



Effectiveness of Structured and Unstructured Laboratory Approaches on the Scientific Comprehension and Performance Skills of Third Year High School Students towards Chemistry Subject

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Article History

Received: 15.12.2025

Accepted: 22.02.2026

Published: 25.03.2026

Abstract: This study aimed to determine the effectiveness of structured and unstructured laboratory approaches on the scientific comprehension and performance skills of Third Year High School students in one of the private secondary schools in Central Philippines towards Chemistry Subject. Quasi-experimental design with matched pairs and post-test only control and experimental groups was employed to 100 respondents who were assessed through comprehensive tests on the physical and chemical properties of matter and performance skill evaluations using teacher-made rubrics. T-test and Pearson Product Moment Correlation were applied at the 0.05 level of significance as the applied statistical tools. Findings revealed that students exposed to the unstructured laboratory approach achieved higher mean scores in scientific comprehension compared to those under the structured approach, both interpreted as satisfactory. Performance skills were also superior in the unstructured group, interpreted as Highly Skilled while the structures group was Highly Skilled. There were significant differences found in both comprehension and performance skills between the two approaches, endorsing the unstructured method.

Additionally, comprehension and performance skills under both approaches showed strong positive correlation which indicated that the cognitive and psychomotor domains complement each other in laboratory learning. The results suggest that unstructured laboratory activities promote stronger independence, critical thinking, and skill acquisition, underscoring their academic significance in Chemistry instruction. Recommendations involve organizational support for unstructured laboratory manuals, assimilation of lecture and laboratory schedules, and focus on safety and proactive student participation.

Keywords: Laboratory approaches, scientific comprehension, performance skills, Chemistry.

Cite this article:

GORRICETA, L. F., (2026). Effectiveness of Structured and Unstructured Laboratory Approaches on the Scientific Comprehension and Performance Skills of Third Year High School Students Towards Chemistry Subject. *ISAR Journal of Multidisciplinary Research and Studies*, 4(3), 20-29.



Introduction

There are great demands in finding ways to strengthen education for international understanding. Colleges and universities should bring their students to function effectively in global society in which time and space no longer isolate the nation, people and markets of the world. Bringing global perspective into the classroom must begin with helping teachers develop that perspective for themselves (Barker, 2000).

Science is a global activity with consequences for all our lives. Science education provides opportunities to relate technological change to changes in a wider context, such as effects in our quality of life. The impact of science is not confined to scientists but affects all people everywhere. Young people need to develop skills, such as critical thinking and relating their own experiences and knowledge to wider issues, in order to participate fully in this global society. Thus, the global dimension is applicable across the curriculum and is increasingly relevant in science, (ase.org, 2005).

The hardest part of sustainable educational leadership and improvement according to Hargreaves and Fink, is the part that provokes us to think beyond our schools and ourselves. We need to perform not merely as managers of organizations or as professionals who produce performance results, but also as community members, citizens and human beings who lead to serving and promote the good of all (2006:20). Thus, it is a significant demand for teachers to become more creative, facilitating, and updated to generate higher level of thinking and acquisition of skills and attitude in the present system of education.

As agents change in this scenario, teachers must manifest strong leadership ability. To be able to lead they must be first to try and innovate instructional techniques and approaches (Salandanan, 2001). Laboratory work, according to Beasley (1998), is generally regarded as a necessary and highly significant component of science education. He further stressed that the expectation is that science education should be concerned with developing skills in making observations and measurement both with unaided senses and instruments, general manual physical skill, the use of specialized equipment, analyzing and organizing information from a variety of sources including drawing out of critical thinking and creativeness about ideas.

In the Philippine Constitution, it was stated that science and technology are essential for national development and progress. The State shall give priority to research and development, invention, innovation, and their utilization, and to science and technology education, training, and services. It shall support indigenous, appropriate, and self-reliant scientific and technological capabilities, and their application to the country's productive systems and national life (Ldb.Org,2006).

