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EFFECTIVENESS OF SMALL-GROUP INSTRUCTION METHOD ON PUPIL'S ACHIEVEMENT IN ELEMENTARY NUMBER LINE CONCEPTS IN AWKA SOUTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE

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Abstract

This study examines the effectiveness of the small-group instruction method on pupil's achievement in elementary number line concepts, employing a quasi-experimental design. The research investigates whether the implementation of small-group instruction enhances pupils' understanding and proficiency in number line concepts compared to teacher-centered instruction method. The study involved a sample of 140 elementary school pupils from selected schools within the Awka South Local Government Area. The instrument for data collection was Number Line Achievement Test (NLAT). The experimental group received instruction through small-group settings, while the control group received the standard whole-class teacher-centered instruction method. Pre-test and post-test measures were administered to both groups to assess their achievement in number line concepts. The collected data were analyzed in Statistical Package for the Social Sciences (SPSS) using the mean and standard deviation. T-test statistics was used to test the research hypotheses at 0.05 level of significance. The results showed that pupils taught elementary number line concepts using small-group instruction method achieved higher scores than those taught using teacher-centered instruction method. The findings of the study provide insights into the impact of small-group instruction on pupil's achievement in elementary number line concepts and offer practical implications for instructional practices in primary education studies. The results contribute to the existing body of knowledge on effective teaching methods for enhancing pupils' mathematical understanding and suggest recommendations for further research and implementation of small-group instruction in the teaching of number line concepts.

Keywords: effectiveness, small-group instruction method, pupil's achievement, number line concepts.

Introduction

The effective teaching of mathematics is crucial in promoting students' mathematical understanding and proficiency. One area of mathematics that poses challenges for elementary school students is the concept of number lines. Number lines are essential tools for developing a conceptual understanding of numerical relationships and operations. Teaching number lines in primary schools holds significant importance in the development of students' mathematical understanding and skills (Andrews, Xenofontos & Sayers, 2022). Number lines provide a visual representation that helps students develop a conceptual

understanding of numbers and their relationships. By observing and interacting with number lines, students can grasp important mathematical concepts such as magnitude, order, and relative position of numbers. Number lines serve as a tool for building number sense and counting skills. Students can use number lines to visualize and count numbers sequentially, understanding the concept of one-to-one correspondence and the relationship between numbers and their positions on the line. Number lines provide a concrete model for students to learn addition and subtraction (Friso-van-den-Bos, et al., 2015). By plotting numbers and using the number line as a reference, students can visually represent and perform these operations, developing a solid foundation for arithmetic skills. Number lines play a crucial role in introducing and understanding negative numbers.

However, many students struggle to grasp the fundamental concepts and principles associated with number lines. Primary school pupils often encounter several difficulties when learning number line concepts in mathematics. These challenges can hinder their understanding and proficiency in utilizing number lines as a tool for mathematical reasoning and problem-solving. Understanding the spatial representation of numbers on a number line can be challenging for young learners (Olasehinde & Olatoye, 2014). Pupils may struggle with accurately placing numbers in their appropriate positions on the number line, especially when dealing with fractions or decimals. Spatial reasoning skills, such as estimating and comparing distances, may need to be developed to navigate the number line effectively. Pupils may face difficulties in comprehending the directional aspects of number lines, including understanding which way the numbers increase or decrease. Differentiating between left and right on the number line and relating it to numerical values can pose challenges for some students. Grasping the concept of magnitude and scale on a number line can be challenging for pupils. Understanding that the distance between two points on the number line corresponds to the difference in their numerical values requires a solid conceptual foundation (Singh & Imam, 2013). Pupils may struggle to interpret the relative positions of numbers accurately and accurately identify the magnitude of numbers represented on the number line. To address this issue, various instructional methods have been proposed and implemented in mathematics classrooms. One such method is small-group instruction, which involves dividing students into smaller groups to facilitate personalized and targeted instruction.

