EFFECTIVENESS OF CONTEXTUALIZED AND LOCALIZED SELF- INSTRUCTED EXPERIMENTAL TOOLKITS (CLoSETs) IN ENHANCING THE ACADEMIC PERFORMANCE FOR SCIENCE 9

DELA CRUZ, ROGELIO JR. T.
rogelio.delacruzjr@deped.gov.ph
Pulo National High School

ABSTRACT

This research endeavor intends to determine the effectiveness of Contextualized and Localized Self-instructed Experimental Toolkits or CLoSETs in enhancing the students' performance of Grade 9 Science learners in Pulo National High School. To improve learners' basic skills in conducting scientific inquiries, gathering and formulating principles and recalling facts in science, the contextualized activities and localized materials as toolkits in conducting science experiments through self-instructed procedures and guide questions are utilized. To master the least-learned learning competencies in MELC, the four (4) stages of learning had been employed which includes the preparatory, experimental, synopsis and assimilation or PESA as validated and presented in the research instrument used. This study further investigated and analyzed if there would be a significant difference in the pretest, formative test and post-test of the experimental and comparison group conditions. The study utilized quasi-experimental method of research and a match-pairing method. To test the mean score of the variables, mean and standard deviation was employed to test while the Independent Samples t-Test and Paired-Sample t-Test were utilized to examine the significant difference between variables. Cohen's d was applied to get the standardized effect size results of the variables. The study showed that the experimental group got a "Very High" result while the comparison group obtained a "High" outcome. In formative assessment the experimental group garnered a "Very High" output for the lessons in Projectile Motion, Momentum, Impulse and Collision compared a "High" output obtained by the comparison group for the same lessons. Furthermore, a significant difference was present between the results of formative test and post-test mean score together with the pretest and post-test mean score of the two groups conditions with a "Very Large" to "Huge" effect size. Also, there was a "Huge" effect size for the pretest and post-test mean score of the experimental and comparison groups conditions. This implied that the utilized innovative learning tool was effective and learners were enabled to master the least-learned learning competencies in MELC and enhance their academic performance in science. iT recommends that the localized materials for scientific quests should be prepared ahead of time and properly facilitated by the teacher. The contextualized and localized learning materials should be unified in other disciplines with technological application developed locally to make science more fun and interactive.

Keywords: Contextualized, Localized Experimental Toolkits, Self-instructed Science Experiments, Student's Performance, Least-Learned Learning Competencies

INTRODUCTION

Teaching science concepts should be fun and interactive. This made learners able to unlock and maximize their potentials and help them improve and focus in conducting scientific inquiries and investigations. In fact, this practice is a directive coming from the Department of Education that a conducive classroom should offer, create and maintain an adequate, holistic and integrated system of basic education which conformed to its objectives in raising quality and competitive life- long learners for national development.

The Department of Education Order No.42, s. 2017 known as the National Adoption and Implementation of the Philippine Professional Standard for Teachers or PPST significantly addressed that good teachers were essential in appraising students' achievement congruent to their quality teaching and learning. This insight reinforced in building holistic education for the sustenance of nation building. The Science Curriculum Framework for Basic Education discussed that science was essential to every individual. The basic education in science toward school should implement and practice scientific literacy among learners and encourage them to take higher career in Science, Technology, Engineering and Mathematics or STEM. The teaching methods for science knowledge should not mainly rely solely on textbooks but also in varied manipulative, interactive and brain-based activities ensuring learners' interest and become active. Also, it was highlighted that the Science and Technology teaching and learning process must be affixed on contextual learning, constructivism and brain-based pedagogy which help and guide them to demonstrate scientific inquiry skills and apply scientific knowledge, attitude and values. As this school year opened, face to face classes were being implemented and rigorous teaching and learning processes should be manifested to resolve the so-called learning loss. The Section 8 of R.A. No. 10533 or Implementing Rules and Regulations of the Enhanced Basic Education Act of 2013 indicated that the basic education should be enhanced and inclusive with their implementation of programs addressing learners' need in physical, intellectual, psychosocial, and cultural. Science education must be aligned to the following rubrics of ideals and philosophies on the implementation of the modified basic education curriculum to make learners become collaborator, self-directed, inquirer of facts and insightful. This could be done through an innovative learning approach, relatable, rounded, interactive, learner-centered, research-based, gender-sensitive, localized and contextualized and competent. This principle was encouraged to produce and develop localized teaching and learning materials in accordance with national policies and standards.