The mission of basic education shall be geared towards the pursuit of a better quality of life for all Filipinos by emphasizing the formation of those skills and knowledge necessary to make the individual a productive member of society, instruct the young and provide leadership in the various field required by a dynamic and self-sustaining economy. Basic education shall likewise be used to harness the productive capacity of the country's human resource

based towards international competitiveness (Zulueta and Gimbatan, 2002).

As Macarayan (1995) pointed out, our country is in times faced with huge and stimulating challenges as schools come to terms with the new age of education and adapt to dramatic social and technological changes. She further added that, "indeed lively footwork is needed to keep up with these changes, and these changing times to develop educational programs designed to meet these challenges".

Lardizabal (1995) stressed that advantages claimed in favor with the laboratory teaching method because it's learning by doing, impressions through several senses make learning more effective, undergoing actual experience is more vivid and what one learns by the laboratory method is retained longer. The laboratory is a vital environment in which science is experienced. It is through laboratory activities that students learn to communicate scientific and qualitative information (Carroll, 2005).

Similarly, Conese, and Gatapia (2005) averred, "to better understand science concepts, emphasis is given on the application of the activities to incorporate students' awareness on the relevance of science, develop critical and creative thinking as well as skills in problem solving".

Balitaan et al (2003) pointed out that science and technology have played a vital role in man's quest for quality of life. It has brought changes that created a great impact on man and society. She further emphasized in her published laboratory manual in Chemistry her goal to provide students with relevant experiences through a series of activities and experiments because she believes that science is learned by discovery inquiry and practical work approach.

The respondents of the study are in dire need to articulate their acquired scientific knowledge in Chemistry into an experienced-based understanding of scientific principles in the laboratory. Since global understanding of science is deeply rooted from the actual basis of learning experiences in the laboratory based on the different standpoints, the researcher found the need to introduce strategies to determine the effectiveness of structured and unstructured laboratory approaches on the scientific comprehension and performance skills of the high school students towards Chemistry subject. The researcher chose this study because of the challenge to meet the need for improvement in science education and to test the significance of the scientific teaching approaches to enhance deeper knowledge and skills of the students in Chemistry. Being aware of the need to improve science learning particularly in Chemistry, the researcher had eagerly designed laboratory experimental approaches, procedures and materials to identify the most effective approach in guiding students into meaningful and challenging laboratory investigations.

Statement of the Problem

This study aimed to compare the effectiveness of structured and unstructured laboratory approaches on the third-year high school students' performance skills and scientific comprehension in Chemistry subject.

The study sought to answer the following questions:

1. What is the level of students' scientific comprehension in Chemistry after their exposure to:
 - a. structured laboratory approach?
 - b. unstructured laboratory approach?
2. What is the level of students' performance skill in Chemistry after their exposure to:
 - a. structured laboratory approach?
 - b. unstructured laboratory approach?
3. Is there a significant difference in the level of scientific comprehension of the Chemistry students after their exposure to structured and unstructured laboratory approaches?
4. Is there a significant difference in the level of performance skill of Chemistry students after their exposure to structured and unstructured laboratory approaches?
5. Is there a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to structured laboratory approach?
6. Is there a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to unstructured laboratory approach?

Hypotheses of the Study

1. There is no significant difference in the level of scientific comprehension of the Chemistry students after their exposure to structured and unstructured laboratory approaches.
2. There is no significant difference in the level of performance skill of Chemistry students after their exposure to structured approach and unstructured laboratory approaches.
3. There is no significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to structured laboratory approach.
4. There is no significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to unstructured laboratory approach.

Theoretical Framework

This study was linked to the Theory of Pragmatism by John Dewey and to the Theory of Constructivism by Jean Piaget. The single statement that captures the essence of pragmatism is "learning by doing" and that of constructivism is "knowledge is constructed in the mind of the learner".

From the standpoint of Dewey's theory, "experience is not an object known but rather an action performed". Zulueta and Guimbatan (2002) elaborated that knowledge is not an end but an instrument which an individual can utilize to attain the desired goal. Moreover, based on Dewey's Theory of Instrumentalism, it may be of interest to note that it is education which emphasizes the importance of experience, experimentation, and learning by doing that which brought tremendous influence to the learner.

