Effectiveness of Game and Poem Enhanced Instructional Strategies and Verbal Ability on Students' Interest in Mathematics Learning

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Abstract

This study investigated the effects of game and poem-enhanced instructional strategies on students' interest in mathematics. The moderating effects of verbal ability were also examined on the dependent variable. A quasi-experimental design was adopted. Three hundred and forty four students in the sixth year of their primary education (primary 6 students) from 12 public primary schools in Ogbia and Yenagoa Local Government Areas of Bayelsa State, Nigeria, formed the sample of the study. The schools were randomly assigned to experimental and control groups. Seven reliable and validated instruments were used for the study. Three null hypotheses guided the study. Treatment had a significant effect on students' posttest interest scores. Game and Poem- Enhanced Instructional Strategies and Verbal Ability improved students' interest in mathematics more than the Modified Lecture Instructional Strategy. It was recommended that teachers, curriculum developers and authors should adopt games and poems to enhance students' interest in mathematics.

Keywords: Game and Poem Enhanced Instructional Strategies; Verbal Ability; Interest in Mathematics Learning.

Introduction

Primary education is the foundation of Nigeria educational system. The first two objectives of primary education are clearly stated in the National Policy on Education as: Inculcating permanent literacy and numeracy, and the ability to communicate effectively; laying a sound basis for scientific and reflective thinking (Federal Republic of Nigeria, 2013). The inculcation of permanent numeracy stresses the need for every child to be mathematically literate at the primary school level (Iji, 2008). Primary education, in Nigeria, is of six years duration. The children in the 6th year are called Primary 6 students.

Mathematics plays a vital role in the achievement of the primary school objectives, particularly to science and technology and science-related disciplines, for it is the language used in expressing them. Ukeje in Aguele and Usman (2007) assert that there is no science without

mathematics, there is no modern technology without science, and without modern technology there is no modern society. Also, Mathematics is a core and compulsory school subject in the curricula from Primary to the Junior Secondary and to Senior Secondary School levels of the Nigeria Educational System (Aguele & Usman, 2007; Kurumeh & Imoko, 2008).

Udegbe (2009) and Anaduaka (2011) observe, however, that a large pool of students express lack of interest in mathematics at all levels of the educational system. This is, probably, responsible for their poor achievement in both external and internal mathematics examinations, which increase students' dislike and phobia for mathematics and mathematics-related courses. Also, Okigbo and Okeke (2011) assert that teachers apply or use wrong methods or strategies in teaching mathematics in classrooms, thereby making the subject uninteresting. The low interest of students in mathematics emanates from anxiety and fear, and this is expressed on their faces, in mathematics classes (Okigbo & Okeke, 2011). Another cause of poor interest in mathematics is the teacher's strategy of teaching mathematics, which does not sustain the development of interest in mathematics among others (Habor-Peters, 2001; Abakporo, 2005; Agwagah, 2005). As an example, the lecture strategy which pays more attention to teachers, is boring for students and diminishes students' interest in mathematics because the students' only job in the classroom is to passively sit and watch the teacher work mathematics exercises on the board and then copy what the teacher did (Peng, 2002). The lecture instructional strategy of teaching mathematics can thus be described as one that does not sustain the development of students' interest in mathematics (Agwagah, 2004) and poorly develops learners' cognitive, psychomotor and affective domains (Kankia, 2008).

To achieve good performance in mathematics, the interest and positive attitude of students towards mathematics need to be developed and properly harnessed right from the Primary School level; this is where the solid foundation for the subject is laid (Ekine, 2010). Kankia (2008) stated that, when students generate interest in mathematics lesson and excitement about it, half of the students' problems in mathematics is solved. In the light of this, Udegbe (2009) states that, interest is a condition for learning mathematics and there can be no real mathematics education without interest in mathematics.

The effective activities recommended for the Primary School Students include the use of games to enhance greater understanding of concepts (Aremu, 1998; Agwagah, 2001), providing a creative corner for less capable students in mathematics, who may be good at arts or writing, which includes activities such as poetry or stories about mathematical situations and geometric drawings (Ojo, 2008; Albool, 2012). Iji (2007) also recommends exhibition of poems to teachers at the primary school level. Similarly, Maduabuchi (2002) and Fakeye (2006) opine that students' verbal ability affect their academic achievement in a standardized test. Therefore, this study examines the effects of poem and game- enhanced instructional strategies and verbal ability on students' interest in mathematics.