The DepEd Order No. 21, s, 2019 gave emphasis in providing education that focused on contextualized learning as to exercise 21st century skills embedded in different learning areas. Also, this study anchored on the Sustainable Development Goal (SDG) on Quality Education in which it offered quality basic education among learners which is equitable and inclusive. As a science educator grasping basic skills and concepts was rooted in conducting various scientific experiments conforming with learning competencies needed to unpack. Similarly, there was a need in applying laboratory work for teaching basic knowledge, skills and concepts in science. This served as a basic pillar in promoting problem-solving, critical thinking and scientific discovery to further enhance student learning (Santiago et.al., 2022). The practical work could explain the value of science and definitely benefit students to perform better and achieve higher academic standards in science (Abulibdeh & Shana, 2020).

Moreover, the researcher believed that performing experiments could be more effective and efficient if the materials to be used that are at students' context, self-instructed and could be found within their reach. This could boost learners' confidence in doing scientific investigations independently and provide practical experiences by physically handling, observing and executing the materials. Through localization and contextualization educators could embed in the Department of Education mission by protecting and promoting Filipino learners to experience complete basic education through just, excellence, and culture-based concepts. This was accounted for the national and local governments a need to encourage local planning for developing educational policies and programs for the betterment on educational endeavor.

In behalf of this huge platform and reform, we cannot embrace the fact that the recently concluded science test and assessment wherein Filipino learners were on the least. The researcher affirmed that this educational difficulty could be alleviated through proper alignment where methods of teaching and principles were anchored on the needs of our learners and put it in a global standard. Localizing materials for science inquiry made them apply and appreciate that scientific thinking was in their reach. Presenting the lessons at their own context could bridge the learning gaps for contextualization resulting in an atmosphere of learning by linking prior knowledge to the recent and using their life experiences to uncover and recall facts and principles. This study would be of great advantage to the educational reform where learning could offer them a variety of opportunities and appreciate that learning science is indeed fun and interactive.
Consequently, it could motivate and give them more interest in pursuing higher or tertiary learning for effective and efficient mechanisms for teaching is no more a problem.

RESEARCH QUESTIONS

This research study was meant to answer the effectiveness of the Contextualized and Localized Self-instructed Experimental Toolkits in enhancing the students' learning skills and development in Science 9 learners of Pulo National High School in the City Schools Division of Cabuyao.

Intently, it sought to give answers to the questions listed below:

1. What is the mean score of the Experimental and Comparison groups in terms of their:
    1.1 pretest;
    1.2 formative test;
    1.3 and posttest?

2. Is there a significant difference between the mean scores obtained by the two groups from their formative test?

3. Is there a significant difference between the posttest mean scores of two groups?

4. Is there a significant difference between the pretest and posttest mean scores of each group?

HYPOTHESIS

Ho1: There is no significant difference between the mean scores obtained by the experimental and comparison group conditions in their formative test.

Ho2: There is no significant difference between the post-test mean scores results of the two groups.

Ho3: There is no significant difference between the pre-test and post-test mean scores of each group.

METHODOLOGY

This research study utilized the quantitative method of research to undertake research phenomena objectively with a target of getting factual data based on experiments, measurement and numerical data (Yazon, et. al., 2019). This study had purposive sampling techniques to select the characteristics of the needed sample through a match-pairing method to categorize the participants who were identified and part of the comparison and experimental groups conditions. The selection was based on the pretest scores being obtained by the learners. The unselected participants with no matched scores were clustered and excluded in the study.

The result of the data was quantified and interpreted accordingly. Likewise, to establish and validate the significant relationship shown between the variables, specifically the independent and dependent, a quasi-experimental method of research was employed. The researcher employed the mean and standard deviation to express the results of the data of the mean scores for the experimental and comparison group conditions in terms of their pretest, formative test and posttest results. In order to determine the presence of significant difference between the formative test mean scores and the post-test mean scores obtained by the two groups the independent samples t-test was utilized. On the other hand, the paired-sample t-test was used to showcase the significant difference between the pre-test and post-test mean scores of each group. The researcher also used Cohen's d to know the standardized effect size between two groups means scores of the comparison group and experimental group conditions. Consequently, these could be of great help to validate and authenticate on the evaluation of the actual result of the intervention material being used. The underlying impact of an intervention material on the target population without random assignment by the pretest and post-test designs could get clearly and meaningfully (Thomas, 2020). Also, the researcher could assess the effectiveness of the instructional materials being made. Then, all the facts and data being gathered were carefully considered, analyzed and interpreted. The researcher would use the data gathered to draw inferences and generalization.