Furthermore, according to Piaget, "scientific thought is a process. More specifically, it is a process of continued construction and reorganization". Articulating Piaget's theory of constructivism with respect to laboratory practice provides road map based on research data for the classroom teacher to use in designing laboratories, as road map to increase learning. Laboratory practice and performances with respect to constructivism is seen as being more than the acquisition of process skills, it is essential ingredient in the understanding of science itself (Shiland, 1999).

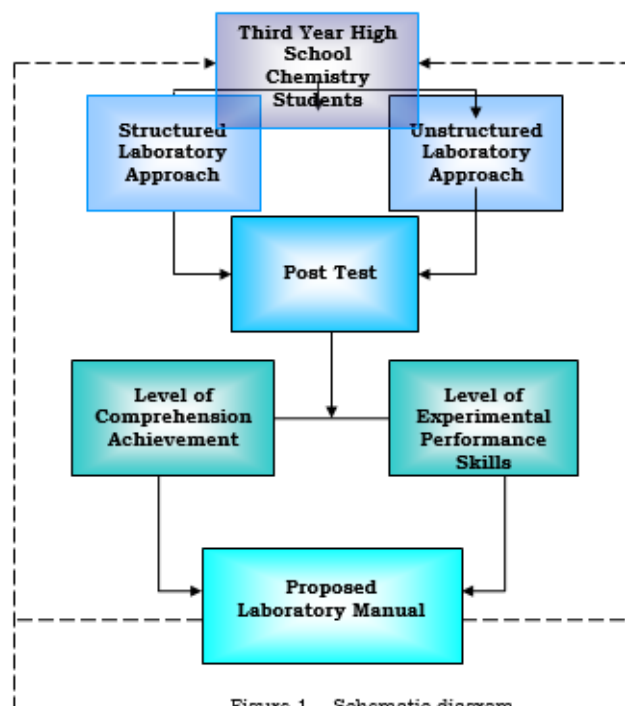


Figure 1. Schematic diagram.

Scope and Limitations of the Study

This investigation compared the effectiveness of structured laboratory approach with that of unstructured laboratory approach on the scientific comprehension and skills of third-year high school students in their Chemistry subject during given academic year.

This study was limited to topics on the chemical and physical properties of matter. The lessons were based on chemistry textbooks and laboratory manual. The experimental group was taught using an unstructured laboratory approach while the control group was taught using the structured laboratory approach.

Methodology

Research Design

This study was a quasi-experimental using a pair-matching, post-test only, control group design. One way that researchers attempt to deal with selection problems in quasi-experimental designs is to match subjects in each group on some variable (bsu.edu, 2006). One of the common characteristics of quasi-experiment include matching instead of randomization. It is important that all groups have about the same number of subjects in them, and as a general rule, there should have no less than 25 subjects in each group (faculty.ncwc.edu, 2006).

Furthermore, the purpose of quasi-experimental design is to establish a cause-effect relationship between independent and dependent variables (dpo.uab.edu, 2006). This design employed researcher-made instruments for the comprehensive achievement test and experimental performance skill test based on the lesson coverage which were taught in Chemistry and corresponding experimental performances or activities guided by structured and unstructured laboratory approaches to assess students' scientific inquiry.

Subjects of the Study

In this study, the subjects were 100 regular students in one of the private secondary schools in central Philippines. The researcher chose pair-matching as a device in selecting the subjects who were included in the experimental study to control possible

extraneous variables that could influence or affect the performances of the subjects under study.

Here, subjects are matched according to similarity or same in the variable and are randomly assigned to the groups. The subjects of this study were 100 students taken from the total of 210 students enrolled as third year high school during specific Academic Year who were paired-matched based on their first grading grades in Chemistry. The researcher facilitated a draw lots method in assigning groups as control and experimental groups. Group A was designated as control group and Group B as experimental group. The experimental group was taught using structured laboratory approach. Likewise, the control group was taught using unstructured laboratory approach.

