



Application of Whole School Model in Addressing Persistent Decline in Numeracy Knowledge among Primary School Pupils in Plateau State, Nigeria

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ABSTRACT

The study addressed the challenges of poor performance in numeracy knowledge at primary educational level by exploring the innovative strategy of whole school instructional model to improve teacher teaching-learning strategies and pupils' attitude/interest towards numeracy at primary level of education. Three objectives and research questions were raised with two hypotheses. The pre-test, post-test quasi-experimental design was adopted with a focus on public primary schools' pupils and teachers teaching numeracy within Plateau state central educational zone. The target population for the study comprised 523 primary five pupils in public schools enrolled in 2023/2024 academic session with sample size of 32 pupils in two intact classes from two Local Government Areas within the plateau central educational zone. The instruments for data collection were self-constructed questionnaire and achievement test titled "Teachers Numeracy Teaching Methods/strategies Observation Checklist (TNTMOC)", "Pupils Numeracy Achievement Test (PNAT)", and "Pupils Interest/attitudes towards Numeracy knowledge Checklist (PINKC)". The instruments were validated using face and content validity by experts and the reliability index of 0.76, 0.75 and 0.81 respectively determined by Cronbach Alpha and split-half Methods. Data was analyzed using mean, standard deviation and paired sampled t-test to examine the differences of the repeated measure on pupils in the study. The study found significant improvement in teachers' teaching strategies and Pupils interest/attitude in numeracy teaching and learning processes respectively with significant Pupils' numeracy performance after being exposed to whole school instructional model. The study therefore recommended the use of whole school instructional model in teaching and learning of numeracy at primary school level.

INTRODUCTION

The target of every educational system is to ensure that students achieve a satisfactory outcome in whatever they were taught based on the curriculum contents and should be able to solve subsequent problems in real life situation. Education is therefore, an act of acquiring knowledge through teaching and learning process of principles and practices that enhanced development. However, the contents of educational process are usually measured to know the extent to which the knowledge is acquired. Academic achievement is one of the major variables that measure an individual's success or failure in school system (Adikwu & Chibabi, 2018). Academic achievement, though measured in different forms, has the tendency of revealing the quality of education received by the respective learner. Quality education supposed to provide solution to societal problems and if any difference, it has not met the desire quality. The global monitoring report for quality education in Battista (2014) indicates that the quality of learning among children in Sub-Saharan Africa is quite low, so there is need to provide quality teaching and learning to make citizens of these nations compete favourably with their counterparts from other nations in the 21st century. This low quality of learning as observed has been credited to be teachers' methods of teaching, students' attitudes/interest, unavailability of learning materials among others (Karue & Amukowa, 2013; Tshabalala & Ncube, 2013).

Therefore, to address the persistent quality of learning among children in the Sub-Saharan especially in numeracy, the concepts of whole school instructional model will be one of the good initiatives. The whole

school instructional model is a teaching strategy that put into consideration the learner's perspective before, during and after teaching learning process. The models as an instructional strategy engages the learners with learning task and prepare the learners ahead the learning activities. Also, the model allows the teacher to explore all avenues to share learning intentions that reflect previous learning linked with prior ideas before the actual learning of the day is introduced. Furthermore, the whole school instructional model provides the teacher to teach explicitly the new concept, knowledge and skills in different forms. The teacher moves further, by moving the students from surface to deep learning in a reflective, questioning and self-monitoring tagged elaborating. Finally, the teacher provides the student activities to reflect on their learning progress through evaluation. When these are done, it is expected that quality learning would have taken place and the learners would have succeeded to acquire the required level of knowledge.

Nigeria precisely needs functional and quality education that can engineer her citizens towards achieving complex skill for further schooling, responsible citizenship, international competitiveness and lifelong learning which can only be achieved through innovative teaching and learning (Akanwa, et al. 2019). Innovative teaching and learning are needed, to tackle poor and decline in quality education by addressing the rate of poor performance in schools especially in numeracy level. It is essential, no subject or field of study that does not make use of some forms of numeracy ability (Abdullahi, 2017). Numeracy is the effective use of mathematics to meet the general demands of life at home, in paid work, and for

participation in community and civic life. Mathematics is a compulsory subject for all academic levels. Despite the importance of mathematics, many problems seem to beset mathematics education in Nigeria. This problem has resulted in the consistent poor and decline performance in numeracy by many people. However, this declining state in numeracy achievement is attributed to a number of factors such as attitude/interest of pupils (Adikwu & Chibabi, 2018); lack of instructional resources (Yara & Otieno, 2010); instructional techniques (Olulonye, 2010), among others. Pupils' academic achievement and interest level have not been encouraging over the years as revealed among primary schools' graduates. This justifies the need for innovative strategies to be adopted in the course of classroom instruction.

