Research Paper

Synergizing For Inclusive Mathematics Classroom: The Socio-Metric Paradigm

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Abstract
This study investigated the aftermath of sociometric ranking in Mathematics classroom for the purpose of fostering inclusive education for sustainable development. There has been an observable division in the Mathematics classroom where some students don't participate in classroom interactions. The interest of the researcher was on how every member of the class could be carried along in the teaching and learning of mathematics so that everyone could be instrument of development for the society in the nearest future. The researcher moved round as the facilitator, encouraging and ensuring even participation of the three identified groups. Quasi-experimental of pre-test, post-test control groups design was adopted. The research sample was 152 pupils selected from five primary schools in Ido/Osi local Government Area in Ekiti State. Multistage sampling technique was used for the selection of the sample for the study. Mathematics performance Test (MPT) and Students Attitude towards Mathematics Questionnaire (SAtMQ) were the instruments used to collect data. Before and after training, data were collected and analysed using t-test analysis. This research is unique in that every learner was involved and interpersonal relationship established. It was observed that pupils performed better in the inclusive education classes compared with the pupils in the control groups that were taught conventionally. The study has being an eye-opener to mathematics teachers to note the effect of having every learner being integrated to the learning process in a class. Hence, it was recommended that mathematics teachers should adopt the inclusive teaching technique in the teaching and learning of mathematics.
Key Words: Synergy, Inclusive Education, Paradigm, Sociometric, Ranking.

I. Introduction

When the school setting becomes a reflection of the biased society, individuals are ostracised as a result of cultural and religious background, tribal discrimination, age gap, colour or racial problem, socio-economic status of the parents, slow learning habit and poverty. If the rejected people are left in rejected position and only the 'the popular' ones are progressing, it brings setback to a nation's progress and peaceful co-existence. Presently, observable interactions and dispositions are mapped along the divides of language, religion, gender and socio-economic class. These class distinctions of parents and the larger society are not lost on the students who mingle and comingle with only those who fit their home observations. Classroom practices must be collaborative and interactive. Teaching and learning strategies in this millennium are not done in isolation of other students. Many a times, classroom teachers' act only as facilitators in a student centered strategy. This is why it becomes imperative to beam searchlight on teaching and learning strategies that could enhance inclusive education. Inclusive Education is a situation where all students in a given classroom have been educated to work together. Individual students can work with any member of the class without prejudice, intimidation and reservation. Inclusive Education can boost group work, encourage slow learners and sustain even participation among the students. This type of education does not give room for the domination of classroom activities by the extroverts nor allows undue favouratism. Mathematics dreadfulness can be minimized as a result of working in

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groups. Sociometry, according to Merriam-Webster Dictionary is the study and measurement of interpersonal relationships in a group. There is the need for inclusive mathematics class if the expected result will be achieved and all-round development will be experienced. In the sustenance of national development, every inhabitant is expected to play a role, no one should be neglected.

The importance of mathematics gave birth to its position in the curricula of primary and post primary levels of education as a core subject. It is a subject that spans through the curricula from Kindergarten (KG) to Senior Secondary Schools (SSS). Mathematics has its tentacles spread to all other fields of human endeavour - Engineering, Medicals, Astronomy, Information and Communication Technology, Agriculture, Arts and Languages to mention a few. Mathematics helps in building mental discipline, logical and critical thinking. It is a tool in other subjects. It helps us in understanding of culture. The usefulness of mathematics cannot be quantified, ranging from the rich to the poor; educated to illiterate; young to old; male to female. It is being made use of either consciously or otherwise (Akinwamide, 2021). Time makes a day and days make lifetime. The use of mathematics starts from the use of clock which consequently can mar or make someone's life. New developments that have got to the level of some countries building flying cars, magnetic flying cars, space activities etc have basis on mathematics. Hodanova & Nocar (2016) describe mathematics as subject of importance that supports all-round personal development. Such a subject of importance like this should be given rap attention that will support better performance in the subject. Mathematics is a major tool in the development of any nation considering its importance. In sustaining educational development, every hand of students should be on deck. Observations have shown that the performance of students in mathematics is not satisfying and this has resulted in learners having negative attitude towards mathematics. (Popoola 2013; Kolawole 2013). This has being the concern of stakeholders. Researchers discovered that among other reasons, strategies adopted by some mathematics teachers have not given consideration to every pupil in the class. (John; Asis; Gumia; Gohiling & Sagpang, 2019) Some students are neglected which can lead to miserable life. This discovered gap is what this study aimed at bridging, hence, the use of sociometric paradigm in a mathematics inclusive class was considered.