Table 1 shows the distribution of subjects into control and experimental groups.

Table 1: Distribution of Subjects

Category	Method	Number of Subjects	Percentage %
A. Control Group	Structured Laboratory Approach	50	50%
B. Experimental Group	Unstructured Laboratory Approach	50	50%
Total		100	100%

To ascertain that the students had similar competence, their first grading grades in Chemistry were utilized for pair-matching.

Research Instruments

To gather data needed to conduct the experimental study, the researcher utilized the following instruments.

Comprehensive Achievement Test – This was a written item analyzed test composed of 50 items multiple choices type from the 100 set A and set B accepted test items. These researcher-made tests were given on a post-test basis to both groups A and B. Group A had undergone structured laboratory approach and group B unstructured laboratory approach. These performance skill tests and comprehensive written tests were content validated by experts in this field of study.

Performance Skill Tests – These were graded experimental written report papers and students' actual experimental performances as a result of their scientific investigations. These were in the form of a laboratory written report composing ten sets of experimental procedures with questions to answer and actual practical laboratory test based on their acquired knowledge as a result of their laboratory experimental activities. These performance skill tests were composed of 50 items practical test taken from 10 laboratory activities and 100 items total score from written laboratory reports. The overall performance skill rating was the average grade of the written experimental report papers and the actual performance grade. The scores of the subjects as results from the tests were given equivalent grades.

Next, the practical performance skill test was done individually to each subject to ensure reliable results and free from intervention and influence of other students. Students managed to stay outside and were called one by one after the other for their turn to perform. Four chemistry college students were hired and

trained to facilitate the subjects' performances, including the teacher-researcher.

After performing experiment numbers 1-5, the first five practical tests were done based on their actual investigations. The second part was facilitated after performing experiment numbers 6-10. Laboratory tables were arranged as station 1-5 and station 6-10 corresponding to 10 experiments where hired facilitators and teacher-researcher positioned themselves and test procedures were posted.

Validity of the Instruments

The constructed comprehensive test as well as the performance skill tests in Chemistry underwent proper validation. The comprehensive test questionnaire and the rubrics for practical test scoring were subjected to the two schemes of validation namely: content validation and jury opinion.

On the other hand, validation by jury opinion was employed by presenting the instruments to a group of people considered experts in their field of studies and in the construction of research instruments and was validated by 10 experts in the field of science with an overall average rating of 4.59 with an Outstanding interpretation. Likewise, the comprehensive test was validated by 5 jurors with average rating of 4.64 and interpreted as Outstanding.

Reliability of Instruments

To establish the reliability of the data gathering instruments, the researcher used the item analysis method. The comprehensive test was pilot tested to 60 third year high school students who were taking Chemistry subject. The comprehensive test of 50 items as set A and the other 50 items as set B were given simultaneously to selected 30 students in two sections of the third-year high school. Test papers were checked and score results were subjected to item analysis. Item analysis was adopted on the interpretations of

Anastassi (1999). Out of 100 total test items, 54 were accepted, but the 4 items with low number of correct answers and less priority were dropped. Fourteen test items were marked revised and 32 rejected.

Data Gathering Procedure

The data gathering procedures were done in three stages: Pre-experimental Stage, Experimental Stage, and Post Experimental Stage

Pre-experimental Stage was conducted among third year high school students in their Chemistry subject. Students under structured laboratory approach had undergone extensive pre-laboratory discussions to help them understand concepts and objectives associated with equipment manipulations as well as proper scientific processes and operations to attain specific objectives. Guided laboratory leading procedures, questions and objectives were provided.

Experimental Stage involved students who were subjected to unstructured laboratory approach with clear and concise student performance objectives integrated in the introductory concepts, but they were expected to design and conduct an experiment without the benefit of detailed laboratory procedures and ready-made objectives. Students formulated their own objectives based on the expected goals of the activities. Pre-laboratory discussions were held but only on the familiarization of laboratory instruments and apparatuses, awareness of laboratory rules and precautions, as well as proper handling and laboratory operations. Students were entirely responsible for experimental design as directed by objectives for observation and logical analysis. Identified questions to answer were given to both groups.

