

Inquiry-Based Approach in an E – Learning Platform and Its Cognitive Effect in Science 10

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Abstract— The study aimed to investigate the Cognitive Effect in the Science of Inquiry – Based Approach in an E – Learning Platform in Science 10. This quasi-experimental research used the Regression Discontinuity Design (RDD). This design has solid internal validity despite the lack of randomized assignments. The study used Aptitude Treatment Interaction (ATI) theory; it focused not only on a single cognitive ability but rather on the diverse cognitive abilities of the subjects. The researcher applied the idea in the Inquiry – Based Approach in an E – Learning Platform in teaching Science to improve teachers' instruction and enhance the cognitive performance of the learners. A total of 180 Grade 10 learners from Canumay West National High School were taken as subjects of this study for the school year 2018 – 2019. The researcher employed a purposive sampling technique where the Diagnostic Test Result Scores were used to determine the cut-off of the three groups. Forty-seven learners were considered above-average performing group, eighty-seven were regarded as Average performing Group, and forty-six were considered low performing group. The results establish that throughout the program, most learners had shown a degree of improvement in their performance. At the same time, a few persist in having learning deficits. The researcher established that the Inquiry – Based Approach in an E-Learning Platform was an effective program that increases learners' cognitive performance.

Keywords— Aptitude Treatment Interaction, E-Learning, Inquiry-Based, Stanine

I. INTRODUCTION

Education is widely accepted to be a fundamental resource, both individuals and societies. Indeed, primary education in most countries today is perceived not solely as a right but conjointly as a requirement. Governments are expected to ensure primary education is accessible to all. In contrast, the law typically requires citizens to achieve education up to an elementary level.

As the learners enter the classroom, they convey a unique background, skills, and academic wants. No two students learn identically because of these traits. Diversity within the room doesn't simply refer to cultural diversity but also diversity in skills, knowledge, and needs. It is necessary to know these attributes to teach the learners effectively. E-learning is distance learning using electronic technology. Technology, along with the Internet, creates the potential for learners to network, interact and learn. Learners using technology tools, or the Internet, collaborate in geographically dispersed virtual work teams or groups. They form partnerships that bring about social learning, learning through observation and modeling. The combination of diversity, e-learning and technology is done through the experience of e-learning in the principles of the Learner Center and supports progressive learning methods through research and community collaboration and learning. There are studies which show the varying

degrees of challenges, innovations, upgrades, readiness, and implementations of technology and the internet [1] [2] [3] [4].

Teachers and school administrators should also possess basic know-how and skills when it comes to e-learning, in particular, a certain degree of knowledge in ICT. Asio and Riego de Dios [5] mainly provided an evaluation of such skills in their study as well as their professional level of development and skills in their institution [6] [7]. In this manner, they can deliver the appropriate learning experience to students. At the same time, it can also lessen the possibility of developing poor study habits like procrastination [8] and cyberbullying [9]. This idea may somehow affect students' performance. It could lead to remediation activities for teachers [10], which is an additional burden for them and somehow may affect their task (e.g. sleep) and mental status [11].

One manner to triumph over these challenges is to embrace an Inquiry-Based Approach, a form of active learning that emphasizes the learners' role within the learning method. Instead of the teacher telling learners what they have to grasp, learners are inspired to explore the fabric, raise queries, and share concepts. According to Smallhorn, Young, Hunter and da Silva, Inquiry – based learning is described as an educational method that combines learner/student-centered, hands-on activities and discoveries. They

emphasized that the important thing in Inquiry – based learning is for the educator to act as a facilitator of learning activities, to encourage learner discussion and provide guidance rather than directing the activity. Inquiry-based learning promotes the development of independent learners by encouraging learners to take responsibility for their own learning. Based on the principles of the scientific method, in inquiry-based learning, learners observe phenomena, integrate research tasks, test them in a repeatable way, and finally analyze and communicate the results [12].

In the City of Valenzuela, the majority of schools are now computer–equipped with a ratio of one computer per learner. However, the main problem of some schools in Valenzuela is the utilization of these computers. The computer system in some schools in Valenzuela, like Canumay West National High School, is not being utilized for positive factors. The curriculum in Technology and Livelihood training – TLE provided and offered by the school and availability of computer teachers. At this point, all subject areas, including subject teachers, have been given a chance to utilize the computer laboratory; however, not all teachers are ready and prepared enough. These ideas led the researcher to analyze the "Inquiry-Based Approach in an E-Learning Platform and Its Cognitive Impact in Science 10".

