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INFLUENCE OF GRAPHIC MATERIALS ON ACQUISITION OF NUMBER WORK SKILLS AMONG PRE-SCHOOL LEARNERS IN KIAMBU SUB-COUNTY, KENYA

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ABSTRACT

Use of instructional graphic resources plays an important role in enhancing learners' acquisition of number work skills. However, in Kiambu Sub- County, acquisition of number work skills by pre-primary school learners is low with many not able to solve basic mathematics problems. The study sought to assess the influence of utilization of graphic materials on acquisition of number work skills among pre-primary school learners in Kiambu Sub- County, Kiambu County, Kenya. The study was guided by The Cognitive Theory of Multimedia Learning and Skills Acquisition Theory. The study adopted mixed methodology and thus, applied concurrent triangulation research design. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using Pearson's Product Moment Correlation Analysis in Statistical Packages for Social Science (SPSS 23) and presented using tables. The study established that pre-primary school learners' number work skills are below average owing to inadequate use of graphic materials. The study thus recommends that pre-primary school teachers should be made to understand that these are educational components which serve to enhance teaching concepts in number work. Pre-primary school teachers should be encouraged to adopt graphic number work materials. The Ministry of Education should enforce the usage of graphic materials to supplement supply of commercial teaching aids as a critical component of pedagogy in pre-primary schools.

Key Words: numberwork skills, audio visuals, graphic resources

INTRODUCTION

Education consists of two components and are classified as inputs and outputs. According to Cramer and Castle (2012), inputs consist of human and material resources and outputs are the goals and outcomes of the educational process. Cramer and Castle (2012) further posits that both the inputs and outputs form a dynamic organic whole and if one wants to investigate and assess the educational system in order to improve its performance, effects of one component on the other must be examined. Graphic resources which are educational inputs are of vital importance to the teaching number work curriculum in pre-primary school education centers.

In a study conducted in the Netherlands, Anyakoha (2013) indicated that improvisation in number work skills reveals

that there are possibilities of alternatives to teaching and learning aids. It should therefore meet specific teaching and learning situation. Anyakoha (2013) further indicated that improvisation in number work skills is an act of designing a replica of standard equipment to play the role it is designated for. In other words, it is an act of using alternative resources to facilitate instructions for teaching wherever there is lack of specific first-hand teaching aids. It develops skills in the cognitive, affective and psychomotor domains and has become imperative in teaching and learning because the economic situation makes the cost of facilities and equipment very high amidst decreasing or near lack of purchasing power. Cognizant of these assertions, Conezio and French (2013) suggested that improvisation in number work skills is an answer to the problem associated with storage, repair, replacement, replenishment of consumable components of commercially available instructional materials and also a solution to the problem of intensive training of teachers and learners who will use the facilities and equipment.

In a study conducted in Nigeria, Dogara and Ahmadu (2013) revealed that the qualities of improvisation in number work skills- talents include creativities or resourcefulness and rich imagination that are transformable into realities. Dogara and Ahmadu (2013) indicated that local resources can be remolded and used to satisfy the quest for knowledge in the schools. These findings affirm the fact that improvisation of instructional materials is also the adoptive

ability of a resourceful teacher to produce facilities and equipment locally at low profile for teaching-learning processes. In the same vein, Horne (2013) also observed that in physical education and sports instructional domain, all types of equipment and supplies like the balls, apparatus, nets and standard implements will be needed for the conduct of individual and team sports as well as for other physical activities, considering the increase number of enrolment and also increase in the number of sport lovers, sport programmes use supplies and equipment that cost a lot of money. Such materials are vital to the health and safety of participants, to goodplaying condition and to values derived from the programme.