The main device utilized in this study was the Contextualized and Localized Self-instructed Experimental Toolkits as an innovative teaching and learning approach in enhancing students' academic achievement toward the least-learned learning competencies in Science 9 specifically in Physics. This pedagogical approach was composed of (1) specific learning area in science (2) topics or contents (3) Most Essential Learning Competencies or MELC that were least-learned (4) learning objective/s (5) the 4 stages of learning which includes the preparatory, experimental, synopsis and assimilation or PESA and (6) feedback or reflection.

The research study chose to get the Grade 9 learners as participants of the study who currently registered in Pulo National High School for School Year 2023-2024. The information about the learners was taken through their respective advisers with the help of the School Registrar and Department of Education Learner's Information System (LIS). Rest assured that all data were kept confidential.

RESULTS AND DISCUSSION

Table 1

Pretest and Posttest Mean Score of the Experimental and Comparison Groups Conditions

Test	Group	Mean	SD	Descriptive Interpretation
Pretest	Experimental	6.87	1.20	Low
	Comparison	6.87	1.20	Low
Posttest	Experimental	18.17	1.32	Very High
	Comparison	13.53	2.22	High

Legend: 17.00 – 20.00 = Very High; 13.00 – 16.00 = High; 9.00 – 12.00 = Average; 5.00 – 8.00 = Low; 1.00 – 4.00 = Very Low

As seen in Table 1, there was a total sample size of 60 participants. The experimental group conditions were composed of 30 learners as well as the comparison group conditions. These two groups took a pretest and a posttest with a 20-items test. Based on the results of table 1, the pretest of both groups had a mean score of 6.87 and a standard deviation of 1.20 which was interpreted as "Low". It explained that the two groups had short knowledge about the topics involved. However, a different result could be seen in their posttest. The comparison group gained a mean score of 13.53 with a standard deviation of 2.22 which was interpreted as "High". Meanwhile, the experimental group obtained a mean score of 18.17 with a standard deviation value of 1.32 which had a descriptive interpretation of "Very High". This implied that students' performance in Science 9 specifically in Physics was improved. The instructional material being used in this study had a significant effect on the learners toward mastering the least-mastered Most Essential Learning Competencies or MELC. Thus, localized and contextualized teaching approaches are beneficial toward the learning performance of the learners (Bello, et. al., 2023).

Undeniably, the employment of localized and contextualized learning activities clearly promotes a better learning and understanding of the lesson (Montero and Geducos, 2022) and played a vital role in educational reform that addressed the local needs of the students (Manuel, 2019).

Table 2

Formative Test Mean Scores of the Experimental and Comparison Groups Conditions

Lesson	Group	Mean	SD	Descriptive Interpretation
Projectile Motion	Experimental	9.17	0.70	Very High
	Comparison	7.30	1.24	High
Impulse, Momentum and Collision	Experimental	9.20	0.71	Very High
	Comparison	7.63	1.10	High
Overall	Experimental	18.37	1.03	Very High
	Comparison	14.93	1.62	High

Legend: 17.00 – 20.00, 9.00-10.00 = Very High; 13.00 – 16.00 , 7.00-8.00= High; 9.00 – 12.00 , 5.00-6.00= Average; 5.00 – 8.00 , 3.00-4.00= Low; 1.00 – 4.00, 1.00-2.00 = Very Low

As shown in Table 2, this study was focused on the topics of Physics which includes (1) the Projectile Motion and (2) Momentum, Impulse and Collision of the objects. The 10-

item formative assessment had been given after every lesson had been delivered to both comparison and experimental group. The result showed that the formative assessment of comparison group under the lesson of Projectile Motion had a mean score of 7.30 and a standard deviation of 1.24 with a descriptive interpretation of "High" while the experimental group got a mean score of 9.17 with a standard deviation of 0.70 with a "Very High" descriptive interpretation.

Additionally, the lesson about momentum, impulse and collision, the comparison group reached a mean score of 7.63 and a standard deviation of 1.10 which interpreted as "High" while the experimental group obtained a mean score of 9.20 and a standard deviation of 0.71 with a descriptive value of "Very High". This explained that both groups expressed learnings about the given topic however the experimental group excelled more. Meanwhile, for the overall value of mean score of the formative test, the experimental group attained 18.37 compared to the comparison group with only 14.93 which interpreted as "Very High" and "High" respectively. This explained that the utilization of contextualized materials though localized materials for science experiments indeed brought a significant impact in students' learning process in formulating, conceptualizing and recalling basic science facts and concepts.

According to Dioneda (2019), the integration of the localized and contextualized instructional materials increased students' achievement and motivated them towards the lessons. This further explains that learners under the experimental group had higher recalling skills of science facts and principles. Also, the practice of localized examples, exercises and illustrations made teaching and learning effective (Garin et. al., 2017).