Finally, the research paper is presented to readers to facilitate easy navigation and reading preferences. The rest of the article is organized as follows. Section I displays the Introduction of the research paper. Section II unveils the statement of the problem. Section III discusses the research methodology, which also contains the following subsections: the research design, the assignment process and cut-off scores, respondents of the study, instrument of the study, data analysis and data gathering procedure. Also, Section IV contains the result and discussion of the study; Section V includes the conclusion, and the final section is the study's recommendations.

II. RELATED WORK

The study aimed to determine the Cognitive Effect of an Inquiry-Based Approach in an E-Learning Platform in Science 10 of Canumay West National High School. Specifically, the study sought to answer the following questions.

- 1) How could the subjects be classified based on the diagnostic test results?
- 2) What is the pre and post-test performance of the:
 - a. Low Performing Group
 - b. Average Performing Group
 - c. Above Average Performing Group
- 3) Is there a significant difference between:
 - a. Pre–Posttest Performance of Above Average Performing Group;
 - b. Pre–Posttest Performance of Average Performing Group; and
 - c. Pre–Posttest Performance of Low Performing Group

- 4) What is the gain score of the three groups after the experimentation?
- 5) Is there a significant difference between the three groups' gain scores?
- 6) What learning gain is exhibited by the three groups basis on their Stanine Score Interpretation?
 - a. Diagnostic Test–Posttest
 - b. Pretest–Posttest

III. METHODOLOGY

A) Research Design

An experimental method is a problem-solving approach that describes the study of what will be and when variables are carefully controlled or manipulated. It is a research method wherein the researcher uses or controls one or more independent variables for variation parallel to the manipulation of dependent variables. As mentioned by Asio [13], it is a quantitative type of research where one determines particular treatment impacts an outcome. The Quasi-Experimental involves an exchange of two or more treatments taken by the subjects during the experiment. Furthermore, the researcher utilized a specific technique, Regression discontinuity design (RDD). This quasi-experimental method perfectly measured the selection process based on a cut-off score on an assignment variable. This design has strong internal validity despite the lack of randomized assignments. This method used an assignment variable instead of a random assignment to identify a cut-off point/ limit. The researchers then determined how the subjects were placed in treatment conditions. [14].

Although often used to select a single cut–off point, the technique can also use the assignment variable to determine more than one cut–off point in the case of multiple treatments [14].

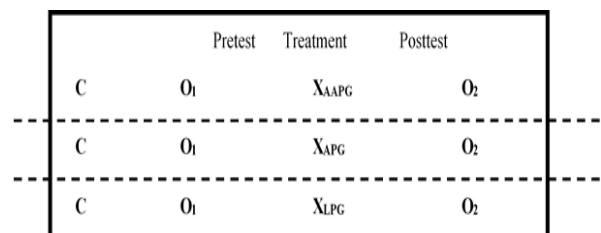


Figure 1. Pretest – Posttest Design

Where:

C – Cut–off criterion

O_1 – represents the pretest of the experimental group

O_2 – represents the post-test of the experimental group

X_{AAPG} – represents the treatment in the Above Average Performing Group

X_{APG} – represents the treatment in the Average Performing Group

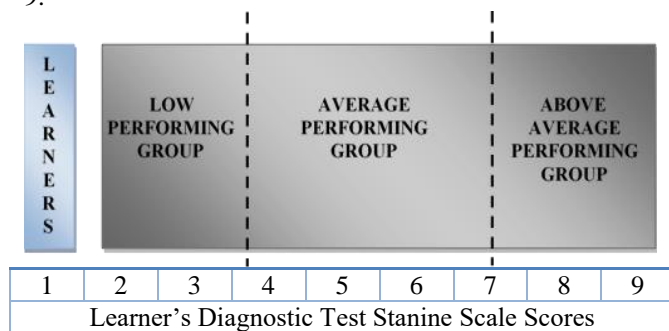
X_{LPG} – represents the treatment in the Low performing group

B) Assignment Process and Cut-Off Scores

The diagnostic test results of Science 10 given to the subject before the start of the 1st quarter of the school year

2018 - 2019 from the Division Office of Valenzuela were used to select the cut-off points/limit for treatment assignment.