II.   Reviewed Literature

Synergizing is the coordination of two or more students to produce a joint effect greater that their previous performance. Synergy is the art of collaboration within the learners which also involve the teacher as an instructor. It fosters the appreciation of the differences in mental, emotional and psychological differences between people. Synergy brings improvement to the performance of students. Inclusion is a model wherein students with special needs spend most or all of their time with non-special needs students (Wikipedia, 2020). Inclusive is the ability of the teacher to bring class socio-metric scale. The teacher is able to search out the 'disadvantaged' ones and 'the popular' ones. Under the disadvantaged ones are the; tribe that is not common, albino, extra-ordinary quiet ones, etc. Inclusive class is away or practice of engaging the full participation or exceptional individuals or marginalized groups in educational, social, or civic activities. Inclusion aimed at embracing all people irrespective race, gender diability, medical or other needs. It is giving equal access and opportunities and getting rid of discrimination and intolerance. Inclusion promotes equity. Principles of inclusion are equity, access, opportunity and the rights. Cillessen (2009) defines Sociometric inclusion as a qualitative method of measuring social relationship. Every member of the group can evaluate every other member of the group. It could be inferred from the definition that Sociometric inclusion addresses attraction and repulsion between students, it measures the social relationship that exists among the members. It measure degree of relatedness among people. In educational environments, this generally refers to the integration of students with disabilities or other special needs into regular curricular or non-curricular activities. It involves social integration, that is, Process of uniting the diverse groups of a society into a cohesive and harmonious whole.
 Cillessen (2009) highlighted the steps that should be taken in the use of sociometric inclusive teaching method thus;
- Researcher begins with a question such as "with whom will you like to work on a group in the project group?.
- A matrix is formed
- Researcher gives code at will such as "1" for a choice and "0" for no choice.
    These steps were adapted in this study as they were considered appropriate for the study.
Socio metric as defined by Jacob Levy Moreno (wikipedia) is the mathematical study of psychological properties of populations, the experimental technique of and the results obtained by application of quantitative methods. Jacob Levy concluded that the reasons for sociometric are as; Focusing on achieving targets, focusing on key contributors who create value- the informal leaders, knowing what is really going on enhancing the informal relationship network, focusing on culture- providing connection, contribution and credibility. These are in agreement with the reason for the use of sociometric inclusion in this study with the focus on the popular, the average and the rejected.

Hypotheses
1. There is no significant difference between the pre-test scores of students in the Sociometric inclusive mathematics class and those in control group.
2. There is no significant difference between the post-test scores of students in the Sociometric inclusive mathematics class and those in control group

III. Research Method

This study adopted quasi-experimental of pre-test, post-test, control group design. The design employed examined the effects of the independent variable on the dependent variables. The homogeneity of the students' performance and were established before treatment by the pre-tests conducted. Post-tests after the treatment were used to measure improvement on performance and change in attitude in the two groups. The experimental group was exposed to Sociometric inclusive mathematics class while the control group was exposed to conventional strategy of teaching.

The design is represented diagrammatically thus:

(Experimental Group) O_1 X O_2

(Control Group) O_3 C O_4

O_1 and O_2 represent the pre-test and post-test of the experimental group,

O_3 and O_4 represent the pre-test and post-test of the conventional group,

X- Sociometric inclusive synergy

C- Conventional strategy.

