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INVESTIGATING THE AVAILABILITY AND THE EXTENT OF USE OF INSTRUCTIONAL MATERIALS BY SECONDARY SCHOOL CHEMISTRY TEACHERS IN NIGERIA

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ABSTRACT: *This study focused on level of utilization of available instructional materials, teacher made instructional materials and the obstacles faced by the chemistry teachers during improvisation of the teacher made instructional materials in Ebonyi State secondary schools.397 chemistry teachers from the 212 government owned secondary schools in Ebonyi State formed the population. Because of the small size of the population, no sampling was done. Questionnaire was the instrument used for data collection; it was validated by 3 experts from Science Education Department, one expert from Measurement and Evaluation and the other 2 from chemistry education. The reliability of the instrument was determined to be 0.81. Descriptive survey research design was adopted for the study. 3 research questions and one hypothesis guided the study. The 3 research questions were answered using mean statistics while the hypothesis was tested at 0.05 level of significance using the z-test statistics. The findings revealed that teachers are not utilizing effectively the available instructional materials in their teaching, the chemistry teachers are not making enough efforts in improvisation of those instructional materials that are not available and that the teachers faced obstacles such as lack of fund and skill for the improvisation of instructional materials. Based on the findings of this study, the researcher made a number of recommendations that would help the teachers in their instructional delivery.*

KEYWORDS: Chemistry, Education, Secondary School, Instructional Materials

INTRODUCTION

The present digital age of human existence had brought about changes in every aspect of human life such as the way we work, the way we live, the way we eat, the way we communicate, the way we transfer or carry money and the way we teach and learn. In the education sector, many new teaching materials are being provided in addition to the old ones. In many schools these teaching materials are not always available in the right quantity, but teaching and learning must go on in the school. Thus, there is need to look at the classroom practices of the chemistry or science teachers which would help them to perform their duties effectively in a situation where the teaching materials are in short supply or not available. Effective teaching and learning is done with instructional materials; Nachias (2000), Owo (2009) and Nwagbo and Ugwuanyi (2015) observed that innovative pedagogical practices using technology and improvisation enhance teachers effectiveness.

Teacher made Instructional Materials

Teaching chemistry in crisis situation means teaching and learning of chemistry or any of the basic sciences in austere economy. The austere condition may arise as a result of the

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following (i) war time (ii) population explosion in schools (iii) economic recession and (iv) high cost of science materials.

Teacher made resource (instructional) materials refer to improvisation. Omiko (2007) stated that improvisation in austere period is very fundamental and crucial because it reasonably reduces cost of procuring new and imported materials. Students learn the working principles in the improvised materials they make or help teachers to make; it creates and develops technological awareness in the students.

Owo (2009) observed that the quest for teacher made materials (improvisation) began in response to the scarcity and expensiveness of science equipment in Nigeria. Hence the improvisation of some of the science instructional materials from locally available material will help to get enough science teaching materials for the growing number of secondary schools in Nigeria. Omiko (2015) opined that many institutions of higher learning have set up Department of Educational Technology aimed at training teachers in the production and use of different software and hardware materials. In some cases the difficulties encountered in purchasing and improvising instructional materials make some science teachers to change their attitude and interest towards science subjects.

Davies in Omiko (2015) and Owo (2009) noted that Educational Technologies normally concern themselves with the choice of designing and creating better in instructional materials which help science teachers to be more efficient instructional delivery. Brown (1969) and Okpala (1991) suggested that science teachers should not use inadequate instructional materials and equipment as an excuse to resort to poor teaching, instead they should learn to improvise the essential instructional materials required in teaching their subjects. Dike (1989) observed that the essence of producing instructional materials is to facilitate the teaching-learning process properly if science skills are to be acquired.