Furthermore, the study used the Stanine score (standard nine), which is a way to scale the score on a 9-point scale. Researchers can use it for any test score up to a single digit score. Like Z-scores and T-scores, stanine is a way to assign numbers to group members. The z-score and t-score can be expressed using decimal numbers such as 1.2 and 3.25, but stanine is always a positive integer from 0 to 9.



C) Respondents of the Study

This study was conducted during the Second quarter of Physics Class at Canumay West National High School in the Division of Valenzuela City of School Year 2018 – 2019. Furthermore, the researcher used the Grade 10 – Science Diagnostic Test Results from the Division Office of Valenzuela to support the cut-off criterion of the three groups.

The researcher employed a purposive sampling technique. According to this method, which is one of the non-probability sampling methods, sample members were selected based on the knowledge, relationships, and expertise associated with the research subject [15]. The study samples were based on the diagnostic test results of the topics that led to the creation of the three groups. The researcher considered four (4) heterogeneous classes in which forty-six (46) learners were considered as part of the Low Performing Group, eighty-seven (87) learners were part of the Performing group, and forty-seven (47) learners were considered as Above Average Performing Group. Furthermore, the experiment subjects were the Grade 10 Learners of Canumay West National High School in the Division Office of Valenzuela.

D) Instrument of the Study

To gather the needed data, the researcher used the following instruments:

Diagnostic Test Result. A pre-assessment enables teachers to determine learners' individual qualities, shortcomings, knowledge, and abilities before instruction. The results from the diagnostic test support the three groups

Pretest and Posttest. The researcher used to pretest and post-test to answer the specific problems # 2, 3, 4, and 5.

The pretest and post-test is a 50 – item multiple-choice test with four choices to which the respondents must circle the correct answer. The instrument used by the researcher is a validated test questionnaire from the Schools Division Office of Valenzuela. The Principal Consultants validated the tests in Science, Department Heads/Coordinators in Science of Valenzuela, and the Education Program Supervisor in Science.

Level of Reliability. To determine the reliability of the achievement test used as a research tool, researcher conducted a pilot test on 50 senior high school learners selected at Malinta National High School. They were not participants in the study. The results were then subjected to the testing of reliability using the Kuder – Richardson 20 (KR – 20). To give a sound interpretation of the reliability analysis results, the study used the reliability analysis yielded a Cronbach's alpha value of 0.742. Through the scale above, we can say that the test has acceptable reliability. It has an internal consistency that can fairly measure students' performance over time and with different sets of respondents.

Administration and Retrieval. The researcher administered the Pretest and Posttest to the subjects of the study. The researcher checked their papers to find out their Cognitive Academic performance.

Lesson Plan (Daily Lesson Log). According to Scrivener [16], Lesson planning includes "prediction, anticipation, sequencing, and simplifying." Lesson-making plans are a vital part of the teaching and mastering procedure.

The main objective of lesson planning is gaining knowledge. Lesson planning enables teachers to set objectives for the learners. It also ensures that learners reach their goals. Via planning instructions, teachers see that activities and lessons lead to learners' development and fulfilment or the attainment of studying results. The researcher used a daily lesson log that provides an opportunity to reflect on what learners need to learn. The daily lesson log used by the research was checked and validated by three experts – Master Teacher, Head Teacher and Education Program Specialist – Science.

Computer Simulation Model (Phet). PhET is a collection of research-based, interactive computer simulations for teaching and mastering knowledge in different areas of science including mathematics. It can be run online or downloaded for free from the PhET website. Simulations are animated, interactive, game-like environments in which learners in all levels learn through exploration. They emphasized the relationship between real lifestyle phenomena and underlying technology. They helped provide learners with a visual and conceptual model of a professional scientist. PhET simulation is a major development and test for learners in some universities and educational institutions. It was discovered to be educational and interesting for "junior high school to college" learners.

Data Analysis

The data that was gathered in the research instruments were computed with the use of statistical tools. The study used these statistical tools to measure and describe the variables in this study.

- 1) **Paired t-test** is a parametric test, also known as a dependent t-test. It determines whether statistical evidence shows that the mean difference between paired observations on a particular outcome is significantly different from zero.
- 2) **Standard deviation** measures the dispersion of a set of data from its mean. If the data points are further from the mean, there is a higher deviation within the data set.
- 3) **One-Way ANOVA** ("analysis of variance") compares the means of two or more independent groups to determine whether there is statistical evidence that the associated population means are significantly different.
- 4) **The Tukey HSD** ("honestly significant difference" or "honest significant difference") test is a statistical tool used to determine if the relationship between two sets of data is statistically significant.