The structured and the unstructured groups in the morning and afternoon were given 1 hour and 20 minutes lecture and laboratory every TTH for the period of 9 weeks. The lecture achievement grades were taken from 50 items comprehensive test and for the average performance skills grade from the 100 items laboratory written papers of 10 experimental activities and 50 items rubric scored practical tests.

Furthermore, for group A, a structured laboratory approach was administered where extensive pre-laboratory discussion and orientation were given with written teacher-identified questions, objectives and procedures while group B were subjected to partial pre-laboratory orientation with teacher-identified questions but they have to explore and make dispositions by themselves in order to meet the objectives and to answer questions.

In the Post-Experimental Stage, the post achievement tests were given to the subjects in both groups. The achievement tests were based on 50 comprehensive written tests and 100 items written laboratory activities including 50 items rubric scored practical test.

The written experimental reports, comprehensive tests as well as the rubric scored performances were checked and given equivalent grades.

The distribution of grades with corresponding achievement interpretation for comprehensive test and performance skill test used were as follows:

Grade	Comprehensive	Performance
	Achievement Interpretation	Skill Achievement Interpretation
93 – 100	Excellent	Very Highly Skilled
85 – 92	Very Satisfactory	Highly skilled
77 – 84	Satisfactory	Moderately skilled
69 – 76	Fair	Unskilled
60 – 68	Poor	Very Unskilled

Statistical Treatments

The data gathered from this study were subjected to the following statistical treatments.

Frequency was used to determine the subjects who were classified as control group and experimental group. It also ascertained the subjects who were classified as poor, fair, satisfactory, very satisfactory and excellent achievers. Percentage was utilized to determine the percentage of the subjects involved for both the control and the experimental group.

Mean was used to determine the value of a descriptive variable being assessed, the researcher assigned numeric values to descriptive data. This yielded to the weighted mean scores and grades as well as the mean of means of certain variables. This tool was used to answer Statement of the Problem numbers 1 and 2 to determine the level of students' scientific comprehension and performance skill in Chemistry after their exposure to structured and unstructured laboratory approaches.

The t-test for independent samples was used to test whether the experimental group and the control group were comparable at the end of the experiment. Particularly this tool was used to answer Statement of the Problem numbers 3 and 4 to determine the significant difference in the level of scientific comprehension and performance skill of Chemistry students after their exposure to structured and unstructured laboratory approaches.

The Pearson Product Moment (PPM) was utilized to measure the degree of relationship between the scientific comprehension and performance skills achievement of the experimental and control group. Specifically, this tool was used to answer Statement of the Problem numbers 5 and 6 so as to determine the significant relationship between the level of scientific comprehension and performance skill achievement of Chemistry students after their exposure to structured and unstructured laboratory approaches.

The 0.05 level of significance for two-tailed test was utilized for all the statistical tests. All statistical computations were done using Microsoft Excel Data Analysis Tool Pack.

Results and Discussion

On the Level of Students' Scientific Comprehension in Chemistry after their Exposure to Structured and Unstructured Laboratory

Table 2: Level of Students' Scientific Comprehension in Chemistry after their Exposure to Structured and Unstructured Laboratory Approach

n = 100

Area	UNSTRUCTURED LABORATORY APPROACH					STRUCTURED LABORATORY APPROACH				
	L	H	SD	Mean	Inter-pretation	L	H	SD	Mean	Interpretation
Comprehensive Test	69	92	6.68	81.88	Satisfactory	68	91	5.63	79.36	Satisfactory

The findings presented in Table 2 reveal the mean equivalent rating in scientific comprehension of students exposed to unstructured laboratory approach which results to 81.88 and is a bit higher compared to students exposed to structured laboratory approach which garnered 79.36 mean value. It could be noted, however, that though the academic achievement of one approach is greater than the other yet both are interpreted Satisfactory.

