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STRUGGLING LEARNERS' ACHIEVEMENT LEVEL USING ELECTRONIC STRATEGIC INTERVENTION MATERIAL IN MATHEMATICS (ESIMATH)

Glory Fe Oraller Balazo[1]

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ABSTRACT

This study focused on the achievement levels of Grade 11 struggling learners using an electronic Strategic Intervention Material in Mathematics (eSIMath) in teaching least mastered competencies in the subject, Statistics and Probability for Senior High School. A Solomon four-group quasi-experimental research design was employed to two classes using eSIMath-based instruction, and two classes via conventional instruction, who were identified through a local diagnostic examination given by the teacher-researcher before the instruction for the second semester of the school year 2019-2020. The data gathered were analyzed using independent and dependent t-test, Dunnett's T3 test for post-hoc analysis of posttest scores, and assessment of mean gained scores. Findings of the study showed that the use of eSIMath-based instruction is an effective approach in the increase of struggling learners' achievement level in Statistics & Probability.

Keywords: Achievement Level, Conventional Teaching, Electronic Strategic Intervention, Material, Pre-test, Posttest

[1] Graduate Student, Eastern Samar State University, Special Science Teacher 1, Dolores National High School

INTRODUCTION

Mathematics is challenging, rewarding, and fun. It is both logical and creative. It needs critical, analytical, problem - solving, and quantitative reasoning. Disciplines such as mathematics and science, unfortunately, create negative feedback for most high school students(Salviejo et al., 2014). Works of Lee, Grigg and Dion (2007) showed that only a few students achieved the proficient level in Mathematics, and at least 33% did not reach even the basic level. In the year 2018, Filipino students participated in the Programme for International Students Assessment (PISA) and among the 79 participating countries, the Philippines ranked second last in the bottom in both mathematics and science (San Juan, 2019). These results are associated with the performance of students in Dolores National High School; the mathematics mean percentage score, specifically in the course Statistics and Probability of Grade 11 students are still below 75%. These poor math results are indicators that learners of today struggles in understanding mathematical concepts and skills. With the pressing issues in the country's present educational system, Supovitz and Klein (2003) opined the need for teachers to be more creative, flexible, and to provide aid to students' performance. According to Zakaria and Iksan (2007), the use of the latest approaches, methodologies, and strategies in teaching will encourage the learners to gain more knowledge and to apply the best practices in mathematics education. The use of technology inside the classroom helps the students become independent (Baylor & Ritchie, 2002; Windschitl & Sahl, 2002). The said approach paves the way for an interactive and collaborative learning inside the four corners of the classroom. As presented by Himmelsbach (2019), technology integration enables students' engagement, maximization of self-paced learning, and promotes innovative teaching techniques. With this, the researcher adopted the idea of integrating technology in teaching least mastered competencies in the subject Statistics and Probability for Senior High School. The researcher's desire to help students develop their mathematical competence is aided through an Electronic Strategic Intervention Material (eSIM). Electronic Strategic Intervention Material is the newest remediation material prescribed by the Department of Education (DepEd). According to Dumigsi and Cabrella (2019), SIM is a useful remediation tool in solving problems, while Dahar (2011) found the use of SIM effective in improving learners' mathematics performance. This eSIMath based instruction utilized a researcher-developed learning tool embedded in a computer software that contains a title card, guide card, activity card, enrichment card, and reference card. The said instructional material focused on regression analysis as a consistent least learned competency based on the item analyses conducted for the school year 2017 – 2018 and 2018 – 2019 in Dolores National High School.

Given all the aforementioned reasons involving a considerable number of learners who are experiencing difficulty in mastering learning and the critical role of technology in understanding complex mathematical concept, this study finds it significant to develop an electronic-based Strategic Intervention Material in Matheamatics (eSIMath) focusing on regression analysis which is included in the topic: Inferential Statistics, among 11th-grade students in Dolores National High School of the school year 2019-2020 via Four Group Solomon approach.

METHODS

Research design

This is a quasi-experimental study via Solomon four group design that determined the achievement levels of struggling students using Electronic Strategic Intervention Material in Mathematics (eSIMath) among Grade 11 Statistics and Probability classes, specifically focusing on the least mastered competencies on Regression Analysis.

Locale of the Study

The experimentation was administered at Dolores National High School located at Reynaldo St. Barangay 09 Dolores, Eastern Samar, Philippines. The school was chosen because it is one of the pilot schools which implemented the Senior High School, has a big enrolment and due to the proximity of its location to the researcher. Results of the tests in Grade 11 Statistics and Probability were limited among four classes of 11th Grade learners enrolled in the Humanities and Social Sciences track for the school year 2019-2020.

Respondents of the Study

The Grade 11 Humanities and Social Sciences (HUMSS) struggling students were the subjects of this study. It is the teacher-researchers' observation that in Dolores National High School, at least 50% among HUMSS students are having difficulty in understanding the concepts in mathematics. So, with this, the researcher decided to have them as the subjects of this study. Four classes, with 30 subjects each, were involved in the experiment, two classes for the experimental group and two classes for the control group.

