	APPARATUS AND MATERIALS	AU		OU		UD		RU		NU	
		f	%	f	%	f	%	f	%	f	%
1	Apparatus and Materials	67	22.3	63	21	0	0	124	41.3	46	15.3
2	Funnel	60	20	68	22.7	0	0	156	52	16	5.3
3	Reagent Bottles	62	20.1	64	21.3	0	0	120	40	54	18
4	Retort Stand and Clamp	62	20.1	61	20.3	0	0	126	42	51	17
7	Porcelain Tile	60	20	68	22.7	0	0	156	52	16	5.3
8	Wash Bottle	63	21	64	21.3	0	0	128	42.7	45	15
9	Measuring Cylinder	68	22.7	58	19.3	0	0	130	43.3	44	14.7
10	Beaker	57	19	61	20.3	0	0	112	37.3	70	23.3
11	Bunsen Burner	41	13.7	48	16	0	0	96	32	115	38.3
12	Tripod stand	38	12.7	42	14	0	0	89	29.7	131	43.7
13	Wire Gauze	42	14	39	13	0	0	93	31	126	42
14	Dropper	72	24	76	25.3	0	0	137	45.7	15	5
15	Test Tube	68	22.7	122	40.7	0	0	91	30.3	19	6.3
16	Test Tube Stand/Rack	71	23.7	119	39.7	0	0	87	29	23	7.7
17	Test Tube Brush	69	23	88	29.3	0	0	73	24.3	70	23.3
18	Test Tube Holder	42	14	39	13	0	0	93	31	126	42
19	Boiling Test Tube	34	11.3	47	15.7	0	0	61	20.3	158	52.7
20	Spatula	71	23.7	88	29.3	0	0	134	44.7	7	2.3
21	Watch glass	74	24.7	84	28	0	0	122	40.7	20	6.7
22	Glass rod	63	21	64	21.3	0	0	128	42.7	45	15
23	China Dish	41	13.7	56	18.7	0	0	67	22.3	136	45.3
24	Gas Supply	31	10.3	68	22.7	0	0	74	24.7	127	42.3
25	Water Supply	62	20.7	64	21.3	0	0	151	50.3	23	7.7
26	Filter paper	36	12	45	15	0	0	67	22.3	152	50.7
WEIGHTED AVERAGE		56.4	18.8	66.5	22.2	0	0	108.9	36.3	68.1	22.7

S.No.	SALTS	AU		OU		UD		RU		NU	
		f	%	f	%	f	%	f	%	f	%
1	Lead Nitrate	71	23.7	96	32	0	0	128	42.7	5	1.7
2	Aluminium Sulphate	64	21.3	108	36	0	0	125	41.7	3	1
3	Aluminium Nitrate	69	23	92	30.7	0	0	133	44.3	6	2
4	Zinc Sulphide	69	23	97	32.3	0	0	126	42	8	2.7
5	Zinc Sulphate	70	23.3	99	33	0	0	126	42	5	1.7
6	Calcium Carbonate	66	22	102	34	0	0	129	43	3	1
7	Barium Chloride	61	20.3	111	37	0	0	124	41.3	4	1.3
8	Magnesium Carbonate	62	20.7	105	35	0	0	126	42	7	2.3
9	Magnesium Sulphate	65	21.7	102	34	0	0	130	43.3	3	1
10	Ammonium Carbonate	72	24	101	33.7	0	0	125	41.7	2	0.7
11	Ammonium Sulphate	67	22.3	96	32	0	0	131	43.7	6	2
12	Ammonium Chloride	69	23	97	32.3	0	0	126	42	8	2.7
WEIGHTED AVERAGE		67.1	22.3	100.5	33.5	0	0	127.4	42.5	5	1.7

S.No.	REAGENTS AND SOLUTIONS	AU		OU		UD		RU		NU	
		f	%	f	%	f	%	f	%	f	%
1	Potassium dichromate	42	14	39	13	0	0	61	20.3	158	52.7
2	Sodium Carbonate	69	23	88	29.3	0	0	73	24.3	70	23.3
3	Silver Nitrate	41	13.7	48	16	0	0	96	32	115	38.3
4	Ammonium hydroxide	72	24	83	27.7	0	0	125	41.7	14	4.7
5	Ammonium Oxalate	34	11.3	47	15.7	0	0	61	20.3	158	52.7
6	Potassium Iodide	63	21	64	19.3	0	0	128	42.7	45	15
7	Potassium ferrocyanide	68	22.7	58	19.3	0	0	130	43.3	44	14.7
8	Potassium Chromate	69	23	88	29.3	0	0	73	24.3	70	23.3
9	Aluminon Reagent	74	24.7	84	28	0	0	122	40.7	20	6.7
10	Nessler Reagent	70	23.3	86	28.7	0	0	125	41.7	19	6.3
11	Magneson Reagent	69	23	81	27	0	0	131	43.7	19	6.3
12	Potassium Permanganate	61	20.3	77	25.7	0	0	92	30.7	70	23.3
13	Ferrous Ammonium Sulphate	67	22.3	69	23	0	0	112	37.3	52	17.3
14	Ferrous Sulphate	66	22	71	23.7	0	0	121	40.3	42	14
WEIGHTED AVERAGE		61.8	20.6	70.4	23.4	0	0	103.8	34.6	64	21.3

