EFFECT OF MODELLING AND TASK ANALYSIS ON THE ACADEMIC PERFORMANCE OF PUPILS WITH DYSCALCULIA

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Abstract
This research work was conducted to determine if modelling and task analysis have an effect on the academic performance of pupils with Dyscalculia. The researchers used experimental design, the pretest-posttest control group design. Forty-five (45) pupils were purposively selected out of the population of 480 primary five students, in Gwale Local Government Area Kano. Three research questions and three hypotheses were formulated, the researcher used t-test for independent sample to test the three hypotheses and to analyse the effectiveness of the independent variables over the dependent variable, all analyses were made using SPSS (version 20) at 5% sig. level. Findings showed that there is a significant difference in the mean scores of students with Dyscalculia when remediated through the Modelling technique”, with a t-cal. value of 7.93. In addition there is a significant difference in the mean scores of students with Dyscalculia when remediated through the Task analysis technique”, with a t-cal. value of 7.73 but no significant difference in the mean scores of students with Dyscalculia when not exposed to either the modelling or the task analysis technique with t-cal. value of 0.67. It is recommended that teachers of mathematics should be more familiar with the condition and implications of dyscalculia, and utilize the most effective instruction such as modeling and the task analysis as strategies for teaching their students.

Key Words: Modelling, task analysis, academic performance, dyscalculia.

Introduction
Human knowledge particularly that of logical and arithmetic operations originates from our interaction with the environment and the society we live. This interaction exist long before children enroll in school, this interaction emerged at birth that the infant can distinguish between two objects and one, even if unable to express this in words, understanding numbers such as number of objects, infant perceives as a vital element in arithmetic. Some children may experience frustration and despair in understanding simple mathematics operation. Children with dyscalculia might have normal intellectual capabilities, but experience problems with certain thought processes. They have difficulties with certain types of cognition. It is typical of these disorders to appear first with telling the time, problem with temporal orientation (understanding what time it is) and problem with planning and remembering and keeping appointment. However, the type of disorder vary from child to child, however, it is possible to diagnose whether or not they experience specific forms of dyscalculia.

Teachers are the instruments of providing good education to the students and to mold their characters to be competent individuals. Therefore the teacher must utilize the most effective
instruction which promote maximum learning. Mathematics is more than just the science of numbers taught by teachers in schools to students, which the students may enjoy or fear. It has a significant role in the lives of individuals and society in general. Mathematics is the only mutual language used by all human beings regardless of their origin, gender, religion, or culture. One plus one is still equals to two despite of which country or language. However, all of us possess the ability to be literate in the mutual language of mathematics. For children, Mathematical literacy is the only element in providing the child with basic skills to live their life. Mathematics helps the child to develop analytical and reasoning skills with logical and structured thoughts (Lasfar, 2010).

Dyscalculia is a mathematics disorder which is categorized by inability to compute simple arithmetic operations. The disorder is not simply being poor at mathematics, but is a developmental impairment of the areas of the brain that process mathematics concepts and related ideas of value, and sometimes time and music as well. (Veronique, 2010). Watts & Serebreni (1983), view dyscalculia as a partial inability to perform mathematical functions. Mathematics disabilities can also occur as the result of some types of brain injury, in which case the proper term is Acalculia, to distinguish it from dyscalculia which is of innate, genetic or developmental origin that affects one’s ability to do simple mathematics functions.

Task analysis is a process of specifying the behaviour needed for a particular task that can help to shape student responses. Students are taught behaviour from simple to the more complex one until they can perform the target behaviour (Vaughn & Bos, 2012). Task analysis, involves breaking down a complex terminal pattern of behaviour or task into its small component. The parts are taught step by step integrating and chaining the parts into the terminal objectives; this ensures success and makes it possible to present material in such an acceptable unit and sequence to ensure easy assimilation (Okeke, 2001).

Modelling in special education seems effective in eliminating unwanted behaviour as well as in stimulating the development of new behaviour. Watching violence on television, for instance, can increase aggression. New response patterns can be developed simply through observing people practicing them (Okeke, 2001). Modeling requires selecting and identifying relevant aspects of a situation in the real world. In modelling, the teacher demonstrates how to compute a problem by using overt self-instruction. This overt self-instruction, or talking aloud about the process, assists students who have learning problems in knowing what they should ask to keep themselves focused on the process (Vaughn & Bos, 2012).

**Characteristics of Children with Dyscalculia**


The evaluation compares a person's expected and actual levels of skill and understanding while noting the person's specific strengths and weaknesses. Below are some of the areas that may be addressed:
• Ability with basic mathematics skills like counting, adding, subtracting, multiplying and dividing
• Ability to predict appropriate procedures based on understanding patterns - knowing when to add, subtract, multiply, divide or do more advanced computations
• Ability to organize objects in a logical way
• Ability to measure-telling time, using money
• Ability to estimate number quantities
• Ability to self-check work and find alternate ways to solve problems.