Small-group instruction provides opportunities for increased student engagement, interaction, and individualized support, which can enhance students' learning outcomes. It usually follows whole-group instruction. Small-group instruction is an instructional approach in which students are divided into smaller, purposefully formed groups to engage in focused and targeted learning activities (Abdu, van-Helden, Alberto & Bakker, 2021). In small-group instruction, the teacher works closely with each group, providing personalized instruction,

guidance, and support to meet the individual needs of students. Overall, small-group instruction can provide a supportive and collaborative learning environment that promotes active engagement, personalized support, and targeted skill development. It can enhance students' learning experiences, facilitates individual growth, and fosters a deeper understanding of concepts and skills (Lloyd & Murphy, 2023). By leveraging the benefits of small-group instruction, teachers can optimize instructional effectiveness and support students' academic success.

This study focuses on examining the effectiveness of the small-group instruction method on pupil's achievement in elementary number line concepts in the Awka South Local Government Area of Anambra State. The Awka South Local Government Area represents a diverse educational landscape within Anambra State, providing a suitable context for investigating the impact of instructional methods on students' achievement in mathematics. The research aims to determine whether implementing small-group instruction in teaching number line concepts leads to improved pupil's achievement compared to traditional whole-class instruction. The significance of investigating the effectiveness of small-group instruction in the context of number line concepts lies in its potential to inform instructional practices and strategies that can enhance students' understanding and proficiency in mathematics (Bonesrønning et al., 2022). If small-group instruction proves to be effective, it may provide valuable insights for educators, curriculum developers, and policymakers in Anambra State, as well as in other similar educational settings, to implement evidence-based instructional approaches to improve mathematics education.

Furthermore, understanding the impact of small-group instruction specifically on number line concepts is important as it can lay a foundation for students' future mathematical learning and success. Number lines serve as a visual representation for comprehending various mathematical concepts, such as addition, subtraction, fractions, and decimals. Proficiency in number line concepts can contribute to students' overall mathematical reasoning and problem-solving abilities. The findings of this study will contribute to the existing body of research on effective instructional methods in mathematics education, particularly in the context of number line concepts. The insights gained from this study can inform the development of instructional guidelines and professional development programs for mathematics teachers, enabling them to implement small-group instruction effectively and enhance students' achievement in number line concepts.

Research Questions

Four research questions were formulated to guide this study thus:

- What are the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method?
- What are the gender difference on the achievement of pupils taught elementary

number line concepts using small-group instruction method**?**

- What are the gender difference on the achievement of pupil taught elementary number line concepts with teacher-centered instruction method?

Research Hypotheses

The following research hypothesis was formulated to guide the study at the significance level of 0.05:

Ho1: There is no significant difference on the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method

Ho2: There is no significant difference on the mean achievement scores of male and female pupils taught elementary number line concepts using small-group instruction method

Ho3: There is no significant difference on the mean achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method

Method

The research design adopted for this study was a quasi-experimental research design. This is a non-randomized, research-control group design in which pre-test and post-test were administered to the pupils involved. The quasi-experimental research design was considered appropriate because there was a deliberate control of variable by the researchers which were used to pass judgment about the entire population. The study was conducted in Awka South Local Government Area. The people are mainly civil servants and business men and women. The sample for the study was one hundred and forty pupils from randomly selected government-owned primary school in Awka South Local Government Area. Seventy (70) pupils regrouped into additional 14 groups containing 5 students each were in experimental group and they were taught with small-group instruction method, while seventy (70) pupils were the control group and were taught with conventional teacher-centered instruction method of teaching. The instrument used for data collection in the study was Number Line Achievement Test (NLAT). The achievement test was developed by the researcher to obtain quantitative assessment of pupils' achievement in elementary number line concepts. The instrument, teacher-centered instruction method was validated by three experts. The validators commented on language level and clarity of the expressions used in the test, the appropriateness of the materials to the level of the pupils, content coverage, the arrangement of questions, time allowed and adequacy of the questions given to the pupils. Their comments and suggestions were used to restructure and modify the final Elementary number line concepts achievement test.

