Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

ISSN NO. 2320-5407

Article DOI:10.21474/IJAR01/17384
DOI URL: http://dx.doi.org/10.21474/IJAR01/17384

RESEARCH ARTICLE

THE EFFECTIVENESS OF THE USE OF FOLDABLE STRATEGY IN SCIENCE INSTRUCTION

Girlie P. Pineda
National University Philippines.

Manuscript Info

Manuscript History
Received: 05 June 2023
Final Accepted: 09 July 2023
Published: August 2023

Key words:-
Foldable Strategy, Outcomes-Based Education

Abstract

Science deals with understanding terminologies, facts, and theories which on some learners might be intimidating. One way to solve this problem is to use strategies to help the learners understand the lesson better without compromising the learning process. Hence, the primary purpose of this experimental research study was to determine the effectiveness of the use of foldable strategy in science instruction to improve the academic performances and learning experiences of the students. The study utilized Randomized Pretest-Posttest Control Group, Using Matched Subjects Design. Data were gathered from 60 matched-sampled students. The data were analyzed utilizing independent t-test and paired t-test. Results of the t-tests showed that there were no statistically significant differences between the pre-test and post-test results of the control and experimental group. However, the experimental group had a higher mean of difference than the control group which indicates that the experimental group had gained more from the intervention.The results of the study were used to prepare an Outcomes-based Education (OBE) guide with the use of Foldable Strategy in Science Instruction. Recommendation made for the teachers was to continue using the traditional mode of teaching with the integration of Foldable Strategy to address higher order thinking skills of the students. Recommendations made for future researchers were to verify the results of the study using greater number of subjects in the control and experimental groups and by completing the four grading period or the whole school year as the length of the study.

Introduction:-

Science is an integral part of any curriculum from primary to tertiary level. The study of science deals so much in terminologies, facts, theories, concepts and applications which in others are complicated and hard to understand. This is especially for those students who are not naturally drawn to the sciences. Pauk and Owens (2005), stressed that students are anxious or even intimidated to study science because they know that they will memorize so many concepts, read textbooks, analyze journals and articles, perform laboratory experiments and even solve scientific problems in quantitative (mathematical) form. This is especially for those learners who are not naturally drawn to the sciences. Schultz (2002) emphasized that learning science involves mistake creation and acceptance in order for the learner to better understand science concepts and principles.

Corresponding Author:- Girlie P. Pineda
Address:- National University Philippines.

One way to solve these problems is to integrate different instructional strategies that would help in deepening the learning process without compromising the facts, theories, and concepts. In the 21st century, the method of teaching and learning had evolved from teacher-centered method into learner-centered method. This is in line with the project-based, interdisciplinary, and research-driven objectives of the 21st century Curriculum. The curriculum and instruction are designed for the learners to create authentic projects based on their learning which are said to be Outcomes-Based. Learning will come through personal experience and not through memorization of concepts, facts and figures. (21st Century Schools, 2008; Ingmire, 2015).

One of the instructional materials that the teacher may use in the Outcomes-based curriculum is the Foldable Strategy. The use of this strategy encourages the active engagement of the learners in the lessonto promote content learning. This strategy has been invented and popularized by Dinah Zike in the year 1984 and has been published in the year 2000 by McGrawHill Companies, Inc. Foldable Strategy is a three-dimensional graphic organizer using different concepts to create a unified concept for better understanding of the lesson. Salandanan (2000) emphasized that a concept is a big idea or generalization which is derived for a number or related particular example. This is one of the innovative ways of teaching learners with concepts, ideas, and information as well as processes that they have to learn. This was supported by Ingmire (2015) and Garcia (2006) in that, hands on learning may give higher performance on the part of the students more than through virtual laboratories and online learning.

Similarly, severalresearches supported the idea that the integration of graphic organizers is effective in science instructions in the secondary science classroom (Clarke, 2014; DuHaney, 2012; Goss, 2009; & McKinney, 2007). These researches reflected the improvement in the academic performances of the learners after the implementation and integration of graphic organizers in their instructions. In addition, Fisher, Frey and Zike (2007), explained that foldable strategy as one of the innovations of graphic organizers can encourage critical thinking and meaningful interaction with ideas and information among the students. This can be used by the teacher during, before or after the lesson to answer the factors that are critical to teaching and learning different disciplines. Thus, graphic organizers may use to emphasize learning; through critical thinking and not through memorization of concepts; from simple context of facts to complex context of ideas and conceptual scheme. Similarly, the use of foldable is one of the innovations in presenting the concept teaching approach in which they can present their learning in their own authentic way.