In a study conducted in Kisumu East Sub-county, Burnett (2013) stated that improvisation in number work skills is an element of creativity. Burnett (2013) indicated that it is the use of local resources in our immediate environment to build, construct, mould, or make instructional teaching learning materials that can assist in the smooth dissemination and transfer of knowledge from teachers to learners. Burnett (2013) asserted that improvisation of culturally materials for instruction have made tremendous enhancement of lesson impact if intelligently used. Consistent with these assertions, Peterson (2014) observed that the utilization of improvised instructional number work materials takes adequate care of the three domains, that is, cognitive, affective and psychomotor thereby reducing the abstractness of the number work concepts for pre-primary school learners. Besides, when teachers improvise number work teaching and learning materials such as sound and heat producing, measurement, movement and construction, it enables pre-primary school learners to develop mental faculties or thoughtssuch as language, reasoning, thinking, imagination and problem solving. In Kiambu Sub- county, many teachers do not have enough time to make supplementary resources, so they just follow the textbook (Mwaniki, 2009). However, a report by KNEC (2017) to monitor learner's achievement in literacy and numeracy had revealed that only 52% of pre-primary school learners were incompetent in solving mathematics problems. In the same token, a survey conducted by Uwezo (2010) had revealed that seven out of ten pupils in class three could do class two work. Uwezo (2010) further revealed that 60% of the pre-primary school learners in public pre-primary schools do not have the basic mathematical skills, while 34% of the pupils could not perform simple tasks that demonstrate numeracy skills. In the same token, a report from the County Government of Kiambu in the Department of Early Childhood Education reveals that 25.8% of the pre-primary school learners are not capable of solving basic mathematics' tasks. This is in line with the findings of studies have also revealed that the 19.8% of pre-primary school learners in Kiambu Sub- county do not possess the mathematical skills required to enter that grade (The Education Network in Kenya, 2011). To mitigate these challenges, teachers have adopted use of improvised materials. The importance of utilizing improvised materials cannot be underestimated. Such media communicate information effectively, promote the acquisition and longer retention of knowledge, when they are systematically designed, reproduced, used and evaluated (Mwangi, 2012). However, the idea of improvisation which involves sourcing, selecting, creating, making, substituting, and providing local media and number work materials obtained within and outside the school environment in the absence of the original ones have not fully been embraced by most pre-primary school teachers, a factor that is likely to have contributed to learners lose interest and poor performance in number work subject in Kiambu Sub-county. Mwangi (2012) has not articulated how different improvised materials influence pre-primary school learners' acquisition of number work skills; hence the study.

Early exposure and effective utilization of improvised materials prepares pre-primary school learners for number work

skills since learners acquire knowledge through interaction with familiar materials within the environment. However, in Kiambu Sub-county, the situation is quite different with acquisition of number work skills by pre-primary school learners in Kiambu Sub-county being low. As stated in the background, a report by KNEC (2017) to monitor learner’s achievement in literacy and numeracy had revealed that 52% of pre-primary school learners were incompetent in solving mathematics problems. In the same token, a survey conducted by Uwezo (2010) revealed that 60% of the pre-primary school learners in public pre-primary schools do not have the basic mathematical skills, while 34% of the pupils could not perform simple tasks that demonstrate numeracy skills. Further, as noted earlier, a report from the County Government of Kiambu in the Department of Early Childhood Education reveals that 25.8% of the pre-primary school learners are not capable of solving basic mathematics’ tasks. The Education Network in Kenya (2011) also pointed out that 19.8% of pre-primary school learners in Kiambu Sub-county do not possess the mathematical skills required to enter that grade. Despite these statistics, few empirical studies had interrogated the extent to which use of improvised materials influence acquisition of number work skills among pre-primary school learners. The objective of the study is to establish the Influence of graphic materials on acquisition of number work skills among pre-school learners in kiambu sub-county, Kenya

THEORETICAL FRAMEWORK

The study was based on Cognitive Theory of Multimedia Learning by Mayer (2007), which is based on three main assumptions that, there are two separate channels for processing information (audio and visual), there is limited channel capacity; and that learning is an active process of filtering, selecting, organizing, and integrating information. The theory centres on the idea that, human memory has two sub-components that work in parallel (visual and verbal/acoustic) and that learning can be more successful if both of this can be used at the sametime. It suggests that learners build meaningful connections between words and pictures and that, they learn more deeply than they could have with words or pictures alone. Words can be spoken or written and the pictures can be any form of graphical imagery including illustrations, photos, animation, real objects or video. The learner’s task is to make sense of the presented materials as an active participant, ultimately constructing new knowledge.

RESEARCH METHODOLOGY

The study adopted mixed methodology and thus, applied concurrent triangulation research design. The target population was 1207 respondents comprising 22 headteachers, 44 pre- primary school teachers and 1141 pre-primary school learners from which a sample of 300 respondents was calculated using Yamane’s Formula. Stratified sampling was applied to create four strata based on the number of zones in Kiambu Sub-county. From each zone, four headteachers and 10 teachers were selected using purposive sampling. However, from each zone, 61 pre-primary school learners were selected using simple random sampling. This procedure enabled the researcher to sample 16 headteacher, 40 teachers and 244 pre-primary school learners. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using Pearson’s Product Moment Correlation Analysis in Statistical Packages for Social Science (SPSS 23) and presented using tables.