The research trained and engaged 14 research assistants. The experimental procedure involved two groups of subjects. These were the group of pupils taught elementary number line concepts using small-group instruction method (small-group instruction group) and the group taught elementary number line concepts using

conventional teacher-centered instruction method. The group taught elementary number line concepts using small-group instruction method was the experimental group while the group taught elementary number line concepts using teacher-centered instruction method was the control group. Before the commencement of the main treatment, pre-test was administered to all groups to ascertain the equivalence of the groups. Pupils in experimental group received instruction on the topics in elementary number line concepts, using small-group instruction method. Pupils in the control group received instruction on the same topic using the conventional teacher-centered instruction method. Also, at the expiration of the teaching, the same post-test was administered to pupils in the group and the post-test scores were collected. The collected data were analyzed in Statistical Package for the Social Sciences (SPSS) using the mean and standard deviation. T-test statistics was used to test the research hypotheses at 0.05 level of significance. The hypotheses were accepted when the calculated t is less than the critical value of t while the alternative is accepted when the calculated t is greater than the critical value of t.

Results

Research Question One: What are the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method?

Table 1: Mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method.

Treatment Group		Pre-test	Post-test
Control group (Teacher-centered instruction method)	Mean	25.69	45.57
	N	70	70
	Std. Deviation	13.450	16.136
	Variance	180.914	260.364
	Skewness	1.006	-.086
Experimental group (Small-group instruction method)	Mean	26.21	58.77
	N	70	70
	Std. Deviation	13.090	19.912
	Variance	171.359	396.469
	Skewness	1.716	-.041
Total	Mean	25.95	52.17
	N	140	140
	Std. Deviation	13.226	19.233
	Variance	174.940	369.927

	Skewness	1.330	.144

Table 1 indicated that pupils in experimental group and control group have mean values of 26.21 and 25.69 respectively before treatment in the elementary number line concepts achievement test. From the result in elementary number line concepts achievement test on the post test, the experimental group achieved higher than the control group. The experimental group had a mean score of 58.77 while the control group had a mean score of 45.57 with standard deviation of 19.912 and 16.136 respectively. From table 1, the pupils taught elementary number line concepts using small-group instruction method achieved higher scores than those taught using teacher-centered instruction method

Research Question 2: What are the gender differences on the achievement of pupils taught elementary number line concepts using small-group instruction method?

Table 2: Gender differences on the achievement of pupils taught elementary number line concepts using small-group instruction method.

Treatment Group	Gender		Pre-test	Post-test
Small-group instruction method	Male	Mean	27.69	63.25
		N	32	32
		Std. Deviation	16.532	21.427
		Variance	273.319	459.097
		Skewness	1.699	-.144
	Female	Mean	24.97	55.00
		N	38	38
		Std. Deviation	9.333	17.965
		Variance	87.107	322.757
		Skewness	.331	-.184
	Total	Mean	26.21	58.77
		N	70	70
		Std. Deviation	13.090	19.912
		Variance	171.359	396.469
		Skewness	1.716	-.041

Table 2 shows that male pupils had a mean score of 27.69 with the standard deviation of 16.532 during pre-test, however their achievement improved significantly after treatment in post-test with a mean score of 63.25 and standard deviation of 21.427. On the other hand, female pupils taught elementary number line concepts using small-group instruction had a

mean score of 24.97 with the standard deviation of 9.333 during pre-test, however their achievement improved significantly after treatment in post-test with a mean score of 55.00 and standard deviation of 17.965. From the analysis, the mean score of the male and female pupils taught elementary number line concepts in post-test is higher than pre-test stage of treatment.

Research Question 3: What are the gender difference on the achievement of pupil taught elementary number line concepts with teacher-centered instruction method?

Table 3: Gender difference on the achievement of pupil taught elementary number line concepts with teacher-centered instruction method.