The table also shows the value for the standard deviation for both the unstructured and structured laboratory approaches. The standard deviation of 6.68 for unstructured and 5.63 for the structured show the homogeneity of the level of students' scientific

comprehension in Chemistry after their exposure to structured and unstructured laboratory approaches.

This was supported by the study of Jimenez (2005) that students learn better when they are actively engaged and given opportunity to construct their own knowledge. The results confirmed that the scientific inquiry style of teaching made a significant impact in changing and improving students' understanding about the nature of science.

On the Level of Students Performance Skills in Chemistry after their Exposure to Structured and Unstructured Laboratory Approach

Table 3: Level of Students Performance Skills in Chemistry after their Exposure to Structured and Unstructured Laboratory Approach

n = 100

Area	UNSTRUCTURED LABORATORY APPROACH					STRUCTURED LABORATORY APPROACH				
	L	H	SD	Mean	Inter-pretation	L	H	SD	Mean	Inter-pretation
Practical Test	90	100	2.19	96	Very Highly Skilled	90	100	2.41	95.36	Very Highly Skilled
Written Experiment	85	96	2.79	90.7	Highly Skilled	78	95	5.11	88.1	Highly Skilled
Over-all Performance Skill	90	98	1.81	93.9	Very Highly Skilled	86	97	3.52	91.92	Highly Skilled

Table 3 shows that students exposed to unstructured laboratory approach based on their practical test have the mean grade of 96 as compared to structured laboratory approach with the mean grade of 95.36. A small difference is noted therefore both are interpreted Very Highly Skilled.

The written experiments mean result under unstructured, revealed 90.7 and under structured is 88.1. Both results are interpreted Highly Skilled. The overall performance skill reveals 93.9 mean achievement grade for students exposed to unstructured with very Highly Skilled interpretation comparing it with those exposed to structured laboratory approach which has the mean achievement grade of 91.92 with Highly Skilled interpretation. Generally, the result shows that the level of students' performance skill in Chemistry after their exposure to unstructured laboratory approach reveals a Very High degree of acquiring skills as

compared to structured laboratory approach which has Highly Skilled level of interpretation.

This finding is supported by the study of Pilane (2003) where students had a great learning impact when they were given the opportunity to become responsible in devising their own problems and entry strategy to make decisions, on what materials to use and variables to manipulate and how to proceed to a resolution acceptable to solve the problem. The results confirmed that an open entry hands-on laboratory investigation could motivate to improve students' performance skills in a broader sense.

On the Significance of the Difference in the Scientific Comprehension of Chemistry Students after their Exposure to Structured and Unstructured Laboratory Approach

Table 4: Significance of the Difference in the Scientific Comprehension of Chemistry Students after their Exposure to Structured and Unstructured Laboratory Approach

n = 100

Laboratory Approach	n	sd	Mean	Computed t-value	Critical t-value	Significance @ 0.05 level	Status of Hypothesis
Structured	50	5.63	79.36	3.0986	2.0096	Significant	Rejected
Unstructured	50	6.68	81.88				

Using the t-test as statistical tool to determine significant difference in the level of scientific comprehension of the Chemistry students after their exposure to structured and unstructured laboratory approaches, Table 4 reveals that the computed t-value at 0.05 level of significance resulted to 3.0986 which is greater than the critical t-value of 2.0096. Based on this result, the null hypothesis is rejected.

The study of Arguelles (1995) affirms the finding that when significant differences between the control and the experimental

group based on their post test results was compared, a significant difference on their academic performances existed in favor with the experimental group. Comparing the result of this study, the experimental group under unstructured laboratory approach gained more score based on their scientific comprehension.