RESULTS AND DISCUSSIONS

Response Rate

In this study, 44 questionnaires were administered to pre-primary school teachers out of which 36 questionnaires were filled and returned. At the same time, the researcher also interviewed 14 headteachers and conducted observation schedules among pre-primary school learners. This yielded response rates shown in Table 1.

Table 1: Response Rates

Respondents	Sample d Respond ents	Those Who Participate d	Achieved ReturnRate (%)
Head teachers		14	87.5
Pre-primary School Teachers		36	90.0
Pre-primary School Learners	2	200	82.0

Total	3	250	83.3
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Source: Field Data (2019)

Table 1 shows that headteachers, pre-primary school teachers and pre-primary school learners registered a response rate of 83.3%. This confirmed the findings of Creswell (2014) that a response rate above 75.0% is adequate and of suitable levels to allow for generalization of the outcomes to the target population.

Graphic Materials and Acquisition of Number Work Skills among Pre-primary School Learners

The study established that Pre-primary school teachers' use of graphic materials influence pre-primary school learners' acquisition of number work skills. This implies that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. Thus, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference. It is also evident that use of PowerPoints has enhanced number work skills such as manipulation, experimentation, observation, interpretation and performance of basic operation such as addition and subtraction among pre-primary school learners. This is indicative of the fact that pre-primary children are naturally visual and can build relationships between numbers and a represented item and that using representation or pictures to clarify a relationship is making the use of mathematics real to a child's mind.

Table 2: Views of Pre-primary School Teachers on the Influence of Graphic Materials on Pre-primary School Learners' Acquisition of Number Work Skills

Test Items	Ratings				
	SA	A	U	D	SD
	%	%	%	%	%
Teachers use charts to enhance number work skills amongst pre-primary school learners	59.5	15.5	4.5	11.5	9.0
Using PowerPoints is rarely undertaken by teachers to improve number work skills amongst pre-primary school learners	56.5	23.5	2.5	9.5	8.0
Teachers always use pictures to help pre-primary school learners improve their number work skills	51.5	8.5	7.0	22.5	10.5
Use of drawings is frequently adopted by teachers while teaching to improve number work skills among pre-primary school learners	68.5	15.5	3.5	8.5	4.0
Teachers rarely use of graphics in classroom to help pre-primary school learners to master number work skills	59.5	12.5	3.5	16.5	8.0

Source: Field Data (2019)

Table 2 shows that slightly more than half (59.5%) of the pre-primary school teachers strongly agreed with the view that teachers use charts to enhance number work skills amongst pre-primary school learners. 15.5% of the pre-primary school teachers. However, only a paltry 4.5% of the pre-primary school teachers were undecided, 11.5% of the pre-primary school teachers disagreed whereas 9.0% of the pre-primary school teachers strongly disagreed. These findings corroborate the findings of a study conducted in France in which Kilpatrick, Swafford and Findell (2001) noted that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. Kilpatrick et al (2001) note that, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference.

Pictures are also one of the most important techniques in teaching new words (Kilpatrick et al, 2001). By pictures the researcher means blackboard drawing, wall pictures charts and flash cards, the image of pictures stimulates the pupils' imagination which encourage them to express their feelings, attitudes, a number of activities can be generated through using pictures. The study revealed that slightly more than half (56.5%) of the pre-primary school teachers strongly agreed with the view that using PowerPoints is rarely undertaken by teachers to improve number work skills amongst

pre- primary school learners. 23.5% of the pre-primary school teachers agreed. However, 2.5% of the pre-primary school teachers were undecided, 9.5% of the pre-primary school teachers disagreed whereas 8.0% of the pre-primary school teachers strongly disagreed.

These findings lend credence to the assertions of Mwangi (2012) that in Kenya and Juja Sub-county, children are naturally visual and can build relationships between numbers and a represented item and that using representation or pictures to clarify a relationship is making the use of mathematics real to a child's mind. This points to the fact that learning the basics of counting can use PowerPoints or pictures of apples or favorite fruits to help children recognize that the number represents the items depicted. Teaching through representation or pictures will allow children to make connections between the real world and the math skills that are vital for academic success.

The study also revealed that slightly more than half of the pre-primary school teachers (51.5%) strongly agreed with the view that teachers always use pictures to help pre-primary school learners improve their number work skills. In the same breath, 8.5% of the pre-primary school teachers agreed. However, 7.0% of the pre-primary school teachers were undecided, 22.5% of the pre-primary school teachers disagreed whereas 10.5% of the pre-primary school teachers strongly disagreed. These findings further lend credence to the assertions of Kilpatrick et al (2001) that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. Kilpatrick et al (2001) note that, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference. Pictures are also one of the most important techniques in teaching new words (Kilpatrick et al, 2001). Use of pictures means blackboard drawing, wall pictures charts and flash cards, the image of pictures stimulates the pupils' imagination which encourage them to express their feelings, attitudes, a number of activities can be generated through using pictures.