The population for this study consisted of all the primary six pupils in Ido/Osi public primary school in Ekiti State while the sample for the study consisted of 152 pupils. Multistage sampling procedure was adopted in selecting the samples. Simple random sampling technique was adopted in selecting five schools, Three for experimental and two for control. Primary six class was purposively selected and intact arms of the class were used. Two research instruments developed by the researcher were used to collect data, namely (i) Mathematics performance Test (MPT) and (ii) Students' Attitude Towards Mathematics Questionnaire (SATMQ). Pre-tests were administered on the two groups. Each pupil in the sociometric inclusive class was given paper on which he/she was asked to write the names of five people He/she would like to work with. This gave the instructor the opportunity to discover the; The popular, the Average and the Rejected. "The popular" were the pupils with higher frequency- many pupils wants to work with them. "The Average" were the pupils that have average frequency while "The neglected" were the pupils with below average frequency. Instructor then grouped the pupils based on the discovery from the Square Matrix that was arrived at through the information on the written papers by the pupils. The groups were heterogeneous; the rejected were paired with the Average and the popular. Group work was done and marks awarded. Tables 1, 2 and 3 show the Square Matrices for the three classes used for experiment. A sociometric matrix is a rectangular arrangement of numbers indicating the choice made by the members of the group.

TABLE 1: SQUARE MATRIX FOR SCHOOL A

					NOMINEE'S				IDENTIFICATION						NUMBER																
	c	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	c		x		x							x						x			x										
2	x	c		x							x		x														x				
3			c				x											x			x	x			x						
4					C				x								x		x		x						x				
5			x		x	c													x		x						x				
6						x	c												x				x						x	x	
7		x			x			c											x			x					x				
8									c		x											x					x			x	x
9			x							c		c				x					x						x		x		
10								x		c								x			x				x						x
11									x		c						x	x			x				x						
12		x	x					x					c														x			x	
13				x				x						c											x				x		x
14		x			x							x			c						x						x				
15					x										x	c					x				x						x
16			x		x												c	x												x	x
17					x							x					x	c			x						x				
18					x					x								x	c						x		x				
19			x		x			x										x		c	x						x				
20				x	x							x									c				x		x				
21			x		x			x										x			x	c					x				
22			x		x							x											c						x	x	
23		x													x			x						c			x	x			
24								x							x						x				c		x				x
25					x			x									x				x					c			x		
26			x	x				x														x					c				x
27					x						x	x						x										c			x
28			x			x	x				x								x								x		c		
29					x													x	x								x		x	c	
30			x		x			x							x			x													c
TOTAL		5	10	4	16	1	2	5	4	2	8	3	2	2	2	1	4	9	6	0	14	5	1	0	7	0	17	2	6	4	8

SOURCE: Self developed
Key:
C=space of two numbers representing the same child
X=a point of nomination

TABLE 2: SQUARE MATRIX FOR SCHOOL B

	c	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
N	1	C	x						x			x						x			x									
O	2	X	c	x							x			x															x	
M	3	X		c														x			x	x		x						
I	4				C				x								x		x			x					x			
N	5		x		x	c									x							x					x			
A	6					x	c												x				x					x	x	
T	7	X						c	x										x		x								x	
O	8								c						x							x					x			x
R	9			x						c					x				x								x		x	
'S	10								x		c							x			x	x			x					
	11									x		c					x	x			x				x					
I	12	X	x					x					c																x	x
D	13			x				x						c							x			x					x	
E	14	X										x			c						x						x			
N	15				x									x		c		x						x	x					
T	16		x					x									c	x						x						x
I	17				x						x						x	c			x						x			
F	18				x							x					x		c					x	x					
I	19	X						x						x				x		c							x			
C	20	X			x									x							c			x						x
A	21		x					x										x			x	c							x	
T	22		x		x						x												c						x	x
I	23	X												x				x				x		c					x	x
O	24								x					x					x						c		x	x		
N	25				x						x							x			x				x	c			x	
	26	X	x								x							x			x						c			
N	27			x	x						x	x									x							c		
U	28	X	x						x															x					c	
M	29				x													x	x							x		x	x	c
B	TOTAL	10	8	4	10	1	0	3	7	2	7	3	3	6	0	1	3	14	4	0	13	5	1	7	4	0	9	2	11	6