Treatment Group	Gender		Pre-test	Post-test
Teacher-centered instruction method	Male	Mean	26.94	45.94
		N	32	32
		Std. Deviation	15.022	14.999
		Variance	225.673	224.964
		Skewness	.835	.171
	Female	Mean	24.63	45.26
		N	38	38
		Std. Deviation	12.075	17.229
		Variance	145.807	296.848
		Skewness	1.175	-.214
	Total	Mean	25.69	45.57
		N	70	70
		Std. Deviation	13.450	16.136
		Variance	180.914	260.364
		Skewness	1.006	-.086

Table 3 shows that male pupils had a mean achievement score of 45.94 with the standard deviation of 14.999. On the other hand, female pupils taught elementary number line concepts using teacher-centered instruction method had a mean achievement score of 45.26 with the standard deviation of 17.229 after treatment. From the analysis, the mean achievement score of the male and female pupils indicate that male pupil has higher achievement ability compared with their female counterpart.

Research Hypothesis 1: There is no significant difference in the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method

Table 4: t-test comparison of mean achievement scores of pupils taught Elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method.

Groups	N	mean ($\bar{x}$)	SD	*df*	t-Cal	t-Crit	p-value
Control group (Teacher-centered instruction method)	70	45.57	16.136				
				138	4.309	1.977	.000015
Experimental group (Small-group instruction method)	70	58.77	19.912				

The result is significant at p < .05.

Table 4 compares the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method. The analysis revealed a mean ($\bar{x}$) of 58.77 and Standard Deviation (SD) of 19.912 with (N) 70 for Small-group instruction method group, while a mean ($\bar{x}$) of 45.57 and Standard Deviation (SD) of 16.136 with (N) 70 for Teacher-centered instruction method group. It can be inferred from the table that at 0.05 level of significance and 138 degree of freedom, the calculated t = 4.309 is greater than the critical t =1.977, therefore the null hypothesis is rejected, the researchers conclude that there is significant difference on the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method.

Research Hypothesis 2: There is no significant difference in the mean achievement scores of male and female pupils taught elementary number line concepts using small-group instruction method

Table 5: t-test comparison of mean achievement scores of male and female pupils taught elementary number line concepts using small-group instruction method

Gender	N	mean ($\bar{x}$)	SD	*df*	t-Cal	t-Crit	p-value
Male	32	63.25	21.43				
				138	2.468	1.977	.000015
Female	38	55.00	17.97				

The result is significant at p < .05.

Table 5 shows gender differences in the in achievement scores of male and female pupils taught elementary number line concepts using small-group instruction method. The analysis revealed a mean ($\bar{x}$) of 63.25 and Standard Deviation (SD) of 21.43 with (N) of 32 for male pupils, while a mean ($\bar{x}$) of 55.00 and Standard Deviation (SD) of 17.97 with (N) of 38 was recorded for female pupils. It is observed that at 0.05 level of significance and 138 degree of freedom, the calculated t = 2.468 is greater than the critical t =1.99, therefore the null hypothesis is rejected, the researchers conclude that there is a significant difference in the mean achievement scores of male and female pupils taught elementary number line concepts using small-group instruction method.

Research Hypothesis 3: There is no significant difference in the mean achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method

Table 6: t-test comparison of mean achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method

Gender	N	mean ($\bar{x}$)	SD	*df*	t-Cal	t-Crit	p-value
Male	32	45.94	14.99	138	0.249	1.977	.000015
Female	38	45.26	17.23				

The result is significant at p < .05.

Table 6 shows gender differences in the in achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method. The analysis revealed a mean ($\bar{x}$) of 45.94 and standard Deviation (SD) of 14.99 with (N) of 32 for male pupils, while a mean ($\bar{x}$) of 45.26 and standard deviation (SD) of 17.23 with (N) of 38 was recorded for female pupils. It is observed that at 0.05 level of significance and 138 degree of freedom, the calculated t = 0.249 is less than the critical t =1.99, therefore the null hypothesis is accepted, the researchers conclude that there is a no significant difference on the mean achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method.