This research was focused on the learning experiences of seventh grade students of Montessori De Sagrada Familia (MDSF) in School Year 2015 – 2016 by using the Foldable Strategy which is an innovative way of organizing information in the form of foldables in science instruction.

Objectives of the study:-

1. To identify the pretest and posttest scores of the control and experimental groups.
2. To identify the significance differences between the pre-test and the posttest results of the control and experimental groups
3. To utilize the findings of this research in preparing an Outcomes-Based Education Guide using Foldable strategy in science instruction.

Methodology:-

The experimental research method was utilized because it is the most appropriate with regards to the purpose of this research, that is, to determine the effectiveness of the use of Foldable teaching strategy (independent variable) in science instruction on the academic performance (dependent variable) of the students. There are two conditions for a research study to become experimental research (Fraenkel, Wallen & Hyun, 2012). First, at least two conditions are compared to assess the effect(s) of particular conditions or treatments (independent variable). In this study, the independent variable is the use of Foldable Strategy as to compare to the traditional lecture method. Hence, the first condition was met. Second, the independent variable is directly manipulated. In this study, I prepared and conducted the intervention. Hence, the second condition was also met.Moreover, I utilized True Experimental Research Design, specifically Randomized Pretest-Posttest Control Group Design, Using Matched Subjects. In some references, this is also called the Matched Control-Experimental Design or the Between-Subject Design, Two Independent Variable: Two Matched Group Design. The said design was utilized since my purposeis to determine the effect of the independent variable (Foldable Strategy) on the dependent variable (academic performance of the students) ensuring that the level of intelligence of the students will not interfere to the results of the study.

The population of this study is one hundred forty-four students from the grade 7 level of MDSF. It comprises of 75 male students and 69 female students. 60 subjects were randomly sampled from this population. Each subject in the population was matched using range matching technique. This technique requires that the members of a pair fall within a specified range of scores(Myers & Hansen, 2006). In this study, I used an interval range of 2 points as the range of score. Subsequently to range matching technique, I utilized simple random sampling technique. According to Blay (2013) simple random sampling technique gives equal chances for each member of the population to be selected as subject. As part of the simple random sampling, I used a random number table to determine the 30 pairs of subjects of the study. The conclusions derived from the data gathered through random sampling were generalized for the whole population.The source of data was limited to sampled Grade 7 students officially enrolled in Montessori De Sagrada Familia (MDSF) situated in Benigno S. Aquino Avenue, Tangos, Baliwag, Bulacan. There was a total of 60 students used as subjects. Half of the sample was included in the treatment group and the other half was included in the control group. Each subject in the control group was matched in the subject of the experimental group based on the results of their IQ test provided by the guidance counsellor of the school.

These were the instruments and techniques I utilized to complete and validate this study: (1.) Lesson plans in science 7. I prepared two sets of lesson plans in conducting the study. The first lesson plan was the lesson plan for the Control group which includes the lessons, strategies, and routines that I used in a common traditional way of teaching and learning. The second lesson plan was the lesson plan prepared for the experimental group which includes the same lessons and routines in the control group; the only difference is the activities used as part of the intervention of the study. To ensure the validity and reliability of the two lesson plans, the contents were content validated and criticized through the unbiased judgment of experienced and competent Assistant School Principal. All the lesson plans were checked and carefully analyzed, ensuring that the objectives are met with or without intervention. (2.) Teacher-Made Summative Test. This test covered lessons reflective of the grade 7 Science. The pre-test was given before the introduction of the lesson to both groups. The post-test was given after the intervention was done to evaluate if there is significant difference in and between the results of the two groups. To ensure the validity and reliability of the test, I made use of the table of specifications in generating items for the test. I also ensured that the numbers of easy, hard, and difficult questions were properly distributed. A dry run of the test administration was done to students who were not included in the study to ensure that there were no ambiguities in the way the questions were formulated. To assess the reliability of the test used, I utilized KR20 reliability test which resulted in .823 in the pre-test and .858 in the post-test. This indicates that the teacher made test that I used was reliable. Data analyses used in this study were descriptive statistics, Shapiro-Wilk test of normality, Levene's test of equal variances, independent t-test and dependent or paired t-test.