To determine the level of the cognitive performance of the learners in the pretest and post-test based on their score and mean, the scale below was used:

Range*	Level of Performance
41 – 50	Outstanding
31 – 40	Very Satisfactory
21 – 30	Satisfactory
11 – 20	Fair
1 – 10	Did not meet Expectations

*Adopted from DepEd Report Card – Form 138 (2018)

Data Gathering Procedure

The procedure is considered to be the most significant thing in research methodology. Without a plan and procedure researcher cannot achieve any conclusion. In the wake of choosing and settling the instruments for data gathering, the researcher carefully followed the step-by-step procedure and planned below:

- 1) **Letter of Approval.** The researcher gave notes to the Schools Division Office – Valenzuela for permission to conduct research at Canumay West National High School. Approved letters from the Schools Division Office – Valenzuela were forwarded to the Principal of Canumay West National High School for the final approval and to start the experimentation within the given time frame.
- 2) **Profiling.** The study started on STATINE ("Standard nine") scale score from the result of the diagnostic test of the subjects for data profiling of the respondents. This test resulted in the creation of the Above Average Performing Group, Average Performing Group, and Low Performing Group that underwent the treatment.

- 3) **Pre-Program.** The pretest given to the three groups (Above Average Performing Group, Average Performing Group, and Low Performing Group) were tallied and categorized according to the level of achievement. The experiment about the Inquiry – Based Approach in an E – Learning Platform and Its Cognitive Effect in Science 10 started after the researcher gave the pretest to the groups. The experimentation lasted for three months.
- 4) **Post-Program.** The post-test was given to both the Average Performing Group and Low Performing Group and then tallied and categorized to the different achievement levels.
- 5) **Analysis.** The researcher gathered all the results and looked for a data analyst to interpret the data.
- 6) **Interview.** The researcher interviewed some selected students regarding their experiences and insights that they had gained from the Inquiry – Based Approach in an E – Learning Platform.
- 7) **Documentation.** The study is supported by documentation of the actual footage of utilizing the Inquiry – Based Approach in an E – Learning Platform and Its Cognitive Effect in Science 10.

IV. RESULTS AND DISCUSSION

Profile of the Learners in Terms of Diagnostic Test Scores

Their diagnostic test scores were taken as fair measures of this variable to have a baseline for learners' mental ability. These test scores were converted into stanine scores. The researcher used them to classify the students as Low Performing, Average Performing, and Above Average Performing. The result of this is shown in the table below.

Table 1. Learners' Profile based on their Diagnostic Test Scores

Stanine Scores	Mental Ability	Frequency (f)	Percentage (%)
1 – 3	Low	46	25.56
4 – 6	Average	87	48.33
7 – 9	Above Average	47	26.11
Total		180	100

Table 1 reveals that of the 180 learners, 46 or 25.56 per cent are Low Performing, 87 or 48.33 per cent are Average Performing, while 47 or 26.11 per cent are Above Average Performing. This indicates that a considerable number of learners perform satisfactorily in Science. Moreover, this implies that students possess the basic knowledge and skills in Science that they need in learning other higher concepts in the said field.

Pretest and Post-test Performances of the Three Groups

The table below shows the pretest and post-test performances of the learners in the Low – Performing group.

Table 2. Pretest and Posttest Performances of The Low Performing Group

Scores	Level of Performance	Pretest		Post-test	
		f	%	f	%
41 – 50	Outstanding	0	0	0	0
31 – 40	Very Satisfactory	0	0	0	0
21 – 30	Satisfactory	0	0	11	23.91
11 – 20	Fair	35	76.09	35	76.09
1 – 10	Did not meet Expectations	11	23.91	0	23.91
Total		46	100.00	46	100.00
Mean		13.152	Fair	18.348	Fair
SD		3.197		4.383	

For the Low Performing Group, table 2 above reveals that 35 or 76.09 per cent of the learners achieved a fair performance with their scores falling from 11 to 20. Meanwhile, the rest of them did not meet expectations before the program. However, after the program, still 35 of them or 86.79 per cent performed fairly while 11 or 23.91 performed satisfactorily.

In general, the learners showed a fair performance before and after the program. This is clearly reflected from the computed mean scores which are 13.152 and 18.348 respectively. This result implies that on both phases of the experiment, the learners can somehow demonstrate an understanding of the basic concepts and skills covered in this study.