The fact that science is a living subject and practical in nature coupled with the impact of population explosion in schools, information and knowledge explosion in science as well as demand for science education in the country necessitated huge material resource requisition for science teaching, Maduabum (1990). In this connection, the case of Nigeria's Economic downturn and galloping inflation being the case, it will be very difficult to adequately fund the procurement of some of the high and heavy equipment like the electronic instruments (computers), and other expensive equipment for science teaching or replacement of the unsuitable and perhaps the unrelated sophisticated imported spare parts; this calls for urgent need to produce materials locally so as to save science and the nation's economy from total collapse because of huge foreign exchange involved. Edger in Owo (2009) remarked that the need for innovative materials in schools is as result of great quest for education due to changes in the society. Some teachers instead of understanding that teaching aids are used for making teaching more effective believe that they make the teacher's work easier. Some teachers see instructional materials as a decoration and not a too to be used in teaching, or are meant for teaching practice students only. Dienye and Gbamanja (1990) and Asiegbu (1986) stressing on the problems of effective utilization of instructional materials stated that in our present education system, untrained teachers are employed to teach in our secondary schools and colleges. Because of insufficient training many of the teachers do not recognise the potentials of many simple teaching aids available at very little cost or how to use them.

The chemistry teachers ought to know the procedures for constructing alternative instructional materials with which they can help their students to visualize whatever topic

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they want to teach. Dike in Omiko (2015) noted that, if instructional materials are to be improvised, emphasis should be laid on using cheap and locally available materials. A chemistry teacher must be conversant with the types, characteristics and advantages of instructional materials before he/she could improvise. Omiko (2007) listed the benefits derived from the use of improvised instructional materials to include; (i) It makes students to participate in creative and analytical thinking when they are involved in making those needed instruments (ii) concepts taught using improvised materials become clearer to the students because those concepts are learnt through play-like activities (iii) It encourages a systematic integration of a variety of resources in a teaching-learning experiences. (iv) Being actively involved in improvisation, the working principles are learnt and in this way the students acquire problem solving skills, manipulative skills, scientific attitude and knowledge needed in solving the daily scientific and technological problems.

Based on the above stated benefits derived from the use of improvised materials in teaching science, it therefore becomes necessary to find out which of these instructional materials that are available in our secondary schools and if teachers improvise and use the non-available instructional materials in teaching chemistry and possible hindrances to these teachers improvisation efforts. Thus, the need for this study.

Purpose of the Study

This study aimed at investigating the use of available and teacher made instructional materials for teaching chemistry in secondary schools in Ebonyi State of Nigeria. Specifically this study sought to:

(a) Determine the level of use of available instructional materials in teaching Chemistry in secondary schools in Ebonyi State

(b) Determine the extent to which the chemistry teachers improvise and use the inadequately available instructional materials.

(c) Identify the factors or obstacles which may hinder chemistry teachers from making and using improvised instructional materials in teaching.

(d) Determine the effect of teaching experience on the chemistry teachers' effort at improvisation of instructional materials.

Research Questions

Three research questions guided the study.

1. What is the level of utilization of available instructional materials necessary for the teaching and learning of chemistry in secondary schools in Ebonyi State of Nigeria?

2. To what extent are the chemistry teachers in our secondary schools improvise and use the inadequately available instructional materials in teaching chemistry?

3. What are the obstacles faced by the chemistry teachers during improvisation of the non-available instructional materials?

Hypotheses

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The following null hypothesis was formulated to guide the study. The null hypothesis was tested at the alpha level 0.05 of significance.

H_{01}: Teacher's teaching experience is not a significant factor in chemistry teachers efforts at improvising and using of instructional materials for chemistry teaching ($P<0.05$)

Design of the Study

The study adopted descriptive survey research design. This involved the study of the subjects in their natural setting without manipulating their environment. 397 chemistry teachers in 212 government owned secondary schools in Ebonyi state formed the population of the study. However, because of the small size of the population of the chemistry teachers in the secondary schools in Ebonyi State, sampling was not done. Since the population of the respondents was small, there was no-problem in accessing them.