Poetry has vital roles to play in children learning. Owen (2010) states that memorizing poetry increases child's cognitive ability because poems present language in more ordered and rhythmical ways than prose. Kurumeh and Imoko (2008) asserts that these techniques increase a child's ability to reason, imagine, think, argue and experience the world in sensory and aesthetic ways.

Children are natural lovers of poetry. Kids love words, rhyme, and beat. The repetitive nature of poems helps children's memory to learn and expand in understanding and knowledge. Children learn better and faster when rhyme is used from an early age (Mazzucco, 1994; St.Cyr, 2008). Rhymes build listening skills which are helpful for later reading comprehension. Learning

to manipulate words through rhyming is an important reading skill and further enhances writing. Writing in mathematics class enhances active learning, problem- solving, invention; increases reading; improves content; a way to participating in interdisciplinary collaboration (Urquhart, 2009). These features in a poem lead to children learning and enjoy whatever they are learning.

Furthermore, Bahls (2009) identifies two important purposes poetry serve in mathematics courses. First, poetry offers a new sort of cognition, new lens, and one based in linguistic metaphor, through which students can examine and re-examine mathematical ideas. Second, writing poetry emboldens students and gives them confidence by allowing them familiar with idioms in which they can express themselves mathematically. Therefore, writing should be as much at home in mathematics class as in English Language class, an activity within the poem-enhanced instructional strategy.

Urquhart (2009) recognizes three kinds of writing prompts that reflect three aspects of learning mathematics — (1) content, (2) process and (3) affective. Content prompts deals with mathematical concepts and relationships; process prompts focus on algorithms and problem solving; and affective prompts center on students' attitudes and feelings. These areas are incorporated in the writing of the poems, especially the content and process. The affective aspect was incorporated effectively in the students' activities and assignments together with the other prompts.

Very few research works are reported in the use of poetry and writing in mathematics. Pugalee (2004) conducted a study with ninth grade algebra students to determine if journal writing can be an effective instructional tool in mathematics education and found a positive effect in problem-solving because the writer organize and describe internal thoughts. Bahls (2009) found that, in writing poetry, many students seemed able to make their own mathematical ideas, yet hidden to them. Some of the students who performed poorly or at least more reluctantly than their peers on traditional mathematical exercise, such as computation, heavy home-work problems and in-class examination relished the chance to work with a new medium. Also, Samuels in Bahls (2009) found that performing poetry in a sociology classroom emboldened weaker students.

The other activity that can be used to enhance students' interest in mathematics is the use of games. A game is a type of play that follows a set of rules, aims at a definite goal or outcome and involves competition against other players or against barriers imposed by nature of the game (Agwagah, 2001). A mathematical game is a game with the course of the game having mathematical structure or consideration (Onwuka, Iweka, & Moseri, 2010).

Games play vital roles in mathematics instruction. The use of games in teaching mathematics make students to be actively involved in the daily lessons since they are interested in learning mathematics as game (Abubakar & Bawa, 2006). Children are natural lovers of game (Akpan, 1988). Games relax tension, clear boredom and foster an environment where teaching and learning are pleasant, interesting, exciting, stimulating, motivating and academically rewarding (Kankia, 2008). Games provide unique opportunity for integrating the cognitive, affective, and social aspects of learning (Azuka, 2002).

Many studies have been carried out on mathematical games with positive results. Ugwuangi (2002) used game and simulation to generate students' interest on Sequence and Series. Dotun (2005) used ladder and tunnel game to teach algebraic expression. Okigbo (2008) employed card games to teach Percentages, Fractions and Decimals in secondary

schools; Aremu (1998) used card and geoboard-based games as instructional strategies on Primary School Students' achievement in practical geometry. The posttest interest score of students in all the experimental groups was better than that of the control groups.