Sampling Procedure

The researcher employed non-random purposive sampling in selecting the subjects for the experimental and control group using a local diagnostic before the instruction for the 2nd semester as the basis in selecting its subjects.

Research Instrument

A 25-item pretest/posttest instrument was drafted by the teacher-researcher, and was content validated among Master Teacher, Senior High Coordinator, and expert teachers who have finished or have completed academic requirements for Master of Arts in Teaching Mathematics. The said instrument was then pilot tested to non-participating class, and the result yielded a 0.731 reliability coefficient through Cronbach's' alpha. An Electronic Strategic Intervention Material in Mathematics (eSIMath) made by the teacher-researcher was also used which undergone content validation, among mathematics teachers in order to determine the strong and weak points of the developed eSIMath. Comments and recommendations were considered in modifying the material.

Data Analysis

The data collected in this study were tabulated, analyzed and statistically treated using percentage achievement scores, dependent and dependent t-test, one-way analysis of variance, and dunnetts' T3 test for multiple comparisons.

RESULTS AND DISCUSSION

Pretest achievement levels of the experimental group and control group

Table 1 presents the pretest achievement levels of the experimental group (EG_1) and control group (CG_1). The experimental group (EG_1) got a percentage score of 24.52, while the control group (CG_1) obtained 22.12. Their scores deviations' showed minimal difference, before their exposure to the instructions. These results were both interpreted as with "Low Achievement".

This pattern of observation on pretest assessment result has been shown in previous works, specifically with Abuda (2019), in which participants assigned in control and experimental groups got low scores in the pretest assessment, and Jitendra and Xin (1997) who suggested that at-risk students first master basic numerical skills before engaging in more complex tasks such as problem-solving. The data signify that the subjects in both groups belong to struggling learners and poorly performing in class.

Table 1. Pretest achievement levels of the experimental group and control group

Groups	Percentage Score	SD	Achievement Level
EG_1	24.52	1.655	Low Achievement
CG_1	22.12	1.332	Low Achievement

SD - Standard Deviation

Posttest achievement level of the four groups

Table 2 showcases the posttest achievement levels of the four groups namely: experimental group/EG_1 (with pretest), experimental group/EG_2 (without pretest), control group/CG_1 (with pretest), and control group/CG_2 (without pretest). The table shows that both the experimental group with and without pretest gained percentage scores of 60.40 and 55.08, respectively of which are interpreted as "Average achievement". On the other hand, the control group with pretest gained a mean score of 43.88 interpreted as "Average achievement", and the control group without pretest got the lowest achievement score of 36.28 interpreted as with "Average Achievement". It can be observed that groups exposed to pretest assessment (EG_1 and CG_1) performed better than their counterparts, although all of the four groups performed in the same achievement level. These findings are consistent with the available data of De Jesus (2019), that the use of SIM significantly increase the learners' performance on the least mastered topics, and Moore (2007) who pinpointed that learners who are into technology became more, engage and concentrated in learning the topics.

Table 2. Posttest achievement levels of the experimental and control groups

Groups	Percentage Score	SD	Achievement Level
EG_1	60.40	2.264	Average Achievement
EG_2	55.08	4.376	Average Achievement
CG_1	43.88	3.624	Average Achievement
CG_2	36.28	3.352	Average Achievement

SD - Standard Deviation

Difference between the pretest achievement levels of the experimental and control groups

Prior to analyzing the test on the significant difference of the pretest scores of the two group, normality test via Shapiro Wilk approach was conducted, and the results showed that the scores of the two groups followed normal distribution since p values from two groups were greater than 0.05.

Results in Table 3 reveal that since the p-value is higher than the level of significance set at 0.05, the researcher fails to reject the null hypothesis. Therefore, the pretest achievement scores of the control and experimental group showed a non-significant difference. This amplifies that the learning achievement of the subjects were homogenous as opined by Fajardo (2004). A similar achievement level resulted due to the pairing made by the researcher to assure that the two groups were made equal.

Table 3. Test significant difference on pretest achievement levels of the experimental and control groups

Groups	t-value	p-value	Decision	Interpretation
EG_1 CG_1	1.547	.127	Fail to reject H_0	Not Significant

df = 58, α = 0.5

Difference between the pretest and posttest achievement levels of the experimental and control groups

Table 4 presents the mean difference of scores between the achievement levels in the pretest and posttest mean scores of the experimental group (EG_1) and control group (CG_1), and the pretest sensitization of the experimental groups and control groups, respectively.