Results and Discussions:-

Difference between the Pre-Test and the Post-Test Results of the Control and Experimental Group

Difference between the Pre-Test Results of the Control and Experimental Group

Independent t-test and paired t-test were used to find if there is significant difference in the students' performance before and after using the Foldable Strategy in Science Instruction. However, prior to finding the statistical significant difference, part of the process involves checking to make sure that the data can actually be analyzed using independent and dependent t-test.

First, equality in the competency level of the control and experimental group should be established prior to conducting the intervention. In this case, the statistical test to be used is a t-test for independent groups. There are six conditions required for an independent t-test to arrive at valid result. First, is that the dependent variable must be measured at the interval or ratio level. In this study, the dependent variable is the score obtained in pre-test. The variable was measured in interval level; hence, requirement for the first condition was satisfied. Second, the independent variable should be two categorical independent groups. In this study, there are two independent groups, the control and experimental group. Third, there should be independence of observations, meaning, there is no relationship between the observations in each group or between the groups themselves. This means that there must be different participants in each group with no participant being in more than one group. Fourth, there should be no significant outliers in the scores obtained in the two groups. Outliers are simply single data points (or scores) that do not follow the usual pattern. In comparison between the extreme values and normal Q-Q plot of difference in pre-test of control and experimental group, it can be seen that there are no significant outliers or single data points within the data that do not follow the usual pattern, hence, requirement for condition four is satisfied.

1. The Test Scores of the Control Group and Experimental Group in Science

Table 1:- Pre-test Scores of the Control and Experimental Group.

Pre-test

The scores in the pre-test of the control and experimental group are shown in table 1. The test of the two groups was given in the same environment to control other variables that might otherwise affect the result of the test. The table shows that 83.3% of the students (25 subjects who scores from 10 to 28) in the control group were in Beginning level during the pre-test with a percentage mean of 67.39. The experimental group has 90% of the subjects (27 subjects) in the same level. The distribution of scores is approximately the same in both groups. This is indicated by the standard distribution of 5.95 in the control compared to 6.28 in the experimental group.

Pre – Test Scores of the Control Group			**Pre – Test Scores of the Experimental Group**		
Scores	**Frequency**	**Percentage**	**Scores**	**Frequency**	**Percentage**
10.00	1	3.3	6.00	1	3.3
11.00	1	3.3	9.00	1	3.3
12.00	1	3.3	11.00	1	3.3
13.00	2	6.7	12.00	2	6.7
14.00	1	3.3	13.00	3	10.0
15.00	2	6.7	16.00	1	3.3
16.00	2	6.7	17.00	2	6.7
17.00	2	6.7	18.00	3	10.0
18.00	1	3.3	21.00	2	6.7
19.00	2	6.7	22.00	2	6.7
20.00	1	3.3	23.00	2	6.7
21.00	2	6.7	24.00	1	3.3
22.00	1	3.3	25.00	3	10.0
23.00	1	3.3	27.00	1	3.3
25.00	2	6.7	28.00	1	3.3
26.00	1	3.3	29.00	1	3.3
27.00	1	3.3	30.00	1	3.3
28.00	1	3.3	34.00	1	3.3
31.00	1	3.3	38.00	1	3.3
32.00	2	6.7			
34.00	2	6.7			
Total	30	100.0	Total	30	100.0
Stat Description	Mean = 67.39 Level= Beginning Std Dev. = 5.95 Sk = 0.425 Minimum = 58.33 Maximum = 78.33		Stat Description	Mean = 66.94 Level= Beginning Std Dev. = 6.28 Sk = 0.261 Minimum = 55 Maximum = 81.67	

Table 2 also indicates that all subjects were on the same cognitive level before the intervention. This satisfies one of the requirements for a pretest-posttest experimental research design that is both groups must be equivalent to avoid confounding.

Table 2 shows that 30% of the students in the control group progressed to Developinglevel while the same proportion in the experimental group improved their performance towards Approaching Proficiency level, one ladder up higher than the control group during the post-test with a percentage mean of 79.25 and 82.17 in the control and experimental group, respectively. The distribution of scores is approximately the same in both groups. This is indicated by the standard distribution of 7.08 in the control compared to 7.39 in the experimental group.