Table 3

Test of Difference for the Formative Test Mean Score of the Experimental and Comparison Group Conditions

Lesson	Group	Mean	SD	t	Mean-Diff	Cohen's d	Effect Size
Projectile Motion	Experimental	9.17	0.70	7.201 **	1.867	1.857	Very Large
	Comparison	7.30	1.24				
Momentum, Impulse and Collision	Experimental	9.20	0.71	6.550 **	1.567	1.696	Very Large
	Comparison	7.63	1.10				
Overall	Experimental	18.37	1.03	9.798 **	3.433	2.534	Huge
	Comparison	14.93	1.62				

*** - Test is Significant @ p-value<0.01; Cohen's d <=0.19: Very Small, d <=0.49: Small, d <=0.79: Medium, d <= 1.19: Large, d<=1.99: Very Large; d>=2.0: Huge. df = 58*

Based on Table 3, there was significant difference between the Formative test assessment for the lesson Projectile Motion of the Experimental and Comparison group conditions; [t (58) =7.201, Mean-Diff=1.867, p-value <0.01]. In the case of Formative test assessment for the lesson Impulse, Momentum and Collision, there was a significant difference between the mean score of the Experimental and Comparison group conditions; [t (58) =6.550, Mean-Diff=1.567, pvalue<0.01]. Finally, there was a significant difference between the Overall Formative test of the Experimental and Comparison group conditions; [t (58) =9.798, Mean-Diff=3.433, p-value<0.01]. Since the results of Independent-

Samples t-Test for the Formative test assessment of the Experimental and Comparison group was significant, Cohen's d was calculated to determine the effect size. The computed Cohen's d was 1.857 (Projectile Motion), 1.696 (Momentum, Impulse and Collision), and 3.433 (Overall) this implied that there was "Very Large" to "Huge" effect size between the Formative test assessment of the Experimental and Comparison group. Since the p value is less than 0.01 the instructional material used in this study is effective which led to the rejection of the null hypothesis stating that "There is no significant difference between the mean scores obtained by two groups from their formative test". The result of the data manifests that the learning tool being applied is essential to learners' learning needs and development. The increase in their formative scores with the localized and contextualized materials made students more interested in the topics and recall concepts easily (Chumacera, 2019).

Table 4

Test of Difference for the Posttest Mean Score of the Experimental and Comparison Group

Test	Group	Mean	SD	t	Mean-Diff	Cohen's d	Effect Size
Posttest	Experimental	18.17	1.32	9.821 **	4.633	2.541	Huge
	Comparison	13.53	2.22				

*** - Test is Significant @ p-value<0.01; Cohen's d <=0.19: Very Small, d <=0.49: Small, d <=0.79: Medium, d <= 1.19: Large, d<=1.99: Very Large; d>=2.0: Huge. df = 58*

There was a significant difference between the Posttest mean score of the Experimental and Comparison group conditions; [t (58s) =9.821, Mean-Diff=4.633, p-value<0.01]. Since there was a significant result of Independent-Samples t-Test for the Posttest mean score of the Experimental and Comparison group, Cohen's d was calculated to determine the effect size. The computed Cohen's d was 2.541, this implied that there was "Huge" effect size between the Posttest mean score of the Experimental and Comparison group. Here, the p value is also less than 0.01, thus, the instructional material applied in this study is effective as well leading to the refusal of the null hypothesis stating that "There is no significant difference between the Posttest mean scores of the two groups".

Bugarso et. al. (2021) reported that students experienced varied hands-on laboratory activities supporting theoretical understanding in science lessons and developed lifelong learning. The CLoSETs material as a pedagogical approach composed also of various self-instructed procedures used by learners in their scientific quests.

Holistically, the contextualized and localized self-instructed experimental toolkits as an intervention program developed a positive impact on learners' attention span, focus, and study habits (Guingayan, et. al., 2019).

Table 5

Test of Difference for the Pretest and Posttest Mean Score of the Experimental and Comparison Group

Group	Test	Mean	SD	t	df	Mean-Diff	Cohen's d	Effect Size
Experimental	Posttest	18.17	1.32	32.028 **	29	11.300	5.849	Huge
	Pretest	6.87	1.20					
Comparison	Posttest	13.53	2.22	14.241 **	29	6.667	2.600	Huge
	Pretest	6.87	1.20					

*** - Test is Significant @ p-value<0.01; Cohen's d <=0.19: Very Small, d <=0.49: Small, d <=0.79: Medium, d <= 1.19: Large, d<=1.99: Very Large; d>=2.0: Huge.*

Presented in Table 5 is the outcome of a paired-sample t-test conducted to examine the statistical difference between the Pretest and Posttest mean score of the Experimental and Comparison group.