Verbal ability of a student also has a positive effect on the teaching-learning process, especially in mathematics. Whetton in Komolafe (2010) defines verbal ability as a group intelligence tests which are largely verbal, designed to provide overall measure of scholastic ability used in an educational context. Researchers (Maduabuchi, 2002; Fakeye, 2006) have documented the fact that students' verbal ability, significantly influence their performance on standardized achievement tests. This may be applicable to students' interest in mathematics. Exploring the influence of verbal ability on students' interest in mathematics is relatively new. Poetry is highly loaded with connotations and figurative language, which requires a reasonable level of verbal ability for students' competence. This study is also interested in finding out the moderating effects of students of varying levels of verbal ability on the learning outcomes in mathematics. This study is based on Skinner's operant conditioning and Ausubel's verbal meaningful learning theories.

Statement of the problem

Studies have indicated that mathematics teaching is done by the chalk-and-talk strategy which has been found to promote rote learning, low level of achievement and low interest in mathematics. Game and poem are recommended to solve the problems of teaching mathematics at the primary school level; however, most studies (Komolafe, 2010; Maduabuchi, 2002) on game in teaching mathematics were carried out at the secondary school level. Also, game was used with other strategies, such as game and simulation; game and analogy; or two distinct games, like ladder and tunnel games, card and geoboard-based games, to determine the most effective strategy. Therefore, this study examined the effects of game and poem-enhanced instructional strategies on students' interest in mathematics. The study, also, determined the moderating effects of verbal ability on students' interest in mathematics.

Hypotheses

The following three null hypotheses were tested at 0.05 level of significance:
$HO_{1:}$ There is no significant main effect of treatment on students' interest in mathematics
HO_{2} :There is no significant main effect of verbal ability on students' interest in mathematics
HO_{3} :There is no significant interaction effect of treatment and verbal ability on students' interest in mathematics

Research Design and Methodology

This study adopted a pretest-posttest, control group, quasi-experimental design. It examined the possible effects of poem and game-enhanced instructional strategies on students' interest in mathematics. A 3 x 3 factorial matrix was adopted with instructional strategy as treatment and verbal ability manipulated at three levels.

Selection of participants

Two Local Government Areas in Bayelsa State and six schools in each Local Government Areas were purposively selected and randomly assigned to treatment and control groups. The selection of the Local Government Areas was based on the following criteria:

(i) The Local Government Areas must have roadways because of the state's terrain (rivers)
(ii) The Local Government Areas must have at least six (6) public primary schools that have roadways.

The selection of the schools were based on the following criteria: (i) the schools must be public schools; (ii) the schools must have experienced teachers who possess teaching qualification and have been teaching mathematics for not less than five years; (iii) the teachers must be willing to be involved in the experiment; (iv) at least 60% of students must know how to read.

Six (6) schools were randomly selected from one local government area; that is, a total of twelve (12) schools from two local government areas were used for the study. One intact class of primary six (6) students was randomly selected from each of the twelve public primary schools in the two local government areas. Two (2) schools each were randomly assigned to treatment (i.e., groups 1 and 2) making a total of four schools to treatment and two (2) schools to control group in one local government area. Further, the same number of schools was assigned to treatment and control group in the second local government area. A total of 344 students (l64 males & 180 females) were used.

Research Instruments

Seven instruments were used in the study; namely:

1. Instructional Guide on Poem-Enhanced Instructional Strategy (IGPEIS)
2. Instructional Guide on Game-Enhanced Instructional Strategy (IGGEIS)
3. Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)
4. Students' Interest in Mathematics Inventory (PIMI)
5. Students' Verbal Ability Test (PVAT)
6. Teacher's Assessment Sheet for Poems (TASP)
7. Teacher's Assessment Sheet for Games (TASG)

IGPEIS, IGGEIS, TASP, TASG were developed by the researchers. IGMLIS and PIMI were adapted from the primary six curriculum and Ekine (2010) respectively. PVAT was adapted from Komolafe (2010). All the instruments were duly validated by expert review. PIMI and PVAT where Structured dichotomous (yes/no) and had reliability coefficients of 0.73 and 0.85, respectively, using Kuder-Richardson 21 (KR-21) statistic. The reliability indices of IGPEIS, IGGEIS, IGMLIS, TASP and TASG were also computed, but using Pearson product moment correlation coefficient statistical tool and were 0.81, 0.74, 0.76, 0.84 and 0.78, respectively. The data for the computation of reliability indices of the instruments, IGEIS, IGGEIS, IGMLIS, TASP and TASG, were obtained from pilot testing on sample of 20 students in primary schools outside the ones used in this study. Test and retest approach was used in obtaining a pair of data for each instrument.