Discussion of results

The results of the study were discussed in line with the research questions and research hypotheses. Table one show the mean achievement scores of pupils taught elementary number line concepts using small-group instruction method and those taught using teacher-centered instruction method. In the research question 1, the groups were control group (teacher-centered instruction method) and experimental group (small-group instruction method). From the result in elementary number line concepts achievement test

on the post test, the experimental group achieved higher than the control group in the post elementary number line concepts test. The use of small-group instruction allows teachers to evaluate students' learning strengths and tailor lessons to them. Also, The one-on-one attention they receive from small-group instruction activities can boost the confidence of students who may otherwise have a hard time joining the conversation. This result confirmed earlier findings of Lloyd and Murphy (2023), that small-group instruction is ideal for providing frequent and personalized feedback. There is more time for students to ask questions, and it promotes feedback that goes far beyond a simple letter grade. Abdu, van-Helden, Alberto and Bakker (2021) stated that small-group instruction method creates an environment in which pupils actively participate in the learning process, take responsibility for their own learning and become better learners in terms of the ability to identify learning issues and ability to assess resources. The findings also agree with Ardasheva, Newcomer, Ernst-Slavit, Morrison, Morrison, Carbonneau, and Lightner (2019) that small-group instruction activities encourage teamwork, inclusivity and collaboration. Students no longer blend into the background of a large classroom—small-group instruction means everyone participates and is working toward the same goal.

Research question two show the gender differences on the achievement of pupils taught elementary number line concepts using small-group instruction method. Data analysis in table 2 revealed that male pupils taught elementary number line concepts with small-group instruction method achieved better than their male counterparts, as indicated by their pre-test and post-test mean scores 27.69 and 63.25 respectively. On the other hand, female pupils taught elementary number line concepts using in experimental group had a mean score of 55.00 with the standard deviation of 17.965 during post-test. This finding supports the finding by Armah and Armah (2020), which indicated that there were statistically significant differences in the achievement of Mathematics between male and female learners with the males attaining higher grades than their female counterparts. Altun and Erden (2013) also showed that there was a difference between the two genders in mathematics achievement explained in terms of self regulation based learning strategies.

Research question three show the gender difference on the achievement of pupil taught elementary number line concepts with teacher-centered instruction method. In the research question three the finding shows that there was a no significant difference on the mean achievement scores of male and female pupils taught elementary number line concepts using teacher-centered instruction method. The results of this finding is contrary to Singh and Imam (2013) who reported that there was a significant difference between mathematics achievement of boys and girls. However, the findings is consistent with that of Olasehinde and Olatoye (2014), who noted that there were no significant difference between male and female students in overall science achievement.

Conclusions

The study revealed that there is a significant difference in academic achievement of pupils taught Elementary number line concepts through the use of small-group instruction method and those taught with teacher-centered instruction method. Small-group instruction method has significant and positive effect on pupils' achievement in elementary number line concepts. The study indicated that small group instruction allows the teacher to differentiate and cater to the education to the pupil needs. Consequently, small-group instruction method caused the pupils to use conceptual understanding in solving elementary number line concepts problems. Hence, in using small-group instruction method, pupils' achievement in elementary number line concepts was enhanced. Finally, the effects of gender on pupils' achievement when taught with teacher-centered instruction method were not significant. However, there was a significant difference ($P< 0.05$) in the academic achievement scores of pupils taught elementary number line concepts with the small-group instruction and teacher-centered instruction methods.

The findings of the present study have obvious education implications, the work indicated that a elementary school teachers can get the optimum performance of pupils by the use of small-group instruction methods. In small group instruction, the teacher supports and guides students on their instructional level throughout the lesson. It is recommended that elementary school teachers should adopt the use of small-group instruction methods to improve the academic achievements of the pupils. Primary school teachers should be discouraged from the continuous use of teacher-centered instruction method in the teaching of elementary number line concepts as the method make pupils performed poorly. Teacher training institutions should include the activity-centered teaching approach in their science course contents.

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