In a study, learners associated with the inquiry-based lessons displayed better maintenance, a superior capacity to issue explain, and better execution on decontextualized scientific issues than their peers who were educated in the conventional design [17]. Furthermore, the Web-Based Instructional framework is more advantageous and powerful than the face to face customary learning according to study of Saini et al. [18]. The convergence of the two studies validated the results above that learners showed an increase in cognitive performance in Science 10.

Table 3. Pretest and Posttest Performances of the Average Performing Group

Scores	Level of Performance	Pretest		Post-test	
		f	%	f	%
41 – 50	Outstanding	0	0	0	0
31 – 40	Very Satisfactory	0	0	19	21.83
21 – 30	Satisfactory	0	0	44	50.57
11 – 20	Fair	76	87.36	14	16.09
1 – 10	Did not meet Expectations	11	12.64	0	0
Total		87	100.00	87	100.00
Mean		13.253	Fair	25.793	Satisfactory
SD		2.752		5.845	

It can be viewed from Table 3 that many learners in the Average Performing Group performed fairly prior to the program. This is evidenced by the frequency of 76 or 87.36 per cent. Also, it is worthwhile to mention that of the 87 members of this group, there were 11 or 12.64 per cent who did not meet expectations. Meanwhile, after the

program, it was found out that 44 or 50.57 per cent have satisfactory performance as they obtained scores ranging from 21 to 30. In addition, a considerable number of learners, that is, 19 or 21.83 per cent attained scores from 31 to 40, which may be interpreted as very satisfactory. Moreover, it can be observed that there were 14 or 16.09 per cent who retained a fair performance before and after the experiment. As a whole, the mean scores, namely 13.253 for the pretest and 25.793 for the post-test are indicative of the fair and satisfactory performances of the learners in the mentioned phases of the experiment.

The overall findings from a study conducted revealed that learners’ performances in conditional probability have improved through the use of Inquiry-Based Approach [19]. In a study of Ercan [20], the scholastic accomplishment and dispositions towards science classes of understudies, who were instructed with electronic programming highlighting media helped instructive movement revealed the post-test scholastic accomplishment scores of understudies, who were instructed with online programming with interactive media helped instructive activity, were observed to be higher than those of control gathering. The results from the two different studies confirmed the results of satisfactory performances of the learners in Average Performing Group.

As seen from the table 4, before the program, there were 46 learners or 97.87 per cent in the above Average performing Group who obtained scores ranging from 11 to 20, which may be interpreted to be fair. While after the program, the majority of the learners accounting for a frequency of 28 or 59.87 per cent scored 31 to 40 which means that they had very satisfactory performance. Looking at the mean performances of the learners in the above-average group, it can be noted that the computed mean scores were 13.575 and 32.936 before and after the program, respectively. Generally, this implies that they have a fair performance before they have been exposed to the program while a very satisfactory performance after the program.

Table 4. Pretest and Posttest Performances of the Above Average Performing Group

Scores	Level of Performance	Pretest		Post-test	
		f	%	f	%
41–50	Outstanding	0	0	5	10.64
31–40	Very Satisfactory	0	0	28	59.57
21–30	Satisfactory	0	0	14	29.79
11–20	Fair	46	97.87	0	0
1–10	Did not meet Expectations	1	2.13	0	0
Total		47	100.00	47	100.00
Mean		13.575	Fair	32.936	Very Satisfactory
SD		1.975		5.067	

The results above were supported by the studies conducted by Abdi [21]. Mixed media is an imaginative and powerful instructing and learning device, since it enables learners to persuade their learning procedure and causes them to comprehend the data exhibited. It enables teachers to

display data in a compelling way. Learners become active in the teaching and learning process as opposed to being uninvolved learners. From the above outcomes, clearly Multimedia-aided Teaching (MAT) is more viable than the traditional way. It is increasingly compelling for the subjective and frame of mind improvement of the learners than the traditional way. The learners who have been taught by inquiry-based instruction bolstered 5E learning cycle strategy have turned out to be more effective than the learners who have been instructed by the conventional educating techniques.

Differences in the Pretest and Posttest performances between each group

To examine the difference between the pretest and post-test performance between each group, the t-test for dependent samples was utilized. The results of this test are as follows. For the Above Average Group, the results of the comparison are shown on the table found next.

