Improvised Science Laboratory Materials: Its Effectiveness in Acid-Base Experiment of Grade 7 Students of Amungan National High School

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ABSTRACT

This study aimed to determine the effectiveness of improvised science laboratory materials in acid-base experiment of selected grade seven students of Amungan National High School, Iba District during the school year 2021-2022.This research is both quantitative and qualitative in nature which utilized the pretest-posttest experimental design and the qualitative thematic analysis method. The student-respondent were given pre-test assessments before introducing the application of improvise science laboratory materials. The improvisation of laboratory materials was utilized during their hands-on experiment at home during distance learning. Based on the summary of the study conducted and the conclusions arrived at, there were only few student-respondents who passed the posttest after experiencing hands on experiments at their respective homes with the aid of improvised materials. The majority of the respondents experience feeling of excitement and appreciation of low-cost improvised materials during the home-based experiment in acid-base. The use of improvised materials had helped students perform experiments by themselves and provided them learning by doing. Difficulties and challenges during the experiments were evident such as lack of money and availability of materials.

Keywords: Acid-base Experiment Improvisation; Home-based; Hands-on

1. INTRODUCTION

Teaching resources, teacher's skill and curriculum played a vital role in child's education. Learning science should start with hands on experiences that the pupils are familiar with and not with abstract definitions of scientific concepts. However, one of the most cited problems of Integrated Science teaching in schools has been the lack of adequate science teaching materials. Improvisation or Substituting Integrated Science materials are clearly an effort towards cost reduction in Integrated Science teaching. It involves teachers making use of available materials as substitute for laboratory equipments where necessary. Students are equally involved as much as possible in the production. The application of the improvise science laboratory materials is important because it develops scientific attitudes, such as (honesty, Patience, skepticism, among others) in students towards the learning of integrated science. It promote students'

creativity in finding laboratory materials by having them improvise out of garbage resources to create extremely effective scientific laboratory materials. It also investigated the effect of laboratory improvisation on the concept attainment and how this materials helped the students in their learning process.

1.1 OBJECTIVE OF THE STUDY

The purpose of this study is to determine the effectiveness of improvised science laboratory materials on enhancing the concept attainment of students among grade seven students of Amungan National High School in the District of Iba Division of Zambales. Specifically, this study sought to answer the following:

1. What is the profile of the respondents in terms of:
   1.1 Age; and
   1.2 Sex?
2. Is there significant difference on the pretest and post test scores of students in the conceptual test?
3. Is there significant difference on the pretest and post test scores of male and female students?
4. What are the perceptions of the respondents in the utilization of the improvised learning materials in acid-base experiment?

2. METHODOLOGY

2.1 Research Design

One group pre-test posttest quasi experimental design whereby a practical research experiment was used. All participants were given pre-test assessments before introducing the significance and application of improvise science laboratory materials. The improvisation of laboratory materials were introduced to the students. The respondents answered the post tests after discussing one lesson by applying improvisation in the laboratory. Quantitative and qualitive methods were employed in the study that described the effect of improvisation on the academic performance of students and how it would help them in their laboratory experiment on acid-base learning.

2.2 Respondents

The respondents of this study were the grade 7 students of Amungan National High School Iba District Division of Zambales during the School Year 2021-2022. Iba District is located in Iba, Zambales. It has a total population of ninety-two (92) but fifty-five (55) students were selected in this school.

2.3 Instrument

A formative assessment was used as the data gathering tool. This enabled to show the impact of improvised experiment materials in science. This study was employed the use of a questionnaire about the topic being discuss and an interview question about their experiences while creating and using their improvise laboratory materials. The questionnaire which was used as the main data gathering instrument would be subjected to validation and reliability. The questionnaire was checked by the Research Adviser and the Defense Panel to ensure the validity and correctness of the instrument. The validated instrument would undergone dry run to see whether the questions are within the context reliable and valid.

2.4 Data Gathering Procedure

After the validation of the instrument, the Researcher sought approval from the superintendent of the Schools Division of Zambales for the distribution of questionnaires to the selected Grade 7 students of Amungan National High School.

The Researcher informed the respective school head for the distribution of the questionnaires to the given respondents. The respondents were first introduced to the pretest using a printed material. After two weeks of applying improvisation of science laboratory materials or equipment, and to further describe how the improvisation helped in their learning process and academic achievement, they were given a posttest and interview questions using the printed materials to assess the effectiveness of improvised science laboratory materials on student's learning process.

The chosen respondents were informed of the objectives of the study so that clarification of information and correctness of answers will be attained. The researcher would ensure one hundred percent retrieval of the questionnaires upon distribution.