It can be observed from the table that highest mean difference can be seen on the experimental group with pretest (EG_1 = -8.97), while the lowest mean difference reflects on the control group without pretest (CG_2 = -3.53). Since the control group without pretest describes pretest sensitization, it is safe to declare that the exposure to pretest has little impact on the posttest performance of the students. Since all the computed p-values were less than the level of significance set at 0.05. The results suggest that there is a significant difference between the pretest and posttest mean scores of the experimental group and control group, and in both pretest mean score of control and experimental groups and posttest mean score of both experimental and control groups without pretest. This clearly suggests that using electronic Strategic Intervention Material in Mathematics (eSIMath) enhances the achievement level of struggling math learners in the 11th grade. It was also observed that there is a significant difference of achievement levels of students who were exposed to pretest and those who were not pretested. This general observation is also supported by findings from Zhang et al. (2015) on the improvement of student learning after exposing them to math apps.

Table 4. Test significant difference of the pretest and posttest achievement levels of the experimental and control groups

Groups	MD	t-value	p-value	Decision	Interpretation
EG_1 (Pretest-Posttest)	-8.97	-19.139	.000	Reject H_0	Significant
EG1(Pretest)/ EG2(Posttest)	-7.64	-7.785	.000	Reject H_0	Significant
CG_1(Pretest-Posttest)	-5.43	-8.649	.000	Reject H_0	Significant
CG_1(Pretest)/ CG_2(Posttest)	-3.53	-5.041	.000	Reject H_0	Significant

df = 29, α = 0.5

Posttest achievement levels of the four groups

Prior to the conduct of multiple post-hoc analysis, Shapiro Wilk-based normality test was conducted. The result revealed that all the four groups are normally distributed since their p-values are greater than 0.05. Furthermore, in choosing what multiple comparison based-

parametric test to be used, a Levene's analysis was generated which guided the researcher to use Dunnette's T3 test since homogeneity of variances cannot be assumed. Prior to post hoc analysis, a one-way ANOVA was calculated to determine whether the differences of scores of the four groups are statistically significant. Since the computed p-value is less than 0.05, there exists a significant difference in the posttest scores of the four groups. Navarro and Siegel (2018) stated that the effectiveness of the treatment can be evaluated by comparisons between experimental and control groups with pretest, and experimental and control groups without pretest. Table 5 shows that there is a significant difference between the experimental and control group with pretest and also, on the comparison between the experimental and control group without pretest. Hence, it can be assumed that the treatment used in the study was effective. Electronic Strategic Intervention Material in Mathematics (eSIMath) based instruction is way better compared to conventional teaching method. This is consistent with the findings reported by Abuda (2019) on the significant difference found on the posttest mastery levels of the comparison groups, and Ferguson (2010) who reported that inquiry-based learning instruction showed a significant improvement in the posttest result rather than in conventional instruction in the Eighth Grade Pre-Algebra Classroom.

Table 5. Dunnette T3 test significant difference of the posttest achievement levels of the four groups

Groups	*F-value/Mean Difference	p-value	Decision	Interpretation
4 groups	*18.253	0.000	Reject H_0	Significant
$EG_1 - CG_1$	4.13	.000	Reject H_0	Significant
$EG_2 - CG_2$	4.70	.000	Reject H_0	Significant

**df = 3, a = 0.5*

Mean gain scores of the experimental and the control group

Prior to determining the significant difference of the mean gain scores of the experimental and control groups with pretest, a test of homogeneity of variances was used to determine the normality of distribution of the two groups. A Levene's statistic of 4.12 with a corresponding p-value of .047 were calculated, which means that equal variances of the two groups are not assumed, which is one requirement for t-test analysis. Furthermore, since both groups show normality in their distributions as depicted in the Shapiro Wilk Test of Normality, a parametric analysis such as an independent (unmatched) t-test can be used.

As shown on Table 6 the mean gain score of the experimental group is higher compared to the control group. It has a mean difference of 3.54. Thus, technology really helps in engaging young minds and enhancing learners understanding (Carlson (2005). Furthermore, a t-value of 4.509 was computed with a corresponding p-value of approximately equal to 0. This means that, there is a statistically significant difference between the mean gain scores of the two groups.

Table 6. Test significant difference of the mean gain scores of the experimental and control groups with pretest

Groups	MGS	MD	t-value	p-value	Decision	Interpretation
EG_1	8.97	3.54	4.509	.000	Reject H_0	Significant
CG_1	5.43					

df = 53.637, MGS – Mean Gain Scores, MD - Mean Difference

CONCLUSIONS

Based on the findings of the present study, it is concluded that both the experimental and control groups got a low achievement mean score in the pretest assessment. After exposing these groups to the instructions, the experimental and control groups with pretest performed better in the posttest assessment, while the control group without pretest shown the least achievement. Further analysis revealed no significant difference observed between the pretest achievement level of the students in both experimental and control groups, while the pretest and posttest achievement levels of the experimental and control groups showed a significant difference. Finally, the achievement levels among the groups significantly improved in the posttest, and based on the ANOVA result all of the four groups significantly differ on their posttest mean scores. Having a significant result on the experimental and control groups with pretest, and experimental and control group without pretest we can say that Electronic Strategic intervention Material (eSIMath) based teaching is better compared to conventional teaching. There is a significant difference between the mean gain score of the experimental and control groups. Experimental group show a higher mean gain score compared to the control group.

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