Table 5. Difference between the Pretest and Posttest Performances of the Above Average Performing Group

Test	Mean	Mean Difference	t statistic	Tabular value
Pre	13.575	19.361	25.915*	2.013
Post	32.936			

Note: *p < .05

As seen from Table 5, the mean difference between the pretest and post-test performance of the Above Average Performing Group is 19.361. This value yields a test statistic of $t = 25.915$ ($p < 0.05$) which is greater than the tabular $t -$ value of 2.013. Hence, the researcher rejected the null hypothesis and therefore there is a significant difference between the pretest and post-test performances of the learners in the Above Average Performing Group. This means that more advanced learners were able to gain significant improvements on various competencies tested. Also, this indicates that they acquired useful knowledge and skills from the program.

Table 6. Difference between the Pretest and Posttest Performances of the Average Performing Group

Test	Mean	Mean Difference	t statistic	Tabular value
Pre	13.448	12.552	20.100*	1.988
Post	26.000			

Note: *p < .05

Based on table 6, for the Average Performing Group, they registered a mean difference of 12.552 while the computed test statistic is $t = 20.100$ ($p < 0.05$). This value is greater than the tabular $t -$ value of 1.988. So, the null hypothesis is rejected at 0.05 level of significance, and therefore a significant difference exists between the pretest and post-test performances of the learners in the average performing group. This indicates that meaningful learning has transpired among the members of the Average Performing Group. That is, the program may be considered as a tool that can enhance the performance of Average Performing learners.

Table 7. Difference between the Pretest and Posttest Performances of the Low Performing Group

Test	Mean	Mean Difference	t statistic	Tabular value
Pre	13.152	5.196	6.973	2.014
Post	18.348			

Note: *p < .05

In Table 7, the Low Performing Group was found to have a mean difference of 5.196 between their pre and post-test performances. This gave rise to the computed test statistic of $t = 6.973$ ($p < 0.05$) which is also greater than the tabular $t -$ value of 2.014. Thus, this directed the researcher to reject the null hypothesis and conclude that the pretest performance of the learners in the Low Performing Group significantly differs from their post-test performance. This goes to show that learners showed marked improvement in their skills in Science when they underwent the program.

Learning Gains of the Three Groups

The table on the succeeding page presents the learning gains of the three groups who participated in this study.

It can be observed from the table 8 above that majority of the learners had 41 to 60 percent of learning gains. Of this number, 31 of them are from the Above Average Performing Group while 34 of them are from the Average Performing Group. Also, it is worthwhile to mention that 49 learners had 21 to 40 per cent of learning gains wherein 4 of them are from the Above Average Performing Group, 34 are from the Average Performing Group, and 11 are from the Low Performing Group. Moreover, there was only one learner, from the Above Average Performing Group, who had 81 to 100 learning gain percentages. Lastly, all the 14 learners who had no learning gains were all from the Low and Average Performing Groups.

Table 8. Learning Gains of the Three Groups

Learning Gains in (%)	Groups						Total	
	Low		Average		Above Average			
	f	%	f	%	f	%	f	%
81 - 100	0	0	0	0	1	2.13	1	0.56
61 - 80	0	0	2	2.30	10	21.27	12	6.67
41 - 60	1	2.17	34	39.08	31	65.96	66	36.67
21 - 40	11	23.91	34	39.08	4	8.51	49	27.22
1 - 20	24	52.17	13	14.94	1	2.13	38	21.11
< 0	10	21.74	4	4.60	0	0	14	7.78
Total	46	100	87	100	47	100	180	100
Mean	13.622		34.281		53.145		33.927	

The results establish the idea that throughout the program majority of the learners had shown marked improvement on their performance while a few still persist to have learning deficits. Furthermore, the mean learning gains of the Above Average, Average, and Low Performing Groups were computed to be 53.145, 34.281, and 13.622 respectively. Evidently, the learners in the Above Average Performing Group had greater learning gains as compared to the other two groups.

Differences in the Learning Gains among the Three Groups

To analyze the differences among the learning gain scores of the Above Average, Average, and Low Performing Groups, the One-Way Analysis of Variance was employed. This test produced the results given in Table 9. It can be noted from the table that the computed test statistic is $F(2, 177) = 83.841$ ($p < 0.05$). This led the researcher to reject the null hypothesis and conclude that there is a significant difference in the learning gains of the three groups.