Post-test

Table 3:- Post-test Scores of the Control and Experimental Group.

Post – Test Scores of the Control Group			**Post – Test Scores of the Experimental Group**		
Scores	**Frequency**	**Percentage**	**Scores**	**Frequency**	**Percentage**
18.00	1	3.3	24.00	1	3.3
22.00	1	3.3	25.00	2	6.7
23.00	1	3.3	26.00	1	3.3
26.00	1	3.3	28.00	1	3.3
27.00	3	10.0	29.00	1	3.3
29.00	1	3.3	30.00	1	3.3
30.00	1	3.3	31.00	1	3.3
31.00	1	3.3	32.00	1	3.3
32.00	2	6.7	34.00	1	3.3
33.00	2	6.7	36.00	2	6.7
34.00	2	6.7	37.00	2	6.7
35.00	1	3.3	39.00	2	6.7
36.00	1	3.3	40.00	1	3.3
38.00	1	3.3	41.00	2	6.7
39.00	2	6.7	42.00	1	3.3
42.00	1	3.3	44.00	2	6.7
43.00	3	10.0	46.00	1	3.3
44.00	2	6.7	48.00	1	3.3
46.00	1	3.3	49.00	3	10.0
50.00	1	3.3	51.00	1	3.3
53.00	1	3.3	52.00	1	3.3
			54.00	1	3.3
Total	30	100.0	Total	30	100.0
Stat Description	**Mean = 79.25** **Level= Developing** **Std Dev. = 7.08** **Sk = 0.11** **Minimum = 65** **Maximum = 94.17**		Stat Description	**Mean = 82.17** **Level= Approaching Proficiency** **Std Dev. = 7.39** **Sk = -0.041** **Minimum = 70** **Maximum = 95**	

Using Shapiro-Wilk test of normality, the result showed that the distribution of the differences in the dependent variable between the two groups is approximately normally distributed. This is satisfying the requirement for condition five with a p-value of 0.130 and 0.920 which are both greater than 0.05 level of significance for Shapiro-Wilk test in both groups.

Finally, using Levene's test for equality of variances for the two groups, it shows that there are no inherent differences in the two groups prior to the intervention. This is satisfying condition six. Thus, after satisfying these six conditions, the t-test of independent means was used in this study.

Table 3:- Significant Difference of the Control and the Experimental Group in the Pre-test.

	Mean	SD	Levene's Test		T-comp	df	p-value	Decision
			F-value	P-value				
Control vs Experimental	67.39 66.94	5.95 7.08	0.032	0.86	0.28	58	0.78	There is no significant difference

Table 3 shows the comparison of the pretest scores of the two groups. Using t-test with degree of freedom 58 and the level of significance of 0.05, it resulted in a t-computed value of 0.28 with a p-value of 0.78. This p-value is greater than 0.05 level of significance (2-tailed). This indicates that the two groups were not significantly different prior to the intervention.

Difference between the Post-Test Results of the Control and Experimental Group

This has to test the significant difference in the two groups after the intervention with the use of independent t-test. Again, the conditions for the independent t-test were met prior to the computation of the difference in the post-test results. Using the same procedure, results showed that there are no significant outliers within the data that do not follow the usual pattern; hence, requirement for condition four is satisfied. Moreover, using Shapiro-Wilk test or Kolmogorov-Smirnov Test of normality, the result showed that the distribution of the differences in the dependent variable between the two related groups is approximately normally distributed and that there are no inherent differences in the two groups after the intervention. This satisfies condition six using Levene's test for equality of variances.

Table 4:- Significant Difference between the Control and the Experimental Group in the Post-test.

	Mean	SD	Levene's Test		T-comp	Df	p-value	Decision
			F-value	p-value				
Control vs Experimental	79.25 82.17	7.08 7.39	0.132	0.72	-1.56	58	0.12	There is no significant difference

Table 4 shows the comparison of the post-test scores of the two groups. Using t-test with degree of freedom 58 and the level of significance of 0.05, it resulted in a t-computed value of -1.56 with a p-value of 0.12. This p-value is greater than 0.05 level of significance (2-tailed). This indicates that the two groups were not significantly different in terms of the mean scores after the intervention. This means that there was no statistically significant difference between classes exposed to the use of Foldable strategy in science instruction and classes that were not exposed to the use of Foldable strategy in science instruction. This could be attributed to the small number of subjects used in the study.