SOURCE: Self developed
Key:
C= Space of two numbers representing the same child
X=A point of nomination

TABLE 3: SQUARE MATRIX FOR SCHOOL C

	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
N	1	c	x						x			x						x		x							
O	2	x	c	x							x		x	x													
M	3	x		c														x			x	x		x			
I	4				c				x							x		x			x						x
N	5		x		x	c									x	x					x						x
A	6			x		x	c								x			x			x		x				
T	7	x						c	x						x			x		x							
O	8		x	x					c					x								x					x
R	9			x						c				x			x				x	x					x
'S	10								x		c						x				x	x			x		
	11									x		c				x	x				x				x		
I	12	x	x					x					c				x		x								
D	13			x					x					c				x			x			x			
N	14	x			x									x	c						x						x
U	15			x										x		c		x						x	x		
M	16		x						x					x		x	c	x						x			
B	17			x								x				x	x	c			x						x
E	18			x								x					x	x	c					x	x		
R	19	x						x					x				x			c				x			x
	20	x		x										x	x		x				c			x			
	21		x						x					x	x						x	c	x				
	22		x		x		x		x	x				x				x			x		c				
	23	x												x				x			x			c	x	x	
	24				x			x						x	x			x			x				c		
	25		x		x						x						x		x		x					c	
	26	x	x											x				x			x						c
	TOTAL	9	8	5	9	1	1	2	8	2	5	2	3	8		8		10	6	1	11	6	2	6	5	1	7

SOURCE: Self developed.
Key:
C= Space of two numbers representing the same child.
X=A point of nomination.

IV. Results

Hypothesis 1: There is no significant difference between the pre-test scores of students in the Sociometric inclusive mathematics class and those in control group.

In order to test this hypothesis, performance mean scores of students in Sociometric inclusive class and control group were compared for statistical significance using t-test statistical tool at 0.05 level. The result is presented in Table 4

Table 4: Pre-test of the Sociometric inclusive class and Control Groups on students' performance in Mathematics

Variable	*N*	*Mean*	*SD*	*Df*	t_{-c}	t_t
Sociometric inclusive class	85	34.50	9.98	150	1.36	1.96
Control	67	35.63	8.98			

SD = Standard Deviation; Df = Degree of freedom

Table 4 shows that the t_c value of 1.36 is less than the t_t value of 1.96 at 0.05 level of significance, this implies that the null hypothesis is not rejected. Since there was no significant difference between the pre-test scores of both groups, it shows that students in the two groups were homogeneous at the commencement of the study.

Hypothesis 2: There is no significant difference between the post-test scores of students in the Sociometric inclusive mathematics class and those in control group.

In order to test this hypothesis, performance mean scores of students in Sociometric inclusive class and control group were compared for statistical significance using t-test statistical tool at 0.05 level. The result is presented in Table 5.

Table 5: Post-test of the Sociometric inclusive class and Control Groups on students' performance in Mathematics

Variable	*N*	*Mean*	*SD*	*Df*	t_{-c}	t_t
Sociometric inclusive class	85	54.31	8.7	150	11.40	1.96
Control	67	38.22	8.6			

SD = Standard Deviation; Df = Degree of freedom

Table 5 shows that the t_c value of 11.40 is greater than the t_t value of 1.96 at 0.05 level of significance, this implies that the null hypothesis is rejected. There is significance difference between the post-test scores of pupils in the sociometric inclusive mathematics class and those in the control group. The difference in mean scores of the two groups (54.31-38.22 = 16.09) shows the effectiveness of the experimental group over the control group.