Before the commencement of instruction/teaching, the researchers gave teachers in the schools assigned to treatment groups (1 and 2) necessary training on the uses of IGPEIS and IGGEIS for one week. Teachers in the schools assigned to control group were, also, trained on how to use IGMLIS for one week. Again, teachers in the treatment schools were trained on how to use TASP, TASG and PVAT to assess academic achievement of students, exposed to poem and game-enhanced instructional strategies and based on verbal ability, respectively, for two days. These measures were taken to certify the teachers competent, enough, to teach the students. The researchers, also, prepared uniform lesson notes for the participating teachers and instructed

them to strictly adhere to the lesson notes during teaching-learning process. The lesson was on concept of multiplication.

Data on students' interest in mathematics were collected with the aid of PIMI from both treatment and control groups, before treatments were made. The pre-test mean scores of students in both groups were computed. Thereafter, students in both groups were taught for two weeks. Group one of the treatment group received teaching through Poem-Enhanced Instructional Strategy (PEIS); group two of the treatment group received teaching through Game-Enhanced Instructional Strategy (GElS). The students in control group received teaching through Modified Lecture Instructional Strategy (MLIS). At the end of two weeks lesson, the posttest mean scores of the various groups of students were computed and compared, after exposing all the groups to posttest.

Method of Data Analysis

The data collected were analyzed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. Estimated Marginal Means (EMM) analysis was used to determine the magnitude of performance of the various groups. Scheffe's post-hoc test was also used when significant differences were observed to show the pairs of groups that were significantly different.

Results

HO_1: There is no significant main effect of treatment on students' interest in mathematics.

Table 1 shows that the main effect is significant on students' interest in mathematics ($F(2,340) = 336.835$; $p < 0.05$; partial eta squared = O.665).The effect size of 66.5% is fair. Hence, HO_1 is not accepted. Consequent upon the observed main effect, Table 2 is presented to determine the magnitude of the mean scores of the groups' performances, exposed to poem-enhanced instructional strategy (PEIS), Game-enhanced instructional strategy (GEIS) and the Modified lecture instructional strategy (MEIS).

Table 2 indicates that, the students exposed to PEIS treatment has the highest posttest mean score of 15.084, followed by students exposed to GElS with a mean score of 14.661, while students exposed to MLIS treatment with the lowest posttest mean score of 10.607; however, the grand mean is 13.450. The source of the significant difference obtained is determined using Scheffe's post-hoc test as shown in Table 3.

Table 3 shows that students exposed to PEIS performed significantly better with a mean score of 15.084 than students exposed to GEIS with a mean score of 14.661. Also, students exposed PEIS are better than those exposed to MLIS with a mean score OF 10.607. This further indicates that the significant difference shown by the ANCOVA test is as a result of the difference between GEIS and PEIS, GEIS and MLIS and PEIS and MLIS.

HO_2: There is no significant main effect of verbal ability on students' interest in mathematics**.**

Table 4 indicates that, the main effect is significant on students' interest in mathematics, $F(2,340) = 12.168$; $p < 0.05$; partial eta squared=0.067). The effect size is 6.7%. Hence, HO_2 is rejected. Consequent upon the observed main effect, table 5 is presented to determine the magnitude of the mean scores of the groups' performances.

Table 5 indicates that, the students with high verbal ability have the highest posttest mean score of 14.789, followed by students with medium verbal ability with a mean score of 14.090, while students with low verbal ability have the lowest posttest mean score of 12.457; however, the grand is 13.779. The source of the significant difference obtained was determined using Scheffe's post-hoc test as shown in table 6.

Table 6 shows that students with high verbal ability have significantly better mean score of 14.469 than students with medium verbal ability with a mean score of 14.090. Also, students with medium verbal ability are better than those with low verbal ability with a mean score of 12.457. This further indicates that the significant difference shown by the ANCOVA test is as a result of the difference between high and low, as well as that of medium and low verbal ability groups.

HO_3: There is no significant interaction effect of treatment and verbal ability on students' interest in mathematics.

Table 7 reveals that the interaction effect is significant on students' interest in mathematics, F (4.334) =2.489; $p<0.05$; partial eta squared=0.033. The effect size is 3.3%. Therefore, HO_3 is rejected.