Researchers have established that students at post primary education levels performed poorly in numerical tasks and this was traced to poor background in numeracy knowledge from their primary level (Oyinloye & Popoola, 2013.). Similarly, at primary school level is also found that, pupils performed very poor and have low competencies in Numeracy, literacy and as well as Life skills (Ikoro & Eleri 2017). Many reasons can be traced to this poor and low performance such as the pupils' interests and attitudes towards numeracy and poor teaching strategies. Sometime, the pupils were not well exposed to numeracy properly through variety of methods and learning innovation that can stimulate their interest and attitude, this has further created gap which are now difficult to be addressed as the pupils advanced in life and educational career. Popoola (2014), Children ought to be helped early enough to develop positive attitude towards numeracy because they will need to build their future academic attainments especially in Mathematics, based on the knowledge acquired during the primary school years.

Problem Statement/Justification

Considering the decline rate in numeracy ability among pupils identified as a problem; there is scanty record and statistics on the rate of poor performance in numeracy knowledge especially at primary schools' level in the state. Similarly, little has been done on a substantive approach that can ameliorate the persistent decline in the performance of the pupils in numeracy at that level of education. Hence, this supports the reason for the research to combat the problem of persistent poor/decline in performance in numeracy by addressing problem associated with teaching strategies and pupils' interest in numeracy using whole school instructional model. Therefore, the study will ascertain the level of the primary school pupil's numeracy knowledge. Examine the pupils' interest and attitude visa vis the teaching strategies employed by the teachers in the teaching and learning of numeracy, and address the problem associated with the causes of decline in numeracy knowledge using Whole School Instructional Model. The model promotes learners as the ownership of their learning through goal setting and assessment to be

accomplished through process of **Engaging, Exploring, Explaining, Elaborating and Evaluating.**

Objective(s) of the Study

The main purpose of the study was to address the decline in numeracy performance among primary school pupils by improving pupils' interest/attitude towards numeracy and teacher teaching strategies using the whole schools' instructional model. The model involves the 5Es of **Engaging, Exploring, Explaining, Elaborating and Evaluating.** The Specific objectives are to:

1. Examine and improve teacher's teaching strategies/method which has been identified as part of the causes of decline in numeracy knowledge at primary schools' level.
2. Examine and improve pupils' interest/attitude towards teaching and learning of numeracy using the whole school instructional model.
3. Determine the impact of the whole school instructional model on pupil's numeracy performance after being exposed to the instructional models.

Research questions

1. What is the impact of whole school instructional model towards improving teachers teaching strategies/methods of numeracy among primary school pupils?
2. How does the application of whole school model enhance pupils' interest/attitude towards numeracy in primary schools?
3. What is the impact of whole school instructional model on pupil's performance in numeracy before and after exposure to the model?

Statement of hypothesis

1. There is no significant impact of whole school instructional model on teacher teaching strategies/method and pupil's interest/attitude towards numeracy in primary school.
2. There is no significant difference in pupils' performance in numeracy when exposed to whole school instructional model in Primary schools

LITERATURE REVIEW

Bybee, (2015) presented an outline for constructivist learning theories that can be effectively utilized in teaching numeracy and other sciences described as 5Es model also known as whole school instructional model. The Es are classified as follows: Engaging, Exploring, Explaining, Elaborating and Evaluating. These classifications were further explained as follows:

Engaging: The learners are engaged with learning tasks that prepare them to want to learn from the

previous learning experience (taught) to build confidence and understanding through mathematical games, interactive, objects etc.

Exploring: Here, the teachers share clear Learning Intentions and Success that may be written with students in some instances through activity that motivates, engage and stimulate curiosity for the lesson. Exploration gives a direction to a later introduced lesson and familiar students with the concepts, process and skills.

Explaining: The teachers explicitly teach new knowledge, concepts and skills in multiple ways to connect new and existing knowledge.