Instrument: The researcher constructed one instrument for the data collection; improvisation of chemistry instructional materials questionnaire (ICIMQ), this instrument was validated by 3 experts one from measurement and evaluation and two from chemistry/education. They carried out both the face and construct validation of the instrument. Another instrument used by the researcher in this study was the science Education curriculum from the faculty of Education, Ebonyi State University, Abakaliki. The instrument was used for data collection. The reliability of the instrument was determined using Cronbach alpha analysis and it was found to be 0.81. The 2nd instrument was not validated because it was a standardized instrument. The instruments were administered on the 397 chemistry teachers (respondents) in the 212 Government owned secondary schools spread across the 3 education zones of Ebonyi State with the help of 8 research assistants trained for one week in their respective education zones for the purpose of this research work. The administration of the questionnaires to the respondents was done by the researcher and the assistants. The completed copies were collected on the spot; this enabled us to achieve 100% return of the documents which were subsequently used for data analysis.

Data Analysis

The mean statistics was used to answer the three research questions of the study. A four-point response likert scaling items was developed to which respondents were expected to indicate their levels of agreement as follows.

Research Question 1

Options	Nominal Values Attached
Highly Utilized (HU)	4
Utilized (U)	3
Unutilized (UN)	2
Highly Unutilized (HUN)	1

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Research Question 2

For research question two, the following statement options and nominal values were attached.

Options	Nominal Values Attached
Very High Extent (VHE)	4
Great Extent (GE)	3
Low Extent (LE)	2
Very Low Extent (VLE)	1

Research Question 3

For research question three, the following statement options and nominal values were attached

Options	Nominal Values Attached
Strongly Agreed (SA)	4
Agreed (A)	3
Disagree (DA)	2
Strongly Disagree (SD)	1

In each case, the nominal values were summed up and divided by the number of scaling items to get the mean value of 2.50, that is

$\frac{4+3+2+1}{4} = \frac{10}{4} = 2.50$

Decision Rule

In the interpretation and presentation of the results the following rules applied. In research question 1, any instructional material listed in the questionnaire that obtained a mean value of 2.50 and above means that the material is adequately available and utilized in the schools while a mean score below 2.50 indicates that the material is not adequately available and not utilized. In research question 2, any item that obtained a mean score of 2.50 and above indicates that the teachers improvise (make) that item, while a mean score below 2.50 indicates that the teachers are not improvising them. For research question 3, any item which scored a mean of 2.50 and above is not a deterrent to the teachers' efforts at improvisation while a mean score below 2.5 shows otherwise. The hypothesis that guided the study was tested at 0.05 level of significance using the z-test. The null hypothesis of the study was rejected if the calculated value of Z at the appropriate level of significance and degree of freedom was equal to or greater than the critical value, if the revise is the case, it will be accepted.

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RESULTS

Research Question 1

What is the level of utilization of available instructional materials necessary for teaching and learning of chemistry in secondary schools in Ebonyi State of Nigeria?

Table 1: Utilization of Available Instructional Materials in Teaching Chemistry in Secondary Schools.