Significance of the Difference in the Level of Performance Skills of Chemistry Students after their Exposure to Structured and Unstructured Laboratory Approach

Table 5: Significance of the Difference in the Performance Skills of Chemistry Students after their Exposure to Structured and Unstructured Laboratory Approach

n = 100

Laboratory Approach	n	sd	Mean	Computed t-value	Critical t-value	Significance @ 0.05 level	Status of Hypothesis
Structured	50	3.52	91.92	3.9780	2.0096	Significant	Rejected
Unstructured	50	1.81	93.9				

Using the t-test as statistical tool to determine significant difference in the level of performance skills of the Chemistry students after their exposure to structured and unstructured laboratory approaches, Table 5 reveals that the computed t-value at 0.05 level of significance resulted to 3.9780 which is greater than the critical t-value of 2.0096. Therefore, the null hypothesis is rejected.

Pallon's (2003) findings support the result of this study where students manifested "fair" in their science process skills. The outcomes simply show that when learners have no adequate knowledge, they would be low in their performance.

On the Significance of the Relationship between their Scientific Comprehension and Performance Skill of Chemistry Students after their Exposure to Structured Laboratory Approach

Table 6: Significance of the Relationship between their Scientific Comprehension and Performance Skill of Chemistry Students After their Exposure to Structured Laboratory Approach

n = 100

Structured Laboratory Approach	Mean	n	df	Computed r	Critical r	Significance @ 0.05 level	Status of Hypothesis
Scientific Comprehension	79.36	50	98	0.73428	0.197	Significant	Rejected
Performance Skill	91.92	50					

To determine if there is a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to structured laboratory approach, the Pearson Product Moment (PPM) is used. Table 6 shows that the computed r resulted to 0.73428 with the critical r of 0.197 at 0.05 level of significance and on the basis of 98 degree of freedom. Based on these statistical results the null hypothesis is rejected.

The study of Tolosa (2004) supports the findings of this investigation. Students' achievement in Biochemistry is significantly related to their performance in Clinical Chemistry I

and II. The significant relationship is positive hence, students with record of performing well in Biochemistry can be expected to perform well academically in Clinical I and II.

However, in the work, the compared variables do not match with laboratory approaches, yet a significant relationship showed positive evidence that academic comprehension and performance complement each other under a specified strategy.

On the Significance of the Relationship between the Scientific Comprehension and Performance Skill of Chemistry Students after their Exposure to Unstructured Laboratory Approach

Table 7: Significance of the Relationship between the Scientific Comprehension and Performance Skill of Chemistry Students after their Exposure to Unstructured Laboratory Approach

$n = 100$

Unstructured Laboratory Approach	Mean	n	df	Computed r	Critical r	Significance @ 0.05 level	Status of Hypothesis
Scientific Comprehension	81.88	50	98	0.386995	0.197	Significant	Rejected
Performance Skill	93.9	50					

The statistical tool used to determine if there is a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of Chemistry students after their exposure to unstructured laboratory approach was Pearson Product Moment (PPM). Table 7 reveals that the computed r resulted to 0.386995 with the critical r of 0.197. The computed r showed greater value than the critical r at 0.05 level of significance and based on 98 degree of freedom. The result leads to a decision to reject the null hypothesis.

The findings are confirmed by the study of Ferzli (2003). Significant statistical findings from this study showed a greater understanding of scientific investigations through laboratory writing or reporting compared to non-lab-write users and students using traditional laboratory report writing instructions. The results confirmed that, method used in the unstructured laboratory showed better understanding of scientific concepts and enhanced performance skills than a traditional cookbook method of investigations.

Summary of Findings, Conclusions and Recommendations

Summary of Findings

The level of students' scientific comprehension in Chemistry after their exposure to structured laboratory approach had a mean result of 79.36 and interpreted Satisfactory.

Likewise, the level of students' scientific comprehension in Chemistry after their exposure to unstructured laboratory approach had a mean result of 81.88 and interpreted Satisfactory. Even though both had the same degree of interpretation, a clear

difference in their mean results was noted that students exposed to unstructured laboratory approach excelled based on the result than those treated with structured laboratory approach.

The level of students' performance skill in Chemistry after their exposure to unstructured laboratory approach had a Very High degree of acquired skills with an overall mean grade of 93.9 as compared to students exposed to structured laboratory approach which garnered 91.92 with Highly Skilled level of performance interpretation.