3. RESULTS AND DISCUSSION

3.1 Profile of the Student-Respondents

Table 1 shows the frequency and percentage distribution of the student-respondents according to their profile variables. For age profile, majority of the student-respondents belonged to age 10-14 years old which is forty-nine (49) out of fifty-five students with 89.09%. The weighted mean of age was 12.65 years old. Only few respondents who are between 15-19 years old. While, there is only 1 student-respondent belonged to 20-25 age group. The students are in Grade VII so, the result was expected.

Out of fifty-five (55) student-respondents, there were more males (29 or 52.73%), while there were 26 females only or equivalent to 47.27%.

Table 1. Frequency and Percentage Distribution on Student-Respondent's Profile Variables

Profile	Category	Frequency (f)	Percentage (%)
Age	20-25	1	1.82
Mean- 12.65	15-19	5	9.09
	10-14	49	89.09
Sex	Male	29	52.73
	Female	26	47.27

Profile | Category | Frequency (f) | Percentage (%)
Age | 20-25 | 1 | 1.82
Mean- 12.65 | 15-19 | 5 | 9.09
10-14 | 49 | 89.09
Sex | Male | 29 | 52.73
Female | 26 | 47.27

3.2 Pre-Test Result

The student-respondents have shown unsatisfactory test results. The mean score is 7.53. There was only one (1) student-respondents who got fifteen (15) correct answers with a rating of 75% which is equivalent to 1.82% of 55 total number of students. It was followed by two (2) student-respondents who garnered a total no. of thirteen (13) correct answers which is equivalent to 3.64% out of 55 students. While most of the student-respondents earned thirteen (13) total scores with equivalent percentage of 23.64% out of 55 student-respondents.

Table 2. Score, Frequency and Percentage Distribution on the Student-Respondents Pre-Test Result

Scores	**Equivalent Rating**	**Respondents**		**Frequency (f)**	**Score Percentage (%)**
		Male	Female		
20	100%	0	0	0	0
19	95%	0	0	0	0
18	90%	0	0	0	0
17	85%	0	0	0	0
16	80%	0	0	0	0
15	75%	1	0	1	1.82
14	70%	0	0	0	0
13	65%	1	1	2	3.64
12	60%	0	2	2	3.64
11	55%	1	1	2	3.64
10	50%	0	5	5	9.09
9	45%	3	1	4	7.28
8	40%	6	2	8	14.55
7	35%	6	3	9	16.36
6	30%	5	2	7	12.73
5	25%	6	7	13	23.64
4	20%	0	1	1	1.82
3	15%	0	1	1	1.82
2	10%	0	0	0	0
1	%	0	0	0	0
Total		29	26	55	100%
4. Mean Score - 7.53 **5. Mean Percentage – 37.64**					

3.3 Table 3. Pre-Test Items, Frequency, and Percentage Distribution Analysis

The students-respondents indicate that the most learned concepts and skills during the pre-test or diagnostic test on acid-base are item numbers 2 which has a percentage of (78.18%) and ranked 1, followed by 3 and 17 (70.91%) which are both ranked 2.5, then item no. 9 (69.09%) which is ranked 4 and item no. 14 (60%) as ranked 5 which refers to nature of salt, taste of an acid, statements about acid, the Ph stands for and the color of litmus in distilled water respectively.

The least learned concepts are items no. 6, 18, 20 which refer to reaction of bases, acid present in tomato, and materials in acidic mixtures respectively. It is followed by item no. 10 which refer to what will be formed when an acid and base are mixed, followed by item nos. 12,13 & 19 which refers to the test for acid using litmus paper, the test for bases using red litmus paper and an example of a strong acid.

Item No.	Frequency (f)	Percentage (%)	Rank
1	26	47.27	6
2	43	78.18	1
3	39	70.91	2.5
4	16	29.09	13
5	17	30.91	11
6	8	14.55	19
7	20	36.36	8
8	17	30.91	11
9	38	69.09	4
10	9	16.36	17
11	17	30.91	11
12	12	21.82	15
13	12	21.82	15
14	33	60	5
15	20	36.36	8
16	20	36.36	8
17	39	70.91	2.5
18	8	14.55	19
19	12	21.82	15

20	8	14.55	19

3.4 Table 4. Score, Frequency and Percentage Distribution on the Student-Respondents Post-Test Result

The total number of student-respondents who got 75% and up were five (5) only with a percentage of 9.10% out of 55 students-respondents. There were 2 males and 3 females who passed the post-test.