S/N	Utilization of Available Materials	HU 4	U 3	UN 2	HUN 1	N	$\bar{x}$	Decision
1.	Bunsen Burner	204	300	422	35	397	2.42	Unutilized
2.	Conical flasks	388	387	208	67	397	2.64	Utilized
3.	Distilled water	176	255	400	68	397	2.26	Unutilized
4.	Litmus Paper	156	270	438	49	397	2.30	Unutilized
5.	Sodium hydroxide	320	429	302	23	397	2.71	Utilized
6.	water bath	112	249	328	122	397	2.04	Unutilized
7.	Burette	274	327	266	86	397	2.40	Unutilized
8.	Measuring cylinder	188	297	286	108	397	2.21	Unutilized
9.	Test-tubes	360	522	194	36	397	2.80	Utilized
10.	Periodic table chart	456	561	216	33	397	2.96	Utilized
11.	hydrochloric acid	324	417	254	50	397	2.63	Utilized
12.	Barium chloride	176	642	206	36	397	2.67	Utilized
13.	silver Nitrate	152	273	420	58	397	2.27	Unutilized
14.	Tetraoxosulphate (vi) acid	148	267	354	94	397	2.17	Unutilized
15.	Pipette	368	447	242	45	397	2.78	Utilized
16.	Sodium triozocarbonate (iv)	312	507	294	3	397	2.81	Utilized
17.	Methyl orange	152	213	382	97	397	2.05	Unutilized
18.	Phenolphthalein	164	267	396	69	397	2.26	Unutilized
19.	Zinc metal	128	261	414	71	397	2.20	Unutilized
20.	potassium metal (pellete)	84	204	474	71	397	2.10	Unutilized
21.	Maynesium hydroxide	148	276	436	50	397	2.29	Unutilized
22.	Iron (II) sulphate	356	384	280	40	397	2.67	Unutilized
23.	Chloroform	92	174	478	77	397	2.07	Unutilized
24.	Absolute ethanol	100	243	526	28	397	2.26	Unutilized
25.	Iodine crystal	120	261	548	6	397	2.36	Unutilized
26.	Ammonia solution	372	396	282	31	397	2.72	Utilized
27.	Paraffin oil	84	219	482	62	397	2.13	Unutilized
28.	Methylated spirit	132	201	504	45	397	2.22	Unutilized
29.	Filter paper	368	513	246	11	397	2.87	Utilized
30.	Weighing balance	248	327	254	99	397	2.33	Unutilized
	Grand Mean					**2.42**		

From the results on table 1 above, it indicates that only items 2, 5, 9, 10, 11, 12, 15, 16, 22, 26 and 29 had mean scores above 2.50. It implies that these items are available and also being utilized by the chemistry teachers. Other items had mean scores below 2.50. This implies that these items are not either available or being utilized by the chemistry teachers in their

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instructional delivery. The grand mean of 2.42 indicates that these items are not effectively utilized in teaching chemistry

Research Question 2

To what extent are the chemistry teachers improvise inadequately available materials in teaching chemistry?

Table 2: Extent of Improvisation and Use of Instructional Materials in Chemistry Teaching

S/N	Improvised and Utilized Materials	VHE	GE	LE	VLE	N	$\bar{x}$	Decision
1.	Water bath	84	117	384	140	397	1.83	Low Extent
2.	Burette	-	-	398	198	397	1.50	Low Extent
3.	Measuring cylinder	76	114	418	131	397	1.86	Low Extent
4.	Test-tubes rack	440	390	200	57	397	2.74	High Extent
5.	Periodic table	396	354	296	32	397	2.72	High Extent
6.	Hydrochloric acid	-	-	216	289	397	1.27	Low Extent
7.	Iodine crystal	-	64	406	162	397	1.59	Low Extent
8.	Iron (II) chloride	-	-	374	210	397	1.47	Low Extent
9.	Absolute ethanol	112	267	400	80	397	2.16	Low Extent
10.	litmus paper	-	-	404	196	397	1.51	Low Extent
11.	Filter paper	212	417	346	82	397	2.41	Low Extent
12.	sodium hydroxide	-	-	462	166	397	1.58	Low Extent
13.	Chloroform	-	-	380	207	397	1.48	Low Extent
14.	Iron filling	-	-	422	186	397	1.53	Low Extent
15.	Distilled water	448	429	178	82	397	2.86	High Extent
16.	Formaldehyde	-	-	464	165	397	1.58	Low Extent
17.	Tripod stand	372	396	186	79	397	2.60	High Extent
18.	Bursen burner	-	99	234	208	397	1.36	Low Extent
19.	Paraffin liquid	-	-	358	218	397	1.45	Low Extent
20.	Soap and Detergents	392	489	176	38	397	2.76	High Extent
	Grand Mean					**191**	**1.91**	