Elaborating: The teachers challenge students to move from surface to deep learning, building student ability to transfer and generalize their learning. The students will be supported in reflective, questioning and self-monitoring learners, encouraging higher order thinking.

Evaluating: Teacher provides structured time and activities for students to reflect on their learning, facilitating self-assessment. Finally, the teachers provide clue for future learning e.g., the next lesson.

There are studies who have empirically established the effect of the whole school instructional model or 5E model. Ahmad, Shaheen and Gohar (2018) in a study found that a significant increase in different aspects of cognitive domain of students' learning; knowledge, application, comprehension and skill development abilities when taught with 5E instructional model. Nkurikiyimana, Uwamahoro, and Ndiokubwayo (2022) revealed that 5E's educational model is more effective in stimulating students' motivation and strong interaction with a better understanding of concepts through interactive activities, discrepant events, and computer simulations. In the study of Alshehri (2016), the researcher concluded that the significant performance of experimental group was due to teaching them with (5E's) instructional model. In another study of Nyirahagenimana, Uwamahoro, and Ndiokubwayo, (2022) found that after the training on the whole school instructional model the result indicated good performance for all teachers in terms of integrating exciting activities, discrepant events, relevant visualization guide, boosting learners' confidence to express their ideas in the teaching process, and using constructive scenarios that helped the learners to relate what they learned to real-life situations.

METHODOLOGY

The pre-test, post-test quasi-experimental design was used for this study. The design was used to examine prevailing teachers teaching method/strategies within the classroom pupils' interest/attitude as well performance of the pupils in numeracy. The study focus was on the public primary schools' pupils and teachers teaching numeracy within Plateau state central educational zone. The target population for the study comprised 523 primary five pupils in public schools enrolled in 2023/2024 academic session. The sample size consists of 32 primary five pupils in two intact classes from two local governments with the plateau central educational zone. The local governments where the schools were located were selected using simple random sampling. However, the central primary schools located in the headquarters of the local government were used for the study. There was no sampling of pupils; rather, the intact classes were used as experimental groups in the study. The pupils were taught in their intact class settings in order not to destruct other academic activities of the pupils.

The instruments for data collection were self-constructed questionnaire and achievement test titled "Teachers Numeracy Teaching Methods/strategies Observation Checklist (TNTMOC)", "Pupils Numeracy Achievement Test (PNAT)", and "Pupils Interest/attitudes towards Numeracy knowledge Checklist (PINKC)". The instruments were validated using face and content validity by experts and the reliability of the instruments were determined using Cronbach Alpha and split-half Method. The reliability index of 0.76, 0.75 and 0.81 respectively were obtained. The instruments were administered by the researchers and research assistants which are teachers teaching in the respective classes used for the study. Data was analyzed using descriptive statistics such as mean, standard deviation and inferential statistics such as paired sampled t-test to examine the differences of the repeated measure in the study.

RESULTS

Research Question One

What is the impact of whole school instructional model towards improving teachers teaching strategies/methods of numeracy among primary school pupils?

Table 1: Mean of Pre and Post Assessment of Teachers Numeracy Teaching Methods

s/n	Effectiveness of Teacher's numeracy teaching strategy(s) (rated 1-4)	Pre-assessment Mean	Std. Dev	Post assessment mean	Std. Dev.
1	The teaching approaches inspire students to want to learn numeracy effectively	2.35	.918	2.95	.655
2	The lesson provides effective challenging tasks for the high achieving students	2.14	.918	2.95	.733
3	Teaching is adapted effectively to engage pupils' interest during learning processes	2.32	.911	3.34	.627
4	Pupils are helped to appreciate the value of learning numeracy	1.72	1.22	3.21	.704
5	Pupils' numeracy comprehensions were effectively assessed during lessons	1.76	.806	2.79	.741
6	The understanding of struggling pupils in the classroom was well addressed	1.84	.918	2.66	.745
7	The relevance of numeracy was made known to students during teaching	1.82	.970	2.76	.675
8	The teachers develop students' higher-order thinking skills optimally	1.72	1.13	2.82	.692
9	There is adequate usage of numeracy text effectively during lessons	1.80	.562	2.87	.623
10	Numeracy teaching-learning material are available/adequate for lesson delivery	1.25	.557	2.45	.828
Overall mean		1.87	.326	2.88	.256

The table 1 above presents the pre and post assessment mean scores on teacher's numeracy teaching strategies through the application of whole school model. The pre-assessment mean score was 1.87 with standard deviation of 0.326 while the post assessment mean score of teacher teaching strategies was 2.88 with standard deviation of 0.256.