S.No.	ACIDS AND BASES	AU		OU		UD		RU		NU	
		f	%	f	%	f	%	f	%	f	%
1	Hydrochloric Acid	62	20.7	61	20.3	0	0	126	42	51	17
2	Sulphuric Acid	72	24	76	25.3	0	0	137	45.7	15	5
3	Nitric Acid	44	14.7	39	13	0	0	78	26	139	46.3
4	Acetic Acid	38	12.7	49	16.3	0	0	44	14.7	169	56.3
5	Oxalic Acid	33	11	40	13.3	0	0	52	17.3	175	58.3
6	Sodium Hydroxide	64	21.3	66	22	0	0	89	29.7	81	27
WEIGHTED AVERAGE		52.2	17.4	55.1	18.4	0	0	87.7	29.2	105	35

S.No.	CHEMISTRY LABORATORY RESOURCES	AU		OU		UD		RU		NU	
		f	%	f	%	f	%	f	%	f	%
1	Apparatus and Materials	56.4	18.8	66.5	22.2	0	0	108.9	36.6	68.1	22.7
2	Salts	67.1	22.3	100.5	33.5	0	0	127.4	42.5	5	1.7
3	Reagents and Solutions	61.8	20.6	70.4	23.4	0	0	103.8	34.6	64	21.3
4	Acids and Bases	52.2	17.4	55.1	18.4	0	0	87.7	29.2	105	35
GRAND TOTAL		59.4	19.7	73.1	24.4	0	0	107	35.7	60.5	20.2

*AU-Always Utilized, OU-Occasionally Utilized, UD-Undecided, RU-Rarely Utilized, NU-Never Utilized.

INTERPRETATION

From Table-2, it is evident that,

- 1) 36.6% of the Apparatus and materials are rarely utilized by students.
- 2) 42.5% of the Salts are rarely utilized by students.
- 3) 34.6% of the Reagents and solutions are rarely utilized by students.
- 4) 35% of the Acids and Bases are never utilized by students.
- 5) 35.7% of the Chemistry Laboratory Resources are rarely utilized, 24.4% of the Chemistry laboratory resources are occasionally utilized, 20.2% of the Chemistry laboratory resources are never utilized, 19.7% of the Chemistry laboratory resources are always utilized by students.

CONCLUSION

Based on the findings of this study, it was concluded that most of the schools do not have adequate chemistry laboratory resources and the available laboratory resources are rarely utilized and a lot of resources are laying waste due to negligence and lack of care. Therefore, all Chemistry laboratories should be well equipped with relevant and modern facilities for effective teaching and learning. Chemistry teachers should make the best use of available facilities to enable learners make use of more than one sense in learning for better retention of knowledge.

REFERENCES

1. Venakateswaran et al. (2017). Basic principles of Practical Chemistry. New Delhi: Sultan Chand & Sons Educational Publishers.
2. Metz, Clyde. (2016). Chemistry: Inorganic Qualitative Analysis in the laboratory. Netherlands: Elsevier Publishers.

3. Ratnani, Sonia. (2018). Laboratory Manual of Inorganic Chemistry. New Delhi: Manakin Press India Ltd.
4. Geleta, Kejela. (2018). The Upshot of availability and utilization of Science laboratory inputs on students' academic achievement in high school Biology, Chemistry and Physics in Ilu Abba Bora Zone, Southwestern Ethiopia. International Journal of Scientific and Research Publications, 8(9), 298-307.
5. Ogan & Arokoyu. (2017). Availability and Utilization of Laboratory Kits for Practical Teaching of Mathematical Skills in Chemistry. American Journal of Mathematics and Statistics, 7(4), 160-165.
6. Amba & Chinwendu. (2015). Utilization of Laboratory Facilities and Students in Calabar, Nigeria. Chemistry and Materials Research, 7(3), 57-62.