From the results of the data analysis on table 2, it shows that out of the 20 items listed only items 4, (test-tube racks), 5(periodic table), 15 (distilled water), 17, (Tripod stand) and 20 (soaps and detergents) are the chemistry teachers improvising and utilizing in teaching their students. It shows also that the teachers are involved to a reasonable extent in improvising those items. Other items scored below 2.50, indicating that the teachers are not involved in improvising them. This may be as a result of several factors which may include the nature of the materials and lack of fund.

Research Question 3

What are the obstacles faced by the chemistry teachers during improvisation of the non-available instructional materials?

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Table 3: The Obstacles Faced By the Chemistry Teachers during Improvisation of Non-Available Instructional Materials for Chemistry Teaching.

S/N	Obstacles (Problems) of Improvisation	SA	A	DA	SD	N	$\bar{x}$	Decision
1.	Chemistry teachers possess the necessary skills for improvisation of instructional materials	112	219	426	83	397	2.11	Disagree
2.	Teacher Education curriculum contains concepts that prepare the chemistry teachers for improvisation of instructional materials	84	384	300	98	397	2.18	Disagree
3.	Many books are rich with the techniques for improvisation of non available instructional materials in the schools for the teachers to use in improvisation	292	459	256	43	397		Agree
4.	Many schools are located in places where instructional raw materials are not available	276	399	248	71	397	2.50	Agree
5.	So many teachers seek the help of experts during improvisation of teaching aids	112	234	434	74	397	2.15	Disagree
6.	The Parents Teachers Association (PTA) of many schools do not encourage the teachers to improvise non-available instructional materials.	96	324	402	94	397	2.08	Disagree
7.	The relationship between the school and the host community is not cordial	76	186	428	102	397	1.99	Disagree
8.	The school authorities help the chemistry teachers by providing fund to them for improvisation of non-available instructional materials	120	270	448	53	397	2.24	Disagree
9.	Textbook authors always provide materials needed for teaching every topic in their books	140	249	378	90	397	2.15	Disagree
10.	Students are always allowed to participate in the process of improvisation of instructional materials	156	231	428	67	397	2.22	Disagree
11.	The time table in our schools has special period for the chemistry teacher to carry out improvisation of non-available instructional materials.	184	237	442	51	397	2.30	Disagree
12.	Many teachers know how to carry out improvisation and use of the instructional materials produced for teaching of chemistry effectively	124	219	284	151	397	1.95	Disagree
	Grand Mean			**1.91**				

The results on table 3 above indicates that only items 3 and 4 had mean scores above 2.50. These two items are not obstacles to improvisation of instructional materials. The rest of the

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items had mean scores below 12.50. This implies that these items are obstacles in the teachers efforts in improvisation of non-available instructional materials.

Hypothesis

Teacher's teaching experience is not a significant factor in chemistry teachers efforts at improvising and using of instructional materials for teaching chemistry.

Table 4: Z-test Results on the Influence of Teachers Teaching Experience on Improvisation of Instructional Materials.

Group	Mean	SD	N	Df	SE	Z-cal	Z-Crit	Decision
Experienced chemistry teachers	3.10	1.39	193	396	0.08	0.19	1.96	Accept HO
Inexperienced Chemistry teachers	3.08	1.35	204					

The result of the Z-test analysis on table 4 above indicates that the calculated value of Z-cal (0.19) is less than the critical value of 1.96 at 0.05 level of significance and 396 agree of freedom. This implies that the null hypothesis that the chemistry teachers teaching experience is not a significant factor in chemistry teachers' improvisation efforts is accepted.

