PRACTICES AND CHALLENGES OF IMPLEMENTING LOCALLY AVAILABLE EQUIPMENT FOR TEACHING CHEMISTRY IN PRIMARY SCHOOLS OF NORTH SHEWA ZONE IN AMHARA REGION

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ABSTRACT

It is in this context that the natural and physical sciences, study and use of environment and local resources has been recognized as one of the basic areas of school curriculum in many developing countries including Ethiopia. Locally available equipment (LAE) offered an alternative solution to do science in classrooms under difficult financial constraints. LAE from locally available materials believed to enrich the capacity to observe, explain and do real chemistry in primary schools and increase the quality of learning. Keeping in view the significance, study in hand is practices and challenges of implementing LAE in teaching chemistry at primary school in North Shewa zone in Amhara Region. The nature of the study is descriptive survey. From 24 woredas 10 of them and from 285 primary schools 130 schools were selected using cluster sampling. From 130 schools all 139 chemistry teachers were including as sample of the study. Data was collected through questionnaire, FGDs, document analysis and observations. It was analyzed by percentage, mean value, t-test and one way ANOVA by SPSS program version 20. Most primary school laboratories of North Shewa Zone are not well equipped with necessary laboratory equipment. That is why; implementing LAE in teaching chemistry is an urgent need everywhere in NSZ at Amhara Region. But the practice of using LAE in the chemistry lesson is poor. But there is a significant difference between teachers taking training on the implementing of LAE and others who didn't take. There is also a good practice of LAE by teachers working on urban areas when we compare with teachers working at rural areas. The main challenges of implementing LAE in teaching chemistry are lack of skills, interest and knowledge; lack of facilities and awareness problem of school principals. Therefore, giving planned and consecutive training for chemistry teachers and creating awareness for school principals solve the problems of utilizing LAE in teaching chemistry. *[African Journal of Chemical Education—AJCE 7(1), January 2017]*

INTRODUCTION

Background of the Study

Practical activities usually require special facilities and equipment. Although fully equipped laboratories and modern equipment are considered essential, it is not necessarily so. It has been argued that conventional laboratory facilities are not needed at the primary level [1]. Purchasing of school science equipment to developing countries has a series of negative side effects. First, foreign exchange is usually in scarce, and the equipment is rather expensive to equip the large number of schools. This results in uneven distribution and partial supply to some schools only [2]. Moreover, spare parts as well as consumable chemicals have to be imported. Besides, the equipment does not suit the existing experiment; it may not be used in the teaching.

One of the approaches to overcome the problems in supply, maintenance and use of equipment for science education is developing equipment from locally available materials. It is possible to design low-cost equipment that are relevant to students and that lead to better understanding [3].

Currently there is also an urgent need everywhere in the world to have low-cost instruments and low-cost experiments for teaching chemistry. As Tilahun, et al [4] indicated, in spite of various efforts, shortage of school laboratory apparatus continues to be a major problem which should be of serious future concern. These necessitate a shift from importing expensive apparatus to a relay on low cost apparatus designed and manufactured by utilizing locally available resources.

In this study the researcher tries to explore how locally available equipment (LAE) is utilized in teaching chemistry, identify the challenges that primary school teachers' encounter and finally suggest possible solutions in order to improve its practices.

Statement of the Problem

Most of the primary schools are situated in rural areas; they are not able to procure the needed laboratory equipment. In addition to this, primary schools suffer to get adequate funds to purchase equipment. So it is very difficult to fulfill sophisticated scientific equipment to all the school laboratories. Hence, teachers should realize the present situation and they must be encouraged developing LAE. According to Hussain [5], Sileshi [6] and Temechegn [7] designing and production of LAE is relatively easy; and our local community is rich in materials; it is low cost or no cost (1 purchased = 40 locally available equipment) and they are efficient.

Science principles can be taught more effectively only with the use of experimental activities. Real learning takes place only when the students observe the experiment or when they perform the actual experiment. The non-availability of equipment in laboratory highly affects teaching chemistry. As expressed by Umar, etal [8], the use of chalk, black board or explaining the experiment in text books are not the solution to the problem. Therefore, there should be low cost chemistry equipment for the learning of chemistry at primary level.