The mean score of the 55 student-respondents is 10.84 with mean percentage of 54.18%. Most of the student-respondents got 10-11 correct answers. The lowest score is 8 who got by 6 student-respondents.

Scores	**Equivalent Rating**	**Respondents**		**Frequency (f)**	Score Percentage (%)
		Male	Female		
20	100%	0	0	0	0
19	95%	0	0	0	0
18	90%	0	0	0	0
17	85%	0	0	0	0
16	80%	1	0	1	1.82
15	75%	1	3	4	7.27
14	70%	0	1	1	1.82
13	65%	1	2	3	5.45
12	60%	3	4	7	12.73
11	55%	9	5	14	25.45
10	50%	6	4	10	18.18
9	45%	6	3	9	16.36
8	40%	2	4	6	10.91
7	35%	0	0	0	0
6	30%	0	0	0	0
5	25%	0	0	0	0
4	20%	0	0	0	0
3	15%	0	0	0	0
2	10%	0	0	0	0
1	5%	0	0	0	0
Total		**29**	**26**	**55**	**100%**
Mean Score - 10.84 **Mean Percentage – 54.18**					

3.5 Table 5. Pre-Test and Post-Test Result of Student-Respondents

The student-respondents indicated that there were differences on the pretest and post test result on acid base concept. The mean score for pretest is 7.53 with a mean percentage of 37.64%. While the mean score for posttest is 10.84 with the mean percentage of 54.18%. The difference between the mean score during the post test result against pretest is 3.31 with a mean percentage difference of 16.54%. There was a minimal difference of pretest and post test results.

The utilization of improvised materials develops by student-respondents at home had at least helped few of the students with their posttest assessment. However, there were only five students who passed the exam with 75% and up. Respondents 1,2,3,27 and 36 almost got scores between 15-16 only which is 9.09% out of 55 student-respondents. Negatively, there were 50 out of 55 (90.9%) student-respondents who got scores below 15. The utilization of the improvised materials should be conducted in the school laboratories.

44	M	5	9	25	45
45	M	7	11	35	55
46	M	5	9	25	45
47	M	9	12	45	60
48	M	5	8	25	40
49	F	6	10	30	50
50	F	5	8	25	40
51	F	9	12	45	60
52	F	5	9	25	45
53	M	6	10	30	50
54	F	5	9	25	45
55	M	8	11	40	55
Mean		7.527273	10.83636	37.6364	54.18182

3.6 Test Difference on the Pre-Test and Post Test

Based on table 6, the result is favorable to the positive ranks, that post test scores of the students, after being allowed to perform experiment using improvised materials. The difference between the pre and post test scores of the students was statistically significant ($z = -6.537$, $p = 0.000 < 0.05$). Therefore, there was improvement in the conceptual understanding of the students after the experiments using improvised materials at home or outside classroom setting. This agrees with the study of Fernandez (2017), the raw scores of pre and posttest from his study showed that the mean post test scores of student-respondents after the acid-base experiments using improvised materials. the Hake gain was calculated as seen on table 7. The calculated value is 0.27, which is considered as moderate Hake gain. The moderate Hake gain value of students can be explained by the involvement and participation in constructing knowledge on relevant concept. The improvements in test scores individually showed that they have better learned scientific concepts particularly on acid-base with the use of improvised materials for experimentation.

Table 6. Wilcoxon Signed Ranks Test of Grade VII Student-Respondents Pre-Test and Post Test

	N	**Mean Rank**	**Sum of Ranks**	**Z**	**Asymp. Sig (2-tailed)**
Negative ranks	0	0.00	0.00	-6.536	.000
Positive Ranks	55	28.00	1540.00		
Ties	0				
Total	55				

Table 7. Effect of Improvised Materials Utilization on the Acid-Base Concepts and Learning

N	**Pre-Test Score Average**	**Post-Test Score Average**	**Hake Gain**
55	7.53	10.84	0.27

3.7 Perceptions of the Respondents in the Utilization of the Improvised Learning Materials on Acid-Base Experiment

Majority of the respondents experienced almost similar feelings, observations and representations such as feeling of excitement, amazement and appreciation of low-cost improvised materials in conducting the home-based experiment in acid-base. They were able to appreciate the improvisation of materials. In this way, most of them confirmed that they have learned something new in doing an experiment at home, though few of them found it hard to carry over. Based on the transcripts of the students, they described the learning experience as fun and exciting, difficult and an opportunity to develop their scientific attitudes. The students considered their learning experience as fun and exciting. Students appreciated the use of improvisation for them to be able to do the experiments. They considered it as fun that they are able to learn something new

through improvisation.