Difference between the Pre-Test and the Post-Test Results of the Control and Experimental Group

To be able to find if there are significant differences between the pre-test and the post-test results of the control and experimental group, paired t-test statistical treatment was used. This is the pairing of the result of pre-test and post-test **within** each group. This means pairing of the pre-test and post-test results of the control group and the pre-test and post-test results of the experimental group. There are four assumptions required for dependent t-test to arrive at valid result. The first assumption is that the dependent variable must be measured at the interval or ratio level. In this study, the dependent variables are the scores obtained in both tests. The variables were measured in interval level; hence, requirement for the first assumption was satisfied. Second, the independent variables should be two categorical related groups or 'matched pairs'. In this study, the same students were present in both pre-test and post-test measured on two occasions on the same dependent variable. Third, there should be no significant outliers in the differences of performance between the two related groups. And fourth, the distribution of the data points should be normally distributed.

Table 5:- Difference of the Means between Pre-test and Post-test Results of the Control and the Experimental Group.

	Mean of differences between pre-test and post-test	SD	T-comp	Df	p-value	Decision
Control Experimental	-11.86 -15.22	4.91 5.17	-13.23 -16.13	29	0.000 0.000	There is a significant difference

The table reflects differences between the mean of the pre-test and post-test of the control and experimental group. -11.86 is the mean of differences of the pre-test and post-test of the control group while -15.22 is the mean of differences of the pre-test and post-test of the experimental group. Both groups showed significant increments as reflected by p-value of less than 0.05 level of significance as shown in Table 5. This means that the control group showed significant increment improvement after the use of lecture method and experimental group showed significant improvement after the use of foldable strategy.

Difference between the Increments of the Control and Experimental Group based on their mean of differences

The Independent t-test was used in comparing the means of differences in the scores of the two groups. Again, compliance to six conditions for independent t-test were verified.

Table 6:- Significant Difference in the Increments of the Control and the Experimental Group.

	Mean	SD	Levene's Test		T-comp	df	p-value	Decision
			F-value	p-value				
Control vs Experimental	11.86 15.22	4.91 5.17	0.833	0.365	-2.58	58	0.012	There is significant difference

Table 6 shows the mean comparison of the increments/gains of the two groups after the intervention. Using t-test with degree of freedom 58 and the level of significance of 0.05, it resulted in a t-computed value of –2.58 with a p-value of 0.012. This p-value is less than 0.05 level of significance (2-tailed). This indicates that one group has gained more than the other. The mean of the experimental group is significantly higher than the mean of the control group which indicates that there is enough evidence to show that the experimental group has gained more from the intervention. The Levene's test also shows that these two groups are homogeneous or have no individual differences aside from the treatment administered to them. Although there is significant difference in the means of the control and experimental group, still it is not enough to prove the real difference between the two groups based on the results of their post-test.

Results showed that there are no statistically significant differences between classes exposed (Experimental group) to the use of Foldable strategy in science instruction and classes that were not exposed (Control group) to the use of Foldable strategy in science instruction that could be attributed to the small number of subjects used in the study. Results of the mean of differences showed that the experimental group had higher mean than the control group. This means that the use of Foldable strategy did make a slight difference in instruction. These results are similar on the study conducted by DuHaney (2012) and McKinney (2007) in that the experimental group had a higher mean score than the control group using graphic organizers. Goss (2009) had a similar process on the collection of data which was the use of pre-test and post-test results in gathering the information and at the same time, they used control group and experimental group in determining the effect on the use of graphic organizers in the performance of the students. Their study showed similarity on the results; that graphic organizer is inextricably linked with improvement in comprehension skills.

Utilized the Findings in preparing an Outcomes-Based Education Guide with the use of foldable strategy in science instruction

Based on the findings of the study, the use of foldable strategy is not significantly different with the use of lecture method of teaching. It showed that both teaching strategies were effective based on the increments of the subjects. The experimental group showed significantly higher increment compared to the control group with a mean of difference of 15.22. This means that incorporating foldable strategy in science instructions may produce a higher percentage of students' learning. Thus, the result of study was used to propose an Outcomes-based Education Guide/Material to be used in Science Instructions for Grade 7 classes.