The result revealed an improvement in teacher's teaching methods/strategies through the used of whole school instructional model. It was observed from the

items of observation teachers were able to an extent inspire pupils, set high task for high ability pupils and pupils appreciate the learning of numeracy by understanding the relevance of numeracy.

Research Question Two

How does the application of whole school model enhance pupils' interest/attitude towards numeracy in primary schools?

Table 2: Mean of Pre and Post Assessment of Pupils Interest/Attitude to Numeracy Teaching

s/n	Pupils interest/attitude towards learning of numeracy (Rated in 1-4)	Pre-assessment Mean	Std. Dev	Post-assessment Mean	Std. Dev
1	Pupils are excited in learning/solving numeracy problems in the classroom	1.45	.513	3.08	.882
2	Learning numeracy challenge pupils' interest/attitude in the classroom.	1.69	.602	2.63	.714
3	Pupils identify/solve numeracy problem with kin interest/attitude in the class	1.46	.765	3.11	.894
4	The learning of new concepts in numeracy is fun for the pupils	1.47	.658	2.92	.784
5	Making mistakes when solving numeracy problem discourages pupils	2.50	.872	2.61	.887
6	Sufficient number of pupils understand numeracy concepts in the class	1.48	.459	2.61	.916
7	Pupils are confident and trying different ways in solving numeracy problems	1.60	.898	3.21	.843
8	Pupils see numeracy problem as solvable anytime	1.48	.855	2.71	.732
9	Pupils makes sense of what to do with numeracy concept as being taught	1.56	.713	2.71	.768
10	Pupils sees numeracy as a useful concept and practice it	1.85	.658	2.67	.567
	Overall mean	1.65	.323	2.83	.232

The table 2 above presents the pre and post assessment mean score on pupils' interest/attitude to numeracy teaching when whole school instructional model was applied. The pre-assessment mean score was 1.65 with standard deviation of 0.323 while the post-assessment mean score was 2.83 with standard deviation of 0.232.

The result revealed an improvement in pupils' interest/attitude towards numeracy teaching through the application of whole school instructional model in the study. It was observed that pupils were excited in

learning and solving numeracy problem with kin interest in the classroom. Also, the study revealed that sufficient number understands numeracy concepts and they were confident in solving the numeracy problem encountered.

Research Question Three

What is the impact of whole school instructional model on pupil's performance in numeracy before and after exposure to the model?

Table 3: Pupils Mean Scores and Differences in Numeracy Performance Test of the Groups

Groups	N	Mean	Std. Dev	Mean diff
Pre-test Group 1	14	12.00	1.301	14.86
Post-test Group 1	14	26.86	2.179	
Pre-test Group 2	17	13.88	1.833	6.53
Post-test Group 2	17	20.41	4.542	

The table 3 above presents the mean scores, standard deviation and the mean differences in the performance of primary school pupils at pre-test and post-test when taught numeracy using whole school instructional model. The result revealed that, group 1 had a pre-test mean score of 12.00 and post-test mean score of 26.86 with a mean difference of 14.86, while group 2 had a pre-test mean score of 13.88 and post-test mean score of 20.41 with a mean difference of 6.53.

Generally, the results showed an increase in numeracy performance for both groups in the study after being exposed to whole school instructional model. This implies that primary school pupils

performed higher in numeracy lesson as a result of the whole school model innovative strategy exposed to during teaching learning processes.

Testing of hypotheses

Hypothesis One

There is no significant impact of whole school instructional model on teacher teaching strategies/method and pupil's interest/attitude towards numeracy in primary schools.

Table 4: Paired Sample t-test Result on the Significant Impact of Whole School Instructional Model

	Mean	N	Std. Dev	T	df	Sig (p-values)
Post-assessment of teachers teaching strategies	2.88	10	.256	13.163	9	.000
Pre-assessment of teachers teaching strategies	1.87	10	.326			
Post-assessment of pupils' interest/attitudes	2.83	10	.232	7.826	9	.000
Pre-assessment of pupils' interest/attitude	1.65	10	.323			

The table 4 above presents the t-test result on the significant impact of whole school model on teacher teaching strategies and pupils' interest/attitude towards numeracy. The hypothesis was rejected since the p-values of 0.00 were less than the 0.05 significance level for both teachers' teaching strategies and pupils' interest/attitude towards numeracy in the study. Therefore, it was concluded that there is significant impact of whole school instructional model on the teachers' teaching strategies/method as well as the pupils' interest/attitude to numeracy learning in the study.