Table 9. Differences among the Learning Gains of the Three Groups

Source of Variation	SS	df	MS	F-test	p-value
Between	36 334.034	2	18 167.017	83.841*	0.000
Within	38 353.101	177	216.684		
Total	74 687.135	179			

Note: * $p < .05$

It can be noted from Table 9 above that the computed test statistic is $F(2, 177) = 83.841$ ($p < 0.05$). This led the researcher to reject the null hypothesis and conclude that there is a significant difference in the learning gains of the three groups.

This implies that e-learning use could incorporate more learners into the learning process [22]. Along these lines, all learners in a classroom would be tended to. Furthermore, utilizing mobile phones as materials for e-learning platforms in an inquiry-based approach, learners have more redone learning pace and process, and got an individual attention and learning direction as the learners conveyed in the field. Meaning to say, the three groups have significantly varying improved performances after they have been exposed to the program.

Table 10. Post – hoc Analysis on the Significant Difference in the Learning Gains of the Three Groups

Pairwise Comparisons	Mean Difference	p-value
Above Average – Average	18.864	0.000*
Above Average – Low	39.523	0.000*
Average – Low	20.659	0.000*

Note: * $p < .05$

Table 10 revealed that the learning gains of the Above Average Performing Group significantly differ ($p = 0.000 < 0.05$) to those of the Average and Low Performing Groups. Likewise, a significant difference ($p = 0.000 < 0.05$) in the learning gains exists between the Average Performing and Low Performing Groups.

The result implies that the utilization of the program produced significantly relative improvements on the performance in Science of the learners within the three groups. Specifically, it can be said that the Above Average Performing Group had the greatest benefit among the three groups, followed by the Average group and lastly by the Low Performing group.

In addition, Intelligence is generally defined by two broad elements: liquid and crystallization. Fluid intelligence refers to the ability to solve problems, reason, act quickly, and adapt to new situations. Crystallized intelligence, on the other hand, contains task-specific knowledge that accumulates throughout life [23]. These two broad cognitive abilities (fluid and crystallized intelligence) of the three groups were developed during and after the treatment.

Learning Gains of the Three Groups’ Basis on their Stanine Scale Score

The next table shows the Cognitive Performance of the learners on the basis of Stanine Scale Score.

Table 11. Cognitive Performance of the Three Groups Based on Stanine Scale Score of Diagnostic Test and Posttest Result

Groups	Diagnostic Test		Posttest	
	Mean	SD	Mean	SD
Low Performing Group	10.783	2.867	18.348	4.383
Average Performing Group	22.77	4.105	25.793	5.845
Above Average Performing Group	32.468	2.999	32.936	5.067

The table 11 demonstrated the Stanine Scale Score of Diagnostic and Posttest Results of the Three Groups. The Diagnostic Test results of the learners filled in as the reason for the cut-off score for the three groups (Low, Average or Average Performing Group). In the Posttest Result of the Low Performing Group with the mean of 18.348 and Standard Deviation of 4.383, 76.09 per cent of the learners were marked as Low Performing and 23.91 per cent as Average Performing. In the Average Performing Group with 25.793 mean and 5.845 standard deviation, 16.09 per cent of the learners were marked as Low Performing, 67.82 per cent learners as Average Performing and 16.09 per cent were named as Above Average Performing in the Posttest Result for Stanine Scale Score. Ultimately, Above Average Performing Group with 2.13 per cent learners were named as Low Performing, 42.55 per cent as Average Performing and 42.55 per cent as better than expected performing in pretest result have a mean of 35.936 and 5.067 standard deviation.

Table 12. Cognitive Performance of the Three Groups Based on Stanine Scale Score of Pretest and Posttest Result

Groups	Pretest		Posttest	
	Mean	SD	Mean	SD
Low Performing Group	13.152	3.197	18.348	4.383
Average Performing Group	13.253	2.752	25.793	5.845
Above Average Performing Group	13.575	1.975	32.936	5.067

Table 12 demonstrated the Cognitive Performance of the three Groups in Stanine Scale Score of the Pretest Posttest Result. In Low Performing Group with a mean of 13.152 and standard deviation of 3.197 in pretest result while on 18.348 mean and 4.383 standard deviation in post-test result, 23.92 per cent of the learners were Low Performing in Pretest result and 76.09 per cent Low Performing in Posttest Result. 52.17 per cent learners were considered as Average Performing in Pretest while 23.91 per cent

learners were additionally Average Performing in Posttest result. 23.91 per cent learners were named as Above Average Performing based of Pretest result and no learners were set apart as Above Average Performing in Posttest result.