Table 8. Observations, Reflections and Over-all Impressions of Student-Respondents on the Acid-Base Experiment

QUESTION	ACTUAL RESPONSES	AXIAL CODE	CATEGORY
Describe your experience on improvisation of acid-base experiment.	*"It's a bit difficult because I don't really understand the other details about the acid-base but it's fun because I learned some new things."* Respondent 3 *"My experience on improvisation of acid-base experiment is exciting because I learn something new."* Respondent 5 *"My experience is wonderful! I learn so much thing and I learn that I can answer all the question but I'm not sure if it is correct."* Respondent 9 *"I am so happy because improvisation is like an adventure. It was fun and full of new knowledge and skills."* Respondent 10 *"I was amazed! I learned that improvisation in experiment will get accurate result too!"* Respondent 13	Fun and Exciting	Fun and Exciting
	"By conducting the improvisation in an experiment I learn various things such as being interested in using a low cost materials in an experiment." Respondent 20 *"One of the difficulties I found during improvisation is the lack of money to buy the samples that I need for the experiment."* Respondent 1 *"Improvisation is hard in doing an experiment when some improvised materials aren't compatible to the exact tool you should use. "* Respondents 22 *"Improvisation is hard in doing an*	Lack of Money Unavailability of the Materials	Difficulties

	*experiment when some improvised materials aren't compatible to the exact tool you should use. Lacking of tools is hard to find substitution."*Respondent25 *"Lack of laboratory materials can be difficult at times and its pretty hard to find a good substitute that is suitable for the experiments."*Respondent 29 *"Yes, sometimes the material that you want to improvise can be very difficult to make because of unavailability of the materials."*Respondent 21 *"Yes, it helped me do the experiment despite the lack of materials."*Respondent 29		
	*"I learn to accept whatever happens in the experiment including mistakes in my improvisation, then I will improve it."*Respondent 12 *"From what I've experienced, making your own analysis defines your innovation or creativity to it. Specially having the principle of that work-ethic, the idea that hard work is fundamentally valuable and worth pursuing."*Respondent 27 *"It helps me boost my confidence about doing something new ."*Respondent 16 *"Yes it helps me learn better because it develops my knowledge of creativity, critical thinking and self confidence."*Respondent 18 *"Yes, it helps me learn. It made me improve my creativeness more and it made me realized that showing your creativeness can help you boost your confidence."*Respondent 21 *"Yes, what I did to overcome this*	Perseverance Boost One's Confidence	Develop Scientific Attitudes

	*obstacle was to be strong and to always think of it as a challenge that I will eventually overcome."*Respondent 20 *"Improvisation develops my creativity as a student. It makes me resourceful at the same time."*Respondent 18 *"Yes, it did help me learn. It made me improve my creativeness more and it made me realize that showing your creativeness can help you sometimes have the things you don't have."*Respondent 24 *"Masaya po dahil nakakagawa po kami ng sarili naming gagamitin sa activity at nagagawan namin ng paraan para magawa yung activity kahit wala kami nung mismong materials na kailangan."*Respondent 28	Creativity Resourcefulness	

4. CONCLUSION

Based on findings and conclusions, majority of the student-respondents belongs to 10-14 years old which is a typical age for a grade seven students. The student-respondents have shown unsatisfactory results during the pretest of which been answered without any experimentation on acid and base. There were only few student-respondents who passed the posttest after experiencing hands on experiments at their respective homes with the aid of improvised materials. There is a minimal difference on the pretest and post test result on acid and base concept. There is a favorable result to the positive ranks in the posttest scores of the students after being allowed to perform experiment using improvised materials. There is significant improvement in the conceptual understanding of the students after the experiments using improvised materials. The majority of the respondents experience feeling of excitement and appreciation of low-cost improvised materials during the home-based experiment in acid-base. The use of improvised materials had helped students perform experiments by themselves and provided them learning by doing. Difficulties and challenges during the experiments were evident such as lack of money and availability of materials.

5. RECOMMENDATIONS

Based on the summary of the study, the researcher offers to conduct hands-on experiments in learning science concepts in the school setting among learners, procure suitable laboratory materials to conduct synchronous laboratory experiments or demonstration, and to provide comprehensive modular and learning materials related to the topic. To arrive at better learning results in any scientific experiments with in the competencies of the grade seven students, the school should give emphasis and importance on procuring suitable laboratory materials to be utilized by the students in order to have expected better results.

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