The pre-assessment of the teachers teaching strategies during numeracy class was seen to be a major factor affecting learning as the strategies did not

stimulate pupil's participation and engagement enough and this tend to affect pupils' interest significantly. But the innovative training of using whole school instructional model improved the teacher teaching strategies during teaching-learning processes and the resultant effect was also seen in pupils' interest/attitude towards learning and understanding of numeracy contents.

Hypothesis Two

There is no significant difference in pupils' performance in numeracy when exposed to whole school instructional model in Primary schools.

Table 5: Paired sample t-test Results on the Significant Difference in Pupil's Performance in Numeracy

	Mean	N	Std. Dev	T	Df	Sig (p-values)
Post-test group 1	26.86	14	2.179	3.332	13	.005
Pre-test group 1	12.00	14	1.301			
Post-test group 2	20.41	17	4.542	5.908	16	.000
Pre-test group 2	13.88	17	1.833			

The table 5 above present the significant difference in pupils' performance when exposed to whole school instructional model. The hypothesis was rejected for both groups as the p-values of 0.005 and 0.000 were less than the 0.05 significance level. Therefore, it was concluded that, there is significant difference in pupils' performance in numeracy test after being exposed to whole school instructional model in the study.

The evidences from both groups used in the study indicate that whole school instructional model significantly affect pupil's performance in numeracy and their interest/attitude towards numeracy learning during teaching-learning processes. Hence the result of the study justifies the following expected outcomes:

- Improvement in the numeracy Teachers teaching strategies after the use of the whole school instructional teaching strategies
- Improved Pupils interest/attitude in numeracy during teaching-learning process by the respective teachers.
- An improved Pupils' numeracy level/performance scores using the Numeracy Achievement test after the use of whole school instructional model

DISCUSSION OF FINDINGS

The research question one revealed that, teachers' numeracy teaching method/strategies were improved due to the rudiments of whole school instructional strategies exposed which implies that, whole school instructional model significantly helped in numeracy lesson delivery and learning processes. The finding agreed with Nyirahagenimana, Uwamahoro, and Ndiokubwayo, (2022) and Alshehri (2016), who indicated good performance for all teachers in terms of integrating exciting activities, relevant visualization guide, boosting learners' confidence to express their ideas in the teaching process, and using constructive scenarios that helped the learners to relate what they learned to real-life situations.

The research question two and hypothesis one revealed an improvement in pupils' interest/attitudes towards numeracy teaching and learning processes with a significant impact when whole school instructional model was employed. There were excited in learning and solving numeracy problem with kin interest in the classroom. This agreed with

Nkurikiyimana, Uwamahoro, and Ndiokubwayo (2022) in a study revealed that 5E's educational model was effective in stimulating students' motivation and strong interaction with a better understanding of concepts through interactive activities.

The research question three and hypothesis two showed an increase in numeracy performance for both groups in the study after being exposed to whole school instructional model and the two groups gained significantly compare to their pre-test performance. The findings agreed with Ahmad, Shaheen and Goha (2018) who found that a significant increase exists in cognitive domain of students' learning; knowledge, application, comprehension and skill development abilities when taught with 5E instructional model.

The study concluded that, whole school instructional model was a veritable tool for effective teaching and learning of numeracy at primary school level. The model improved teachers' teaching strategies and stimulate pupils learning interest/attitude toward numeracy which eventually, significantly improved performance in terms of knowledge, comprehension and application of numeracy learning contents in the study.

RECOMMENDATION

1. Teachers should employ the principles of whole school instructional model tagged as 5Es model of learning in teaching and learning processes of numeracy at all level
2. The classroom environment and lesson content structure should be built to accommodate principles of whole school model to enhance pupils' interest/attitude towards learning
3. The government should expose teachers through training and workshop to the principles and practice of whole school instructional model of learning to generally improve pupils' interest and academic performance at primary schools' level.

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