From the studies mentioned and the researcher's experience; informal observation while providing training to chemistry teachers at different levels; and providing chemistry courses for in- service trainees in the college made the researcher to doubt the implementation of LAE to realize chemistry concepts using practical work. This initiated him to investigate the teachers practice and challenges of implementing LAE for teaching chemistry.

Having this in mind, the study has the following objectives:

- To explore how LAE is practiced in teaching chemistry.
- To identify if there is any significant difference among different groups on the use of LAE.
- To identify the problems of implementing LAE in teaching chemistry.

- To suggest possible solutions in order to improve its practices in teaching chemistry.

In order to have detailed and comprehensive information, it would have been good if the study takes place throughout Amhara Region; however, to make the study manageable and to complete the study within the time limit, it is restricted to NSZ selected government full cycle primary schools. In addition, it would have been good if the study includes all science subjects at primary schools; however, the researcher's experience, informal observation while providing training to chemistry teachers at different levels and providing chemistry courses for in- service trainees in the college, it is limited to chemistry subject at grade 7 and 8.

METHODOLOGY

Research Design and Sampling

The purpose of the study is to explore how LAE is utilized in teaching chemistry, to identify the challenges that primary school teachers encounter and finally to suggest possible solutions in order to improve its practices. The study is descriptive survey in nature. This research follows quantitative method. Qualitative method was used to supplement quantitative analysis.

In Amhara Regional State North Shoa Zone there are 24 woredas, of which 10 woredas were selected for study site using cluster sampling. From the total number of 285 schools, 130 schools were taken using cluster sampling in each woreda. Again, from 130 schools having 139 chemistry teachers, all of them were used as sample of the study.

Instruments, Pilot Testing and Validity

In order to assess the practice and challenges of implementing LAE in teaching chemistry at primary schools of NSZ and to answer the basic research questions, the researcher used

questionnaire, document analysis, focus group discussions and observations as means of data collection.

In order to ensure the face and content validity of the questionnaire, draft copies were distributed to different individuals who have better experience in different field of study.

To identify vague and ambiguous items and to modify the shortcomings of the instruments, piloting the instrument was carried out with teachers. After getting valuable comments from the colleagues, pilot study were conducted on 12 (9 males and 3 females) chemistry teachers; they were not part of sample of the study. A total of 3 items were modified after pilot test and the reliability for each group of items were checked by alpha and its reliability test was 0.78.

The data were analyzed using both qualitative and quantitative method. Accordingly, percent, mean, t-test and ANOVA were used for analyzing data collected by questionnaire. Moreover, the responses on observation, document analysis, open-ended items and FGD were organized and analyzed on the basis of common themes in each category of items. The use of qualitative analysis was in supplementing the quantitative data.

RESULTS AND DISCUSSION

Demographic Characteristics of Chemistry Teachers

Table 1 below presents information about respondents characteristics related to sex, qualification, experience and their training exposure.

Table 1: Demographic characteristics of chemistry teachers

Categories		Frequency	Percent
Sex	Male	74	53.2
	Female	65	46.8
	Total	139	100.0
Types of qualification	12+2 chemistry diploma	14	10.1
	10+3 three major NS diploma	44	31.7
	10+3 linear chemistry	61	43.9
	10+3 cluster NS diploma	11	7.9
	Others (chemistry degree)	9	6.5
	Total	139	100.0
Experience	Less than or equal to 5 years	56	40.3
	6-10 years	43	30.9
	11-15 years	27	19.4
	Above 15 years	13	9.4
	Total	139	100.0
Training on conventional laboratory applications?	never	46	33.1
	once	40	28.8
	twice	22	15.8
	three times	14	10.1
	more than three	17	12.2
	Total	139	100.0
Training on LAE laboratory applications?	never	111	79.9
	once	17	12.2
	twice	9	6.5
	three times	2	1.4
	more than three	0	0
	Total	139	100.0

These results indicate that LAE didn't get enough attention by the concerned bodies.

Background Information about School Laboratory

In Table 2 we see the general information related to the school and the availability school laboratory.