Statement of the Problem
Mathematics is an essential and basic areas of the school curriculum which has a wide variety of subject matter. According to the National Research Council, much of the failure in school mathematics is due to a tradition of teaching that is inappropriate to the way most students learn. (Encyclopedia of Education, 2003). Young children with mathematics learning disabilities can have difficulty learning the meaning of numbers (number sense), trouble with tasks like sorting objects by shape, size or color; recognizing groups and patterns; and comparing and contrasting using concepts like smaller/bigger or taller/shorter.

Learning to count, recognizing numbers and matching numbers with amounts can also be difficult for these children. As mathematics learning continues, school-age children with mathematics-based disabilities may have difficulty solving basic mathematics problems using addition, subtraction, multiplication and division. They struggle to remember and retain basic math facts (i.e. times tables), and have trouble figuring out how to apply their knowledge and skills to solve math problems.

Objectives of the Study
1. To find out if Modelling can improve the performance of students with Dyscalculia.
2. To find out if Task analysis can improve the performance of students with Dyscalculia.
3. To determine the performance of students with Dyscalculia when not exposed to Modelling or Task analysis.

Research Questions
1. Can modelling technique improve the academic performance of pupils with Dyscalculia?
2. Can task analysis technique improve the academic performance of pupils with Dyscalculia?
3. What is the performance of pupils with Dyscalculia when not exposed to the Modelling or Task analysis technique?

Research Hypotheses
1. Modelling will not significantly improve the performance of students with dyscalculia.
2. Task analysis will not significantly improve the performance of students with dyscalculia.
3. There is no significant difference in the performance of students with Dyscalculia when not exposed to either the modelling or the task analysis technique.

Methodology
Experimental design was employed in this research, particularly the Pretest-Posttest-Control Group Design so as to find out if the independent variable has an effect over the dependent variable, i.e. to determine if Modelling and Task analysis has an effect to the students with Dyscalculia. Therefore, the sample population was divided into three groups, two experimental groups versus one control group. Both the experimental groups and the control group were pre-tested and then post-tested after the exposure of the treatment to the experimental group.

The population of this research was derived from the pupils of Ja’en Primary School in Gwale Local Government Area of Kano State. The pupils of primary five were the target population with a number of four hundred and eighty (480) students from primary 5A, 5B, 5C and 5D respectively, with the average number of 120 pupils per class. Two hundred and eighteen (218) pupils were identified to have experienced a particular mathematics problem; the identification procedure is made through teacher nomination and by going through the previous record of the pupils’ arithmetic performance. Forty-five (45) pupils were purposively selected out of the population of 480 primary five students. A non-probability sampling method was employed to this research using the Purposive Sampling Technique, because the selection is based on children that are suspected to have a particular learning problem in mathematics.

The researcher used intervention materials which comprises of Assessment profile for children with dyscalculia, flashcards and papers, assorted colored pens, the multiplication table, arithmetic symbols, money and time symbols, calculator, and also using concrete and manipulative objects, such as, sticks, stones, tins, bottle-tops, leaves and fruits, cups and water, calendar and posters, scissors and objects picture, different paper notes and wall clock, etc. The instrument “Assessment profile for children with learning disabilities” was developed and used by Ihenacho, 2011. While the remaining instruments were adopted from Olabisi (2005) in his book “Therapies for children with arithmetic problems”, which the author called Instructional materials. The instrument were validated by experts in the field of special education, the reliability coefficient was calculated using Test-Retest method, a Cronbach’s Alpha of 0.88 reliability index was reported. The researcher used t-test for independent sample to determine the effect of independent variables on the dependent variable (to find out if the technique of modeling and task-analysis will improved the arithmetic performance of students with dyscalculia) the three hypotheses were analyzed after the attainment of pre-test and post-test data.

Results

Hypothesis One: Modelling Technique will not significantly improve the performance of students with dyscalculia.

Table 1: t-test analysis on the effect of modeling technique on performance of students with dyscalculia

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t-cal</th>
<th>p-value</th>
<th>Sig.</th>
<th>Decision</th>
</tr>
</thead>
</table>


Table 1 above shows the differences in the academic performance between Experimental Group 1 (exposed to modelling) and the Control Group (offered no treatment). t-test for independent sample was used to compare between the two groups. The posttest data of Ctrl shows the mean of 24.45, SD of 6.28, while the posttest data of Exp1 shows the mean of 15.45, SD of 2.96. The test showed t-cal value 7.93 at the probability value of .000. The result of the test concludes that there is a significant difference between the variables under study p>0.05. The null hypothesis, there is no significant difference in the mean scores of students with Dyscalculia when remediated through Modelling technique, is therefore rejected.

**Hypothesis Two:** Task analysis will not significantly improve the performance of students with dyscalculia.

Table 2: t-test analysis on the effect of task analysis on performance of students with dyscalculia.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>DF</th>
<th>t-cal</th>
<th>p-value</th>
<th>Sig.</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15</td>
<td>24.45</td>
<td>6.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exp2 (Task-anal.)</td>
<td>15</td>
<td>19.45</td>
<td>2.92</td>
<td>28</td>
<td>7.73</td>
<td>0.000</td>
<td>0.05</td>
<td>H₁ rejected</td>
</tr>
</tbody>
</table>

Table 2 above shows the differences in the academic performance between Experimental Group 2 (exposed to task analysis) and the Control Group (offered no treatment). t-test for independent sample was used to compare between the two groups. The posttest data of Ctrl shows the mean of 24.45, SD of 6.28, while the posttest data of Exp2 shows the mean of 19.45, SD of 2.92. The test showed t-cal value 7.73 at the probability value of .000. The result of the test concludes that there is a significant difference between the variables under study p>0.05. The null hypothesis, there is no significant difference in the mean scores of students with Dyscalculia when remediated through task analysis technique, is therefore rejected.