Conclusion:-

In conclusion, matched group technique before randomization appeared to be evident on the result of the study. The IQ levels of each student were matched, and then randomly selected on to which group each subject belongs. Thus, confounding on the results was avoided.The use of foldable strategy was not statistically significant different with the use of lecture method of teaching.Using Foldable Strategy in Science made learning easy and enjoyable. Students would forget their fear in learning science since their classroom environment is friendly, cooperative, enjoyable and conducive to learning. Foldable strategy was also used by the students to produce authentic products based on their own learning. In addition, well planned activities by using an Outcomes-based Education Guide may encourage students in learning and at the same time retain their interest in the lesson being discussed.

Based on the findings and conclusions, it is being recommended that teacherscontinue using the lecture method in teaching science. They may also incorporate foldable strategy and make use of different teaching strategies and instructional materials that are engaging, enjoyable and most of all addressing higher order thinking skills of the students. Furthermore, school administrators may provide teachers with sufficient trainings and extensive seminars about the new trends in teaching and learning; new assessments tools and activities; and how to address the need of 21st century learners. Lastly, future researchers may verify the results of the study by using a larger number of subjects (n>30) in the control and experimental groups and conduct a follow up study on the use of foldable strategy in other grade levels and even in other disciplines. They may also elaborate the results of this research by completing the four grading period or the whole school year as the length of the study.

References:-

1. 21st century schools (2008), What is 21st Century Education?: Introduction – Education in the 21st Century. Retrieved from http://www.21stcenturyschools.com/what_is_21st_century_education.htm
2. Blay, B. E. (2013) . Elementary Statistics. Mandaluyong City: Anvil Publishing, Inc.
3. Clarke, W. G. (2014) . A Correlational Study of Graphic Organizers and Science Achievement of English Language Learners (Doctoral dissertation). Retrieved from ProQuest. (UMI number: 3671854)
4. DuHaney, C. M. (2012). Enhancing learning through the use of graphic organizers to teach science to grade eleven students in jamaica (Order No. MR90183). Available from ProQuest Dissertations & Theses A&I; ProQuest Dissertations & Theses Full Text. (1170996054). Retrieved from http://search.proquest.com/docview/1170996054?accountid=3430
5. Fisher, D., Frey N., &Zikes D. (2007), Foldables: Improving Learning with 3-D Interactive Graphic Organizers. Classroom Notes Plus. 25 (1)
6. Fraenkel, J.R., Wallen N.E. & Hyun, H.H. (2012) How to Design and Evaluate a Research in Education 8th Ed. New York N.Y.: McGraw-Hill Companies Inc.
7. Garcia, M. B. (2006) . Focus on Teaching: Approaches. Methods. Techniques. Quezon City: Rex Book Store.
8. Goss, P. A. (2009), The Influence of Graphic Organizers on Students' Ability to Summarize and Comprehend Science Content Regarding the Earth's Changing Surface. (Thesis) Retrieved from ProQuest. (UMI number: 1466065)
9. Ingmire J. (2015) . Learning by doing helps students perform better in science. UChicago News. Retrieved from http://news.uchicago.edu/article/2015/04/29/learning-doing-helps-students-perform-better-science
10. McKinney, C.D. (2007) . Integrating Graphic Organizers for Effective Reading in the Secondary Science Classroom (Doctoral Dissertation) . Retrieved from ProQuest. (UMI number: 3276896)
11. Myers, A. & Hansen, C. (2006). Experimental Psychology, 6th Ed. Philippines: Cengage Learning.
12. Pauk, W. & Owens, R. J. (2005) .How to Study in College. U.S.A.: Houghton Mufflin Company Retrieved from http://college.cengage.com/psychology/nevid/essentials/2e/assets/students/success/fm_01.pdf
13. Salandanan, G. G. (2000) .Teaching Approaches & Strategies. Quezon City: Katha Publishing Co., Inc.
14. Schultz J. (2002) .Learning How to Learn: Science Education for Struggling Students. Retrieved from http://ww2.odu.edu/ao/instadv/quest/StrugglingStudents.html.