There was significant difference between the Pretest and Posttest mean score of the Experimental group conditions; [t (29) =32.028, Mean-Diff=11.300, p-value<0.01] and there was significant difference between the Pretest and Posttest mean score of the Comparison group conditions; [t (29) =14.241, Mean-Diff=6.667, p-value<0.01]. Since there were significant results of Paired-Sample t-Test for the Pretest and Posttest mean score of the Experimental and Comparison group, Cohen's d was calculated to determine the effect size. The computed Cohen's d was 5.849 (Experimental) and 2.600 (Comparison), this implied that there was "Huge" effect size between the Pretest and Posttest mean score of the Experimental and Comparison group. Hence, the hypothesis stating that "There is no significant difference between the Pretest and Posttest mean scores of each group" was rejected. This entailed that the lesson became lively and attractive to students where they could actively engage and construct their own insights by linking the acquired knowledge in real-life application (Reyes et. al., (2019).

The Contextualized and Localized Self-instructed Experimental Toolkits or CLoSETs as innovative pedagogical learning material served as a new pillar in enhancing students' performance toward the least-learned learning competencies in Science 9 particularly in Physics. Upon conducting this study, the researcher observed that learners were actively engaged in various scientific investigations because of the familiarity of localized materials for science experiments. They could answer contextualized activities even at home. As a result, they were able to conceptualize basic concepts, formulate principles and recall facts. The learners were enabled to identify quantities and solve word problems easily. They could appreciate and connect science ideas and applied it in real-life scenarios. Lastly, the learners' developed the ability of conducting science investigation independently and had a pursuit to get higher learning in Science, Technology Engineering and Mathematics.

CONCLUSION

Based on the data gathered salient findings are as follows: The pretest results of the participants of the study started with low knowledge on the topics. But, after the intended learning tool for both groups, applied, a shift of scores manifested in their posttest. The experimental group had "Very High" results compared to a comparison group with "High" results only. This implied that the CLoSETs learning material enhanced students' performance in learning and recalling science concepts.

In terms of the formative assessment of two groups, the experimental group had "Very High" output for the lessons in Projectile Motion, Momentum, Impulse and Collision. Meanwhile, the comparison group obtained a "High" output for both lessons as well. This explained the positive attribute of the instructional material being employed.

The study discovered that there was a significant difference between the mean scores of Formative test assessment for the lessons Projectile Motion and Impulse, Momentum and Collision of the Experimental and Comparison group conditions. The two groups attained a "Very Large" to "Huge" effect size on their Formative test. This proved that the learning tool used is effective toward learners' academic development. The study found out that there was a significant difference between the Posttest mean score of the Experimental and Comparison group conditions. The effect size between the Posttest mean score of the Experimental and Comparison group was "Huge". This explained the effectiveness of the teaching strategy employed in this study.

This study showed that there was a significant difference between the Pretest and Posttest mean score of the Experimental group conditions and Comparison group conditions. Additionally, there was a "Huge" effect size between the Pretest and Posttest mean score of the Experimental and Comparison group. This pointed out that the contextualized and localized self-instructed experimental toolkits are of great help in mastering the least-learned Most Essential Learning Competencies in Science 9 Physics topics. Thus, all of the null hypothesis are rejected.

Furthermore, the utilization of Contextualized and Localized Self-instructed Experimental Toolkits as innovative instructional materials enabled learners to assimilate the concepts well. Their improved scores justify that they are able to conceptualize independently and already learn the requisite skills and eventually enhance their academic performance. Thus, students could really recall and apply their acquired and manifests the effectiveness of the materials being utilized and served as essential factor to make them master the needed learning skills and competencies in Science 9.

RECOMMENDATION

In accordance to the findings and conclusions of this study, here are the lists of recommendations.

1. It is strongly recommended that the teacher should have a mastery of the lesson before utilizing innovative learning tools to address immediate learning gaps and to make learning effective and efficient.

2. Localized materials for scientific investigations may prepare ahead of time to lessen or prevent difficulties.

3. In conducting scientific investigations, teacher may constantly check and monitor the procedures being done by the learners to prevent unwanted incidents.

4. Further studies may be conducted using this learning tool with other learning areas in Science like Biology, Chemistry and Earth and Space.

5. Future researchers may consider the integration of technological applications developed locally.

6. Integrating contextualized and localized materials in teaching learning process to other subjects in the academe.

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