**Hypothesis Three:** There is no significant difference in the performance of students with Dyscalculia when not exposed to either the modelling or the task analysis technique.

Table 3: The Pretest & Post-test results of the Control group

<table>
<thead>
<tr>
<th>Group</th>
<th>Post-test Mean X₁</th>
<th>Pretest Mean X₂</th>
<th>Mean Difference</th>
<th>DF</th>
<th>Level of Significance</th>
<th>Obtained t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.80</td>
<td>2.53</td>
<td>0.27</td>
<td>28</td>
<td>0.05</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Table 3 above shows the difference between the performance of students with dyscalculia in pretest and post-test when not exposed to any treatment. The t-test for dependent sample was
used to compare the difference in the performance of same control group in pretest and post test data. The post test result of the control group shows the mean scores $X_1$ of 2.80, while the pretest result of the same control group shows the mean scores $X_2$ of 2.80. The mean difference is 0.27, the degree of freedom is 28, using the 5% level of significance, and the obtained $t$-value is 0.67.

The result of the test concludes that there is no significant difference between the variables under study $p > 0.05$. The null hypothesis, there is no significant difference in the mean scores of students with dyscalculia when not exposed to either modelling or task analysis, is therefore accepted.

**Discussion of Findings**

The findings of this work were strongly supported by most of the researchers, for instance, the appropriate application of modeling and or task analysis has repeatedly been demonstrated to improve the performance of students with dyscalculia. A recently published meta-analysis by Ise & Dolle (2012) evaluated eight studies. The overall effect strength was 0.50, which is considered an intermediate value (neither strong nor weak).

No difference in effectiveness was found between curricular and non-curricular treatment approaches, but all interventions tended to be more effective the longer and the more intensively they were carried out. Time delay, modeling and ask analysis were among the interventions with more effectiveness. Another scientifically studied learning programs by Kucian, Grond, Rotzer, & Henzi (2011) which is based on neuroscientific models of the development of number processing and arithmetic.

The effect strength of these intervention programs has been studied. The interventions are intended to promote the establishment of basic numerical and scholastic precursor skills (the concepts of quantity and number, counting order, and various types of notation). Task analysis begins with basic numerical skills and addresses the automatization of various number representations in increasingly large numerical domains, the understanding of arithmetical operations, and the establishment of factual arithmetical knowledge. Modeling has an adaptive structure, i.e., it can be adapted to the individual child’s learning difficulties.

The effective treatment of dyscalculia demands special expertise, which is most likely to be found among graduates of specialized training and continuing-education programs. A further role for the treatment from special educator, psychologist or physician may be to point out that an established legal framework exists for giving the affected persons special means to compensate for their learning difficulty in situations calling for high performance, including situations where their performance will be evaluated (tests). The availability of methods to acknowledge an individual’s learning difficulty within the school setting (e.g., by allowing more time to complete written examinations, modeling, chaining, etc.) whatever opportunities of this kind are available should be tried out in the individual case and made use of where appropriate.

Early recognition largely depends on information provided by the child’s parents or other carers. Depending on the age of the child, specific questions should be asked about his/her
understanding of quantity, counting skills, and mathematical performance in school to date. The history should also include questions about any secondary disturbances that might be present, e.g., learning disorders in other areas and/or psychopathological manifestations, dislike of school, mathematics anxiety, and/or school phobia.

Summary of Findings
The findings highlighted the effectiveness of Modelling or Task analysis technique when used as a treatment approach to students with Dyscalculia, as shown under research question 1 and 2. It also highlights the insignificant improvement in the performance of students with dyscalculia when no intervention was employed, as in research question 3. Hypothesis 1 and 2 of this study accept that a significant difference exists in the performance of students with Dyscalculia between those remediated through Modelling or Task analysis and those with no intervention, while Hypothesis 3 agreed that there is no significant difference in the performance of students with Dyscalculia when not exposed to any treatment approach.

Conclusion
The findings of this research concluded that modeling and task-analysis were effective on the academic performance of students with dyscalculia, because, the two experimental groups Exp1 & Exp2 demonstrated remarkable improvement after being exposed to the treatment. Therefore, null hypotheses H0¹ and H0² were rejected.

Recommendations
1. It is recommended that teachers should utilize the most effective instruction like modeling and task analysis to promote maximum learning, through an organized, concise and comprehensible presentation of the Mathematics lessons.
2. Teacher should be more familiar with the condition and implications of dyscalculia and diligently watch for dyscalculic error. Teacher should understand that students process mathematics concepts differently, as this disorder affects processing, application and understanding.

References