Table 2: General information about school and school laboratory

Items	Responses	F	%
Place of School	urban	63	45.3
	rural	76	54.7
	Total	139	100.0
Do you have Science (chemistry) laboratory class in your school?	Yes	114	82.0
	No	25	18.0
	Total	139	100.0
Status of school laboratory	Well equipped	6	4.3
	Partially equipped	32	23.0
	Not equipped	76	54.7
	No laboratory room	25	18.0
	Total	139	100.0
Why is the school laboratory not equipped? Why don't you have laboratory room in your school?	money problem	60	43.2
	market problem	50	36.0
	management problem	20	14.4
	other	3	2.2
	Well equipped	6	4.3
	Total	139	100.0
Who is responsible, in order to equip your laboratory or in order to have laboratory room in your school?	Government should allocate budget	69	49.6
	NGO should support the school	21	15.1
	Teachers should use LAE	42	30.2
	Others	7	5.0
	Total	139	100.0

Most primary schools in Ethiopia are not equipped and it is very difficult to equip school laboratories due to budget and shortage of equipment in the local market. That is why LAE are very essential for primary school chemistry classes. As can be seen from the last item of Table 2, only 42 (30.2%) of primary school teachers have awareness of LAE and believe preparing and using LAE could solve problems that originated from laboratory facilities.

Practice of practical works for chemistry lesson

Teachers were asked about implementation of practical works for chemistry lesson and their responses are presented in Table 3.

Table 3: Teachers response about implementation of practical works for chemistry lesson

Items	Responses	F	%
Do you have laboratory (practical) period allocated in your weakly timetable?	Yes	78	56.1
	No	61	43.9
	Total	139	100.0
How much your locality is rich in LAM?	It is rich in materials.	12	8.6
	It has some materials.	90	64.7
	I could not identify it.	19	13.7
	No material at all	18	12.9
	Total	139	100.0
How can you perform different experiments in chemistry lesson?	I thought using lecture method.	61	43.9
	I used demonstration method.	38	27.3
	I jump it.	28	20.1
	I used LAE.	12	8.6
	Total	139	100.0

In addition to the above result, FGD and observations confirmed that there were serious problems of teaching different concepts of chemistry using practical work.

Teachers' utilization level of LAE for teaching chemistry

Analyses of teachers' responses were made using percentage and mean. Teachers rated a five point likert scale for utilization level of LAE: always =5; frequently=4; occasionally=3; rarely=2; never=1; for challenges of implementing LAE: strongly agree = 5; agree = 4; undecided = 3; disagree = 2; and strongly disagree = 1. Regarding the items, for the purpose of this study, mean from 2.50 – 3.49 range was taken as moderate level, while from 3.50 and above was considered as high level participation in the statement and mean of less than 2.50 was considered to indicate low level of participation in the statement.

Table 4: Teachers response on utilization of LAE for teaching chemistry

No	Items	Response					Mean	St.D
		Never	Rarely	Occasionally	Frequently	Always		
		F (%)	F (%)	F (%)	F (%)	F (%)		
1	How often you use locally available apparatuses for teaching chemistry?	25(18)	50(36)	44(31.7)	18 (12.9)	2 (1.4)	2.01	0. 979
2	How often you use locally available chemicals for teaching chemistry?	33 (23.7)	43 (30.9)	43 (30.9)	18 (12.9)	2 (1.4)	1.98	1.031
3	Do you prepare plan to use LAE for chemistry lesson?	35 (25.2)	55 (39.6)	38 (27.3)	9 (6.5)	2 (1.4)	1.35	0. 939
4	Do you motivate your students to use LAE for their practical work?	30 (21.6)	36 (25.9)	44 (31.7)	22 (15.8)	7(5.0)	2.25	1.142
5	Do you read and ask questions to refresh your knowledge about LAE?	35 (25.2)	55 (39.6)	38 (27.3)	9 (6.5)	2 (1.4)	1.35	1.183
6	Do you discuss with your colleague to prepare LAE?	33 (23.7)	43 (30.9)	43 (30.9)	18 (12.9)	2 (1.4)	1.98	1.045
7	Do you share ideas about LAE with your colleagues during department or cluster schools meeting?	57 (41)	28 (20.1)	37 (26.6)	8 (5.8)	9 (6.5)	1.20	1.213
	Total	248(25.5)	310 (31.9)	287 (31.3)	133 (29.5)	26 (2.7)	1.81	1.076

Note:- F = frequency, % = percentage and St.D = standard deviation

This shows that significant number of chemistry teachers did not use LAE for teaching chemistry. Similarly, data collected by FGD, document analysis and from the observation of schools laboratory almost all school did not have laboratory plan to use LAE. In some schools, the researcher observed very few numbers of low-cost apparatuses prepared by teachers.