Findings

From the data collected and analysed in this study the researcher discovered that;

(1) Most schools do not help their teachers in carrying out improvisation of non-available instructional materials.
(2) Some teachers lack the skills necessary for carrying out improvisation of instructional materials
(3) Many schools lack instructional materials
(4) There is lack of fund for purchasing the necessary raw materials needed in improvisation of instructional materials
(5) Many teachers do not involve both the students and experts during improvisation.

Discussion of the Findings

The result obtained from this study revealed that most science (chemistry) teachers do not utilize effectively the instructional materials available in the school laboratories in teaching chemistry. This is shown by the grand mean of 2.42 (table 1) and the mean scores of most of the items which fell below 2.50. This result is in agreement with earlier studies by Owo (2009) and Omiko (2015) who observed that most of our present day science and technology teachers are transmitters of dead tradition. They prefer to use the chalk and talk method without engaging the students in activities that would enable them to acquire the scientific and technological skills needed for industrialization. Therefore, without appropriate utilization of the teaching materials, all the efforts made by the government and corporate bodies at transferring technology will definitely become wasted efforts.

The results in table 2 indicate that the teachers are not making appreciable efforts at providing or improvising those instructional materials that are not available in their

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laboratories. The teachers inability to improvise non-available instructional materials may be as a result of lack of the raw materials in the school environment or that the teacher lacks the skills for improvisation as a result of poor training they received from their preparatory institutions. A good teacher should make use of the school's environment including the immediate community from where he/she can source out materials and experts who would help him/her in carry out improvisation.

The results on table 3 revealed that science teachers are faced with a lot of obstacles in improvisation. All the items apart from items 3 and 4 scored a mean score below 2.5 and with a grand mean of 191 shows that the teachers have problem in improvisation of the instructional materials. In improvisation of instructional materials, fund is important but it should not be a major hindrance if the teachers really know what it takes to be called good teachers. They should always use their experience to source for materials locally using any available material as an alternative to non-available ones. The teachers should learn to use cheap and locally available materials in improvisation of instructional materials.

The t-test analysis in table 4 of this study shows that the number of years a teacher has taught is not a factor in his/her desire to improve his teaching through the improvisation of instructional materials.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are hereby made to achieve desired and better results in chemistry instructional delivery and learning outcomes at the secondary school level.

1. Training and re-training programmes should be embarked upon by the government to assist and foster positive teachers' attitude towards making improvisation as part of their duty.
2. The curriculum of Teacher Education Programme (TEP) at any level should be made to build in practical courses in material construction and utilization for the number of years the students-teacher will be in the school. Science, particularly chemistry teachers need to be exposed to practical aspects of the subject at any level of their study. This will enhance science process skills acquisition by the learners.
3. Advocacy for learning-by – doing as an integration into teaching methodology particularly for the sciences and technology courses is important in teacher training programmes. This is very necessary because skill based education has become more needed than ever to sustain the effort of translating theory to practice.
4. The school administrators: The PTA and the Government should go into counterpart funding for the provision of instructional materials to the schools. Science teachers can always hire some local experts to help them to teach some of the science concepts which the local people know very will in their environment. Their good relationship with the community would help them to tap the wealth of knowledge of these local experts to their own advantage.
5. The science teachers should take the students to places of interest to enable them see things in their natural ways.

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6. Donor agencies like the Universal Basic Education (UBE), World Bank, UNESCO, UNICEF and Education for All (EFA) can be approached for assistance in providing instructional materials for the schools.

CONCLUSION

The aim of this study was to examine the ability of the chemistry teachers in utilization of available teaching materials and their ability also to improvise non-available ones for teaching of chemistry. The results of the data analysis suggested that the use of the instructional materials in teaching chemistry is low. This generally implies that learning-by-doing is not being done by many teachers in our secondary schools. The government and school authorities should encourage the science teachers to improvise those instructional materials that are not available in their laboratories by providing the teachers with money to buy some of the raw materials and transport them to the schools where the actual improvisation will take place.

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