Moreover, the table uncovered that in Average Performing Group with a mean of 13.253 and 2.752 standard deviation in pretest result while 25.793 mean and a standard deviation of 5.845 in post-test result, 26.77 per cent of the learners were low performing in pretest result and 16.09 per cent learners were additionally low performing in post-test result. 49.43 per cent learners were named as average performing in pretest result and 67.82 per cent learners were likewise marked as average performing after the treatment in post-test result.

Finally, Above Average Performing Group with a pretest mean of 13.575 and 1.975 standard deviation while 32.936 mean and 5.067 standard deviation on post-test result, have 12.77 per cent learners that set apart as low performing in pretest result while 2.13 per cent learners were likewise low performing in post-test result. There were 70.21% learners in pretest result were marked as average performing and for post-test result, 42.55 per cent learners were average performing. For the Above Average Performing Group of pretest, there were 17.02 per cent learners and 55.52 per cent learners for the post-test result.

Table 13. Mean Learning Gains of the Three Groups in Diagnostic Test and Posttest Result

Groups	Mean Learning Gains in %
Low Performing Group	62.79
Average Performing Group	36.58
Above Average Performing Group	0.63

It can be noted on table 13 that the Low Performing Group have the highest computed learning gains of 62.79 per cent followed by the Average Performing Group with 36.58 percent and 0.63 percent for the Above Average Performing Group.

The outcome infers that the program created a degree of enhancements on the learners' performance in Science 10. In particular, the Above Average Performing Group were expected to have lower learning gains since at the beginning of the program Above Average Performing group possessed high cognitive qualities.

Table 14. Mean Learning Gains of the Three Groups in Pretest and Posttest Result

Groups	Mean Learning Gains in %
Low Performing Group	13.48
Average Performing Group	33.93
Above Average Performing Group	52.59

Table 14 demonstrates the computed mean learning gains of the three groups. Above Average Group have the highest mean learning gains of 52.59 per cent while 33.93 per cent for Average Performing Group and 13.48 per cent for the Low Performing Group. These results gave an idea that throughout the program, Above Average Performing Group had greater learning gains as compared to the other two groups. On the other hand, some learners had shown

marked improvement on their cognitive performance while a few still persist to have learning deficits.

This idea proved that Inquiry-Based Approach in an E-Learning platform increases both fluid and crystallized intelligence of the learners.

V. CONCLUSION AND FUTURE SCOPE

From the abovementioned results and discussions, the researcher drew the following conclusions:

- 1)The learners showed different levels of skills and knowledge prior to the conduct of the experiment. Thus, they possessed prior knowledge which may be helpful in developing the target skills and competencies covered in this investigation.
- 2)It is evident from the findings that there is a degree of improvement in learners' performances as ruled by Above Average Group.
- 3)Embedding Inquiry-Based learning in an E-learning platform helped all the learners, regardless of their mental ability, to improve their performance in Science. Thus, it is an effective tool to reach out the diversity of the learners.
- 4)The results of the learning gains signify that learning occurs differently across learners with varied abilities and skills. It may be said that the program can have relative effects on learners' performance. Furthermore, Good learners who are the Above Average Performing Group in the beginning of the program were consistently good after the program.

Based on the results and conclusions derived above, the researcher humbly offers the following recommendations:

- 1)Since it was found out that the convergence of Inquiry-Based Learning and E-learning poses positive effects on learners' performance, the Science teachers are encouraged to adopt the program in their respective classes. They are suggested to utilize various forms of blended learning environment that they think would best suit to the abilities, needs, and skills of their learners.
- 2)Homogenous of the groups must be taught differently.
- 3)The school administrators are recommended to take the initiative of conducting seminars/trainings/workshops that focus on employing fusions of various strategies such as the one tried out in this study. Also, they may give highlights on how to effectively carry out teaching strategies through platforms run by the present technology.
- 4)Instructional material developers are encouraged to allow provisions of exercises that are technology-driven so that learners can both reinforce and keep track of the progress of their learning and at the same time be wiser users of technology.
- 5)Parallel researches may be conducted to validate the findings of this study. They may be done in other locale and to a different grade level that more or less covers other sciences. In addition, future researchers may be include other variables which were not covered in this study to come up with a more in-depth analysis of the relative effects of converging Inquiry-Based Learning with E-learning.

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