Hypothesis 3: There will be no significant difference in the attitude of students in the Sociometric inclusive mathematics class and those in control group.

Attitudinal mean scores of students in the Sociometric inclusive class and control group were compared for statistical significance using Analysis of Covariance (ANCOVA) at 0.05 level. The result is presented in Table 6

V. Findings and Discussion

The findings showed that the three groups highlighted actually existed in all the arms of the selected class; the popular, the average and the rejected. This is clearly displayed in the three matrices tables 1, 2 and 3. From the tables, there were pupils with total frequencies up to 14,16 &17; average frequencies of 10,9 & 8 and the low frequencies to zero level. The low frequencies showed pupils in the rejected group. Zero frequency showed that nobody wanted to work with such a child. The number of pupils in the rejected group was far above the pupils in the popular and the average groups. This is in consonance with the summation of Mag; Sinfield & Burns (2017); Mara (2014) that aclasses are heterogeneous in nature. Table 4 showed the results of the instrument administered on the pupils before treatment. The table showed that the t_t. was less than the t_t. It showed that the groups were homogeneous at the beginning of the study, hence the null hypothesis was not rejected. This presented the arms of the class used as qualified for the study. Table 5 showed the results of the

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post-test conducted after treatment. The table showed that the t_c was greater than the t_t. This established the positive effect of treatment on the experimental group. Hence, the null hypothesis was rejected since there was significant difference in the post-test of the experimental and the control groups. This was in agreement with Sinfield & Burns (2017) who opined that a child needs to be listened to, valued and re-evaluated as these will foster improvement in the performance of such child. Table 6 showed that treatment has effect on the attitude of the experimental class as t_c is greater than t_t Better performance could have brought a change to the attitude of the pupils towards mathematics positively, this would be in agreement with Bacete, 2017; Trevethan 2017; Akinwamide (2019) which submitted that when a child is socially accepted in the peer group, it is vital to his social and academic developments.

VI. Conclusion

In the pursuit of functional education that sustains national and individual development, mathematics teachers should go extra mile in taking care and having concern for every child under his tutorship. Sociometric inclusion enables the teacher to identify the various groups in the class. The nature of mathematics demands for collaborative work, when a child is neglected by the classmates, he is lonely, disturbed and confused. This can lead to life frustration, if this continues, its effect at adulthood can be devastating. It becomes a function of low probability for such individual to contribute to the development of the community. From the square matrices, it was observed that every member of the class wants to work with the pupils in the "popular group", while the students in the rejected group are avoided like plague. The attributes in the popular group that attract others can be multiplied through the sociometric inclusion. This becomes a baseline for sustenance of interpersonal relationship that is a tool in any effective mathematics class. This study has been able to bring into lime light the fact that there are pupils that suffer silently from peer rejection and the teachers should take cognisance of this group and help. Also it is an avenue for the average to gain more insight for knowledge enhancement. In all sociometric ranking can be viewed as a leverage and inclusion parameter that paves way for collective participation and enables others to contribute their views in a free market of ideas.

VII. Recommendations

The following recommendations are made based on the outcome of this study.
1. Mathematics teachers should embark on the use of sociometric inclusion so as to take care of the rejected ones in their classes.
2. Every other means of eliciting even participation as demonstrated by Sociometric strategy should be sought and utilized by Mathematics teachers
3. Introvert among students could be prevented from showcasing their inherent skills and academic prowess if the appropriate teaching strategy is not employed by the teacher; therefore, teachers should make use of Sociometric and other helpful strategies
4. Sociometric strategy opens avenues for peer interactions and it should be embraced by Mathematic teachers so that students will have opportunity and freedom to question colleagues without the fear of intimidation.

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