The practice of LAE among different groups

Table 5: Independent Sample t-test values of implementing LAE by sex and place of school

Items		**N**	**Mean**	**Std. Deviation**	t	df	p
Sex	Male	74	15.4750	4.76797	-0.556	137	0.579
	Female	65	16.0000	6.36532			
Place of work	Urban	63	18.1515	5.38587	3.027	137	0.003
	Rural	76	14.9340	5.31533			

Independent sample t-test was used to examine the difference between male and female chemistry teachers on their implementation of LAE. It was found that there were no significant

statistical differences between male and female teachers ($p>0.05$) but there was a statistical significant difference between town and rural school chemistry teachers on their implementation of LAE ($p<0.05$) as shown in Table 5.

Table 6: One way ANOVA values of implementing LAE by experience and qualification

Items		N	Mean	Std. Dev	df	Mean Square	F	p
Experiences	≤ 5 years	56	13.9630	5.76783	3	43.274	1.451	0.231
	6 -10 years	43	15.6607	5.52441				
	11-15 years	27	16.3953	5.32800				
	>15 years	13	17.1538	4.91335				
Qualification	12+2 chemistry diploma	14	18.5000	4.43471	4	83.939	2.945	0.023
	Others (chemistry degree)	9	17.8000	5.93296				
	10+3 three major diploma	44	17.5000	5.11950				
	10+3 linear chemistry diploma	61	14.5765	5.44753				
	10+3 cluster diploma	11	10.0000	3.87734				

As indicated in Table 6, implementation of LAE based on experience, the value of significant level is greater than 0.05. It shows that there is no significant difference among chemistry teachers in their experience. But implementation of LAE based on qualification has significant difference ($p<0.05$). Concerning qualification, pre-service training has its own impact in implementing LAE.

Table 7: One-way ANOVA values of implementing LAE based on training experience

Items		N	Mean	Std. D.	df	Mean Square	F	p
Training on LCE	never	111	14.6757	5.00393	3	207.652	7.936	0.000
	once	17	18.7059	5.88180				
	twice	9	21.3333	5.00000				
	three times	2	21.5000	4.94975				
	> three	-	-	-				
Training on conventional lab. work	never	46	15.5152	4.87456	4	100.767	3.599	0.008
	once	40	14.2000	5.50617				
	twice	22	16.5000	6.26973				
	three times	14	18.5000	2.51661				
	> three	17	21.8571	5.49025				

As shown in Table 7, implementing LAE based on training on LAE has significant difference ($p<0.05$). Post Hoc comparison using Tukey HSD test indicated that the mean scores for teachers participating training on LAE twice and three times have significant difference from others.

Similarly, conventional laboratory practice training has also statistically significant difference ($p<0.05$) as shown in Table 7. Post Hoc comparison using Tukey HSD test indicated that the mean scores for teachers participating conventional laboratory training more than three times has significant difference from others. This helps to infer that chemistry teachers participating on LAE training performed better than teachers participating on conventional laboratory training in the implementation of LAE on their chemistry class.

Challenges of implementing LCE for teaching chemistry

The chemistry teachers also expressed their views about the challenges in implementing LAE in primary schools. The results are presented in Table 8 below.