Discussion

Tables 1, 2 and 3 revealed that students exposed to PEIS had significantly better mean interest score than students exposed to GEIS and MLIS. Also, students exposed to GEIS were better than those exposed to MLIS. These findings agree with findings of Ezeamenyi in Udegbe (2009) that students taught with game achieved more and generate more interest than those taught with lecture instructional strategy. It also supports the findings of Okigbo and Okeke (2011). That game was effective in improving students' interest in mathematics. Further, students exposed to PEIS had better mean interest scores than those exposed to GElS and MLIS. This supports the assertion of St Cyr (2008), that children are natural lovers of poetry. Additionally, Mazzuco (1994) noted that children have natural affinity for poetry. Ekine (2010), found a significant main effect of treatment on students' interest in primary science. All these results support Aremu's (2008) assertion that learner friendly strategies should be adopted in the teaching and learning of science, mathematics and technology. These factors must have accounted for the better interest mean scores of GElS and PEIS over MLIS. This confirms the assertions of some mathematics educators (Peng, 2002; Agwagah, 2004; Kankia, 2008) that the lecture instructional strategy diminishes students' interest in mathematics, does not sustain the development of students' interest in mathematics and poorly develops learners' cognitive, psychomotor and affective domains.

Tables 4, 5 and 6 revealed that the high verbal ability group obtained the highest mean interest score, followed by the medium verbal ability students, while the low verbal ability group obtained the lowest mean interest score. This result contradicts the findings of Iti (2005), who indicated no significant difference of verbal ability on primary 3 students' interest in science. It also contends with the findings of Komolafe (2010) that there is no significant effect of verbal ability on primary 4 and primary 5 students' attitude in composition writing. This study found a significant effect of verbal ability on primary 6 students' interest in mathematics. The difference in the results of these studies could be the nature of the instruments used for data collection. The

interest and attitude scales of Iti (2005) and Komolafe (2010) are on a four-point adapted Likert scale which according to Akinbote in Ekine (2010), note that the yes/no response mode, has been found to be more appropriate and better understood by the primary school students. Iti (2005) attributed the no significant effect of verbal ability on students' interest in primary science to the method of data collection and immaturity of the students to appreciate what is of interest to them. Komolafe (2010), citing Akinbote (1999), gave a similar report.

The findings of this study, however, are in conformity with those of Yoloye (2004), who notes that when students' level of participation in an instruction increases, students' interest is aroused; consequently their achievement also increases. Lazar (2004) asserts that verbal fluency of students determines easy understanding, comprehension and recall. The above reports are practical, especially in PEIS, where students boldly read, explain, write and role-play the actions in the poems.

Table 7 showed that the interaction effect of treatment and verbal ability was significant on students' interest in mathematics. The result contradicts the assertion of Wilkinson and Ortiz (2000) and Komolafe (2010) that treatment of a group of learners and their verbal ability do not have anything to do with achievement of the learners in and attitude in language learning. This, however, supports the findings of Iti (2005) and Awofala et al. (2011), in primary science and mathematical word problems on achievement, respectively. Therefore, the teacher must take into consideration the treatment he/she gives to the students along with their verbal ability levels in order for all to improve their performance equally, since different verbal ability students are in the same class.

Recommendations

Mathematics teachers should give special attention to the use of poems and games to enhance students' interest in mathematics. This is because the rate of failure in mathematics across the nation is high. Teachers should find a means of enhancing the verbal ability of the students by engaging all public primary school students in the verbal reasoning exercise taught in schools. Another way is to use activities like poems, where every child is involved in reading, writing, verbal communication with the whole class and teachers.

The National Mathematical Centre (NMC) and the government should embark on in-service training for mathematics teachers to equip them with new skills, such as games and poems needed for effective teaching. This will, therefore, make students have greater interest in learning mathematics.

Nigeria Educational Research and Development Council (NERDC) should emphasize that teachers embrace innovative strategies, like the use of games and poems while implementing the mathematics curriculum. Games and poems should be included in the curriculum as activities to enhance mathematics instruction.

Authors of mathematics text books should write books on mathematical poems as they have done on mathematical games for easy access and use. This will, to a large extent, enhance interest in mathematics learning.