There was a significant difference in the level of scientific comprehension of the Chemistry students after their exposure to structured and unstructured laboratory approaches. The computed t -value at 0.05 level of significance resulted to 3.0986 had greater value than the critical t -value of 2.0096. Therefore, the null hypothesis was rejected.

There was a significant difference in the level of performance skill of Chemistry students after their exposure to structured laboratory approach and unstructured laboratory approach. The computed t -value resulted to 3.9780 with the critical t -value of 2.0096 at 0.05 level of significance. The computed t -value was greater than the critical t -value and therefore the null hypothesis was rejected.

There was a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of chemistry students after their exposure to structured laboratory approach. The computed r resulted to 0.73428 with the critical r of 0.197 at 0.05 level of significance and on the basis of 98 degree of freedom. Based on these statistical results the null hypothesis was rejected.

There was a significant relationship between the level of scientific comprehension achievement and level of performance skill achievement of chemistry students after their exposure to unstructured laboratory approach. Using the Pearson Product Moment, the computed r resulted to 0.73428 with the critical r of 0.197. The computed r showed greater value than the critical r at 0.05 level of significance and on the basis of 98 degree of freedom. Therefore, the null hypothesis was rejected.

Conclusions

Based on the significant findings of the study, the following conclusions were drawn:

The level of scientific comprehension of those students exposed to structured and unstructured laboratory approaches gained both satisfactory yet a significant difference was noted based on the mean grade result in favor with the unstructured laboratory approach as mainly preferable. The findings implied that the acquisition of knowledge would absolutely enhance their academic comprehension if students were taught substantially and given the chance to explore a free inquiry laboratory leading to a self-discovery method of experimental investigations.

Students exposed to unstructured laboratory approaches garnered a very high degree of acquiring skills compared with those under structured laboratory approaches as revealed on the mean grade results. The findings entailed that students who were strategically motivated to draw out their critical thinking and initiative in a broader perspective without being controlled by a cookbook laboratory operations and teacher's dictation, will become more skillful being given the chance to explore their freedom to discover more beyond limited boundaries towards scientific quest of knowledge.

There was a significant difference in the level of scientific comprehension between students' exposure to structured and unstructured laboratory approaches based on the statistical results of their mean grades. Laboratory techniques played a very important role in articulating a deeper understanding of knowledge taught where students could apply these well understood scientific principles to actual basis and relate themselves to meaningful laboratory investigations.

There was a significant difference in the level of their performance skills and unstructured laboratory approach proved relevant. The findings implied that the ability of the students to acquire knowledge and skills through learning and doing chemistry could be identified by a distinct relationship the way they respond to a particular strategy. Their capacities to comprehend scientific ideas were manifested on the actual basis of their performances.

There was a significant relationship between the level of scientific comprehension achievement and performance skill achievement of the students after their exposure to structured laboratory approach based on the result of their mean grades. It could be connoted that students' strengths and weaknesses in the two aspects of comparison between the cognitive and psychomotor domains of educational objectives significantly relate to each other.

There was a significant relationship between the level of scientific comprehension achievement and performance skill achievement of the students after treated with unstructured laboratory approach as revealed on the statistical result. This

implied that the knowledge the students got in their minds in understanding the lesson, the more they could comprehend in expressing it in actual practical applications.

Recommendations

Utilizing the results of the study as point of reference and based on the significant findings, the following recommendations were offered:

The school should support the acquisition of this proposed unstructured laboratory manual by considering the positive result of the study and the effectiveness of the approach to the third-year high school students in their Chemistry subject.

To integrate knowledge of science and technology, a predetermined schedule for lecture and laboratory periods may be put-up since scientific comprehension and application complement each other.

Active participation, keen observation of laboratory investigations and deeper understanding of scientific principles should be taken seriously in order to acquire acceptable and reliable answers to experimental inquiries and accuracy to the expected results.

A parallel study may be conducted to other groups of students to test whether the applied strategies or approaches are effective and applicable to acquire higher level of scientific comprehension and performance skills.

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