Table 8: Teachers' response on challenges in implementing LAE in primary schools

No	Item	Response					Mean	St.D
		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree		
Concerning Knowledge challenges		F (%)	F (%)	F (%)	F (%)	F (%)		
1	You have awareness to use LAE for chemistry class?	20 (14.4%)	24 (17.3%)	47 (33.8%)	43 (30.9%)	5 (3.6%)	2.35	1.042
2	You know how to use LAE to teach chemistry.	20 (14.4%)	25 (18%)	39 (28.1%)	47 (33.8%)	8 (5.8%)	2.33	1.106
3	You know how you replace commercially prepared apparatus with locally prepared apparatus.	10 (7.2%)	41 (29.5%)	47 (33.8 %)	29 (20.9%)	12 (8.6%)	1.88	1.064
4	You know how you replace commercially prepared chemicals with locally prepared chemicals.	25 (18%)	22 (15.8%)	42 (30.2%)	32 (23%)	18 (12.9%)	2.17	1.268
5	You have enough knowledge on application of LAE in chemistry lesson.	11 (7.9%)	25 (18%)	44 (31.7%)	49 (35.3%)	10 (7.2%)	2.19	1.053
		86 (12.4%)	137 (19.7%)	219 (31.5%)	205 (29.5%)	53 (7.6%)	2.18	1.107
Concerning Skills challenges								
6	You have skill to construct LAE to teach chemistry.	17 (12.2%)	35 (25.2%)	41 (29.5%)	39 (28.1%)	7 (5%)	2.17	1.096
7	You have skill to prepare LAE from LAM for chemistry class.	16 (11.5%)	33 (23.7%)	34 (24.5%)	37 (26.6%)	19 (13.7%)	1.99	1.234
8	You could replace traditional lab apparatus by LAE for effective practical work.	8 (5.8%)	40 (28.8%)	51 (36.7%)	23 (16.5%)	17 (12.2%)	1.75	1.057
9	You don't have any problem to choose LAE for teaching chemistry.	9 (6.5%)	54 (38.8%)	37 (26.6%)	15 (10.8%)	24 (17.3%)	1.50	1.099
10	You have skill to use LAE for teaching chemistry effectively.	9 (6.5%)	35 (25.2%)	43 (30.9%)	36 (25.9%)	16 (11.5%)	1.91	1.109
		59 (8.5%)	197 (28.3%)	206 (29.6%)	150 (21.6%)	83 (11.9%)	1.86	1.119
Concerning Attitude challenges								
11	You are interested to use LAE for teaching chemistry.	23 (16.5%)	24 (17.3%)	38 (27.3%)	46 (33.1%)	8 (5.8%)	2.37	1.125
12	LAE are efficient to teach chemistry at primary school.	31 (22.3%)	30 (21.6%)	30 (21.6%)	40 (28.8%)	8 (5.8%)	2.40	1.214
13	Replacing traditional lab equipments by LAE is relevant to your own situation.	21 (15.1%)	28 (20.1%)	44 (31.7%)	37 (26.6%)	9 (6.5%)	2.24	1.133
14	You are committed to teach chemistry using LAE.	20 (14.4%)	35 (25.2)	35 (25.2%)	27 (19.4)	22 (15.8%	1.91	1.288
15	Teaching load is not a factor in order to construct and use LAE.	9 (6.5%)	42 (30.2%)	42 (30.2%)	9 (6.55%)	37 (26.6%)	1.36	1.136
		104 (15%)	159 (22.9%)	189 (27.2%)	159 (22.9%)	84 (12.1%)	2.06	1.179

The challenges of implementing LAE were challenges of knowledge, skill and attitude and their mean values are 2.18, 1.86 and 2.06, respectively. These challenges are also observed during observations and document analysis.

CONCLUSIONS

Based on major findings, the following conclusions were drown:

- Most primary school laboratories of North Shewa Zone are not well equipped with necessary laboratory equipment. That is why; implementing LAE in teaching chemistry is an urgent need everywhere in Amhara region at Ethiopia.
- Even if, the practice of using LAE in chemistry lesson in those primary schools is poor, there is a good practice of using LAE by 12+2 diploma chemistry teachers, 10+3 three major diploma teachers and degree graduate chemistry teachers. Moreover, a significant difference between teachers who took training on the implementing of LAE and others did not was observed. In addition, there is also a good practice of LAE by teachers working on urban areas when we compare with teachers working at rural areas.
- The main challenges of implementing LAE in teaching chemistry are lack of skills, interest and knowledge; lack of facilities and awareness problem of school principals. Therefore, giving planned and consecutive training for chemistry teachers and creating awareness for school principals solve the problems of utilizing LAE in teaching chemistry.

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