Conclusion

Poem-enhanced instructional strategy is most effective in improving students' interest in mathematics, followed by the game-enhanced instructional strategy; therefore, GElS and PEIS

are better activities to improve students' interest in mathematics than the modified lecture instructional strategy. Students' verbal ability has a significant effect on students' interest in mathematics. Thus, students' verbal ability has a significant role to play in learning mathematics.

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Table 1

One way analysis of covariance (ANCOVA) of post-test scores of students' interest in mathematics with treatment using pre-test scores as covariates

Source of variation	Type III Sum of squares	Df	Mean square	F-cal.	Sig.	Partial Eta squared
Corrected Model	3571.350	3	1190.450	613.306	0.000	0.844
Intercept	1198.999	1	1198.999	617.711	0.000	0.645
Pretest scores	2252.333	1	2252.333	1160.376	0.000	0.773
Treatment	1307.619	2	653.809	336.835	0.000*	0.665
Error	659.953	340	1.941			
Total	68228.000	344				
Corrected Total	4231.302	343				

R. Squared .844 (Adjusted R Squared = .843) * = Significant at $p < 0.05$ alpha level

Table 2
Estimated marginal mean analysis of the post-test scores of students' interest in mathematics by treatment

Grand Mean = 13.450	Mean	Std Error	95% Confidence Interval	
Treatment			Lower Bound	Upper Bound
GEIS	14.661	0.129	14.406	14.915
PEIS	15.084	0.123	14.841	15.326
MLIS	10.607	0.139	10.333	10.881

Table 3
Scheffe's Post Hoc Pairwise Comparison Analysis of Treatment and Students' Interest in Mathematics

Treatment	N	Mean	GEIS	PEIS	MLIS
GEIS	116	14.661		*	*
PEIS	128	15.084	*		*
MLIS	100	10.607	*	*	

*Pairs of group significantly different at p< 0.05.

Table 4
One Way Analysis of Covariance (ANCOVA) of Posttest Scores of Students' Interest in Mathematics with Verbal Ability Using Pretest Scores as Covariates

Source of variation	Type III sum of squares	Df	Mean square	F-cal.	Sig.	Partial Eta square
Corrected Model	2395.160	3	798.387	147.838	0.000	0.566
Intercept	985.716	1	985.716	182.526	0.000	0.349
Pretest scores	734.584	1	734.584	136.023	0.000	0.286
Treatment	131.429	2	65.714	12.168	0.000*	0.067
Error	1836.143	340	5.400			
Total	68228.000	344				
Corrected Total	4231.302	343				

R. Squared .566 (Adjusted R. Squared = .562) * = Significant at p < 0.05 alpha level

Table 5
Estimated marginal mean analysis of the posttest scores of students' interest in mathematics by verbal ability

Grand Mean = 13.779	Mean	Std Error	95% Confidence Interval	
Verbal Ability			Lower Bound	Upper Bound
Low	12.457	0.271	11.924	12.989

Medium	14.090	0.169	13.757	14.423
High	14.789	0.469	13.867	15.710

Table 6
Scheffe's Post Hoc Pairwise Comparison Analysis of verbal ability and Students' Interest in Mathematics

Treatment	N	Mean	Low	Medium	High
Low	109	12.457		*	*
Medium	202	14.090	*		
High	33	14.469	*		

*Pairs of group significantly different at p< 0.05.

Table 7
3x3 Analysis of Covariance (ANCOVA) of Posttest Scores of Students' Interest in Mathematics with Treatment and Verbal Ability Using Pretest Scores as Covariates

Source of variation	Sum of squares	df	Mean square	F-cal.	Sig.	Partial Eta squared
Corrected Model	3673.724	9	408.525	246.038	0.000	0.869
Intercept	831.648	9	831.648	500.868	0.000	0.600
Pretest scores	811.353	9	811.353	488.645	0.000	0.594
Treatment	728.916	2	364.458	219.498	0.000	0.568
Verbal ability	76.053	2	38.027	22.902	0.000	0.212
Treatment*						
Verbal ability	18.920	4	4.730	2.849	0.024*	0.033
Error	554.578	334	1.660			
Total	68228.000	344				
Corrected Total	4231.302	343				

R. Squared .869 (Adjusted R. Squared = .865) * = Significant at p < 0.05 alpha level