These findings also corroborate the findings of a study conducted in India by Noor et al (2003) about Role of Pictures in Teaching Number work which revealed that effective use of teaching resources in classrooms had witnessed improved test-scores in basic arithmetic. The study further revealed that children with good access to educational media have improved intellectual and cognitive abilities to master the number systems. These findings thus affirm the fact that number work helps children make sense of their world outside of school and helps them construct a solid foundation for success in school. In elementary and middle school, children need scientific understanding and skills.

In the same vein, a fair majority (68.5%) of the pre-primary school teachers strongly agreed with the view that use of drawings is frequently adopted by teachers while teaching to improve number work skills among pre-primary school learners. A small proportion of 15.5% of the pre-primary school teachers agreed. Likewise, 3.5% of the pre-primary school teachers were undecided, 8.5% of the pre-primary school teachers disagreed whereas 4.0% of the pre-primary school teachers strongly disagreed. Majority (59.5%) of the pre-primary school teachers strongly agreed with the view that teachers rarely use of graphics in classroom to help pre-primary school learners to master number work skills. A small proportion of 12.5% of the pre-primary school teachers agreed. Likewise, 3.5% of the pre-primary school teachers were undecided, 16.5% of the pre-primary school teachers disagreed whereas 8.0% of the pre-primary school teachers strongly disagreed. These findings lend credence to the assertions of Kilpatrick et al (2001) that by drawings the researcher means blackboard drawing, wall pictures charts and flash cards, the image of pictures stimulates the pupils' imagination which encourage them to express their feelings, attitudes, a number of activities can be generated through using pictures.

The teacher can display the drawings very quickly one by one in order to teach a letter or to explain the meaning of words. Also, to elicit a quick response they are very useful in teaching structures and drill new letters. These findings thus attest to the fact that teaching number work skills through representation or pictures will allow children to make connections between the real world and the math skills that are vital for academic success. Without making a connection between life and math, children can become confused about the information provided in a classroom.

Inferential Findings on the Influence of Graphic Materials on Acquisition of Number Work Skills among Pre-primary School Learners

To verify the possibility of difference between use of graphic materials and learners' acquisition of number work skills, data were collected on how often pre-primary school teachers use graphic materials (very often =5, often = 4, sometimes

= 3, rarely = 2 and never = 1) and learners' performance in number work skills. The results are shown in Table 3:

Table 3: Results on How Often Teachers Use Graphic Materials and Learners' Performance in Number Work Skills

Frequency of Teachers' Use of Graphic Materials	Performance of Pre-primary School Learners in Number Work Skills (%)
2	64
2	61
2	61
2	59
2	45
1	37
1	33
1	29
0	28
0	27
0	23
0	22
0	19
0	17

Source: Sample Number Work Achievement Test (2019)

Table 3 shows that pre-primary school teachers who use graphic materials frequently during teaching have their pre-primary school learners register good performance in number work skills. These findings further corroborate the findings of a study conducted in France in which Kilpatrick, Swafford and Findell (2001) noted that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills among pre-primary school learners. Kilpatrick et al (2001) note that, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference. These findings suggest that, learners attempt to build meaningful connections between words and graphics and that, they learn more deeply than they could have with words or graphics alone. These results were subjected to Pearson's Product Moment Correlation Analysis and results are shown in Table 4.

Table 4: Pearson's Product Moment Correlation Analysis Showing Relationship Between Frequency of Teachers' Use of Graphic Materials and Performance of Pre-primary School Learners in Number Work Skills

	Frequency of Teachers' Use of Graphic Materials	Performance of Pre-primary School Learners in Number Work Skills
Frequency of Teachers' Use of Graphic Materials	Pearson Correlation Sig. (2-tailed) N	.936* .00 1
Performance of Pre-primary School Learners in Number Work Skills	Pearson Correlation Sig. (2-tailed) N	.936* .00 1

** . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Generated (2019)

Table 4 shows Pearson's Product-Moment Correlation Analysis which was run to determine the relationship between the frequency of teachers' use of graphic materials and performance of pre-primary school learners in number work skills. The test generated a correlation coefficient of $r = 0.936$ with corresponding significant level (p-value) of 0.000 which was less than the predetermined level of significance, 0.05, that is, $p\text{-value} = 0.000 < 0.05$. These findings further affirm the fact there is significant relationship between pre-primary school teachers' use of graphic materials and pre-primary school learners' performance in number work skills in terms one, two and three. These results were consistent with the findings of a study conducted in Juja Sub-county by Mwangi (2012) which generated a p-value of $0.044 < 0.05$. These findings attest to the fact that children are naturally visual and can build relationships between numbers

and a represented item and that using representation or pictures to clarify a relationship is making the use of number work concepts real to a child's mind. This implies that pre-primary school learners are naturally visual and can build relationships between concepts and a represented item and that, using charts or any form of representation to clarify a relationship between different concepts in number work is making learning real to a learner's mind.

Thematic Analysis of Qualitative Findings on the Influence of Graphic Materials on Pre-primary School Learners' Acquisition of Number Work Skills

The headteachers also echoed similar sentiments. The interviewees noted that Pre-primary school teachers' use charts enhance number work skills such as manipulation, experimentation, observation, interpretation and performance of basic operation such as addition and subtraction among pre-primary school learners. Just like in quantitative findings, these views corroborate the qualitative findings of a study conducted in France in which Kilpatrick, Swafford and Findell (2001) noted that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. Kilpatrick et al (2001) note that, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference.

Pictures are also one of the most important techniques in teaching new words. This was also noted by the researcher who observed that pre-primary school teachers use pictures during teaching of number work skills. The interviewees concurred with the assertions of Kilpatrick et al (2001) that, by using pictures the researcher means blackboard drawing, wall pictures charts and flash cards, the image of pictures stimulates the pupils' imagination which encourage them to express their feelings, attitudes, a number of activities can be generated through using pictures. Headteacher, H4, noted;

“Using PowerPoints has enhanced number work skills such as manipulation, experimentation, observation, interpretation and Performance of basic operation such as addition and subtraction among pre-primary school learners”.

Likewise, these views lend credence to the views expressed by Mwangi (2012) that children are naturally visual and can build relationships between numbers and a represented item and that using representation or pictures to clarify a relationship is making the use of mathematics real to a child's mind. Hence, these views point to the fact that learning the basics of counting can use PowerPoints or pictures of apples or favorite fruits to help children recognize that the number represents the items depicted. That is, teaching number work concepts through representation or pictures allow children to make connections between the real world and the math skills that are vital for academic success.

The headteachers also responded in favor of the view that pre-primary school teachers always use pictures to help pre-primary school learners acquire number work skills such as manipulation, experimentation, observation, interpretation and performance of basic operation such as addition and subtraction among pre-primary school learners. One headteacher remarked,

“Use of drawings has enabled Pre-primary school learners acquire number work skills such as manipulation, experimentation, observation, interpretation and Performance of basic operation such as addition and subtraction among pre-primary school learners”.

These views further corroborate the viewpoints held by Kilpatrick et al (2001) to the effect that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. Kilpatrick et al (2001) assert that, to be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference. That is, drawings stimulate the pupils' imagination which encourage them to express their feelings, attitudes, a number of activities can be generated through using pictures. In the same vein, these views also corroborate the findings of a study conducted in India by Noor et al (2003) which revealed that effective use of teaching resources in classrooms had witnessed improved test-scores in basic arithmetic. The study further revealed that children with good access to educational media have improved intellectual and cognitive abilities to master the number systems. Thus, just like in quantitative findings, these views also attest to the fact that number work helps children make sense of their world outside of school and helps them construct a solid foundation for success in school. In elementary and middle school, children need scientific understanding and

skills. These views further indicate that teaching number work skills through representation or pictures will allow children to make connections between the real world and the math skills that are vital for academic success. Without making a connection between life and math, children can become confused about the information provided in a classroom.

It is evident that pre-primary school teachers always use pictures and drawings to help pre-primary school learners acquire number work skills such as manipulation, experimentation, observation, interpretation and performance of basic operation such as addition and subtraction among pre-primary school learners. This means that graphic materials such as charts and motion pictures contribute effectively to acquisition of number work skills in early childhood education. To be effective pictures must be understood from pictures learners can develop the ability to see, describe and draw inference.

RECOMMENDATIONS

On pre-primary school teachers' use of graphic materials, the study has established that they are rarely used to teach concepts in number work. The study thus recommends that pre-primary school teachers should vary the use of different graphic materials to breakdown monotony of learning by theory

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